



Issue 59, February 2015

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## **We Have Low Impact Development, Now We Need Low Impact Construction**


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The development industry is investing a lot of time and effort (read: money) designing and constructing the new era of post-construction stormwater BMPs. A typical design with distributed practices—such as bioretention, permeable pavement, and other runoff reduction practices—requires careful site planning and intricate hydrologic and hydraulic design. But what if all the anticipated protection of downstream aquatic resources (that would otherwise be achieved through the full life cycle of this carefully planned high-performance post-construction stormwater management strategy) were to be completely undone before the strategy is even implemented? With all the focus on Low Impact Development, Better Site Design, Runoff Reduction, and the like, maybe we need a catchy slogan for good construction site erosion and sediment control to attract the collective attention of the development industry (including regulators and inspectors!).

Construction is considered the most damaging phase of the development cycle for streams and other aquatic resources. It is generally accepted that the performance of typical erosion control practices is highly variable and correlates to rainfall intensity and soil particle sizes, among numerous other site-specific factors. Since these factors are not generally included in the design of erosion and sediment controls, it is not uncommon for there to be periodic sediment discharges from a construction site that are several orders of magnitude greater than what would otherwise be allowed (or considered to be an authorized discharge) by the Environmental Protection Agency's (EPA's) Construction General Permit.

Further, considering the temporary nature of the construction phase, impacts to the hydrologic capacity of the native soils due to grading or compaction, as well as sedimentation in the receiving water body have an extremely long, if not permanent, recovery period. In order to influence the design of the construction phase of the development project and help avoid these impacts, EPA has incorporated the guiding principles of the post-construction stormwater rules (to maintain or restore the predevelopment hydrology) into the Construction and Development Point Source Category (C&D) rulemaking. These guiding principles are part of the Effluent Limitations Guidelines (ELGs) and Standards that have evolved from numeric effluent turbidity limits and monitoring requirements to the recently finalized narrative ELGs of 40 CFR Part 450.21 (effective May 5, 2014).

In general, the narrative ELGs focus attention on reducing the discharge of pollutants from construction sites and are divided into three categories: 1) *erosion and sediment controls*, 2) *pollution prevention measures*, and 3) *prohibited discharges*. These categories include strategies that represent the effluent reduction attainable through the application of the best practicable control technology (BPT) currently available. BPT is EPA's first tier of technology-based strategies and in terms of erosion and sediment controls, it represents control 'technologies' that generally consist of 1) minimizing impacts by design, and 2) utilizing site-specific parameters to improve the design and performance of on-site control practices. Some would like to refer to these strategies as Low Impact Construction (although I think we'll have to think of something more interesting if we want to market the next great acronym!).



So what does this mean to the site designer? In some states one could argue: not much! The prevailing regulatory wisdom has determined that compliance with state or local approved erosion and sediment control (ESC) plans, is equivalent to the BPT of the narrative ELGs. Whether or not this is true depends on the details of the state or local requirements and the level of detail to which the designer utilized site-specific parameters in the ESC design.

The following provides a list of the narrative ELGs excerpted from the Federal C&D Rule (these are carried over directly or by reference into the State Construction General Permits). Each is accompanied by a brief explanation of how they can be incorporated into an ESC design.

## **EROSION & SEDIMENT CONTROLS**

1. Control stormwater volume and velocity to minimize soil erosion in order to minimize pollutant discharges.

This is a very broad requirement that is likely consistent with most state ESC programs and applies to areas of exposed soils as well as temporary and permanent conveyances. Designers should consider documenting the extent to which this is achieved by utilizing the Revised Universal Soil Loss Equation (RUSLE)(USDA). This includes accounting for the erosive power or energy of the rain (R) and soil erodibility factor (K) of the exposed soil horizon, and then appropriately manipulate the site drainage areas and construction phasing in order to minimize the length-slope (LS) factor, maximize temporary or permanent cover management or stabilization (C), and where possible implement redundant erosion control practices (in the RUSLE this referred to as the supporting practices factor (P) and is intended to describe practices applied to agricultural operations, but can also be used to incorporate the effect of sediment control practices (Dion 2002)).

2. Control stormwater discharges, including both peak flow rates and total stormwater volume, to minimize channel and stream bank erosion and scour in the immediate vicinity of discharge points.

