TEAM EJP

WATER • WASTEWATER • STORMWATER

SOLUTIONS

STORMWATER **FIELD GUIDE**

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SAFETY **FIRST!**

A REMINDER FROM TEAM EJP

While this field guide strives to provide solutions to many common jobsite problems, there is nothing more important than the well being of every single person working on an active jobsite.

Virtually all site work involves the use of light and heavy construction equipment, and it is important that all operators and workers onsite understand and avoid the common problems that can lead to incidents or accidents. Education and attention to detail are key components of any solid safety program.

Here are a few common principles that all site workers must understand:

1. **Trench safety.** The use of trench boxes and compliance with OSHA trench safety rules and regulations are of vital importance.

2. **Careful equipment loading and unloading.** Strict protocol must be followed, and the importance of caution during this process cannot be overstated. Extra care must be given to climbing onto and off from heavy equipment.

3. **Extra attention to details.** Beware of crowding of work areas or workers standing too close to moving equipment. Operators need to be continuously aware of the swing radius of their equipment, and also have firm knowledge of both overhead and buried obstructions. Extra care must be taken when working on sloping areas, while backing up or tipping equipment, and taking time to secure and stabilize loads properly.

4. **Fasten that seatbelt.**

5. **Meet regularly and discuss the critical importance of jobsite safety!**

PREFACE

Team E. J. Prescott is committed to helping its clients and its communities develop and implement the best possible solutions in the area of stormwater management. Our goal is to assist in providing cost effective products and services while preserving the integrity of our environment.

Our founder, Everett J. Prescott, was firmly dedicated to building strong positive relationships with our customers and vendors, and today, more than six decades later, those principles continue to guide the company. We have a strong commitment to education, and regularly sponsor seminars, workshops and in-house training events. Our Know H_2Ow® Seminar Series has driven our educational efforts since 2007.

Within the last decade, the University of Prescott was founded. The University of Prescott is a reflection of our commitment to training our own employees to bring the best possible service to our clients. The University of Prescott is a two-year on the job learning program that now has graduates in management, sales and service. The program recently became the first of its kind to achieve national certification as an apprenticeship program.

This field guide is intended to help solve some of the basic stormwater related problems encountered on construction sites. The information provided here reflects our experience with jobsite construction issues, and also our strong desire to help everyone involved in construction activities

PREFACE CONT.

solve their site related problems economically and effectively.

If you are a contractor, inspector, resident engineer or public works official, we hope you carry this field guide in your vehicle and use it often. If your work is in design or behind the scenes, we hope you will find this tool equally helpful.

All Team E. J. Prescott members stand ready to help you. If you are looking for assistance with jobsite visits or recommendations, we are most willing to help. Our vendors represent some of the world leaders in stormwater management technology, and they can provide the technical support required for your success. We can also provide in-house training at your location.

Our overall goal is to keep our clients informed and in compliance with federal, state and local regulations, while preserving our precious environment for future generations.

This field guide is intended to help solve some of the basic storm water related problems encountered on jobsites.

INTRODUCTION

This field guide is broken into five separate categories. Each represents a different but important segment of total jobsite management. All are mutually dependent, and all are very critical to success.

The toolbox for site management has increased quickly over the past five decades. When Congress passed the Clean Water Act into law in the early 1970's, the importance of jobsite erosion and sediment control was pushed into the forefront.

As the erosion and sediment control industries grew, more and more attention turned to the impact of development on downstream property. This led directly to the Low Impact Development (LID) movement, which promotes the reduction of drainage discharge from new and existing development. Finally, as innovations in stormwater management have emerged, more emphasis is being given to the removal of nutrients and pollutants from stormwater prior to release.

Overall, the goal of this manual is to provide useful and timely information on total jobsite management. We believe strongly that a proactive approach will lead you all to positive results, and help minimize problems and costly remobilization.

INTRODUCTION CONT.

THE CATEGORIES

Sediment Control--Sediment, by definition, is the movement of matter by some natural process. For purposes of this manual, we are dealing with soil movement as a result of water movement or wind. Sediment Control measures help prevent sediment from entering adjacent property, drainage structures, waterways and roadways.

Erosion Control--Erosion is usually caused when wind or water move soil particles. Erosion Control measures provide immediate erosion protection and are designed to permanently stabilize disturbed areas.

Ground Stabilization--Ground stabilization measures provide for reinforcement, separation, filtration and drainage between soil layers.

Site Drainage--Site drainage technology provides solutions for the movement, collection, storage and treatment of stormwater.

Pollution Prevention--Pollution prevention measures provide a toolbox for the employment of safe and environmentally friendly practices for specialized job management sites.

A LETTER FROM OUR **PRESIDENT**

Greetings:

I hope you find this Stormwater Solutions Field Guide to be helpful. Its creation reflects our company's sixty plus years of experience helping private and public sectors deal with important jobsite issues, related not only to stormwater, but also to safety, drinking water and wastewater systems.

Conservation has always been important to us. In fact we launched our Quality, Conservation, Revenue (QCR) program in 1968, several years before the Clean Water Act was even introduced to Congress. That program remains active to this day.

The cost of doing business is increasing, so it has never been more important to look closely at both construction costs and life cycle costs. Doing it right the first time has always made sense, and today it makes more sense than ever. Our intent with this field guide is to connect you with the latest technology and the most effective tools available.

Making the right choices also helps reduce ever increasing remobilization costs. There is nothing more frustrating than having to rebuild or refurbish failed systems.

We view our vendors as partners in helping our

A LETTER FROM OUR **PRESIDENT CONT.**

customers solve their toughest problems. I want to personally assure you that if there is a solution out there, our employees and vendors will do everything in their power to assist you. Overall, the vendor support we receive is second to none.

We often say, “Whatever you need. Whenever you need it. No matter what.” We mean that and live by it.

If you need jobsite assistance or consultation, we will be there. If you require technical assistance, we will provide it. If you can’t attend one of our educational events, we will bring training directly to your location.

I sincerely hope you use this field guide and that it adds value to your business.

Sincerely,

Steven E. Prescott, President
Everett J. Prescott, Inc.

We often say, “Whatever you need. Whenever you need it. No matter what.” We mean that and live by it.

TEAM EJP'S **TOP TEN**

10 Tips For Successful Jobsite Management

1. **Address Drainage and Soil Stabilization Issues First**
   Even properly installed erosion control products will fail when installed over unstable or poorly drained soils.

2. **Keep Disturbed Areas to a Minimum**
   Working in phases can help control the high costs associated with maintenance of sediment control measures.

3. **Pay Attention to Slopes and Channels**
   Steep slopes and high velocity drainage swales are especially prone to higher erosion rates.

4. **No Exit Policy**
   Pay close attention to keeping sediment and runoff contained on the jobsite.

5. **Reduce Velocity**
   Slowing down flow rates helps minimize soil transport and soil loss.

6. **Design for Infiltration**
   Promoting infiltration of stormwater into the ground reduces pressure on erosion and sediment controls.

TEAM EJP'S **TOP TEN CONT.**

7. **Inspect and Maintain**
   A strict cleaning and maintenance program is essential to the success of sediment control structures.

8. **Protect Waterways, Lakes and Streams**
   Keep sediment from even getting close to adjacent water bodies.

9. **Think Multiple Lines of Defense**
   No single measure will protect any site. Use a combination of measures to assure success.

10. **Install Permanent Erosion Control Measures As Soon As Possible**
    Sediment control is costly and temporary, erosion control is cost effective. Remember that!

SEDIMENT **CONTROL**

Silt Fence

Applications and Effective Use

Silt fence is commonly used to contain sediment on active jobsites.

It should be installed anywhere sediment can flow off the site, and is designed to intercept and retain sediment in disturbed areas.

Silt fence should never be used in concentrated flow areas.

The quality of available silt fence varies greatly. Key components to higher quality silt fence include post quality, post spacing and fabric quality.

Installation

Silt fence can be installed by machine or by hand.

The product must be trenched in to be effective. When hand installed the fabric should be buried in a 6" x 6" trench and then backfilled and compacted on both sides. Machine installation slices the fabric into the ground, eliminating the need for trenching.

Stakes can be wood or metal depending upon designer specifications.

Always install silt fence along slope contours. Install as far away as possible from toe of slopes in order to create maximum storage.

Termination points at both ends should be extended uphill to avoid possible flow bypass.

