Stormwater Best Management Practice

Concrete Washout

Minimum Measure

Construction Site Stormwater Runoff Control

Subcategory

Good Housekeeping/Materials Management

Description of Concrete Washout at Construction Sites

Concrete and its ingredients

Concrete is a mixture of cement, water, and aggregate material. Portland cement is made by heating a mixture of limestone and clay containing oxides of calcium, aluminum, silicon and other metals in a kiln and then pulverizing the resulting clinker. The fine aggregate particles are usually sand. Coarse aggregate is generally gravel or crushed stone. When cement is mixed with water, a chemical reaction called hydration occurs, which produces glue that binds the aggregates together to make concrete.

Concrete washout

After concrete is poured at a construction site, the chutes of ready mixed concrete trucks and hoppers of concrete pump trucks must be washed out to remove the remaining concrete before it hardens. Equipment such as wheelbarrows and hand tools also need to be washed down. At the end of each work day, the drums of concrete trucks must be washed out. This is customarily done at the ready mixed batch plants, which are usually off-site facilities, however large or rural construction projects may have on-site batch plants. Cementitious (having the properties of cement) washwater and solids also come from using such construction materials as mortar, plaster, stucco, and grout.

Environmental and Human Health Impacts

Concrete washout water (or washwater) is a slurry containing toxic metals. It's also caustic and corrosive, having a pH near 12. In comparison, Drano liquid drain cleaner has a pH of 13.5. Caustic washwater can harm fish gills and eyes and interfere with reproduction. The safe pH ranges for aquatic life habitats are 6.5 – 9 for freshwater and 6.5 – 8.5 for saltwater.

Construction workers should handle wet concrete and washout water with care because it may cause skin irritation and eye damage. If the washwater is dumped on the ground (Fig. 1), it can run off the construction site to adjoining roads and enter roadside storm drains, which discharge to surface waters such as rivers, lakes, or estuaries. The red arrow in Figure 2 points to a ready mixed truck chute that's being washed out into a roll-off bin, which isn't watertight. Leaking washwater, shown in the foreground, will likely follow similar

Figure 1. *Chute washwater being dumped on the ground*

Figure 2. *Chute washwater leaking from a roll-off bin being used as a washout container*

paths to nearby surface waters. Rainfall may cause concrete washout containers that are uncovered to overflow and also transport the washwater to surface waters. Rainwater polluted with concrete washwater can percolate down through the soil and alter the soil chemistry, inhibit plant growth, and contaminate the groundwater. Its high pH can increase the toxicity of other substances in the surface waters and soils. Figures 1 and 2 illustrate the need for better washout management practices.

Best Management Practice Objectives

The best management practice objectives for concrete washout are to (a) collect and retain all the concrete washout water and solids in leak proof containers, so that this caustic material does not reach the soil surface and then migrate to surface waters or into the ground water, and (b) recycle 100 percent of the collected concrete washout water and solids. Another objective is to support the diversion of recyclable materials from landfills. Table 1 shows how concrete washout materials can be recycled and reused.

Table 1 – Recycling concrete washout materials

Uses of Recycled Materials	Concrete Washout Materials					
	Washwater	Cement fines[a]	Fine aggregate	Coarse aggregate	Hardened concrete	Unused wet concrete
Reused to washout additional mixer truck chutes or drums	x					
Reused as a ready mixed concrete ingredient	x	x[b]	x	x		
Reused as an ingredient of precast concrete products, e.g., highway barriers, retaining wall blocks, riprap	x	x	x	x		x
Reused as crushed concrete products, e.g., road base or fill		x	x	x	x	
Reused to pave the yards of ready mixed concrete plants						x
Returned back to a surface water, e.g., river, lake, or estuary	x[c]					

a. Fine particles of cementitious material (e.g., Portland cement, slag cement, fly ash, silica fume)

b. Recyclable, if allowed by the concrete quality specifications

c. Treated to reduce the pH and remove metals, so it can be delivered to a municipal wastewater treatment plant, where it is treated further and then returned to a natural surface water

Washwater recycling, treatment, disposal

Washwater from concrete truck chutes, hand mixers, or other equipment can be passed through a system of weirs or filters to remove solids and then be reused to wash down more chutes and equipment at the construction site or as an ingredient for making additional concrete. A three chamber washout filter is shown in Figure 3. The first stage collects the coarse aggregate. The middle stage filters out the small grit and sand. The third stage has an array of tablets that filter out fines and reduces the pH. The filtered washwater is then discharged through a filter sock. An alternative is to pump the washout water out of the washout container (Fig 4) and treat the washwater off site to remove metals and reduce its pH, so it can be delivered to a publicly owned treatment works (POTW), also known as a municipal wastewater treatment plant, which provides additional treatment allowing the washwater to be discharged to a surface water. The POTW should be contacted to inquire about any pretreatment requirements, i.e., the National Pretreatment Standards for Prohibited Dischargers (40CFR 403.5) before discharging the washwater to the POTW. The washwater can also be retained in the washout container and allowed to evaporate, leaving only the hardened cementitious solids to be recycled.

Figure 3. *Concrete washout filter*

Figure 4. *Vacuuming washwater out of a washout container for treatment and reuse*

Solids recycling

The course aggregate materials that are washed off concrete truck chutes into a washout container can be either separated by a screen and placed in aggregate bins to be reused at the construction site or returned to the ready mixed plant and washed into a reclaimer (Fig. 5). When washed out into a reclaimer, the fine and course aggregates are separated out and placed in different piles or bins to be reused in making fresh concrete. Reclaimers with settling tanks separate cement fines from the washwater, and these fines can also be used in new concrete unless prohibited by the user's concrete quality specifications.

