IT LOOKED SO GOOD ON PAPER, WHAT WENT WRONG?

HOW A LACK OF MAINTENANCE CAN RUIN THE BEST OF PLANS

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ABSTRACT

How time flies! Forty years ago the Environmental Protection Agency (EPA) implemented the Clean Waters Act to clean up our natural waterways and reduce the amount of pollutants making their way to our watersheds. After 40 years, have we truly succeeded at cleaning up our environment? Have we reduced the dissolved chemicals that are making it to our streams, rivers, lakes, oceans? We proceed to implement the National Pollutant Discharge Elimination System (NPDES), but somewhere between writing the regulations, issuing permits, inspection construction, and actually improving the quality of the water entering our watersheds, there has been a serious breakdown. Where have we gone wrong? Why are we not making progress? With over three hundred pollutants defined by the EPA as a threat to our watersheds, is the task too big of a problem? Are we not capable of stopping the pollutants from making it to our waters? We have implemented BMPs of all types. We have even started to realize that discharging an excess volume of stormwater runoff is overtaxing our drainage system and even our natural waterways, We know that the larger flows delivered by that system of pipes, swales and ponds is overtaxing our streams, so we start implementing green infrastructure and Low Impact Development (LID) in an attempt to reduce the load we are placing on our waterways. Still, positive results are the exception rather than the rule. Are our ideas and methods wrong at the planning level, or is it our failure to follow up in the field that is causing failure despite our best efforts? Poor inspection and maintenance efforts are literally trashing our efforts to improve our valuable water resources.

THE SOURCE OF THE PROBLEM

During a recent visit to New Orleans, Louisiana, I toured the Katrina Museum and found it very interesting that part of the cause of the flooding was major changes to the structure and delta of the Mississippi River. Additional water volume from runoff has increased the velocity the Mississippi River flows and literally caused the mouth of the river at the gulf to shift its position and wash away the delta. These flows have eroded away the sediment deposits that were once found at the mouth of the river. How did this contribute to Katrina and affect so many people? By eroding away those natural wetlands, we left ourselves unprotected from the surge of the storm. These major changes to the natural river course are actually the end result of the effects our progress and growth is having on our world in general and this river in particular. In order to determine a cause, we need to go to all the way up river, to the streams that feed into it, up the storm pipes that are tied in, and all the way back to the construction project and the Best Management Practices (BMPs) that were installed to improve the control of water volume and water quality in the 31 different states that use the water that flows in to the Mississippi.

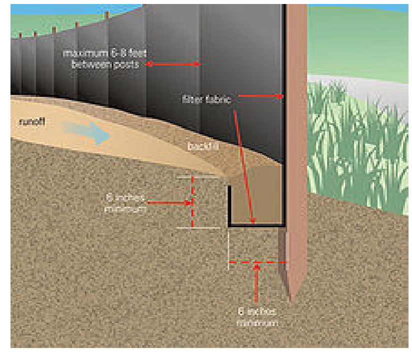
THE SOLUTION'S PLANNED

Our solutions to the problems that have produced the end results seen in our rivers are called "Best Management Practices" (BMPs). BMP by definition is a schedule of activities, practices, or procedures to prevent or eliminate pollution. By one method or another, there must be a physical or chemical separation of the undesirable constituents from the water that carries them. Where do the constituents go once we separate them, into the food chain via plants or animals, or to the soil and ground water? Most likely they are gathered into settling areas, filters, absorbed into some media, in the sumps of catch basins, manholes, or water quality devices where they can be removed. What do BMPs and car filters, dumpsters, or even air filters all have in common? They are all designed to trap, absorb or retain pollutants and hold them until they are removed. In addition, they all require either cleaning or change out to properly work and continue to do their job, What happens if we do not change our car filter, or clean the filter on our aquarium? It is very simple. They become full and over time begin to release the exact material they were designed to capture. Why do we choose to ignore this need with our BMPs? When do our BMPs become the source of our pollution?