Inspection, Maintenance and Removal

Sediment must be removed when it reaches one-third the height of the fabric.

Inspect the fabric for damage. As dictated by jobsite conditions, install additional silt fence as needed.

Remove silt fence on a timely basis and dispose of properly.

Note: Alternatives to silt fence include straw and wood fiber wattles, coir fiber logs, compost socks, and berms composed of wood mulch, engineered soil or rock.

SEDIMENT **CONTROL**

Wattles

Applications and Effective Use

This technology can be used as an alternative to silt fence for perimeter protection. Many of these products are biodegradable.

The products can consist of agricultural straw or wood fiber. The filler material is stuffed into a netting or tube structure. Typically the products range from 8" to 20" in diameter, but other sizes are available.

These are very versatile sediment control tools, and can also be used as ditch checks in concentrated flow areas, for storm water inlet protection, and for temporary diversions.

Often used along contours, these lightweight products can be used in successive rows to slow down sheet flow and collect sediment on long slopes.

Installation

The products should be installed along slope contours.

To help avoid undercutting, a two-inch key in trench is recommended. Stake wattles into the ground with wood stakes. Drive stakes at intervals determined by manufacturer's site specific written instructions.

Stakes should be driven through the rear half of the logs at a 45 degree angle, with the top of the stake pointing uphill.

Overlap adjoining logs six inches, and stake joints securely. Termination points should be extended uphill to minimize flow bypassing.

Inspection, Maintenance and Removal

Inspect for undercutting and bypass of devices.

Most of these products are totally degradable. In those cases, the devices can either be left in place or easily disposed of.

Because of the relatively low profile of these products, it is especially important to remove accumulated sediment after storm events.

SEDIMENT **CONTROL**

Compost Socks

Applications and Effective Use

Compost socks offer another alternative to silt fence for perimeter protection. Both degradeable and non-degradeable socks are available.

The products consist of a filter sock filled with a filter media, often consisting of composted wood chips and fibers. The filler material is then stuffed into a netting or tube structure. The composted filler material has proven effective on sites where nutrient and pollutant removal are important considerations. Typically the products range from 8" to 20" in diameter, but other sizes are available.

These are very versatile sediment control tools, and can be used as ditch checks in concentrated flow areas, and also for storm water inlet protection and for temporary diversions.

Often used along contours, they can be used in successive rows to slow down sheet flow and collect sediment on long slopes.

Installation

The products should be installed along slope contours.

Because they are much heavier than wattles, compost socks can be installed without staking over frozen ground, near tree roots or on hard surfaces. On non-frozen ground, follow manufacturer's written installation instructions.

Overlap adjoining socks six inches, and stake joints securely. Termination points should be extended uphill to minimize flow bypassing.

Inspection, Maintenance and Removal

Inspect for undercutting and bypass of devices.

Many of these products are non-degradable. Particularly in areas where pollutants have been trapped, proper disposal is mandatory.

Because of the relatively low profile of these products, it is especially important to remove accumulated sediment after storm events.

Compost and Mulch Berms

Applications and Effective Use

This practice utilizes either shredded mulch or compost. They provide a perimeter protection option to silt fence, wattles and socks.

Can be effectively used on small sites where space is limited.

This treatment should be used only in relatively flat areas.

Installation

Typical dimensions for berms are a minimum of 12 inches in height and 36 inches in width.

Berms should be terminated uphill at ends to avoid possible bypass.

Inspection, Maintenance and Removal

Regular inspection and maintenance is extremely important.

Sediment behind these barriers needs to be removed when it reaches half their height.

The material can be easily worked into the soil once stabilization is complete.

Check Dams

Applications and Effective Use

Check dams are designed to slow down and collect sediment in high flow areas, such as roadside ditches and drainage swales.

Manufactured ditch checks or wattles and socks can be effectively used for such applications. Temporary rock check dams can also be used. Hay bales and silt fence should never be used as check dams in high flow areas.

Installation

Proper spacing dictates that the top of each downstream structure is level with the bottom of the upstream ditch check.

Ditch checks must be installed to allow overtopping. It is very important to install ditch checks sufficiently high on both sides of the ditch to avoid flow bypass.

The center of each check dam should be 6 inches lower than its outer edges.

Avoid unbroken slope lengths greater than 75 feet.

Check dams should never be installed in an active waterway.

Inspection, Maintenance and Removal

Accumulated sediment must be removed once it reaches one-third the height of the structure.

Inspect for undercutting, bypassing and damage to the check dam structures.

Check dams should be removed and disposed of properly once the contributing drainage areas and drainage swales are stabilized.

SEDIMENT **CONTROL**

Silt Curtains & Water Inflated Dams

Applications and Effective Use

Both silt curtains and water inflated dams are used when construction activities are either directly in-stream or adjacent to waterways or other water bodies.

Silt Curtains isolate in-stream construction areas where water depth is four inches or more.

Water inflated dams are very large water inflated tubes and are used in waterways where heavy construction is taking place.

Installation

Install silt curtains and water inflated dams before construction activities begin.

Water inflated dams are installed exclusively by factory trained and qualified installers.

A one to two inch gap should exist between the weighted lower end of the silt curtain and the waterway bottom.

The ends of the silt curtain must be securely anchored to the shoreline to fully enclose the area where sediment could enter the water.

Inspection, Maintenance and Removal

These in-water structures should be inspected daily for effectiveness. Repairs must be immediate and must be continued throughout the life of the project.

These barriers can be removed only when the water behind them reaches the same clarity as the water beyond the curtain or dam.

Inlet Protection

Applications and Effective Use

The most effective devices remove sediment from stormwater runoff, preventing clogging of drainage systems.

Both internal and external devices can be used, either separately or in combination.

Manufactured internal and external devices are most often sized to match up with the specific casting or inlet type and dimensions.

Installation

Devices must be installed according to manufacturer's written installation instructions. A very wide range of inlet protection products are available.

Excavated sediment traps are often appropriate when high flows are expected and overflow capacity is required.

Inspection, Maintenance and Removal

Perform inspection and cleaning after every rainfall event and as required by permit.

Flooding of streets can be an unintended consequence of inlet protection installations. The most effective internal devices have an emergency overflow feature. The most effective external devices combine strong filtering capabilities with high flow rates.

Devices should be removed no more than 30 days after final site stabilization, and disposed of properly.

SEDIMENT **CONTROL**

Stabilized Construction Entrances

Applications and Effective Use

Properly designed construction entrances limit or define entrances and exits to sites, with a goal of minimizing vehicle tracking onto adjacent roadways.

Site conditions vary widely. Soil types and traffic volume are key factors in appropriate design.

Typical solutions include a geosynthetic fabric layer installed under a layer of aggregate. For larger sites, shaker grates and tire washing devices can also be used.

Installation

Construction entrances must be graded so that runoff does not enter adjacent roadways. Entrance dimensions should be a minimum of 20 feet wide and 50 feet long.

Well drained soils should be protected by a layer of non-woven geotextile fabric and a layer of aggregate at least one foot thick. Larger aggregate is most effective, with a minimum range of one and one-half to three inches suggested.

Poorly drained soils should be protected by a layer of woven geotextile fabric, covered by a 12 inch layer of stone that is at least one and one-half inches in diameter.

On sloping areas, cellular confinement grid can be an effective tool for holding aggregate in place and preventing washout. After fabric installation, grid is stretched into place, pinned and then filled with aggregate.

For practical purposes, it is often effective to leave the temporary entrance in place as a foundation for the permanent entrance.

Inspection, Maintenance and Removal

Construction entrances should be inspected daily for effectiveness. Replace or add aggregate if it becomes clogged with sediment. Top dressing of additional rock will often be required. Conduct street sweeping operations as needed.

SEDIMENT CONTROL

Dust Control

Applications and Effective Use

Dust control is particularly important when dust generating activities occur near populated areas. Gravel pits and other areas where soils are stockpiled are obvious applications for dust control measures. Dust can also be a byproduct of major grading activities. Other construction related activities, such as concrete cutting, can result in serious dust generation problems. When these factors are combined with high wind velocities, appropriate dust control measures take on critical importance.

Airborne dust can create both safety and health hazards, making effective dust control an essential best management practice. Soils vary greatly in texture and density. Sandy soils, for example, dry out very quickly, making them very vulnerable to wind generated erosion.