Figure 5. *Ready mixed truck washing out into a reclaimer*

Hardened concrete recycling

When the washwater in a construction site concrete washout container has been removed or allowed to evaporate, the hardened concrete that remains can be crushed (Fig. 6) and reused as a construction material. It makes an excellent aggregate for road base and can be used as fill at the construction site or delivered to a recycler. Concrete recyclers can be found at municipal solid waste disposal facilities, private recycling plants, or large construction sites.

Figure 6. *Crushed concrete stockpile and crusher*

Wet concrete recycling

Builders often order a little more ready mixed concrete than they actually need, so it is common for concrete trucks to have wet concrete remaining in their drum after a delivery. This unused concrete can be returned to the ready mixed plant and either (1) used to pour precast concrete products (e.g., highway barriers, retaining wall blocks, riprap), (2) used to pave the ready mixed plant's yard, (3) washed into a reclaimer, or (4) dumped on an impervious surface and allowed to harden, so it can be crushed and recycled as aggregate. Unused wet concrete should not be dumped on bare ground to harden at construction sites because this can contribute to ground water and surface water contamination.

Washout Containers

Different types of washout containers are available for collecting, retaining, and recycling the washwater and solids from washing down mixed truck chutes and pump truck hoppers at construction sites.

Chute washout box

A chute washout box is mounted on the back of the ready mixed truck. If the truck has three chutes, the following procedure is used to perform the washout from the top down: (1) after the pour is completed, the driver attaches the extension chute to the washout box, (2) the driver then rotates the main chute over the extension chute (Fig. 7) and washes down the hopper first then the main chute, (3) finally the driver washes down the flop down chute and last the extension chute hanging on the box. All washwater and solids are captured in the box. After the wash down, washwater and solids are returned to the ready mixed plant for recycling. A filter basket near the top of the washout box separates out the coarse aggregates so they can be placed in a bin for reuse either at the construction site or back at the cement plant.

Figure 7. *Chute washout box*

Chute washout bucket and pump

After delivering ready mixed concrete and scraping the last of the customer's concrete down the chute, the driver hangs a washout bucket shown in Figure 8 (see red arrow) on the end of the truck's chute and secures the hose to insure no leaks. The driver then washes down the chute into the bucket to remove any cementitious material before it hardens. After washing out the chute, the driver pumps (yellow arrow points to the pump) the washwater, sand, and other fine solids from the bucket up into the truck's drum to be returned to the ready mixed plant, where it can be washed into a reclaimer. A removable screen at the bottom of the washout bucket prevents course aggregate from entering the pump. This course aggregate can also be returned to the plant and added to the coarse aggregate pile to be reused. All the materials are recycled.

Figure 8. *Chute washout bucket and pump*

Hay bale and plastic washout pit

A washout pit made with hay bales and a plastic lining is shown in Figure 9. Such pits can be dug into the ground or built above grade. The plastic lining should be free of tears or holes that would allow the washwater to escape (Fig. 10). After the pit is used to wash down the chutes of multiple ready mixed trucks and the washwater has evaporated or has been vacuumed off, the remaining hardened solids can be broken up and removed from the pit. This process may damage the hay bales and plastic lining. If damage occurs, the pit will need to be repaired and relined with new plastic. When the hardened solids are removed, they may be bound up with the plastic lining and have to be sent to a landfill, rather than recycled. Recyclers usually accept only unmixed material. If the pit is going to be emptied and repaired more than a few times, the hay bales and plastic will be generating additional solid waste. Ready mixed concrete

Figure 9. *Hay bale and plastic washout pit*

Figure 10. *Leaking washout pit that has not been well maintained*

trucks can use hay bale washout pits, but concrete pump trucks have a low hanging hopper in the back that may prevent their being washed out into bale-lined pits.

Vinyl washout container

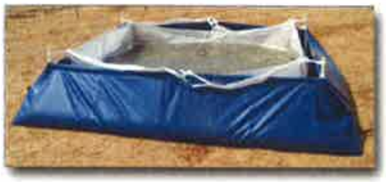

Figure 11. *Vinyl washout pit with filter bag*

The vinyl washout container (Fig. 11) is portable, reusable, and easier to install than a hay bale washout pit. The biodegradable filter bag (Fig. 12) assists in extracting the concrete solids and prolongs the life of the vinyl container. When the bag is lifted, the water is filtered out and the remaining concrete solids and the bag can be disposed of together in a landfill, or the hardened concrete can be delivered to a recycler. After the solids have been removed several times and the container is full of washwater, the washwater can be allowed to evaporate, so the container can be reused. The washwater can be removed more quickly by placing another filter bag in the container and spreading water gelling granules evenly across the water. In about five minutes, the water in the filter bag will turn into a gel that can be removed with the bag. Then the gel and filter bag can be disposed to together.

Figure 12. *Extracting the concrete solids or gelled washwater*

Metal washout container

The metal roll-off bin (Fig. 13) is designed to securely contain concrete washwater and solids and is portable and reusable. It also has a ramp that allows concrete pump trucks to wash out their hoppers (Fig. 14). Roll-off providers offer recycling services, such as, picking up the roll-off bins after the washwater has evaporated and the solids have hardened, replacing them with empty washout bins, and delivering the hardened concrete to a recycler (Fig. 15), rather than a landfill. Some providers will vacuum off the washwater, treat it to remove metals and reduce the pH, deliver it to a wastewater treatment plant for additional treatment and subsequent discharge to a surface water. Everything is recycled or treated sufficiently to be returned to a natural surface water.

