Stormwater Best Management Practice

Construction Sequencing

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

Description

Construction sequencing (also referred to as construction scheduling) involves following a specified schedule that coordinates the timing of earth-disturbing activities and the installation of erosion and sediment control (ESC) practices and post-construction stormwater controls. It is a cost-effective way to control erosion during construction. Construction procedures that limit land clearing, provide for timely installation of ESC practices, and quickly restore protective cover after completion can significantly reduce a site's erosion potential (WES, 2008). Construction sequencing disturbs only part of a site at a time to minimize erosion and sediment transport. Construction staff control and complete grading and earth-disturbing activities in portions of the site with active construction, allowing soil to stabilize there before commencing grading and construction at another part of the site. This sequencing limits the areas with active earth disturbance and promotes phasing of site clearing so that inactive portions of the site are less vulnerable to erosion. To be effective, design engineers and construction staff should incorporate sequencing into the overall site plan in the early stages of project planning.

Applicability

Construction sequencing can be used to plan earthwork and ESC activities at sites where earth disturbance might affect water quality in a receiving waterbody. This practice is particularly important for projects with large areas of earth disturbance.

Siting and Design Considerations

Construction staff should sequence construction projects to reduce the amount and duration of bare soil exposure while maintaining compatibility with the general construction schedule. The construction schedule and associated sequencing should plan for an orderly listing of earth-disturbing activities in conjunction with appropriate ESC practices. Protecting existing natural features can help minimize the amount of clearing and grading as well as the amount of ESC practices required, in turn reducing costs (MDE, NRCS, & MASCD, 2011). If possible, earth-disturbing activities should coincide with the dry season to minimize erosion and sediment impacts to downstream waterbodies (MPCA, 2018). Construction staff should achieve final stabilization as quickly as possible after completing major phases.

Aerial view of a subdivision construction project with sections completed in stages. Some areas are permanently stabilized while other areas are disturbed.

Table 1 summarizes specific construction activity scheduling considerations. Note that construction staff should install and maintain all scheduling activities and associated ESC practices according to approved grading plans, ESC plans, and applicable regulations.

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Table 1. Scheduling considerations for construction activities (adapted from MPCA, 2018).

Construction Activity	Schedule Consideration
Construction planning	Before beginning construction activities, construction staff should identify natural features and sensitive areas (e.g., streams, wetlands, buffer zones), mark their locations on maps and site plans, and flag them on-site. ESC practices should be installed, as needed, to protect these features before construction activities. Additionally, construction staff should consider and coordinate the locations of cuts and fills of the land to minimize soil movement. ESC practices should be installed around areas where soil is stockpiled at the site.
Construction access, site entrance, construction routes, areas designated for equipment parking	As soon as construction begins, construction staff should stabilize any bare entrances and exits to the site and traffic routes with gravel and temporary vegetation. During construction sequencing for residential properties, residents who access recently constructed homes should be able to do so from a point that will not disturb active construction activities in another area of the site.
Sediment traps and barriers, basin traps, silt fences, inlet/outlet protection	Within the site, construction staff should install principal basins or other ESC practices—per approved plans—and add more traps and barriers as needed during grading. If existing inlets to the stormwater conveyance system are present on-site, construction staff should also apply ESC practices to these areas to prevent sediment and debris from entering the system during construction activities.
Stormwater control diversions, perimeter dikes, water bars, outlet protection	Construction staff should install ESC practices, per approved plans, during or before initial site access and before land grading. Additional stormwater control measures should be installed during grading, as needed.
Stormwater conveyance system, stabilization of stream banks, storm drains, channels, inlet and outlet protection, slope drains	If applicable, construction staff should stabilize stream banks as soon as possible and install a principal stormwater conveyance system with stormwater control measures. The remainder of the systems should be installed after grading.
Land clearing and grading, site preparation (cutting, filling, and grading; sediment traps; barriers; diversions; drains; surface roughening)	Construction staff should conduct major clearing and grading activities after installing principal ESC practices and key stormwater control measures. Additional ESC practices should be installed as grading continues. Construction staff should clear disposal areas as needed, and mark trees and buffer areas for preservation. Additional ESC practices should be installed as needed.
Surface stabilization, temporary and permanent seeding, mulching, sodding, riprap	Construction staff should immediately apply temporary or permanent stabilizing measures to any disturbed areas where work has either been completed or delayed.
Building construction, utilities installation, paving	During construction, staff should install any erosion and sediment control practices that are needed. These practices should be inspected regularly to ensure they are properly operating and adequately maintained.
Landscaping and final stabilization, topsoil application, trees and shrubs, permanent seeding, mulching, sodding, riprap	Construction staff should remove temporary ESC practices and stabilize all open areas to prevent erosion.