This is another requirement that is likely consistent with most state ESC programs; however, designers should determine the peak rate and volume of stormwater discharge considering the construction activity land cover (exposed and likely compacted soils) and the transitioning drainage areas based on site grading operations, and design the sediment basin outlet controls appropriately. (Refer to item no. 9).

3. Minimize the amount of soil exposed during construction activity.

On large sites (e.g., 20 acres or more), designers should coordinate with the operator to the extent possible in order to establish an appropriate phasing plan that allows the project to proceed without the entire acreage being disturbed at one time. Clear delineation of phasing should be provided on the plans with areas demarcated in the field at the commencement of land disturbance. Areas that are not to be disturbed at any time during construction should likewise be demarcated. If the operator determines that additional area is needed for equipment or material storage, or access to other parts of the site, the plans can be amended.

4. Minimize the disturbance of steep slopes.

If not already established, designers should define "steep slopes" (e.g., greater than 15%). Where the disturbance of these areas is unavoidable, the designer should establish stabilization timing and techniques such as immediate application of soil stabilization matting, benching, or other strategies to limit erosion.

5. Minimize sediment discharges from the site. The design, installation and maintenance of erosion and sediment controls must address factors such as the amount, frequency, intensity and duration of precipitation, the nature of resulting stormwater runoff, and soil characteristics, including the range of soil particle sizes expected to be present on the site.

This provision requires a careful design of combined stabilization and sediment trapping strategies. Some of these parameters are included in the RUSLE (refer to item no. 1). Likewise, sediment traps, basins, and intermediate check dams, etc., should be sized and designed (geometry of surface area and depth) according to the soil texture and particle sizes of the soil horizons to be exposed during construction. Settling basins are designed very differently for areas with sandy soils versus areas with predominantly silt and clay sized soil particles.

6. Provide and maintain natural buffers around surface waters, direct stormwater to vegetated areas to increase sediment removal and maximize stormwater infiltration, unless infeasible.

EPA has provided guidance on the appropriate width of vegetated buffers, applicable exceptions to the requirement, as well as techniques for providing equivalent sediment reductions if a vegetated buffer is not feasible. It has been said that vegetated buffers are the best strategy for protecting water quality. Whether this is an acknowledgement of the filtering

capacity of the vegetated buffer, or the ability of the buffer to keep the bulldozer out of the stream can be debated. In either case, the benefit can be both significant and cost effective (EPA 2012).

7. Minimize soil compaction (unless the intended function of a specific area of the site dictates that it be compacted).

Designers should establish limits of disturbance and, equally important, limit construction traffic to only those areas that are to be compacted for specific functional purposes (e.g., roads and/or building pads). These areas should be identified on the plan and demarcated in the field. When areas must be impacted, designers can include soil amendments or other restoration techniques to restore the hydrologic capacity prior to stabilization.

8. Preserve topsoil (unless the intended function of a specific area of the site dictates that the topsoil be disturbed or removed).

Stripping and preserving topsoil in order to re-establish a pervious land cover after grading operations should be accompanied by a soil analysis to verify that the newly exposed soil horizon (in areas of cut and the newly formed grade in areas of fill) have the soil structure to hold the layer of topsoil being reapplied. The thickness of the reapplied topsoil and the depth of incorporation will vary based on the soil structure.

### **SOIL STABILIZATION**

9. Stabilization of disturbed areas must, at a minimum, be initiated immediately whenever earth disturbing activities have permanently or temporarily ceased on any portion of the site.

This provision, along with working definitions of 'immediately' and 'temporarily' have been added to many construction permits as a result of TMDLs.

### **SURFACE OUTLETS**

10. Utilize outlet structures that withdraw water from the surface, unless infeasible, when discharging from basins and impoundments.

Many innovative surface-skimming dewatering products have been developed that are specifically designed to withdraw water from the surface, while still allowing sediment particles to slowly settle and, ideally, remain locked into the bottom of a sediment basin or trap.

The implementation of these ELGs can complicate the design and review of erosion and sediment controls. On the other hand, the design is already complicated: multiple contractors and sub-contractors all focused on their own responsibilities, often-daily changes to grades and drainage patterns, stabilized areas being re-disturbed for the installation of additional utilities or other infrastructure, and other realities of an active construction site. This complexity is why the construction phase is often the most damaging, and why the design must be carefully developed and implemented. Construction site operators and qualified personnel should constantly be monitoring the site activities to ensure that the adjacent properties and aquatic resources are protected.