Figure 13. *Mixer truck being washed out into a roll-off bin*

Figure 14. *Pump truck using the ramp to wash out into a roll-off bin*

Figure 15. *Delivering hardened Concrete to a recycler*

Another metal, portable, washout container, which has a rain cover to prevent overflowing, is shown in Figure 16. It is accompanied by an onsite washwater treatment unit, which reduces the pH and uses a forced weir tank system to remove the coarse aggregate, fine aggregate, and cement fines. The washwater can then be reused at the construction site to wash out other mixer truck chutes and equipment. The solids are allowed to harden together and can be taken to a concrete recycler (Fig. 17) to be crushed and used as road base or aggregate for making precast products, such as retaining wall blocks. All materials are recycled.

Figure 16. *Washout container with a rain cover and onsite washwater treatment*

Figure 17. *Delivering hardened concrete to a recycler*

Siting Washout Facilities

Concrete washout facilities, such as washout pits and vinyl or metal washout containers, should be placed in locations that provide convenient access to concrete trucks, preferably near the area where concrete is being poured. However they should not be placed within 50 feet of storm drains, open ditches, or waterbodies. Appropriate gravel or rock should cover approaches to concrete washout facilities when they are located on undeveloped property. On large sites with extensive concrete work, washouts should be placed at multiple locations for ease of use by ready mixed truck drivers. If the washout facility is not within view from the pour location, signage will be needed to direct the truck drivers.

Operating and Inspecting Washout Facilities

Concrete washout facilities should be inspected daily and after heavy rains to check for leaks, identify any plastic linings and sidewalls have been damaged by construction activities, and determine whether they have been filled to over 75 percent capacity. When the washout container is filled to over 75 percent of its capacity, the washwater should be vacuumed off or allowed to evaporate to avoid overflows. Then when the remaining cementitious solids have hardened, they should be removed and recycled. Damages to the container should be repaired promptly. Before heavy rains, the washout container's liquid level should be lowered or the container should be covered to avoid an overflow during the rain storm.

Educating Concrete Subcontractors

The construction site superintendent should make ready mixed truck drivers aware of washout facility locations and be watchful for improper dumping of cementitious material. In addition, concrete washout requirements should be included in contracts with concrete delivery companies.

Reference

NRMCA 2009. Environmental Management in the Ready Mixed Concrete Industry, 2PEMRM, 1st edition. By Gary M. Mullins. Silver Springs, MD: National Ready Mixed Concrete Association.

Websites and Videos

Construction Materials Recycling Association
www.concreterecycling.org

National Ready Mixed Concrete Association
www.nrmca.org

National Ready Mixed Concrete Research and Education Foundation
www.rmc-foundation.org

Additional information and videos on concrete washout containers and systems can be found by a web search for "concrete washout."

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Stormwater Best Management Practice

Construction Track-Out Controls

Minimum Measure: Construction Site Stormwater Runoff Control
Subcategory: Sediment Control

Description

Construction track-out controls minimize the amount of sediment leaving or being tracked out from the construction site as dirt, mud or other sediment attached to vehicles. Stabilization measures, vehicle wash stations and sediment collection devices are all common track-out controls.

Installing a pad of gravel over filter cloth where construction traffic leaves a site can help stabilize sediment at a construction entrance/exit. As a vehicle drives over the pad, the pad removes mud and sediment from the wheels and reduces soil transport off the site. The filter cloth separates the gravel from the soil below. It also reduces rutting by vehicle tires.

In addition to using a gravel pad, construction staff can install a vehicle washing station at the site entrance/exit. Using washing stations routinely can remove a lot of sediment from vehicles before they leave the site. Construction staff should divert wash water from vehicle washing stations into a sediment trap that will handle sediment from vehicles properly and keep it on-site.

Several other types of track-out controls, such as shaker racks (also called exit grids, rumble strips or cattle guards) and other similar proprietary devices, can help knock mud and dirt off vehicle tires. Shaker racks work by removing mud or soil from vehicle tires through bouncing or shaking action as the vehicle drives over the rack.

Applicability

Construction staff should install track-out controls anywhere construction traffic leaves or enters a construction site. Track-out controls can also provide benefits from a public relations point of view, as the site entrance/exit is often the most noticeable part of a construction site and can show community members that controls are in place to minimize sediment being tracked onto nearby streets and neighboring areas. Minimizing sediment on roads can improve both the appearance and the public perception of the construction project as well as limit the occurrence of complaints about the site. Additionally, a stabilized construction entrance/exit is generally a requirement of any construction permit, though design engineers should contact local authorities for specific requirements and design specifications.

A construction entrance stabilized with gravel over filter cloth reduces the amount of sediment transported off site.
Photo Credit: PG Environmental for USEPA

Siting and Design Considerations

Before considering track-out controls, design engineers should consider the locations of construction site entrances/exits. Where possible, they should place site entrances/exits in well-drained areas, away from streams or wetlands, and in a place where construction staff can easily conduct regular maintenance. If including wash areas, design engineers should account for adjacent, downstream areas on-site that can collect and treat wash water (e.g., using a sediment basin or similar temporary treatment practice).