Techniques

Structural techniques for dust control include the construction of wind barrier berms and the installation of wind barrier fencing. Ridges constructed perpendicular to prevailing winds can be effective.

Dust suppression chemicals, such as polyacrylamides and calcium chloride, are often applied to assist with dust control. These chemical treatments help hold soil particles together, making them less erosive. Caution should be exercised to assure that the chemicals used do not have a harmful effect on nearby waterways and aquatic life.

Mulches and erosion control blankets can also be effective in protecting exposed soils. Loose mulches are very vulnerable to wind erosion, but their effectiveness can be increased by crimping them into the soil, adding tacifiers, or by covering them with a netting structure.

Water helps hold soil grains together, making water trucks a common sight on dry construction sites.

Inspection, Maintenance and Removal

Areas susceptible to wind erosion should be monitored closely, especially during dry periods. Structures such as berms and barrier fencing need to be inspected regularly and maintained appropriately.

If chemicals are used, their life cycle varies, and it is important to reapply when necessary. Watering activities need to be repeated as dictated by site conditions.

Surface Protection Systems

Applications and Effective Use

Portable mat systems are used for surface protection in high traffic construction zones. Lighter weight panels, sometimes made of polypropylene, are available to protect turf from damage caused by construction equipment.

Much heavier products are also available to protect access roads over soft ground, for emergency site access, or to construct oil drilling platforms.

This technology was developed as an alternative to well established solutions such as plywood and cut timber mats. The products are significantly lighter, last longer, are much more reusable, and are more portable than traditional systems.

Installation

Portable mat systems should be installed in compliance with the manufacturer's written installation instructions.

Many manufacturers of portable mat systems supply fastening systems, allowing the mats to be joined together to form larger or custom sized panels.

Inspection, Maintenance and Removal

Inspect the panels for damage or movement. Replace or reset panels as required.

Install additional panels as needed. When panels are to be used in muddy conditions, it is often necessary to place a geotextile fabric layer under the mats.

Remove the panels when site work is complete.

SEDIMENT **CONTROL**

Dewatering

Applications and Effective Use

Dewatering is commonly used when working below grade, on bridge foundations, culvert installations, around retaining walls, and in a host of other applications.

This practice also is used during the maintenance of sediment basins.

Techniques

Dewatering can involve pumping water directly into temporary or permanent sediment basins with overflow protection.

Use a floating head skimmer/pump.

Place pump head into a barrel with holes buried in a filter rock.

Polymers provide a method of removal of turbidity from storm water runoff. The introduction of polymers causes soil particles to merge and drop out of the water column. Polymers can be used in a wide variety of water clarification applications, including but not limited to treatment ditches, split pipes and in-stream baskets. For best results soils must be tested and matched up with site-specific polymers.

Dewatering bags are often used to collect turbid water and remove sediment. The turbid water is pumped into the bags, with the sediment collecting in the bag and the water bleeding through the bag. Bag size is dictated by the diameter of the pump hose.

Geosynthetic tubes are larger dewatering devices. Working on the same principle as dewatering bags, but on a much larger scale, they can capture large volumes of sediment. Often the accumulated soil, after testing, can be reused.

Inspection, Maintenance and Removal

Check turbidity at the discharge point. Be sure that the discharged water is at least as clear as the receiving water body. Make sure that no scouring is occurring at the discharge point.

Dewatering bags or Geosynthetic tubes should be placed only on vegetated, paved or other stable surfaces. When such devices are placed on bare soil, the discharged water causes further sedimentation to occur.

Maintain filtering/settling mechanisms and structures as needed. At the conclusion of construction activities, all devices must be properly disposed of or stored.

Pond Skimmers

Applications and Effective Use

Pond skimmers are often used on active construction sites to drain the cleanest water from sediment basins. These devices are designed to remove the water just below the pond surface. Removing water just below the surface helps prevent clogging caused by floating surface debris, while at the same time, avoids pulling more sediment laden water from deep below the high water mark.

Manufactured pond skimmers are available with differing sizes and openings to make certain that pond drawdown rates are in compliance with site specific requirements and in compliance with specific erosion control plans.

Installation

Assemble pond skimmers in strict compliance with manufacturer's written instructions. Be sure that pond skimmer sizing and opening sizes are in compliance with written plans and jobsite needs.

Once the units are assembled, follow manufacturer's written installation instructions very carefully. In particular, be sure that trenching or other adjustments to the pond fully comply with the manufacturer's specifications. Keep the skimmer itself as far away from inflowing sediment as possible.

Inspection and Maintenance

Keeping the pond skimmer inlet clean is of extreme importance. Be sure to remove any debris or trash that may clog the pond skimmer inlet. Remove any sediment that builds up around the skimmer.

During cold weather, keeping the inlet ice free is very important to maintaining flow. Keep any ice broken up as much as possible around the inlet.

Skimmers are very fragile and should be handled carefully. Backhoes or other equipment should not be used to move or adjust pond skimmers.

Temporary Sediment Basins

Applications and Effective Use

Sediment basins are sediment control devices constructed with an engineered outlet, formed by embankment or excavation to intercept sediment-laden runoff and hold the sediment.

Temporary sediment basins are used in areas of concentrated flow or near points of off-site discharge on active construction sites.

Sediment basins can be located near entrances when exit wash stations are utilized.

Installation

Site topography must allow for runoff to be directed toward the basin.

The basins must be constructed before beginning earth disturbing activities upslope.

Basin depth should be a minimum of five feet deep, with a maximum depth of 10 feet.

Inlets to the sediment basin must be designed to prevent excessive scouring.

Inspection, Maintenance and Removal

Sediment must be removed to retain a minimum three foot depth of the treatment surface area.

The outlet must be cleaned to restore flow capacity if it becomes clogged.

Temporary Slope Drains

Applications and Effective Use

Temporary slope drains convey stormwater flows down the length of exposed slopes. Sometimes called pipe slope drains, they are designed to convey runoff while preventing erosion on both slopes and at the base of slopes. Rugged, flexible corrugated polyethylene pipe is often employed for such applications. All joints should be watertight and flared end sections should be used at the inlet.

For shorter and flatter slopes, polyethylene lined swales can be employed.

This measure, usually used for less than two years, can be removed once slope stabilization is complete.

Installation Technique

Temporary slope drain pipes must be anchored at intervals of 10 feet or less. Soils around the pipe inlet should be carefully compacted. Diversion berms at the inlet should be at least twice the height of the pipe.

To prevent erosion around the inlet, slope drain pipes should be anchored at least six inches into the ground. Inlet protection, such as a flared end section, must be provided. Compacted earth berms or dikes should be constructed to further protect the inlet.

Outlets must also be stabilized unless discharge is into a drainage basin or directly into a reinforced or erosion resistant area.

Inspection, Maintenance and Removal

Be sure that anchors are installed at proper intervals and all joints are secure. Inspect berms around inlet for both proper height and stability.

Inspect after each rain event and make needed repairs promptly. Keep construction traffic away from slope drain installations to avoid damage.

Temporary Diversions

Applications and Effective Use

Temporary diversions are berms or channels constructed across slopes to collect and divert stormwater runoff.

Diversions are useful on construction sites where temporary surface water runoff controls are needed.

Earth berms can be placed to form temporary diversions, but other techniques can be used also. Manufactured ditch checks can be configured to form diversions, as can many other products depending on site requirements.

Installation

Earth berms should have side slopes that are 2:1, with a top width of two feet, and should be at least one and one-half feet high.

It is very important to immediately stabilize the diversion channel and the outfall area to prevent failure.

Check dams may be required to reduce velocities of water runoff within the berm.

Inspection, Maintenance and Removal

Accumulated sediment should be removed when it reaches half the height of the diversion berm or channel.

Non-degradable devices must be disposed of properly at the conclusion of construction activities.

Vegetated Buffers

Applications and Effective Use

Vegetative buffers utilize existing vegetation to slow and filter runoff and collect sediment. They are sometimes referred to as filter or buffer strips. Buffer strips can assist in protecting adjacent property, roadways and waterways.

Installation

Buffer strips are located along the entire length of the down slope edge of disturbed areas.

The vegetative buffer should have a minimum width of 25 feet.

It is important to designate the area as an area of no disturbance.

Inspection, Maintenance and Removal

Inspect vegetative buffers and remove debris, sediment and litter.

Because vegetative buffers need to provide infiltration, it is extremely important to keep them free of sediment buildup.