We take great pains in ensuring our projects are designed correctly and each project is in compliance with the local regulations for volume control to material requirements. The process starts with the design engineer who diligently works to stay up with regulations and latest products, to the regulators that are reviewing the projects for accuracy and compliance with the regulations. When the plans are approved by the project engineer, the state agency, and the local regulatory agency, and the permit is finally issued! But are we taking the same great pain in ensuring our plan become reality. What happens once the plans go to the field or when the project is completed? Today very few BMPs are being properly maintained or even inspected. I once had a town inspector meet me on site during an installation of a water quality device. This was a perfect opportunity to get the town properly educated on how to service this device and properly inspect it once it had been placed in service. Once I finished showing him how to access the product, what to initially look for and how simple it was to inspect the product he simply looked at me and said, "I do not see this thing ever being cleaned before I retire, let alone inspected. Can we leave that panel out in case our maintenance crews do need to clean it." If this is the perspective of our regulatory agencies what are the chances property owners will follow through with their Storm Water Pollution Prevention Plan (SWPPP) once their construction project is complete. If the regulators are not inspecting and maintaining their own BMPs, how are they going to police others?

How can poor inspection and maintenance lead to failure for the best of solutions? When our car engine fails because we never changed the oil or the oil filter, do not blame the car manufacturer. The car manual clearly stated the need for maintenance, and we ignored that need. When LID techniques and other BMPs fail, do not blame the designer or the manufacturer. They all have manuals, and they all clearly state the need for inspection and maintenance. The need is clear; the techniques are well known; the results are predictable. The following catalogue of failures will show the result of neglecting inspection and maintenance. These failures should show us the way forward to water quality.

A SIMPLE CONSTRUCTION SITE BMP



Let's start by taking a look at one of the simplest of BMP's that are used on practically every project across the country…Silt Fencing. The sole purpose of this product is to reduce sediment from being washed off a site under construction. Starting with the design, project engineers take great pain in ensuring the silt fence is properly detailed on the plans showing correct installation methods. Always ensuring the silt fence is placed at the low points of the project by following the grade around the property.

The BMP now moves from being just an idea on paper to reality during installation. Assuming of course, that everything has been done correctly during design, especially since everyone has checked the plans several times, and it has completed the permitting process. After all, we excel at writing the regulations! Installation is the next likely place for failure. At this point, the contractor decides whether to simply look down the property line and start pounding stakes in a straight line and staple the fabric to the stakes, or to follow the laid out plan. Many times it is the latter, it sets the precedent for how we handle this BMP for the remainder of the project. In most cases everything gets installed per the plans and the end result is the perfect silt fence BMP. So many times, it is easy to tell which projects are new and which ones are old when we drive past the various sites under construction. The new projects have the silt fence installed neatly with the fabric properly installed in the ground as shown in the rendering. When utilizing silt fence on our project the most common problems we will find does not happen during the design or installation of the product. The problem starts as soon as it is installed, and after the first rainfall event when it actually starts doing its job, this is when maintenance needs to begin. So many times we can visit sites that have been under construction, and we find the silt fencing starting to droop. Sometimes we find the rain has washed the sediment up against the fabric pushing it over. In some extreme cases we can find the rainwater either washing the sediment under the fabric or around it completely. The worst case scenario is the newly opened convenience store for example, with overgrown weeds that forced the silt fence over and the silt fencing is still lying on the site after the contractor is gone. Are we stopping pollution or contributing to it at this point?

THE MOST VISIBLE OF BMPs

Over the years, we have always focused on controlling stormwater runoff with regulations driving the demand for volume control. An easy solution has been to either provide an above or below ground storage system, slowly releasing it either back into the storm drainage system, or directly into the watershed. In almost all of these cases, ponds or detention products provide more of a service than just volume storage. Because the water is held back and slowly released so as to not over tax our stormwater system, they actually act as a settling device for sediment, trash, debris and other pollutants of concern that have attached themselves to the sediment.