Design engineers should follow local design and installation details for all construction entrances/exits. Some common design practices include the following (Caltrans, 2017; MPCA, 2019):

- Stabilize all entrances/exits to a site before land disturbance begins.
- Make sure the stabilized site entrances/exits are long and wide enough to allow the largest construction vehicle to fit with room to spare. If many vehicles will use an entrance/exit in any one day, make the site entrance/exit wide enough for two vehicles to pass at the same time with room on either side.
- If a site entrance/exit leads to a paved road, make the end of the entrance/exit flared so that long vehicles do not leave the stabilized area when they turn onto or off the road.
- Grade the exit pad so that sediment-laden stormwater does not flow onto streets or into storm drains.
- Install non-woven geotextile on graded soil to support the exit pad and spread rock evenly over the geotextile.
- Make sure the stone and gravel used to stabilize the construction site entrance/exit is large enough that vehicles do not carry it off-site.
- Avoid using sharp-edged stones, which can puncture tires.
- Install stone or gravel at a depth of at least 6 inches for the entire length and width of the stabilized construction entrance/exit. If the design uses shaker racks, make sure they are wide enough to fit the widest vehicles and long enough to allow enough shaking time. Make sure there is enough storage beneath the rack—at least 4 inches is typical.
- If a construction site entrance/exit crosses a stream, swale or other depression, provide a bridge or culvert to prevent erosion from unprotected banks.

Operational practices can also help limit sediment track-out. To limit overloading track-out controls, construction staff should avoid vehicle traffic on exposed, muddy areas of the site where possible. They should also limit traffic onto and off the site by parking vehicles on the street if possible.

Limitations

Although stabilizing a construction entrance/exit reduces the amount of sediment leaving a site, vehicle tires might still deposit some soil onto paved surfaces. To further reduce the chance of these sediments polluting stormwater, construction staff should sweep the paved area adjacent to the stabilized site entrance/exit as needed. Times of wet weather will likely call for increased sweeping and maintenance. For sites that use wash stations, a reliable water source might not be initially available and trucks might have to bring water to the site at an additional cost. Using a recapture and treatment system can help reduce the cost of water imports.

Maintenance Considerations

Construction staff maintain track-out controls in compliance with applicable permits and local regulations, generally until they have fully stabilized the rest of the construction site. Below are some steps they can follow:

- Add stone and gravel periodically to each stabilized construction site entrance/exit.
- Remove mud and dirt clods to keep the stabilized pad relatively clean.
- Immediately sweep up or vacuum soil and dirt clods tracked off-site for proper disposal.
- Make sure not to hose or sweep tracked-out sediment into any stormwater conveyance or storm drain inlet, or directly into any creek, stream or other waterway.
- Periodically remove sediment from wash rack sediment traps to make sure they keep working.

Effectiveness

The effectiveness of track-out controls is highly variable and depends on their design, use and maintenance. Sediment removal rates can range from less than 30 percent up to 60 percent for gravel pads and shaker racks. Wheel washing racks, when properly installed, can remove 75 percent or more of sediment (MPCA, 2019).

In some cases, such as areas with high clay content or persistent rain, stabilizing the site entrances/exits might not be very effective without routine use of a wash rack. Track-out controls are only effective when site rules require vehicles to use them and physical constrictions force traffic through the controls. This can be problematic for sites with multiple entrances/exits and high vehicle traffic.

Cost Considerations[1]

Track-out control costs will vary greatly depending on the controls' type and design specifications, as well as site conditions (MPCA, 2019). According to Minnesota Department of Transportation project bids awarded in 2019, the average cost for a stabilized rock construction entrance was $3,100 (MnDOT, 2019, bid item 2573501/00025). This cost includes maintenance of the track-out control throughout the project. The Construction BMP Online Handbook cites an average annual cost for installation and maintenance of $2,900 (range of $1,500–$5,900) for a stabilized rock entrance. With an added wash rack and sediment trap at the entrance, the average cost increases to $4,400 (range of $1,500–$7,300) per entrance (CASQA, 2009).

[1]Prices updated to 2020 dollars. Inflation rates obtained from the Bureau of Labor Statistics CPI Inflation Calculator Web site, https://data.bls.gov/cgi-bin/cpicalc.pl. Reference dates for the calculation are October 2011 and September 2019.

Additional Information

Additional information on related practices and the Phase II MS4 program can be found at EPA's National Menu of Best Management Practices (BMPs) for Stormwater website

References

California Department of Transportation (Caltrans). (2017). *Construction site best management practices (BMP) manual.* CTSW-RT-17-314.18.1.

California Stormwater Quality Association (CASQA). (2009). *Construction BMP online handbook.*

Minnesota Department of Transportation (MnDOT). (2019). *Average bid prices for awarded contracts, state aid projects not included: 1/1/2019 to 12/31/2019.*

Minnesota Pollution Control Agency (MPCA). (2019). Sediment control practices—vehicle tracking BMPs. In *Minnesota stormwater manual.*

Disclaimer

This fact sheet is intended to be used for informational purposes only. These examples and references are not intended to be comprehensive and do not preclude the use of other technically sound practices. State or local requirements may apply.

Stormwater Best Management Practice

Construction Phase Plan Review

Minimum Measure: Construction Site Stormwater Runoff Control
Subcategory: Municipal Program Oversight

Description

Municipal separate storm sewer system (MS4) permittees should have procedures for site plan review that incorporate consideration of potential water quality impacts. State or EPA Construction General Permit (CGP) requirements include requirements to develop stormwater pollution prevention plans for projects that disturb 1 acre of land or more (sometimes less depending on local requirements) and to identify erosion and sediment controls (ESCs) as well as controls for "other waste" at the site. Construction site stormwater controls reduce the generation and transport of pollutants and sediment in stormwater discharges from construction activities—generally by requiring the project applicant (either the design engineer or construction staff) to develop a stormwater pollution prevention plan (SWPPP) to control pollutants and stormwater discharges. The SWPPP is broader in scope than an ESC plan or site plan and encompasses both. EPA's Developing Your Stormwater Pollution Prevention Plan guide provides additional information about developing a construction SWPPP (U.S. EPA, 2007).

