Green Streets and Porous Pavement: Lessons for Sustainability, Savings, and Success. *Evan N. Pratt, P.E., Water Resources Commissioner, Washtenaw County, MI and Freeman Anthony, P.E., Project Engineer, City of Bellingham, WA*

Overview

To paraphrase the AT&T commercials with the kids, "What's better; cheaper and cleaner or dirtier and more expensive? It's pretty simple."

Municipalities are a top contributor of non-point source pollution – that's right, the very subject of our Phase I and Phase II stormwater permits. One midwestern city recently estimated that *over 50% of all non-point source pollution may come from City streets.* The challenge: reduce pollutant loading and improve pavement at or below existing life cycle costs.

Ramping up the inclusion of stormwater pre-treatment with paving projects has resulted in a number of innovative, cost effective practices focused on infiltration that may be achievable in your community, while also decreasing projected street maintenance costs. In short, Green Streets can be cheaper to build ***and maintain*** while improving local water quality and helping meet stormwater permit compliance**.** Plus, at least one agency has found several ways to get the water quality (and quantity) benefits of infiltration using traditional asphalt instead of porous pavement, an attractive proposition where there are design or maintenance concerns, or a desire to shave peaks from downstream flooding, a common issue in urbanized areas.

Introduction

This article will provide an overview of a range of proven strategies to reduce non-point source pollution from municipal roadways of all types. We also provide case study examples showing all the cost considerations for construction and for maintenance. $42,000 was saved on a 900 foot street construction, and maintenance savings of $37,000 to $57,000 are demonstrated in our examples. In addition, the authors of this article will be presenting detailed information at Congress, with a session at 8:30 am Sunday, August 25th.

Because the use of these techniques has exploded the past 4-5 years, we have also posted a few key resources here: http://tinyurl.com/streetrunoff

These resources include a short list of municipalities who have implemented porous streets along with some case study resources and two of the more informative presentations we have seen in the past several years, particularly with respect to pavement mix design and cross-section design.

How does this affect me?

To first establish why it might make sense to reconsider how your agency integrates water quality goals into pavement management strategies, we ask you to take a look at a map of your City, town, or village.

As an example, the City of Ann Arbor, MI, with an area of 27.5 square miles and a population of about 115,000 recently took a look at their map and did some quick GIS analysis. While it may not be obvious when looking at a typical grid pattern, according to Jerry Hancock, CFM, Stormwater and Floodplain Programs Coordinator for the City,*"Ann Arbor's ROW is 2.9 square miles (10.5%) of the City's area, but we found it includes 25.9% of the City's impervious surfaces"*. Hancock went on to explain that *"Although we started requiring developers to provide detention in the 70s, then pre-treatment in the 80's and 90's, it wasn't until the 2000's that the City started including pre-treatment with major paving projects"*.

In an often cited study by Roger Bannerman of the Wisconsin DNR, "54% of all runoff volume in residential neighborhoods comes from the streets, and accounts for the highest pollutant loads". Because the upgrade to pre-treating street runoff is long-term, most street runoff is still untreated, so Hancock made the correlation that 26% of the impervious area in the City could result in 54% of the total runoff since the ROW is mostly all "directly connected" runoff.

Gosh, is there more I should know?

Yes!! Some of your peers have already found the most cost-effective methods of dealing with street runoff, and have also found ways around the real and perceived shortcomings of these 3 basic approaches to promote infiltration:

1. Strategic use of planted areas during streetscape or paving projects – the City of Portland, OR has found that a mini-planter in a bumpout can handle water from a block or more of urban street.

In Lansing, MI, on Michigan Avenue, a similar approach was used as part of a streetscape, with long term monitoring to