When designing detention systems, engineers always do their homework and design to meet the local regulations. They make sure they provide the proper slope, outlet control structures, and enough volume to accommodate for the 100 year storm event. As with the silt fence, we can do everything perfect during design, assuring we meet the regulations, but are we accounting for maintenance or the lack of. Obviously, the design was completed and the storage volume was based on a perfectly clean new pond. Did we account for the contractor possibly using this as a holding pond to settle out his runoff and meet

turbidity requirements? Often the elevations in the pond are never checked once it has standing water in it, and we seldom see ponds being inspected and cleaned once they are in service!. After 10 years is the pond still capable of storing the 100 year storm volume? If we estimate that there is, on average, 5,000 P.A.Y. (Pounds/Acre/Year) coming off our projects as demonstrated in an earlier paper "Challenging BMP Assumptions" (Moll, StormCon 2005). That is 47cubic feet of sediment per acre per year being washed into our detention ponds. If we assume a 10 acres site draining to a 0.8 acre pond that is 3 feet deep, this will produce 104,544 cubic feet of storage. Without proper maintenance the ponds storage volume is being reduced by 4,700 cubic feet of storage every 10 years, which is equal to 498,200 pounds of pollutants sitting in the pond. Maintenance for detention systems typically calls for them to be cleaned every 10-20 years depending on a range of variables.

One specific way to reduce the amount of sediment, trash and debris from making its way to our detention facilities, is the use of pre-treatment devices upstream of the pond. These devices typically capture between 50%-80% of the pollutants washed of a site. In the example above, that is close to 400,000 pounds in 10 years that will be kept out of the pond nearly doubling the maintenance cycle of the pond. Sometimes we see stormwater treatment practices moved downstream of detention facility instead of upstream to reduce their footprint. In most cases, it is simply to reduce the cost of the treatment practice by reducing the model size. When this is done, there are savings in construction material costs and an increase in maintenance costs, by simply ensuring more pollutants are retained in the pond, shortening the maintenance cycle. The treatment device is simply polishing clean water. You can drive into any subdivision and typically find a pond with vegetation grown up or trash and debris blocking the outflow pipe. One of the most commonly used practices is the least maintained practice in the country.

ONE SOLUTION EQUALS ANOTHER PROBLEM

Proprietary practices as mentioned above can be very effective in helping preserve the life of many BMPs, such as detention ponds, infiltration swales, or sand filters. Just like the silt fence or detention facility these devices also need inspection and maintenance. Proprietary devices are typically located below ground and once the project is complete, the product is forgotten. During a recent webinar engineers where asked “Do we educate the owner of the BMPs installed on the property and the need to perform maintenance on them?” Over 56% of them responded that they do it sometimes and 25% said never. When the property is sold, is this something that is disclosed to the new owner? Manufactured devices once serviced, are one of the only BMPs that perform to the same level as the day they were installed. If we look at the example above, even at the lowest performance rate of 50%, a pre-treatment BMP is capable of capturing close to 25,000 pounds of sediment per year. That is 12 tons of pollution that can be eliminated from our watersheds.

THE SOLUTION

With so many BMPs being installed across the country, it is not difficult to find either man made or proprietary BMPs in failure. In order to correct this, or prevent future BMPs from failing, we need to understand the critical stages or of all BMPs. The examples of just a few types of Best Management Practices cited above and their likely failure points clearly demonstrate that design, installation, and maintenance are all critical stages. We need to look at each stage and determine what the best course of action or improvements should be made for each stage in order to improve the process and prevent failure over the long term.

DESIGN

Design is the starting and ending component of every BMP. We currently put the most focus on this stage in hopes that if we get the design right, we will ensure everything else falls in place. A solid foundation is a great starting point for any process or product, but it is only starting point. It is the foundation or design stage that will define how the product will be installed and maintained, during and after the project is complete. This is the point at which we lay out our plan on paper, ensuring that the BMP is configured on the project so as to be the most effective. In many cases, when using manufactured products we should look for companies have civil engineers on staff that understand our projects, and can help with the design and implementation of their products on the project. This puts the responsibility of the product design on the manufacturer and does not transfer the liability of the product performance to the project engineer. Companies that typically have engineers on staff positioned to work with you on your project are looking to design the product to your project, not take a one size fits all approach. At this point engineers should even consider consulting with local contractors, site owners, and inspectors so they know what they design will work in the field and is cost effective for the installation. In many cases contractors can point to products that are the most installation friendly which will save money.

INSTALLATION

Installation is the next stage of every BMP. This is the time when the engineer’s design is implemented on the project. At this point the engineer should visit the site periodically to ensure their design is able to be accurately applied, and provide support for the contractor. In many states the construction permit requires a certified individual to visit the project after every 1" rainfall event, and make sure the SWPPP is being followed during construction. The same approach should be taken with post construction BMPs that are being installed on the project, and should be inspected during and after installation. Interim site inspections should be a part of the 1" rainfall event inspection and to be sure that the system is not becoming inoperable.