This fact sheet describes the construction phase plan review process to meet MS4 permit requirements. Related activities include a municipal construction inspection program, contractor training and local ordinances for construction site stormwater controls.

Program Implementation

Municipal staff who are familiar with the components of the SWPPP and applicable local regulations should review ESC plans to ensure they address local requirements and consider water quality impacts. ESC plans are generally part of the SWPPP; MS4 permittees can choose to review the entire SWPPP or just the site plan portion, depending on how they implement their municipal program.

A successful review program will support the MS4 permittee's ability to ensure that project applicants achieve ESC requirements using stormwater controls that may include non-structural (e.g., good housekeeping) and structural (e.g., silt fence) practices to reduce stormwater pollutant discharges from construction sites.

Municipal staff reviewing a construction plan.

Construction Plan Review Procedures

Developing construction plan review procedures typically includes the following four topics:

- *Identifying responsible plan review staff.* Some MS4 permittees review ESC plans through an existing permit application process. The permittee should clearly identify staff responsible for ESC plan review. The permittee should also ensure that there is periodic feedback between the plan review staff and inspection staff to make sure that construction staff install the approved controls in the plans at the construction site and that the controls are properly functioning.
- *Developing a system to track plans.* Most MS4 permittees already have systems to track plans that project applicants have submitted for review. Some MS4 permittees have also identified projects that may need coverage under their state CGPs. One particularly effective way that some have used to address CGP coverage involves using a construction project tracking system that requires

project applicants to submit proof of their Notice of Intent submittal to the permitting authority before approving a project. Some MS4 permittees notify project applicants that they should apply for permit coverage for projects disturbing more than 1 acre that discharge stormwater.

- This system could also include specifics about the ESC plan, such as the site size and the plan's review status. After a construction project begins, the system should ideally track information on inspection and enforcement actions related to that site and identify a construction staff point of contact.
- *Developing tools and procedures for consistent plan review.* Permittees should develop tools such as checklists to ensure that plan reviews are consistent and thorough. These checklists should address the ESC plan elements that this fact sheet describes below, in addition to the common issues and problems inspectors find at sites.
- *Training municipal staff.* Plan review staff should receive training on the local selection, installation and maintenance requirements for the ESC measure, as well as EPA/state construction permitting requirements. Many sources offer training, including the International Erosion Control Association.

Elements of an Effective ESC Plan

Plan review staff should check site plans to ensure they address common, critical elements and comply with local requirements. Some MS4 permittees also review site plans to see if they comply with state and/or EPA CGP requirements, as applicable. The following are elements of an effective ESC plan (adapted from MDE, NRCS, & MASCD [2011] and MPCA [2017]) that should be checked as part of the plan review process:

1. *Minimize clearing and grading.* ESC plans should take all measures possible to avoid clearing/grading stream buffers, forest conservation areas, wetlands, springs and seeps, highly erodible soils, steep slopes, environmental features, and stormwater infiltration areas. They should clearly delineate and convey limits of disturbance to construction staff.

2. *Protect waterways.* ESC plans should identify waterbodies on-site and adjacent to the site. If construction activities occur near a waterbody, clearing/grading activities should be minimal and ESC plans should include silt fencing and/or earthen dikes.

3. *Phase construction to limit soil exposure.* ESC plans should break activities into phases. Plans should limit grading activities to the phase immediately under construction to decrease the time that soil is exposed, which, in turn, decreases the potential for erosion. Additional phases should begin when the last phase is near completion and preferably when construction staff have stabilized exposed soil. Construction scheduling should facilitate the installation of ESC measures before the start of construction, detail time limits for soil stabilization after grading occurs and schedule maintenance.

4. *Stabilize exposed soils.* ESC plans should stabilize exposed soils within two weeks of the onset of earth-disturbing activities. The long-term goal is to establish permanent vegetation after each construction phase. Mulch, hydroseeding, geotextile or other soil coverage measures may protect exposed soil while facilitating vegetation growth. The ESC plan should detail the appropriate plant species to seed, as well as weather and climactic conditions necessary for successful vegetation establishment.

5. *Protect steep slopes and cuts.* ESC Plans should avoid cutting and grading steep slopes (>15 percent) wherever possible. If a steep slope exists, ESC plans should redirect all water flowing onto the slope with terraces, diversions or a slope drain. They should also require anchoring of the silt fence at the top and toe of the slope, although this measure may not provide adequate protection by itself. On steep slopes, ESC plans should combine jute netting and erosion control blankets (geotextiles) with seeding, soil matting or mulching, as seeding alone may not be effective.

6. *Install perimeter controls to filter sediments.* ESC plans should include ESC practices, such as silt fences, around the perimeter of the construction site. Additional practices, such as a fiber roll on the inside (site-facing) of the silt fence, further improve filtration. In areas of heavy flows or breech concern, ESC plans should include a properly sized earthen dike with a stabilized outlet. In addition, plans should include adequate inlet controls to protect catch basin

7. inlets receiving stormwater flows from the construction site.

8. *Employ advanced sediment settling controls.* ESC plans should implement sediment basins or other large-scale sediment control practices, if necessary, where space is available; however, discharge from basins should be non-turbid. The use of skimmers and multiple-cell basins supports sediment dropout.

9. *Certify and train site operators/contractors on SWPPP and ESC plan implementation.* Site operators and their staff should receive training to effectively install and manage ESC practices. Meetings and site inspections by permittee staff provide opportunities to discuss effective ESC installation and maintenance. Permittee inspectors should strongly commit to contractor education to develop a constructive and responsive relationship.