Stockpile Protection

Applications and Effective Use

Stockpile protection prevents soil from eroding from storage areas and migrating onto adjacent property and waterways.

Installation

Silt fence, wattles or other perimeter protection must be installed around all open stockpile areas, regardless of size.

Perimeter protection should be installed a minimum of eight inches below the toe of the slope to maximize effectiveness.

Stockpiles containing organic matter should be temporarily seeded if the material is not to be moved or worked within seven days.

Inspection, Maintenance and Removal

Inspect perimeter protection to be sure that sediment is being properly contained.

Remove sediment build up behind perimeter protection devices as needed.

Seed Bed Preparation

Applications and Effective Use

Proper seed bed preparation is critical to success. First of all, a simple soil test is of vital importance. The test results will dictate the soil amendments needed to produce the highest quality turf possible. Choosing the correct seed mixture is also very important. For example, heavily used athletic fields require seed mixtures that are very different from those used on residential lawns.

Drainage patterns must be incorporated into final grading. Climate considerations also must be considered. Sunny and shady areas have different seed requirements. Sites subject to high prevailing winds can also significantly impact seed mixture choices.

Careful consideration must be given to the placement of irrigation and subsurface drainage systems.

Installation Techniques

Existing vegetation must be removed. Plants, trees, shrubs and large diameter roots all require removal. Large rocks and boulders also must be extracted.

After rough grading, remove debris or exposed rocks and add the appropriate amount of topsoil. After topsoil placement, install subsurface drainage and irrigation systems when required. Add soil amendments as required.

After finish grading and rolling, apply seed, plant plugs or sod. Depending on site requirements, some seeded areas may require protection using hydromulches, erosion control blankets, or turf reinforcement mats.

Inspection and Maintenance

Carefully inspect newly seeded areas during the process of vegetation establishment. If hydraulic mulches or rolled erosion control products are part of the plan, be sure proper installation requirements were met.

Repair eroded areas as required. When necessary, reapply seed to areas where vegetation fails to emerge. Proper irrigation is very important during vegetation establishment and should be carefully monitored.

Slope Tracking

Applications and Effective Use

Slope tracking is a simple and inexpensive practice, utilizing tracked equipment, that can help to significantly slow down erosion in newly excavated sloping areas.

By slowing down flows on sloping areas, tracking can reduce sediment loss and resulting deposition at the base of slopes. As velocities are slowed down, infiltration is increased.

Slope tracking is generally a short-term solution used in conjunction with mulching, seeding, erosion control blankets or other best management practices.

Installation

Track vertically up and down slopes, creating small berms or channels perpendicular to the slopes.

It is essential that tracking be done vertically. Horizontal tracking is a counterproductive practice that actually accelerates slope erosion.

Inspection and Maintenance

Slope tracking should be repeated at the end of each working day until permanent erosion control measures can be installed.

All exposed slopes 3:1 and greater, or more than 20 feet in length, should be tracked.

EROSION **CONTROL**

Mulching

Applications and Effective Use

Mulching is a time proven and effective method for protecting exposed soils and promoting the establishment of vegetation.

Commonly used mulch materials include straw, wood fiber and grass clippings. Mulching assists with vegetative growth by holding seed and soil in place, retaining moisture, protecting plant roots, and by holding soil temperatures at levels conducive to plant growth. By accelerating seed germination, mulches speed up desired plant growth and help minimize the impact of competing weeds.

Mulch based products such as hydromulches and erosion control blankets further underscore the positive attributes of mulch application.

Installation

There are multiple options for mulch deployment, including mulch blowers and spray equipment. Most importantly, mulches should be applied evenly over soils after seed bed preparation.

Loose mulches are most vulnerable to the erosion caused by wind, rain and runoff. To increase their resistance to erosion, mulches can be crimped into the ground, bound together by tackifiers, or secured by netting.

Hydromulches and erosion control blankets are mulch based products that can help increase mulch performance in more challenging applications.

Inspection and Maintenance

Biodegradable mulches such as straw and wood fiber can be left in place. Ideally, gradual degradation will give way to the establishment of a healthy stand of vegetation.

Inspect mulch installations regularly until vegetation is fully established. Inspections are especially important after significant rain events. Repair problem areas as needed.

Seeding

Applications and Effective Use

Seeding begins the process of healthy vegetation establishment. Ultimately, the most effective erosion and sediment control is achieved by a strong stand of vegetation.

Temporary seeding is sometimes employed to stabilize areas under construction. Permanent seeding provides long-term stabilization of exposed soils.

Installation

Choosing the correct seed for each individual site is of prime importance. Soil tests are crucial, and are very inexpensive. Matching the seed mixture to site requirements will bring the best results.

Dry seed can be applied in multiple ways. Seed can also be mixed with water, mulch, tackifiers and fertilizers in hydraulic applications.

Seed that is out of date, wet or moldy should not be used. Be sure that seed is applied in direct contact with the ground. Be sure seed is evenly applied at prescribed rates.

Inspection and Maintenance

Overall, it is very important to note that seeding will not compensate for problems caused by unstable or poorly drained soils. Soil compaction must be even. Improperly compacted areas, such as filled in areas, are extremely vulnerable to rill and gully erosion. Also look for wet or poorly drained areas. All such areas are highly vulnerable to eroision.

Inspect for acceptable germination rates and full vegetation establishment. Inspect seed bags to be sure that specified seed mixtures were used and that seed was used within its prescribed shelf life.

Sod

Applications and Effective Use

Sod provides immediate vegetation and erosion control. It is often installed on commercial sites or in residential developments where aesthetics are an important consideration.

Pinning or staking is often required in concentrated flow areas or slopes. Test the soil that will form the sod bed. Add fertilizer or soil amendments as needed.

Installation

Proper soil bed preparation is extremely important. Sod should be placed over a topsoil bed that is loosened to a three inch depth and evenly graded.

Stagger end joints and be sure that all edges firmly meet adjoining strips. Avoid stretching the sod strips.

After installation is complete, water thoroughly.

Inspection and Maintenance

Sod installations should be closely monitored during the month following installation.

Replace sod strips that are damaged, weed infested, dead, or displaced.

Proper watering is of critical importance. Light to moderate watering will encourage root penetration into the organic soil mixture immediately below the sod installation. If sod is overly saturated, such root growth will be discouraged.

EROSION **CONTROL**

Erosion Control Blankets

Applications and Effective Use

Erosion control blankets are temporary manufactured products designed to protect seeded areas during the vegetative process. They are designed to be installed after seed bed preparation is complete. As vegetation becomes established, the blankets gradually biodegrade.

Blankets are manufactured with an evenly distributed mulch layer fastened with stitching to a netting structure. Mulch materials typically used in blanket manufacturing include straw, wood fiber and coconut fiber.

The netting and fibers used in blanket manufacturing are matched to product longevity and specific jobsite requirements. Erosion control blankets are available with product longevity ranging from 45 days to three years.

Erosion control blankets are typically used on slopes or in low velocity waterways.

Installation

Blankets should be trenched in at the uphill termination point. Adequate stapling is also very important. It is important that all overlaps be done in a shingle pattern. Overall, it is very important that installation causes runoff to flow over installed blankets and not under them.

Proper ground contact is essential. Remove any large rocks or sticks that could cause tenting of the blankets.

In channel applications, blankets should be laid parallel to the direction of flow. Blankets should be installed over prepared seed beds only, and never over existing vegetation. Soils must also be evenly compacted.

Be sure to follow manufacturer's written installation instructions.

Inspection and Maintenance

Pay close attention to proper stapling and anchoring of the blankets. Be sure that water flows are not undermining the installation.

Blanketed areas damaged during or after installation must be repaired or replaced.

Coir Fiber Logs and Mats

Applications and Effective Use

Coir fiber logs are composed of coconut fiber, and are most often used to stabilize shorelines and provide long-term erosion protection during vegetation establishment. Depending upon their density, coir fiber logs can provide stabilization for as long as five to seven years. The coir fiber is encased by a netting structure. Netting types vary, and are dictated by site conditions.

Coir logs sometimes are pre-drilled and then plugged with vegetation.

Typically coir fiber logs are available in diameters ranging from eight to 20 inches.

Coir fiber mats are often used in sloping areas adjacent to coir fiber log installations, and provide longterm soil protection as vegetation becomes established.