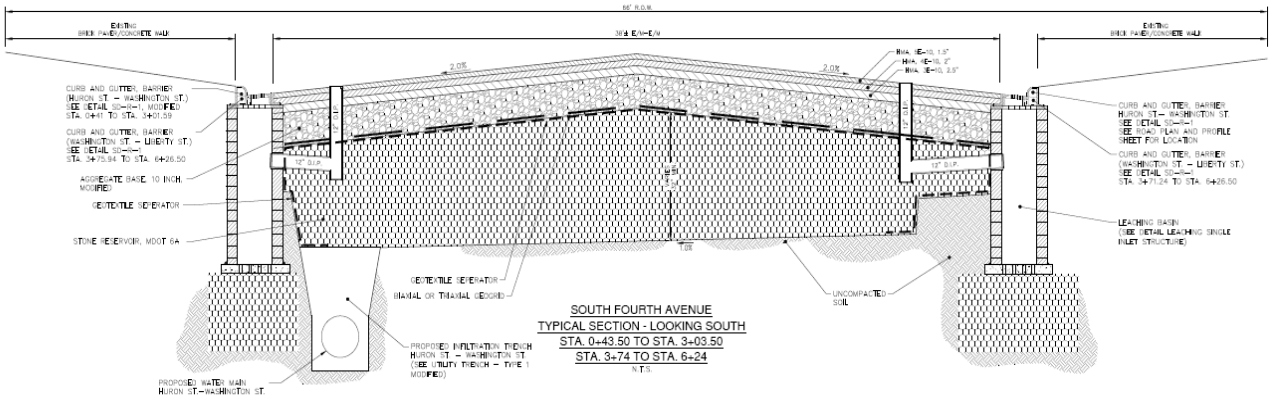
show the success of pollutant removal.

2. Porous pavement has been used since the 1970s for parking lots (Walden Pond), and now many agencies have used porous asphalt and concrete in specific applications. Later, we present some facts so you are well-informed on the concerns and learning curve. A highlight of our analysis has been that contrary to conventional wisdom, porous pavement is much less expensive to maintain than traditional HMA, for two reasons. Porous asphalt does not crack, and porous pavement is designed to have water in the base. How much less would your street maintenance costs be if you never had to do crack repair, or patching as a result of cracking or base issues?

HMA pavement at 5.5 years

Adjacent porous pavement at 5.5 years

3. The City of Ann Arbor, MI has used porous pavement and other techniques in the past on low volume streets, and for 2013 is using infiltration to meet stormwater quality and quantity goals on 3 higher volume urban streets that also see some truck traffic too. The solution that hit the risk management and cost-benefit sweet spot was to use traditional asphalt (HMA) and a wide range of infiltration tools in the base of the HMA, basically providing the same base that would have been under a porous pavement. The tools were used based on sub-surface site conditions, and include infiltration trenches, leaching basins, and easily maintained methods of transferring the water from the road surface to the drainage layer.



South Fourth Avenue, Ann Arbor, MI.
3' of stone and sand base in lieu of underground pipe

On that last point, it is worthwhile to note that many of us have heard that European roads are designed for a 40 year life versus our 20 year designs. It is very important to understand that European pavement is rarely thicker, but the stone base is much thicker. Obviously there is some increase in strength, but the greatest benefit of the thicker stone base is better drainage, and keeping the water farther from the pavement.