Limitations

Weather and other unpredictable variables might affect construction sequence schedules. However, the site plan should plainly state the proposed schedule and a protocol for making changes due to unforeseen problems.

Maintenance Considerations

Construction staff should follow the construction sequence schedule throughout the project and modify the written plan before changing any construction activities. They should also update the plan and implement additional erosion and sediment control practices if a site inspection indicates the need to do so. This should be a dynamic and ongoing process from project design to completion. Additionally, construction staff should ensure that temporary ESC practices are maintained and properly functioning throughout the project and that temporary and permanent stabilization techniques are effective.

Effectiveness

Construction sequencing effectively reduces erosion and sediment transport because it requires the strategic installation of ESC practices where necessary and appropriate. The sequencing schedule and construction documents should be updated if needed to maximize the effectiveness of the ESC practices under changing conditions. A comparison of sediment loss from a typical development project versus a phased project showed a 40 percent reduction in sediment export in the phased project (Claytor, 2000; NRCS, 2012).

Cost Considerations

Construction sequencing is a low-cost strategy when implemented early and executed correctly during a project. It requires a limited amount of a developer's time to write a plan that coordinates construction activities and management practices. When grading and clearing an entire site at one time, developers should use additional ESC practices to keep sediment from discharging off-site. By using construction sequencing, developers can better reduce costs, minimize maintenance activities and control sediment.

Application and Design Considerations

With very few exceptions (e.g., very small lots or lots with no landscaping), some sort of on-lot treatment applies to most sites. Traditionally, municipalities have encouraged but not widely adopted on-lot treatment of residential stormwater discharge, as the property owner is responsible for initial and maintenance costs. However, more local governments are offering financial incentives for on-lot treatment, such as reducing fees and supporting public outreach (see "Cost Considerations" below).

Although simpler than other types of stormwater controls, on-lot treatment still has certain design elements common to all practices. Pretreatment is important to ensure the controls do not clog with leaf litter or debris. For rainwater collection systems, a settling tank, first flush diverter, or debris-trapping grate or filter in the downspout is recommended.

Both infiltration- and storage-based on-lot treatment stormwater controls typically incorporate some type of bypass to direct heavy stormwater discharges away from buildings. In many cases, this simply entails allowing for an overflow route that will not cause erosion or flooding. For cisterns or rain barrels, emptying the container before large storm events helps prevent the container from overfilling. For example, property owners typically mount a hose at the bottom of the barrel or cistern to irrigate gardens or for landscaping; owners can use the hose to manually empty the tank or connect the hose to a drip tape to allow for slow drawdown after each rain event. In infiltration-based on-lot treatment, an aboveground opening in the downspout can serve as the bypass. Additionally, design engineers can design grassed swales and bioretention cells to absorb all but the largest of stormwater flows. In extreme cases, flows generally pass untreated over these stormwater controls.

When designing infiltration-based on-lot treatment stormwater controls, it is important to locate the infiltration area far enough away from the building's foundation to prevent the undermining of the foundation or basement seepage. The infiltration area should be at least 10 feet away from the house.

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

Claytor, R. (2000). Practical tips for construction site phasing. In T. R. Schueler & H. K. Holland (Eds.), *The practice of watershed protection* (pp. 317–322). Ellicott City, MD: Center for Watershed Protection.

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Natural Resources Conservation Service (NRCS). (2012). Revised universal soil loss equation, version 2. U.S. Department of Agriculture.

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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.