Installation

Installation methods vary greatly, and are dictated by site conditions. Typically, along streams coir logs are trenched in, and then secured by wooden stakes driven on both sides of the log. Coir or nylon twine is often laced among the stakes to help prevent floating of the logs. On the upstream limit of stream installations, it is important to key the log three to five feet into the embankment. This will discourage flows from getting behind the installation.

Higher flow areas often dictate more aggressive fastening systems. These can include hand driven stainless steel cable anchors or metal piling systems.

Inspection and Maintenance

Coir fiber log and mat installations should be inspected after the first significant storm event. Be sure that the logs are securely fastened to shoreline or embankment. After the first growing season, dead or dying plant plugs will need to be replaced.

Turf Reinforcement Mats

Applications and Effective Use

Turf reinforcement mats (TRMs) are designed to provide permanent reinforcement to the root and stem structure of vegetation.

Vegetated TRMs have been evaluated in independent testing facilities and have proven to be very effective in providing an alternative to hard armor systems in high flow channels, along shorelines, and on steep slopes.

While TRMs will not replace all riprap and other hard armor systems, they do provide a vegetative alternative to these methods in many cases.

Installation

Turf reinforcement mats are installed directly after grading and seeding has taken place. They must be in firm contact with the soil. They also must be trenched in properly. Overall, it is extremely important to install TRMs in accordance with the manufacturer's written instructions. TRMs are fastened with pins, which may be metal, wood or plastic, depending upon design considerations.

Large roots, rocks and other debris must be removed before mat installation.

Some turf reinforcement mats require soil filling, while others do not. Because the products on the market vary greatly, following the specific manufacturer's written installation instructions is extremely important.

Turf reinforcement mats must be installed over newly seeded areas only, and not over existing vegetation.

Inspection and Maintenance

Inspect installation to be sure the mats are in solid contact with the soil and have been securely fastened. Be sure the mats have been trenched in at all flow entry points. Also make certain that all overlaps have been secured and that no flowing water can move beneath the mats.

For the first few growing seasons, it is recommended that mower decks be raised to six inches above the mats. Over time, as the vegetation matures, mower decks can gradually be lowered to normal mowing levels.

EROSION CONTROL

Bioengineering

Applications and Effective Use

Bioengineering uses living or dead plant materials to provide erosion control, structural support and flow mitigation. Such installations provide stability while promoting the establishment of permanent vegetation. Soil bioengineering techniques are commonly used along shorelines, but can also be used anywhere that soft armoring methods are required.

Installation

Bioengineering products and practices are many and varied. Here are a few examples:

Live Stakes--stakes of woody plant material capable of rooting. The cuttings are driven into the ground and then grow into mature plants that will provide stability to the soil surface.

Coir Fiber Logs and Mats--provide long term protection along shorelines or on steep slopes. They can be installed in conjunction with live plant plugs.

Live Fascines--bundles of live cut branches, usually willows or dogwood. The bundles are placed in trenches along embankments, growing to provide both cover and root structure to those areas.

Brush Mattress--layers of living branches laid in a crisscross pattern installed on sloping areas.

Live Cribwall--a rectangular framework of timbers or logs. These structures provide streambank stabilization while producing overhead cover for fish habitat.

Root Wads--cut from the base of larger trees, with the roots exposed. The wads are often deployed at the bottom of eroded embankments to help absorb and deflect flow energy.

When used along flowing streams or in tidal areas, it is essential that installation instructions are custom fitted to the flow characteristics on each specific site.

Inspection and Maintenance

Inspect installations on a regular basis until structures are fully vegetated. Check anchoring stakes and devices and make appropriate repairs or adjustments when necessary. If live plant plugs are used, discard dead plants and replace when necessary.

Porous Pavement Systems

Applications and Effective Use

Porous pavement systems provide alternatives to concrete and asphalt paving in high traffic areas. These products are designed to withstand heavy traffic while allowing significant infiltration. Pourous pavement systems are available that can be vegetated or filled with stone. These permeable surfaces can significantly reduce runoff and reduce pressure on stormwater conveyance and storage systems.

Installation

Care must be taken in assuring appropriate loading capacity to meet site requirements. Emergency vehicle access lanes will require higher performing products than residential applications.

Grassed porous pavement systems work well in areas where periodic access is required. When steady traffic is anticipated, aggregate filled products are more appropriate.

The porous pavement products on the market vary, and it is important to follow manufacturer's written installation instructions.

For both vegetated and aggregate filled products, proper base preparation is very important. Loading capabilities for the products is a function of the filled product working in conjunction with the base material. Grass filled products typically require an engineered base material that is a combination of aggregate and topsoil. Compaction is to be avoided, as it impacts permeability.

Inspection and Maintenance

Check to be sure that all cells are full and that joints between units have been secured properly. Refill cells as necessary for vegetated systems. inspect carefully to be sure that seed has germinated properly and that grass cover grows in completely.

Scour Protection Mats

Applications and Effective Use

Scour protection mats are used in high water flow energy areas to reinforce vegetation and protect against soil loss. Typical applications include culvert outfalls in high flow channels, and along shorelines subject to erosion caused by wind driven wave action.

The material used to manufacture these mat systems is typically polypropylene or some other synthetic plastic material. The systems provide openings to allow vegetation to grow through, while at the same time providing a rigid surface to accelerate flow and minimize damage to vegetative root systems.

Installation

After seeding operations, sod installation, or blanket or mat installation, the mats are fastened over the surface to be protected. Interlocking systems or bolted systems must be connected properly to assure a flat finished surface. In all cases, install in accordance with manufacturer's written installation instructions.

Proper anchoring system installation is essential. Many manufacturers specify the use of cabled earth anchors that are driven well beneath the surface. Earth anchors are installed by driving them into the ground with a drive rod, and then by pulling on the cable to lock the swivel head securely into place.

Provide surface treatment if required to do so by project plans.

Inspection and Maintenance

Inspect to assure that panels are all laying flat and conform to the surface. Check to be sure that all panel connections are tight and secure.

Check for erosion around edges of the installation, and make necessary repairs. Protruding edges of installed mats can interfere with mowing operations.

Vegetated Retaining Walls

Applications and Effective Use

Vegetated retaining walls provide an attractive alternative to modular concrete block systems, poured concrete and other non-vegetated systems. Engineered like all wall systems, vegetated walls are designed with careful consideration of soil stability, drainage and long-term performance.

When site conditions require a vertical or near vertical wall, vegetated walls provide an attractive alternative to traditional walls systems. Vegetated walls provide drainage through the wall surface itself, significantly helping reduce hydrostatic pressure.

A wide variety of vegetation types can be used depending on job specific requirements.

Installation

Three dimensional vegetated wall systems are typically built of panels installed in consecutive horizontal layers. The exposed cells are filled with topsoil, while non-exposed cells are filled with aggregate. It is critical that all vegetated wall systems are installed in strict compliance with manufacturer's written instructions.

Walls of heights greater than three to four feet normally require a stamp from a structural engineer. Virtually all such walls require geogrid reinforcement and compaction of disturbed soils behind the walls. Proper drainage is also essential.

Inspection and Maintenance

Most often the geogrids used in wall construction are uni-axial, or strong in one direction. Be sure that such grids are installed in the correct direction, or from the front of the wall surface back to the limit of soil disturbance. Be sure that all panel to panel connections are secure.

During construction pay close attention to soil compaction and drainage. Repair and seed or plant areas where vegetation has failed to establish itself.

Hydromulch

Applications and Effective Use

Hydraulic mulches are machine applied mixtures of water and mulch materials. Seed can also be added to such mixes. In some cases special additives are included to assist with adhesion to the soil surface.

Such products provide a cost effective alternative to traditional seeding methods. Most commonly hydromulches are used to stabilize moderate to steep slopes and other areas where seed bed protection is desired. Hydromulches provide an alternative to other surface treatments such as sod or erosion control blankets.

Hydromulches should not be used in concentrated flow areas.

Installation

Hydraulic mulches vary widely, depending on jobsite requirements. Lower performing mixtures, for example, might consume as little as 500 pounds of mulch material per acre. The highest performing mixtures will require much higher application rates. In all cases, follow manufacturer's specific requirements for installation.

Higher performing mulches often require spraying from multiple directions to assure 100% coverage.

Inspection and Maintenance

Visually inspect installations to assure uniform and adequate coverage. This is especially important when higher performing mulches have been specified and used.