Inlet and outlet pipes of structures or treatment devices are usually either placed at the same elevation, or may include a minor drop in the pipe from one side of the structure to the other. Some stormwater treatment products require the inlet to be significantly lower than the outlet which defies what contractors typically expect to see when water enters a structure on the high side, and exits on the low side. Some products need to be assembled on-site and may require compacted backfill in lifts, or have components that must to be assembled on site and placed inside the structure. The project engineer should be required to be on site during engineered installation of these products reducing the possibility of error. A few products on the market provide an engineered product that comes completely assembled, which requires less labor and supervision. Some manufacturers even provide onsite support ensuring the product is properly orientated and placed correctly in the excavation. Engineers should make this a requirement of the manufacturer by including onsite support in the bid documents for the project. Either having on-site supervision of assembly, or using factory assembled products are effective methods. The key is ensuring the product is installed correctly whether a engineered installation or a engineer product.

MAINTENANCE

The design and installation may have only taken a couple of days, while maintenance goes beyond the life of the project, assuming we have taken as much care in installing the product as we did in designing the project. Maintenance can be and probably is the most over looked stage of any BMP. Whether it is during or after construction, maintenance is critical to ensuring that the BMPs continues to operate the same as the day it was installed. This requires ongoing attention and up keep. All BMPs are much like a trash dumpsters and need to be emptied when they are full. Many times contractors will place BMPs online prior to stabilization of the site, whether to meet their stormwater management requirements, or simply from a misunderstanding of the product. To avoid situations where construction phase mistakes have caused a structure to be permanently damaged, all BMPs should be inspected prior to the Notice of Termination being signed and the property being turned over to the owner. The owner should receive a Letter from the BMP manufacturer informing him that the unit was installed properly, is clean, and is fully functional. This is a requirement engineers can stipulate in their designs. Engineers should select companies that are experienced in maintenance of their products and other BMPs. Some of the companies will even provide extended warranties on their products for maintaining them in accordance with their operations manual. Most importantly engineers should design maintenance into their projects. If owners are not going to complete the required maintenance, then let's be sure it is in place at completion of the project by making it part of the bid contract and the project specifications. Many jurisdictions require this as a part of their plan permitting, but few follow up after the site is operational, to be sure that maintenance is actually being done.

SUMMARY

With so many Best Management Practices being designed and installed across the county, we should be seeing a huge impact on the improvement of our watersheds. We need to focus as strongly on post construction maintenance as we do on the development of regulations and the design of our projects. Just because the project is complete and turned over to the owner, the need for maintenance does not stop there. We must do a better job of educating the owner about the post construction BMPs on their property and their legal responsibility for their upkeep. One option is to put more of a burden on the product manufacturers to help address this problem. A few of these product manufacturers already offer maintenance programs for their products, and have a proven creditable history of performance. At design time, engineers ensure the product they are specifying provides the owner with some level of long term protection not only with warranties but with long term maintenance.

At the completion of the project the ideal solution would be for the owner, engineer, product manufacturer, and a local maintenance company to walk the site and review each BMP installed on the site to include, design, installation and long term maintenance of the BMP. With potential fines of up to $37,000/day, it can surely offsets the costs that might be imposed on an owner and may prevent legal entanglements from impacts downstream. .

The final step to ensuring proper Design, Installation, and Maintenance is regulatory accountability. Regulatory agencies have required owners to pay for, and install extensive BMPs. Why should they not police the property to ensure these BMPs are being inspected and maintained? Everything reverts to funding (or a lack thereof), but many jurisdictions have found revenue sources by issuing fines for non-compliant owners. The intent would not be to implement a punitive system to harass owners, but rather an emphasis on seeing that the BMPs so carefully planned and conceived actually become an asset to the watersheds, not a liability for all parties. Instead of concentrating on obtaining grants for pilot projects, it might be more effective to seek funds to implement an effective inspection and maintenance program for BMPs that are already in place, bur failing for a lack of attention. Simply by cleaning what is already in place, billions of pounds of pollutants can be removed before the next storm washes them out of the overloaded BMPs, and into our watersheds.