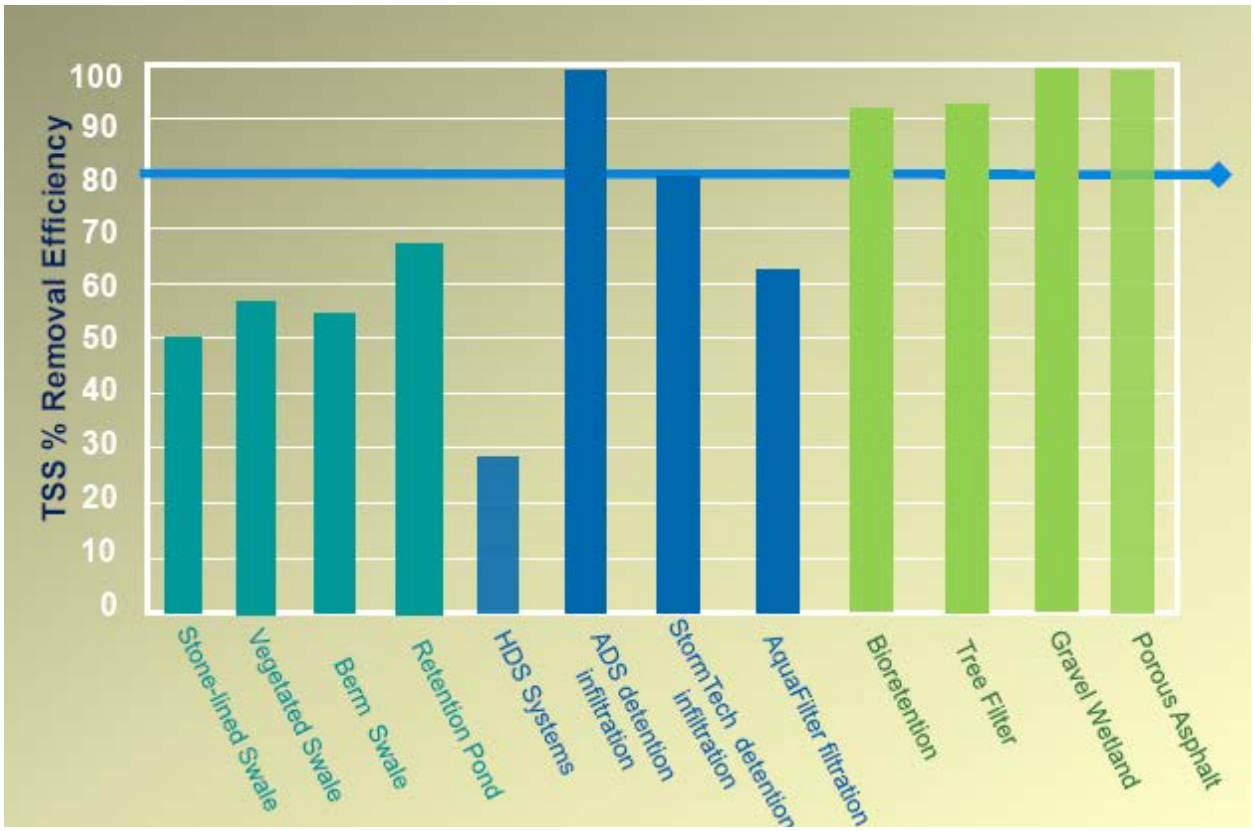
Debunking Myths

With newer ideas, we all know there are a host of concerns and fears, some rational and real and some representing a natural fear of change or the unknown. Well, as we have experienced the past 5-10 years, change is the only constant in public works. There is less funding to work with, and a whole host of problems to deal with from customer expectations and satisfaction to regulatory compliance. While there is no silver bullet, we want to make sure you have the facts, so you can add a few more cost effective tools to your toolkit. While porous pavement construction may result in as much as a 25% premium in paving costs, it is important to consider total project costs, such as the drainage system, detention, water quality treatment, curbing, and maintenance.

One myth is that there is a single magical mix design for porous pavement, and it is only good for parking lots and low volume streets. In fact, there are as many mix design variables as for traditional pavement, and the important part is to take the word "design" seriously. Two of the resources we provide in the link at the beginning of this article provide some excellent details about mix design for low, medium, and high durability. The key factors are the aggregate, the asphalt content, and fiber or other additives that can improve strength. While Caltrans has a standard for using porous as a wearing course only for noise reduction on certain freeway projects, the Arizona DOT placed porous asphalt on 3,500 feet of SR-87 in Chandler, AZ back in 1986, with subsequent studies available detailing positive performance. At the time, this roadway carried over 30,000 vehicles per day.

Maintenance is discussed more fully below, but one other common myth is that the vacuum maintenance required for porous pavement is wildly expensive. We checked on rental prices, and about $125/hour is the average rate nationally, for a sweeper with a 90" wide capability. Plus, most urbanized communities are already committed through their Phase I or Phase II community with street sweeping as a maintenance practice for regular streets, which is estimated at about $300-$400 per lane mile annually for four times per year with a traditional brush sweeper. Since most communities do not have enough porous pavement to justify purchasing the regenerative vacuum sweeper needed for the recommended twice a year maintenance, renting may make the most sense for many agencies.