Be sure that the specific seed and fertilizer requirements for the project have been met. Reapply hydromulch mixtures to areas where coverage is inadequate or where repairs are needed. Be sure watering needs are met as required.

Tackifiers

Applications and Effective Use

Tackifiers are additives blended with hydromulches, helping to bind the material and help with adhesion to soil surfaces. Tackifiers can also assist with more even particle distribution and moisture retention.

There are many tackifiers on the market, with guar gum and polymers among the most commonly used.

Some tackifiers lose effectiveness after one or two rain events. Others will perform well for significantly longer periods.

Installation

Most of these materials should be blended with hydromulch mixtures and sprayed, while others can be applied dry. In all cases, apply per manufacturer's installation instructions.

Coverage rates vary widely. Consult manufacturer's recommendations when calculating coverage rates.

When using polymers, be aware that there are materials on the market that may be toxic. The most reputable polymer producers can produce third-party verification that their materials are non-toxic.

Inspection and Maintenance

Inspect newly mulched areas to be sure coverage is uniform. Verify that correct mulch materials and the specified seed mixture was used on the site. Reapply as necessary.

Woven Geotextiles

Applications and Effective Use

Woven geotextiles are used extensively to separate soil layers. The products are comprised of woven slit film polypropylene materials. Typical uses are beneath driveways, parking lots, residential streets and highways. This product group has been found to be particularly effective in bridging over weaker or less desirable subgrade materials.

For more than half a century, woven geotextiles have delivered consistent results in lowering costs and in realizing positive performance results. Because these products have consistently contributed to better performance and lower short and long term costs, their use and acceptance has increased tremendously in a relatively short period of time.

Installation

Woven geotextiles are placed directly on the prepared site. Care should be taken to roll out the material as tight and as flat as possible. The material should be rolled out in the direction specified on site plans.
Depending on site requirements adjacent rolls should either be overlapped or seamed. Once the material is rolled out, it is most often necessary to anchor or pin the material in place prior to filling operations. Anchoring is especially important when high winds are a factor.

Once securely in place and properly covered, woven geotextiles will perform well over the long term. However, most problems occur when the product is damaged during backfilling operations. Be sure heavy construction equipment and tracked vehicles are not run directly over the geotextile fabric. This can result in shifting and tearing of the product.

Inspection and Maintenance

During covering operations, watch closely to be sure the material remains tight and firmly in place. Also be sure that soil cover quality and thickness requirements have been met.

Nonwoven Geotextiles

Applications and Effective Use

Nonwoven geotextiles are used extensively to separate soil layers and also in drainage applications. Comprised of needle punched polypropylene, nonwoven geotextiles are highly permeable, and allow positive water flow while maintaining strong soil separation performance.

The products are often used in backing rock riprap and in French drain installations, helping to achieve both separation and filtration. The products in this group range from lightweight to heavyweight, with specifications driven by specific site and installation requirements.

Nonwoven geotextiles have delivered consistent results in lowering costs and in realizing positive performance results. Because these products have consistently contributed to better performance and lower short and long term costs, their use and acceptance have increased tremendously in a relatively short period of time.

Installation

Nonwoven geotextiles are placed directly on the prepared site. Care should be taken to roll out the material as tight and as flat as possible. The material should be rolled out in the direction specified on site plans. Nonwoven geotextiles can easily be cut to custom widths during installation . Once the material is rolled out, it is most often necessary to anchor or pin the material in place prior to filling operations. Anchoring is especially important when high winds are a factor.

Once securely in place and properly covered, the products will perform well over the long term. However, most problems occur when the product is damaged during backfilling operations. Be sure heavy construction equipment and tracked vehicles are not run directly over the geotextile fabric. This can result in shifting and tearing of the product.

Inspection and Maintenance

During covering operations, watch closely to be sure the material remains tight and firmly in place. Also be sure that soil cover quality and thickness requirements have been met.

GROUND **STABILIZATION**

Woven Monofilament Geotextiles

Applications and Effective Use

Comprised of individual woven polypropylene fibers, woven monofilament geotextiles possess unique characteristics designed to assist when both separation and filtration are required. When properly matched to site soils, the products allow for enhanced flow rates while maintaining strong soil layer separation. They are often used in areas where the combination of durability, high flow rates and solid separation are all required. Typical applications include bank stabilization, rock underlayment and spillways.

Woven monofilament geotextiles have delivered consistent results in lowering costs and in realizing positive performance results. Because these products have consistently contributed to better performance and lower short and long term costs, their use and acceptance has increased tremendously in a relatively short period of time.

Installation

Woven monofilament geotextiles are placed directly on the prepared site. Care should be taken to roll out the material as tight and as flat as possible. The material should be rolled out in the direction specified on site plans. Once the material is rolled out, it is most often necessary to anchor or pin the material in place prior to filling operations. Anchoring is especially important when high winds are a factor.

When installed on steep inclines, the product should be trenched in firmly at the top of the slope.

Once securely in place and properly covered, the products will perform well over the long term. However, most problems occur when the product is damaged during backfilling operations. Be sure heavy construction equipment and tracked vehicles are not run directly over the geotextile fabric. This can result in shifting and tearing of the product.

Inspection and Maintenance

During covering operations, watch closely to be sure the material remains tight and firmly in place. Also be sure that soil cover quality and thickness requirements have been met.

Spun Bonded Geotextiles

Applications and Effective Use

Spun bonded geotextiles are non-woven and deliver a distinctive combination of high permeability and high strength. In the manufacturing process, polypropylene is spun, rolled and heated to produce a very tough yet permeable finished product. The products are often used in areas where toughness and long product life are required, such as septic systems, subsurface drainage and in landscaping.

Spun bonded geotextiles have delivered consistent results in lowering costs and in delivering positive performance results. Because these products have consistently contributed to better performance and lower short and long term costs, their use and acceptance has increased tremendously in a relatively short period of time.

Installation

Spun bonded geotextiles are placed directly on the prepared site. Care should be taken to roll out the material as tight and as flat as possible. The material should be rolled out in the direction specified on site plans. Once the material is rolled out, it is most often necessary to anchor or pin the material in place prior to filling operations. Anchoring is especially important when high winds are a factor.

Once securely in place and properly covered, the products will perform well over the long term. However, most problems occur when the product is damaged during backfilling operations. Be sure heavy construction equipment and tracked vehicles are not run directly over the geotextile fabric. This can result in shifting and tearing of the product.

Inspection and Maintenance

During covering operations, watch closely to be sure the material remains tight and firmly in place. Also be sure that soil cover quality and thickness requirements have been met.

GROUND **STABILIZATION**

Geomembranes

Applications and Effective Use

Geomembranes are synthetic membranes with very low permeability. The products are most used as barriers to fluid migration. Typical applications include pond liners, landfill covers and landfill liners. There are many types of geomembanes on the market, with high-density polypropylene (HDPE), low density polypropylene (LDPE) and polyvinyl-chloride (PVC) being the most common.

Installation

Geomembrane installation is very complex, and therefore most often entrusted only to highly qualified commercial installers. Before installation, careful consideration must be given to site conditions. If gases are to be generated, then venting must be part of the design. Installations should also be well above water tables.

Drainage both during and after construction requires careful planning. Surfaces must be free of sharp rocks and objects, and slopes must be carefully raked and prepared. Proper slope top anchoring is critical. Professional field seaming is also of vital importance. Panels must be carefully unrolled and placed to assure proper alignment and minimize damage.

Proven methodology will assure attachments to liner structures and necessary pipe connections. In all cases, strict adherence to manufacturer's written installation requirements is essential.

Inspection and Maintenance

Inspect all surfaces and watch carefully for any protrusions or covered objects. Be certain that the material is carefully trenched in at all termination points.

Be sure that drainage is functioning as designed, and carefully inspect pipe boots, attached structures and field seams.

Cellular Confinement Systems

Applications and Effective Use

Cellular confinement systems have proven effective in a wide variety of applications. The individual cells can be vegetated or filled with stone or concrete.

Most cellular confinement panels are perforated, allowing for more even drainage, better locking in of stone, and assisting with long term root reinforcement in vegetated systems.

Uses include load support, earth retention, slope protection and channel protection. Applications are widely varied, and include roadway base reinforcement, living retaining walls, drainage swale lining and boat ramp stabilization.

Installation

A wide variety of fastening options are available for cellular confinement systems, including anchors, clips and tendons. Application instructions are both product and site specific, so it is extremely important the specified instruction methods are followed closely.