### **References:**

Dion, T.R. Land Development for Civil Engineers. John Wiley & Sons, Inc. New York. 796 pgs. 2002.

USDA. United States Department of Agriculture, ARS and NRCS. *Revised Universal Soil Loss Equation Agricultural Handbook No. 537.*

EPA Final 2012 Construction General Permit and Related Documents <http://water.epa.gov/polwaste/npdes/stormwater/EPA-Construction-General-Permit.cfm>

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## Investigating the Demand for Stormwater Offsets and Banking

In a stormwater offset and banking system, one entity funds or builds urban restoration projects for purposes other than or in addition to managing his/her stormwater management requirements and can transfer or sell the credits to another entity who has difficulty meeting their own stormwater management requirements on-site. Stormwater banking offers the opportunity to reduce costs of stormwater permit compliance, facilitate local water quality improvements, and, when coupled with local incentives, can open up an inventory of properties that would not have otherwise been targeted for restoration. The Center for Watershed Protection ("the Center"), under a grant from the National Fish and Wildlife Federation (NFWF), assessed the availability of potential retrofit sites that could serve as supply for a stormwater bank in the cities of Baltimore, Maryland and Hampton, Virginia. After showing that a suitable supply of locations was available, the Center set out to evaluate the demand side of the all-important supply-demand equation by conducting a survey of potential stormwater credit purchasers.

Our initial survey target was the development community since developers often encounter site constraints or face high costs of meeting stormwater management requirements on new development and redevelopment sites. Best management practices (BMPs) take up valuable space and the costs to construct them often increase greatly in a retrofit or redevelopment situation because it may involve modifying existing infrastructure. But developers aren't the only ones who have a potential need for stormwater offsets; municipal separate storm sewer system (MS4) owners may also have difficulty meeting their permit requirements, commercial or industrial property owners may have significant stormwater utility fees associated with their large impervious areas, and even individual homeowners may enter the picture. So we asked everyone!

We sent out a survey far and wide, and collected over 230 responses from developers, MS4-regulated cities and towns, engineers, non-profits, homeowners and commercial property owners, and an assortment of other folks as well. Our responses came from as far away as Australia, though most were spread all across the United States. What we found was surprising in some ways, and not at all surprising in others. Not surprising was the finding that demand was low in communities that do not have at least one of the key market drivers that exist in the Chesapeake Bay watershed: state stormwater regulations that require significant on-site retention of runoff, MS4 permit requirements that include significant numeric load reductions to meet TMDLs, or a local stormwater utility fee that offers credits for installing BMPs. We found that MS4 and other municipal entities in many cases had experienced great difficulty in implementing changes to their stormwater management regulations, including several disappointing failures to enact a stormwater utility fee. Without a fee or requirement, there was nothing to drive improvement. Only new development or redevelopment stormwater management standards or MS4 permits would give somebody reason to bank or buy stormwater offsets. Overall, the responses confirmed a tangible demand for stormwater offset and banking options where market drivers are present.

The range of concerns expressed by respondents about the logistical difficulties of implementing an offset and banking system was perhaps the most interesting because it helped to identify specific elements of the program that would need to hold up to public scrutiny in order for it to be acceptable, such as inspection and verification procedures. Also, the expressed concerns about the intended effects and the actual effects of trying out a system of offsets were the most charged. People are passionate about water and water quality, and people's doubts about the administrative effectiveness and competence of a managing organization were evident in their responses. The developers' responses were the ones we were most interested in initially and although the response from this sector was low, many of the responses from municipal entities shed some light on the demand from the development community. The take-away concepts from the developer responses were that the risk associated with not knowing what stormwater management might cost is actually a stronger driver than lower costs, and that any managing entity needs to instill confidence in their ability to manage an offset and banking system, which would likely be a complicated and difficult system to establish and maintain.

Overall, the survey responses suggest there is a demand for stormwater offsets, and a belief that these types of systems would be at least beneficial, if not absolutely necessary. Communities who wish to further explore the potential for such a system would want to further evaluate both local supply and demand. The Center's final report from this work provides guidance on both and discusses the building blocks of a local stormwater offset and banking program. The document, *Using Stormwater Banking to Provide Economic & Local Water Quality Improvements in Chesapeake Bay Watershed Jurisdictions*, is available on the Center's Online Watershed Library.