10. *Control waste at the construction site.* The ESC plan and SWPPP should describe the type of construction waste at the site (e.g., discarded building materials, concrete truck washout, chemicals, litter, sanitary waste) and how construction staff will control that waste to minimize adverse impacts to water quality. For example, the plan should clearly label concrete washout and trash storage areas, which construction staff should contain and locate away from waterbodies and catch basin inlets. If necessary, a design engineer should develop a spill prevention and control plan.

11. *Inspect and maintain ESC practices.* Each ESC plan should clearly describe construction ESC practice inspection and maintenance procedures, including inspection staff and inspection frequency. Ideally, the plan should include an example inspection form. Inspections should occur regularly and immediately before and after rain events. The plan should also describe how construction staff will maintain the ESC practices.

Additional Information

Additional information on related practices and the Phase II MS4 program can be found at EPA's National Menu of Best Management Practices (BMPs) for Stormwater website

References

Maryland Department of the Environment (MDE), Natural Resources Conservation Service (NRCS), & Maryland Association of Soil Conservation Districts (MASCD). (2011). *2011 Maryland standards and specifications for soil erosion and sediment control.* Baltimore, MD: Maryland Department of the Environment.

Minnesota Pollution Control Agency. (2017). MS4 staff site plan review guidance. In *Minnesota stormwater manual.*

U.S. Environmental Protection Agency (U.S. EPA). (2007). *Developing your stormwater pollution prevention plan: A guide for construction sites* (EPA 833-R-06-004).

Stormwater Best Management Practice

Erosion and Sediment Control Inspection and Maintenance

Permits for Clean Water NPDES

Minimum Measure: Construction Site Stormwater Runoff Control
Subcategory: Construction Site Planning and Management

Description

Erosion and sediment controls (ESCs) need regular inspections to ensure their effectiveness, and many permitting authorities require construction staff to perform self-inspections. ESC inspections fall into three categories: routine inspections, inspections before rain events and inspections after rain events.

Construction staff inspecting a storm drain with inlet protection in an active construction area.
Photo Credit: PG Environmental for USEPA

Routine Inspections

Routine inspections are an integral part of regular maintenance. They are necessary to ensure the integrity and effectiveness of ESCs and give construction staff an opportunity to correct any problems found. Furthermore, routine inspection and maintenance minimizes the work needed to prepare a site before a rain event and helps protect a site from unexpected storms.

Inspections Before Rain Events

It is critically important for construction staff to pay attention to weather forecasts. To prepare for a rain event, they should walk the construction site and ensure that ESCs are clear and operating properly. They should verify that they have covered all dumpsters, covered paint and other chemicals, and cleaned up any oil spills. Construction staff should perform these types of housekeeping practices routinely. They should also visually inspect all ESCs when the site will be inactive for several days, such as over weekends or holidays. This will help to prepare for rain when workers are off-site. These inspections also minimize the risk of on- or off-site property damage due to inoperative or malfunctioning ESCs.

Inspections After Rain Events

After a rain event, construction staff should prepare the site for the next event. Typically, within 48 hours after a rain event, they should inspect, clean and repair any damaged ESCs. This will keep the site "clean" and minimize complaints from nearby residents. To prevent health and safety hazards, staff should remove tracked-out sediment or mud in traffic areas and remove standing water to prevent mosquito breeding. They should also clean or repair any ESC clogged with mud or debris so it works properly the next time it rains.

Applicability

Stormwater discharges from construction sites disturbing 1 or more acres are generally covered under a state or EPA permit. These permits typically require construction staff to conduct routine site inspections looking at, for example, installation, function, and operation and maintenance of controls. As well, local permits may impose ESC requirements—and other inspection requirements—on a site. Staff should design and inspect all ESC controls in accordance with applicable local, state and federal requirements. Adequate ESC performance requires not only proper installation, but also regular inspection and maintenance.

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Implementation

The construction site operator should ensure the site undergoes regular inspections. At small sites, the site superintendent or other qualified members of the construction team can perform and document inspection tasks. At large sites, the developers may hire a firm with ESC expertise to implement an inspection, maintenance and repair program for the site. Some permitting authorities require construction sites to undergo inspection by a certified inspector and/or offer inspector certification programs (e.g., the California Water Board's Qualified SWPPP Developer and Practitioner Training Program [CWB, 2020]).

Inspectors should be familiar with the location, design specifications, maintenance procedures and performance expectations of each ESC. Often, a site will have a stormwater pollution prevention plan (SWPPP), which should include specifications for ESC maintenance (e.g., remove sediment before it accumulates to half of the above-ground height of any silt fence or other perimeter control).

> For more information on contractor training programs, see EPA's Contractor Training and Certification fact sheet.

The frequency of required inspections will vary by state. Many permits require weekly inspections, or inspections once every 14 calendar days and within 24 hours of a storm. The inspection frequency may also increase in areas with a higher risk of sediment discharge, or where the site discharges to a sensitive water. The frequency may decrease to account for arid, semiarid, drought or freezing conditions.

At a minimum, inspections should assess the following areas of a site:

- All areas that construction staff have cleared, graded or excavated but not begun stabilizing.
- All ESCs and other types of stormwater controls implemented at the site.
- Material, waste and equipment storage and maintenance areas.
- All areas where stormwater typically flows within the site, including drainageways designed to divert, convey and/or treat stormwater.
- All points of discharge from the site.
- All disturbed locations where staff have begun implementing stabilization measures but have not completed stabilization.

During the inspection, construction staff should check for conditions that could lead to spills, leaks or other accumulations of pollutants on the site. They should check for visible signs of erosion or sediment deposition caused by site activities. They should also check the banks of any waters flowing within or immediately adjacent to the site to ensure site activities and plans are not polluting existing waters. Any areas of erosion or sedimentation may warrant new or modified stormwater controls.