Inspection and Maintenance

Inspect to be sure of proper anchoring and trenching in of the cellular confinement panels. Also be sure that all cells are filled completely, and that all adjacent sections are properly anchored and connected.

Over time, for stone filled systems, site conditions may warrant the addition of more stone. Vegetated systems can be mowed and will virtually disappear from sight over time.

Roadway Stabilization Grids

Applications and Effective Use

Roadway stabilization geogrids are widely used to improve the performance and extend the life of traffic bearing surfaces. The products are installed under parking lots, city streets and highways. The technology has proven to improve long-term traffic bearing performance. The combination of a geogrid installation and its aggregate covering forms a platform that can reduce the volume of aggregate required.

From a value engineering perspective, using geogrids in conjunction with aggregates contributes to both significant cost savings and better results.

The performance of roadways and other paved surfaces is tied directly to base course stability, and for decades geogrids have proven themselves in the field.

Installation

Roadway geogrid installation is quite simple. The material is simply rolled out and then covered with the specified aggregate. No connections are normally required. Simple overlaps are sufficient and sewing is not required.

When excavation after installation requires cutting the material, it can be easily patched during backfilling operations.

Inspection and Maintenance

Geogrids vary in performance, and are specified based on project requirements. Be sure the specified material is used, and also carefully monitor compliance with aggregate material specifications and thickness requirements.

The leading manufacturers of these products have developed software that will assist in matching specific product needs to project specifications.

GROUND **STABILIZATION**

Earth Reinforcement Grids

Applications and Effective Use

Earth reinforcement grids are commonly used to stabilize soil layers, both on slopes and behind retaining walls. Used in combination with proper compaction and engineered design, they can provide long-term soil stabilization on steep and long slopes and behind vertical wall structures.

On taller walls, soil stability takes on even greater importance. Earth stabilization grids are typically rolled out perpendicular to the wall or soil surface. In most cases, the embedded length is 60-80% of the wall or slope height.

Installation

Before installation be sure that the base surface is free of any stones, roots or other objects that could damage the material. Be sure that the material is installed in the proper direction, and in compliance with manufacturer's specific installation instructions.

Vehicles must not be allowed to drive directly on the installed grid. Sections of installed grid must match the total length of the area to be stabilized, from the edge of the slope back to the limit of disturbance.

Under no circumstances can such runs be broken up or filled in with overlapping pieces. This will compromise the design strength of the installation.

Inspection and Maintenance

Be sure that specified aggregate materials are being used, and also inspect product compliance with job specifications. During installation it is critical that compacting operations match job plan requirements, and that specified spacing between geogrid layers is maintained. Be sure that the material is stretched out firmly and tightly, with complete coverage.

GROUND **STABILIZATION**

Gabions & Reno Mattresses

Applications and Effective Use

Gabions and Reno Mattresses are rectangular metal wire baskets that are filled with stone to form three dimensional structures. Depending on jobsite requirements, the wire component can be galvanized steel, PVC coated or stainless steel.

The products are widely used for retaining walls, channel lining, culvert outfalls, slope stabilization and weirs. Typically, gabions, in the form of cubes, are used for wall construction. Reno Mattresses, on the other hand, are flatter and more elongated, and are often used to line spillways or channels.

This technology has been proven over centuries of use. Gabions and Reno Mattresses are highly permeable structures that over time will fill in with silt and promote vegetative growth and blend in with the surrounding environment.

Installation

Gabions and Reno Mattresses are shipped flat and must be carefully unfolded and stretched out. Fasteners are used during the assembly of the baskets.

Once the baskets have been individually assembled, they then need to be set in place and connected in continuous fashion. Typical gabions, which are three feet in height, should be filled in one-foot lifts, with bracing wire installed between lifts to eliminate any potential bulging.

Inspection and Maintenance

Be sure that the required number of fasteners are used, and also be sure that all wall surfaces are straight and true. Inspect to be sure that aggregate fill requirements are met.

It is of critical importance that the products being installed meet job specifications. Gabion wire type and wire fabrication requirements must be met to assure effective performance.

Level Spreaders

Applications and Effective Use

Level spreaders, as the name implies, are designed to slow down, spread out, and diffuse concentrated stormwater flows. By breaking down the energy associated with high concentrated flows, level spreaders can reduce the negative downstream impacts of such flows on receiving waters.

Properly designed level spreaders will convert concentrated flows into less harmful sheet flows, which are then released into vegetated buffer areas. As the flows pass through these areas, infiltration increases and sediment and nutrients are removed through physical and biological processes.

Installation

There are three critical components to level spreaders. First of all, at the collection site at the top of the slope, a forebay is constructed. The forebay is a bowl shaped excavated area designed to intercept stormwater and allow sediment to settle out.

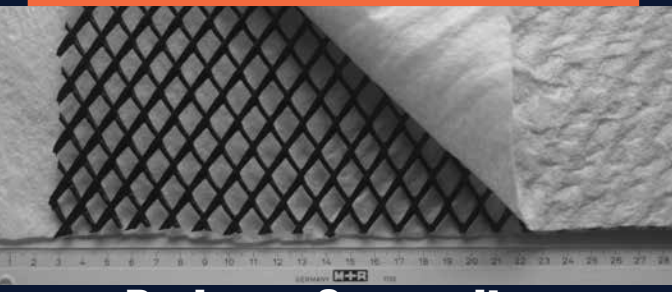
The main body of the spreader is known as the channel. The channel is level and runs along the top of the slope. Along the slope side, or front of the channel, a lip is constructed of concrete, metal or rock. This structure serves as a weir. Stormwater enters and fills the channel and then spreads and flows evenly over the lip.

The third component of the level spreader is the vegetated buffer area. The buffer is designed to remove both nutrients and sediment before runoff reaches the stream or other water body.

Inspection and Maintenance

Sediment build up in level spreaders needs to be monitored closely. Remove accumulated sediment and other debris from the forebay and channel regularly.

At a minimum level spreaders require annual maintenance. Trees and shrubs that attempt to grow on spreader lips must be removed. Ideally, buffer vegetation immediately downslope of the spreader should be mowed.



Drainage Composites

Applications and Effective Use

Drainage composites are designed to facilitate drainage in a high variety of specialized applications. The products feature a high performance three dimensional plastic core and are faced with a protective layer of non-woven geotextile fabric. Drainage and filtration occurs first through the protective fabric, and then through voids in the plastic core.

Uses are many and varied. There are products designed for the turf industry that are used widely for athletic field drainage, during golf course construction, around foundations, on green roofs, and under patios and decks. Heavier drainage composites are used on landfills and under and along highways.

The products have proven to be particularly cost effective when compared to traditional drainage treatments such as pipe and stone and French Drains.

Because stone and additional filter fabric do not need to be used, installation costs of drainage composites are significantly lower than traditional treatments.

Installation

Drainage composites must be installed in strict compliance with manufacturer's written installation instructions.

In landscaping applications, the products are typically encased with coarse sand. This protective layer removes smaller soil particles as water flows toward the product, helping preserve the flow through capabilities of the filter fabric.

Inspection and Maintenance

Properly installed drainage composites are by and large maintenance free, once backfilling operations are complete. During installation it is essential that product specific installation instructions are followed precisely.

Stormwater Storage

Applications and Effective Use

The impact of high volume stormwater discharges from developed areas has created a demand for effective solutions. The Low Impact Development (LID) movement has put increased pressure on developers to find methods of minimizing the effect of such flows on adjacent property.

Just as impervious surfaces accelerate off site flows, LID dictates that offsite flows should be managed through the installation of solutions that hold discharges as close as possible to historic levels.

Subsurface cubes and chambers are often used to store and retain large volumes of stormwater during and after storm events. The evaluation of such systems requires close scrutiny of installed costs, project life cycle, and maintenance costs.

Installation

The installation requirements for manufactured stormwater storage units vary widely. These requirements are both product and project specific. Many factors have to be considered, including volume and loading. Proper project design and onsite installation guidance are almost always required on commercial projects.

In all cases, project requirements and manufacturer's written installation instructions must be carefully followed.

Inspection and Maintenance

Monitor installations closely from start to finish. Project details such as proper compaction, aggregate needs and cover material depth are all critical to success.

Virtually all stormwater storage installations require maintenance. Once installation is complete, it is important to comply with system specific maintenance regimes.

