The unique character of the transportation environment often presents challenges associated with managing construction stormwater runoff and protecting receiving waters. Traditional guidance and regulation do not always distinguish between residential, commercial, and linear development. If inappropriate and ineffective practices are implemented or expected by regulators, it can create inefficiencies for the transportation stormwater professional.

Transportation projects typically cross multiple watersheds and have many outfalls. The topography eliminates the possibility of utilizing the regional or single projectwide treatment approaches that sometimes are possible with nonlinear development. Available right-of-way and treatment areas typically are also more limited in a transportation setting.

Slope lengths and steepness, the types of soils encountered, seasons of construction, and proximity to surface waters usually are not all chosen at the discretion of the roadway designer and contractor. Many of these variables are beyond the control of the transportation stormwater professional and are not accounted for by a traditional approach to managing construction stormwater.

To fulfill its mission of providing for the movement of people and goods, a transportation agency must engage in activities that can negatively affect the environment. This potential for impact triggers environmental responsibilities in the form of regulatory requirements and social expectations (Figure 1). These responsibilities, if left unfulfilled, can lead to costly delays in project delivery and can affect the fulfillment of the agency’s mission.

**Traditional Erosion Control**

Historically, construction stormwater management has focused primarily on the symptom of stormwater-related issues—sediment in the receiving water, sediment in the wetland, and sediment deposited on adjacent property. Sediment is still largely a primary target of management efforts,
Alabama DOT also began to see water entering its projects as worthy of protection and developed a mantra: “clean water in, clean water out.”

As the agency began to recognize the role the runoff itself plays in the actions of erosion and sediment transport and deposition. Both erosive energy of stormwater and its sediment-carrying capacity can be significantly reduced by simply slowing the runoff.

Water is a common factor in erosion and sediment transport. Applying the knowledge of the benefits of slowed water, stormwater professionals began shifting from the unachievable goal of capturing all projects’ waters to the more attainable goal of simply slowing down the waters as they ran over and across a construction site.

Alabama DOT also began to see water entering its projects as worthy of protection and developed a mantra: “clean water in, clean water out.” The agency worked hard to develop ways to keep run-on and flow-through waters separate from runoff from areas where required soil-disturbing activities were taking place. Temporary open and enclosed diversions were employed to convey water across, under, and around areas where sediment-laden waters could cause these clean waters to become dirty and trigger a need for sediment control.

Soon, managing water became as important and critical to managing construction stormwater runoff as managing erosion and managing sediment.

But Alabama DOT didn’t stop there. Construction stormwater professionals studied the Revised Universal Soil Loss Equation (RUSLE) to better understand the mechanics of soil loss and see how they could further improve Alabama DOT’s program.

RUSLE is an erosion model developed principally by the U.S. Department of Agriculture’s Agricultural Research Service. The model predicts the average annual soil loss resulting from raindrop splash and runoff from slopes, given rainfall, slope, soils characteristics, land cover types, and management practices (Figure 2). The units of the product of the model were particularly intriguing: tons per acre per year; in other words, the mass of transported soil per area of disturbance per duration of disturbance.

Alabama DOT questioned whether it could reduce the area of disturbance and the duration of disturbance in order to reduce the soil loss from its project. The agency decided that through managing the work of the contractor, it could.

Alabama DOT saw that its contractors were smart, capable, innovative, and ready to do just about anything the agency needed—if the work and the method of payment was fully described before bid submittal. Effectiveness lies more in how the contractor performs the work rather than what the contractor installs. Effectively managing the work of the contractor requires the acknowledgement and acceptance of a few basic points:

- The contractor works for the owner—agency, not the other way around;
- The interests of the owner are different from the interests of the contractor and should be considered and protected;
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**FIGURE 1** Environmental responsibilities are directly connected to a transportation agency’s mission.
Based on these experiences, Alabama DOT developed and implemented a new, fundamental approach for managing construction stormwater. This approach prioritized effectiveness over compliance and economy over prescription. It made sense to designers, inspectors, and contractors as Alabama DOT implemented the concepts into its training, processes, and specifications. The approach was coined “The Five Pillars of Construction Stormwater Management.”
Implementing stormwater pollution prevention plans. The agency has also drafted an update to its construction stormwater management specifications that will incorporate the five pillars. Hans Gucker, Ohio DOT’s construction hydraulic engineer, has observed that the new framework is a means of strategically bringing and clarifying meaningful and effective change to the Ohio DOT construction stormwater program.

Nebraska DOT is currently incorporating the five pillars into a construction stormwater management chapter of its drainage design manual. Nebraska DOT highway environmental program manager Ronald Poe has encouraged adoption of the five pillars as a way to update Nebraska DOT’s design standards to reflect the state of practice for managing construction stormwater in a transportation environment.

Conclusion

The five pillars of construction stormwater management represent a holistic and fundamental approach to managing construction stormwater in a transportation environment. The approach has been successfully implemented by transportation agencies and deployed on construction projects in linear and nonlinear settings. The five pillars may be applied at any stage of project development and delivery to enhance effectiveness, reduce risk, and promote regulatory compliance.

Five Pillars

The five pillars of construction stormwater management are to be implemented in order of effectiveness and economy. They include the following actions, in order:

1. Manage communication,
2. Manage work,
3. Manage water,
4. Manage erosion, and
5. Manage sediment.

A state DOT can choose to focus solely on managing sediment, but it runs the risk of soon communicating with regulators, neighbors, attorneys, and reporters about the lack of management in the other areas.

The five pillars have been implemented in planning and design, during construction, and while troubleshooting issues on ongoing projects and have been applied to many types of development projects, including transportation, residential, commercial, and even utility-scale solar facilities.

Over the past decade and a half, Alabama DOT has more fully fleshed out the five pillars approach and has added to it, as better practices have supplanted best management practices of yesterday. The approach has been shared with and adopted by transportation and other agencies and organizations across the United States.

Two state DOTs are currently working on new applications of the five pillars. Ohio DOT is using the concept to categorize its practices in a new construction stormwater manual developing and implementing stormwater pollution prevention plans. The agency has also drafted an update to its construction stormwater management specifications that will incorporate the five pillars. Hans Gucker, Ohio DOT’s construction hydraulic engineer, has observed that the new framework is a means of strategically bringing and clarifying meaningful and effective change to the Ohio DOT construction stormwater program.

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Linear (left) and nonlinear (right) construction sites vary greatly in appearance and in stormwater management needs. A one-size-fits-all approach to regulation, implementation, or both may not be completely appropriate or effective.