If a discharge is occurring during the inspection, construction staff should identify all discharge points at the site; observe, photograph and document the visual quality of the discharge; and take note of the characteristics of the stormwater discharge (including color; odor; floating, settled or suspended solids; foam; and oil sheen).

Regardless of who does the inspections, it is critical to maintain proper documentation. Inspectors should use an inspection form or checklist to document the findings from each inspection. At a minimum, inspection documentation should include:

- Inspection date
- Name and title of personnel conducting the inspection
- A summary of inspection observations, including notes about required maintenance or corrective actions
- Weather station and rain gauge measurements, as applicable

During an audit, permitting authorities will generally review a construction site's self-inspection reports to assess compliance. Permitting authorities may also wish to see maintenance documentation for each specific ESC. Communities with regulated municipal separate storm sewer (MS4) systems develop programs that should include procedures for site inspection and enforcement of ESC control measures. Therefore, municipal inspectors may also perform inspections of sites to ensure compliance with MS4 and local regulations.

During the span of a construction project, more than one person may have been responsible for site inspections. Therefore, it is important to keep adequate documentation of inspection dates, findings, and maintenance and repair of all ESCs. Site operators should make sure that inspection reports are signed and certified in accordance with permit requirements, keeping a copy of each one at the site or at an easily accessible location so they make it available during an audit or upon request by an inspector.

See the following EPA fact sheets for more information on specific management practices for hazardous materials at construction sites:

- Concrete Washout
- General Construction Site Waste Management
- Spill Prevention and Control Plan
- Vehicle Maintenance and Washing Areas at Construction Sites

Routine Maintenance and Other Corrective Actions

Inspections provide an opportunity to determine where a site needs repairs or other corrections. A well-conducted inspection will identify whether stormwater controls need repair or replacement, or whether specific stormwater controls are absent or incorrectly installed. An inspector may also identify discharges that the permit does not allow, such as discharges from concrete washout areas or releases of fuels, oils, soaps, solvents, or toxic or hazardous pollutants. When inspection reveals conditions such as these, construction staff should take reasonable steps to address the problem, including cleaning up any contaminated surfaces so the material will not discharge in subsequent storms. They should complete minor corrective actions by the close of the next business day. If the corrective action involves significant repairs or installation of a new or replacement control, staff should finish the work within seven calendar days from the time of discovery or as soon as feasible after that. Construction staff should document any corrective actions taken in response to an inspection finding.

Limitations

The most common limitation that site operators will face is a lack of funding or time for regular site inspections and ESC maintenance. It is therefore critical to reserve resources from the start of every project to address these requirements.

Lack of adequate training can limit the success of an ESC inspection program. Those responsible for inspecting and maintaining ESCs should have training on their design and operation. This will help ensure that workers know when ESCs need cleaning, repair or replacement. Similarly, as site conditions change, ESC designs may prove inadequate in controlling erosion and sedimentation. A knowledgeable inspector will be able to identify these deficiencies and ensure that staff make necessary improvements.

Effectiveness

The effectiveness of self-inspection and maintenance programs vary according to the amount of resources allocated to the tasks. When made a priority, inspections and maintenance ensure that ESCs function properly and help prevent harmful discharges.

Education of on-site personnel is another important factor in an effective program. To recognize and preempt problems, those responsible for maintaining ESCs should be familiar with their design and installation. Additionally, making everyone at the site aware of general ESC principles can expedite identification of maintenance issues and repairs and decrease the chance that normal construction activities will damage ESCs (e.g., driving over a silt fence).

Cost Considerations

ESC inspection and maintenance requires dedicating both management and staff time to training, inspecting, cleaning, and repairing or replacing ESCs. Inspector training requirements for staff vary by region and state, but typically include 8 to 24 hours of training with classroom and field components (as well as passing an exam in some cases). If repairing an ESC is impossible, construction staff may need to buy additional materials. For example, a ripped silt fence can often need replacement.

Additional Information

Additional information on related practices and the Phase II MS4 program can be found at EPA's National Menu of Best Management Practices (BMPs) for Stormwater website

References

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Stormwater Best Management Practice

Preserving Natural or Existing Vegetation

Minimum Measure: Construction Site Stormwater Runoff Control
Subcategory: Construction Site Planning and Management

Description

Preserving natural or existing vegetation is the practice of protecting desirable trees, vines, bushes and grasses from damage during project development. This practice has benefits during and after construction because natural, existing or established vegetation generally:

- Can withstand greater quantities of stormwater flow than newly seeded areas.
- Does not require time to establish.
- Has a higher infiltration capacity than newly planted vegetation due to a more developed and deeper root structure.
- Reduces stormwater discharge through greater interception and evapotranspiration.
- Buffers and screens against noise and visual disturbance.
- Provides habitat for wildlife.
- Improves air quality.
- Usually requires less maintenance (e.g., irrigation, fertilizer) than planting new vegetation.
- Enhances aesthetics.

Applicability

Construction staff can preserve natural or existing vegetation at any construction site where vegetation exists in the predevelopment condition. This practice can be particularly beneficial for floodplains, wetlands, perennial and intermittent streams, environmentally sensitive areas, steep slopes, and other areas where erosion controls would be difficult to establish, install or maintain (SPU, 2017).