Stormwater Treatment

Applications and Effective Use

Increased scrutiny regarding stormwater runoff volume has led to concerns about water quality. Nutrients and pollutants carried by stormwater can have a devastating impact on receiving waters. Manufactured systems are now available to remove such substances prior to release.

The best manufactured systems mimic nature by using a combination of microbes, plant matter and stone to reduce levels of harmful substances such as phosphorus, chromium, zinc and suspended solids. The units are living filters.

Evaluation of the performance of such units is ongoing. In all cases, it is recommended that potential users rely on independent third party testing results during the decision making process.

Installation

The installation of stormwater treatment units is complex and critical at the same time. Following manufacturer's written installation instructions is a must.

It is of critical importance to employ qualified contractors to install these units. It is also highly recommended that a manufacturer's representative be on site during the installation process.

Inspection and Maintenance

Stormwater treatment installations must be closely monitored. Soils, aggregates and plants used must be installed in compliance with product specifications.

Like all filters, stormwater treatment systems require maintenance. Replace plant materials as needed, and be sure regular maintenance is performed by a qualified contractor.

Culvert Relining Systems

Applications and Effective Use

Aging culverts create a special problem in highway maintenance. Nationally thousands of metal and concrete culverts are failing. Replacement costs are expensive, especially when factoring in road closures and resulting traffic detours. Failed culverts can result in flooding, sink holes or road collapse.

Technology is now available to reline and rehabilitate existing culverts. This alternative eliminates the need for excavation or removal of the existing pipe.

Installation

Culvert relining systems vary widely. Some systems involve the insertion of a plastic or metal sleeve in highly deteriorated culverts. The sleeve is sized to accept the new pipe. Connections are normally accomplished via watertight sealing. Many systems require the injection of a concrete grout mixture to fill gaps between the new liner and the deteriorated existing culvert.

In all cases, it is important to follow manufacturer's written installation instructions.

Be sure a qualified factory or manufacturer's representative is on site for the installation.

When concrete grout is used, it is critical that the flowable mixture meets National Concrete Masonry Association grout or other flowable fill specifications.

Arch Culverts

Applications and Effective Use

The use of arch culverts has increased significantly due to new regulations regarding fish and wildlife passage. In many cases, existing culvert pipe no longer meets government standards, and arch culverts are installed.

Properly sized arch culverts allow streams to flow through the structures without interruption. As a result, amphibians, invertabrates, fish and mammals can more easily pass through.

Installation

As most pipe arches pass directly under highways and roadways, proper installation is critical. Sizing requirements are a complex factor of normal stream flow width and other design parameters. For example, arch culverts designed for a 25-year storm event will be significantly larger than those designed for a 10-year storm. Usually, the width of the arch opening should be at least as wide as the stream channel at the normal high water mark.

Footings must be poured or placed in accordance with manufacturer's specifications.

Inspection and Maintenance

Be sure that all permitting is in place prior to construction. Be sure that the substrate or material that is beneath the arch is compatible with the adjacent streambed. It is extremely important that elevations are set correctly.

Also, working around moving water requires special attention to controlling sediment. Adequate measures must be in place before the start of construction activity, and then removed promptly when permanent stabilization has been achieved.

Spill Kit

Applications and Effective Use
Spill kits should be readily accessible on the jobsite and ready for use for cleanup and containment of hazardous spills.

Common Procedures
Isolate and dike off any areas with soil or other barricades to contain spills.

Immediately excavate soil beyond saturation level and store in plastic sheeting or container.

Use floor drying material to absorb spills.

Sweep or mop up material and store in a sealed container.

Disposal of all hazardous materials must be carried out in compliance with state and federal regulations.

Spill kit items should be stored in a 8 foot by 10 foot container on site.

Check to be sure the spill kit contents are in place:
30 gallon plastic trash can with lid • Two large bags of floor dry

Large bag of neutralizing agent • Two pairs of safety goggles

Two bags of cloth rags • Two rolls of duct tape

Broom • Shovel • Gloves

Two of each type of inlet protection being used on the site

Secondary Containment

Applications and Effective Use

Secondary containment is both external to and separate from primary containment. Primary containment of solid waste or hazardous materials consists of the inner surface of the container or device that comes into contact with the material.

Federal requirements as addressed by the Environmental Protection Agency (EPA) now requires a second line of defense against spills or migration of hazardous materials or waste. Secondary confinement structures and techniques can include portable containment units, tank systems, buildings, barriers or liners

Important Elements of Successful Containment Systems

1. Containment Building: Used to store or treat hazardous materials or waste.
2. Containers: Portable devices used for the storage, treatment and disposal of hazardous materials.
3. Leak Detection Systems: Monitoring devices that monitor possible releases or failures.
4. Liners: Designed to prevent the downward or lateral escape of waste materials.
5. Portable Tanks: Equipped with skids and designed for effective loading and removal.
6. Stationary Tanks: Larger units not intended for loading and unloading.
7. Sumps: Pits or reservoirs designed to collect hazardous waste or materials.

Inspection and Maintenance

Covered storage is ideal when the material stored is subject to weather related problems or potential vandalism. Be sure secondary containment capacities are well above the volume of stored materials.

Storage systems need to be chemically compatible with the materials being stored. Everyone on the jobsite needs to be fully educated on spill response procedures.

Concrete Wash Out

Applications and Effective Use

Secondary containment procedures for concrete washout areas need to be sited with consideration of traffic concentrations, maintenance and the density of site conditions.

Some specifications require lining of concrete washout areas. Others do not. Be sure to verify plans and specifications prior to construction.

Common Procedures

Locate the concrete washout area at a high location away from any critical site resources.

Make sure the area is well signed and that all subcontractors are fully aware of usage expectations.

Procedures for pumping waste water and dumpster exchange must be planned and implemented at the very beginning of the project.

Inspection and Maintenance

Be sure that all areas designated for concrete washout are contained and that no infiltration is occurring.

Provide approach and exit stabilization to manage density of construction traffic.

Maintain and clean when capacity of storage reaches at least three quarters of device height.

Mason's Work Area

Applications and Effective Use

A contained and defined mason's area should be located on a high, well drained area on the jobsite.

All masonry tools, materials and equipment must be located and stored in the defined area.

Provide convenient trash receptacles and disposal for this area.

Surround this area with runoff controls and maintain these controls throughout the construction cycle.

Inspection and Maintenance

This area should be clearly marked. It is vital to educate contractors and subcontractors regarding the use and maintenance of this area.

Provide regular maintenance.

Make storage and disposal convenient. This will help increase compliance and good housekeeping.

Accountability must be built into the jobsite requirements. Penalties for non-compliance must be clearly communicated.

Equipment Maintenance

Applications and Effective Use

Onsite fuel tanks must meet all federal and state regulations and have spill containment with the required capacity.

The location of all maintenance areas must be clearly indicated and dated on each posted site map.

The area must be located and sited appropriately, with consideration for traffic density and drainage patterns.

Inspection and Maintenance

Educate subcontractors regarding the expectations and use of this area. The area needs to be regularly maintained.

Be sure that storage and maintenance are convenient for subcontractors. This component will help increase compliance.

It is important that subcontractors understand the importance of the proper use of this area. Be sure that all users of this area understand the ramifications of non-compliance.

EJP **LOCATIONS**

Bangor, ME
207-990-5000

Gardiner, ME
207-582-2006

PEP Gardiner, ME
207-582-5019

PPF Gardiner, ME
207-582-4795

Portland, ME
207-797-3330

Concord, NH
603-224-9545

Keene, NH
603-256-6466

Montpelier, VT
802-223-2385

So. Burlington, VT
802-865-3958

Brockton, MA
508-586-3875

Mashpee, MA
508-539-0990

Middleton, MA
978-777-7738

Pittsfield, MA
413-443-3987

Shrewsbury, MA
508-845-1480

QWP So. Barre, MA
978-355-6833

Springfield, MA
413-543-8888

Whately, MA
413-665-2499

Vernon, CT
860-875-9711

Lincoln, RI
401-333-1317

Blasdell, NY
716-822-1544

Round Lake, NY
518-877-6737

Syracuse, NY
315-451-1272

Lima, OH
419-225-6292

W. Carrollton, OH
937-847-2665

Fort Wayne, IN
260-482-2100

Jeffersonville, IN
812-218-9405

Lafayette, IN
765-449-2723

West Indianapolis, IN
317-247-0005

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