Siting and Design Considerations

As part of the project planning phase, design engineers should visit the site to identify and map site features that may influence natural or existing vegetation stabilization measures such as drainage ways, highly erodible soils and steep slopes (MDE, NRCS, & MASCD, 2011). They should prepare a site map with the location and extent of trees, environmentally sensitive areas, and buffer zones to be preserved. They should also plan the locations of roads, buildings and other structures to avoid sensitive areas. Before clearing activities begin, construction staff should clearly mark the vegetation and other natural features that are to be preserved. Successfully preserving natural or existing vegetation requires careful site design and construction management to minimize the impact of construction activities on existing vegetation.

A construction safety fence preserves existing grass near a paved area.

Direct contact and adjacent compaction, filling or excavation activities can damage trees and other vegetation (SPU, 2017). Therefore, construction staff should protect large trees near construction zones, as damage during construction could result in reduced vigor or death after construction ends. It is important to extend and mark the boundaries around contiguous natural areas and tree drip lines to protect the root zone from damage. Construction staff should clearly set limits using orange safety fence and signs spaced 100 feet apart (WES, 2008). Design engineers should consult local regulation and design standards for buffer zone width requirements near streams and other environmentally sensitive areas.

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A certified arborist can help inform the choice of which trees to preserve, offering information on the following sorts of factors:

- *Tree vigor.* Preserve healthy trees that are less susceptible to damage, disease and insects. Indicators of poor vigor include dead branch tips, stunted leaf growth, sparse foliage and pale foliage color. Hollow, rotten, split, cracked or leaning trees also have a lesser chance of survival.
- *Tree age.* Choose older trees because they are more aesthetically pleasing as long as they are healthy.
- *Tree species.* Preserve species that are well suited to present and future site conditions. Keeping a mixture of evergreens and hardwoods can help conserve energy—specifically, keep evergreens on the northern side of the site to protect against cold winter winds and keep deciduous trees on the southern side to provide shade in the summer and sunshine in the winter.
- *Wildlife and aquatic species benefits.* Choose trees that wildlife prefer for food, cover and nesting. Protect low-hanging trees, bushes and grasses, which provide habitat for fish in streams.

Other considerations include following natural contours and maintaining preconstruction drainage patterns. Altered hydrology may no longer meet the environmental needs of preserved vegetation, which could lead to its death (SPU, 2017).

The following are best practices for preserving natural or existing vegetation:

- Do not nail boards to trees during building operations.
- Do not cut tree roots inside the tree drip line.
- Use barriers to prevent equipment from approaching protected areas.
- Keep equipment, construction materials, topsoil and fill dirt outside the limit of preserved areas.
- Keep the duff layer (partially decomposed organic matter), native topsoil and natural vegetation undisturbed to the maximum extent practicable (SPU, 2017).
- Consider assigning a monetary value for trees or vegetated areas and visibly post this value on fencing (SPU, 2017).
- If construction activities damage a tree or shrub marked for preservation, remove and replace it with a tree of the same or similar species with a 2-inch or larger caliper width from balled and burlap nursery stock when construction is complete.
- During final site cleanup, remove barriers from around preserved areas and trees.

Limitations

Several factors can limit the practicality of preserving natural or existing vegetation throughout the development process. First, the practice is only suitable for sites with ample existing stands of healthy vegetation. In many urban areas, existing vegetation may be patchy and unhealthy, providing little overall benefit to site hydrology or aesthetics. In these cases, new vegetation may provide greater benefit. During planning, design engineers should consider the footprint of proposed structures relative to the total footprint of the site; for high-density development or where land prices are high, preserving existing vegetation may not be cost-effective. During construction, staff may need to remove existing vegetation that would interfere with the maneuverability of construction equipment.

Maintenance Considerations

Even if workers take precautions, some damage to protected areas might occur. If this happens, construction staff should repair or replace damaged vegetation immediately to maintain the integrity of the natural system. They should also consider enhancing the preserved area (e.g., removing invasive species). If fertilization is needed, construction staff should minimize adverse water quality effects by using the following practices (MPCA, 2019):

- Apply fertilizers to the minimum area needed.
- Apply fertilizer in lower amounts and more often if necessary.
- Work the fertilizer deeply into the soil (without harming root structures) to reduce nutrients' exposure to stormwater.
- Limit hydroseeding (i.e., simultaneously applying lime and fertilizers).

- Ensure that erosion and sediment control practices are in place to prevent stormwater from transporting fertilizers and sediments off-site.
- Inspect fencing and signs to ensure they are secure and undamaged.
- Do not mow protected areas.

Effectiveness

Preserving natural or existing vegetation can provide water quality benefits by reducing the quantity and improving the quality of stormwater discharge that a construction site generates. The overall effectiveness varies depending on the size of the area preserved, the type of vegetation and the amount of stormwater directed to the preserved area. Table 1 lists load reductions from several practices that are similar to the conservation of natural or existing vegetation. Although they are specific to the Chesapeake Bay region, they provide an approximation of the range of effectiveness that could be achieved by these practices in other locations.

Table 1. Range in annual load reductions provided by natural vegetation buffers.

Buffer Practice	Units	Total Nitrogen	Total Phosphorus	Total Suspended Solids
Forest buffer	lb/acre of buffer	5.9–12	0.36–1.5	120–1,500
Conservation landscaping practices	lb/acre treated	2.2–4.8	0.070–0.23	NA
Filter strip	lb/acre treated	1.1–2.5	0.15–0.49	68–900

Source: CPB, 2018

Cost Considerations

When implemented successfully, preserving natural or existing vegetation is a low-cost practice. Damaging existing vegetation (and needing to replace it) can increase costs. Preserving natural or existing vegetation can also require additional labor costs to maneuver around trees or protected areas.

Additional Information

Additional information on related practices and the Phase II MS4 program can be found at EPA's National Menu of Best Management Practices (BMPs) for Stormwater website

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