For porous asphalt, this results in about $300-$400 per lane mile annually for the necessary two times per year. Why not as often? Because the particles are lodging into the pavement, and not in any danger of washing down the drain. From a water quality standpoint, repeated research by the Stormwater Center of New Hampshire has shown porous pavement and other infiltration techniques as the most effective ways of eliminating Total Suspended Solids (TSS), as shown by this chart from their 2005 Data Report (link included in our resource links) results:

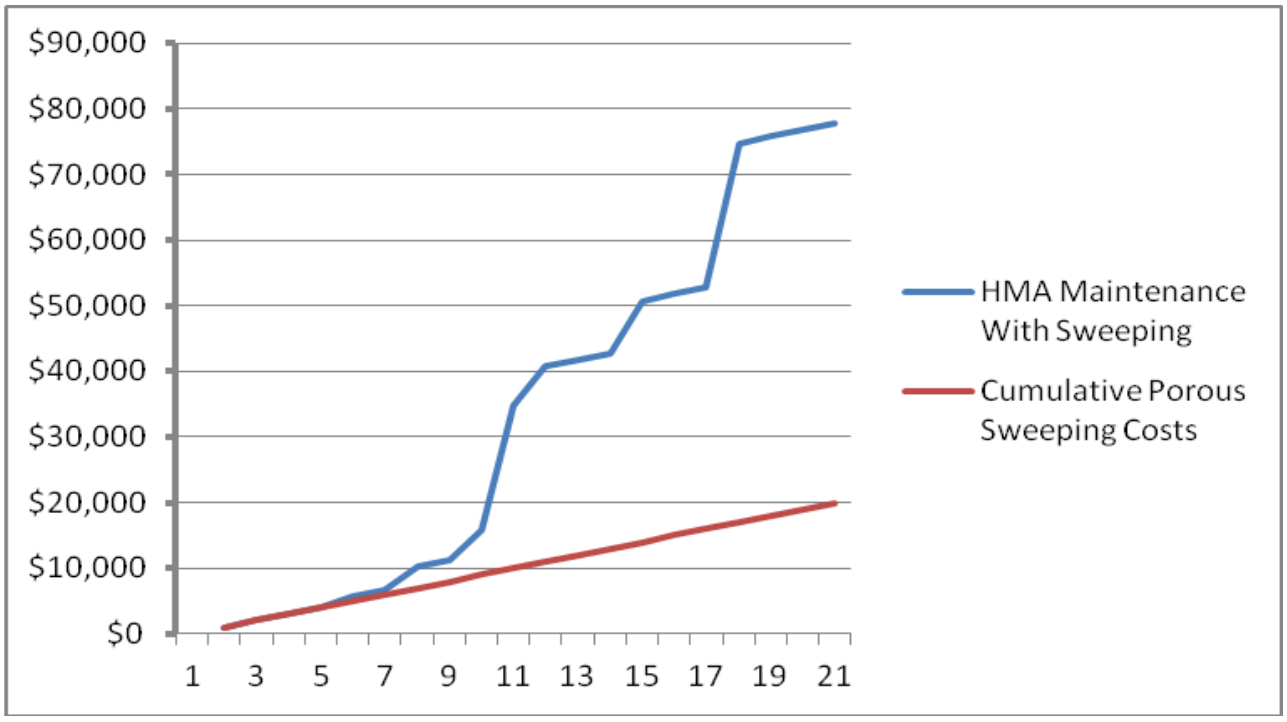


Source: UNH Stormwater Center, 2005 Data Report

Maintenance - What does your Agency spend on crack sealing and patching?

What if your agency never had to seal pavement cracks, patch severely cracked pavement, patch/replace pavement with a failed base, or use coldpatch? It occurred to us in looking at installations in several locations, plus reviewing photos from all over the country, that cracking was not evident in the porous asphalt. So what if your agency used a pavement product that didn't crack?

And if your agency doesn't spend money on pavement maintenance, do you think your taxpayers and elected officials would be pleased if there was a new way of providing the original smooth ride quality for 20 years or more? Here is a table showing typical costs of maintenance, and again the important part is capturing the line items you actually use in your community, and really figuring out what do you spend annually per lane mile on pavement maintenance. You are the only one who can figure out the benefit in your community, our purpose is only to equip you with the ideas and information folks around the country have been finding as they sit down and really think through how well traditional paving has been working.



And how did we come up with this information? Due to space limitations, the details don't fit here, but our Congress presentation details a typical maintenance cycle with costs totaling some $57,750 over 20 years for crack sealing, patching, and other typical maintenance on a 36' wide residential street. Any member can view this presentation under the electronic postings for Congress sessions. Or come and see us in Chicago at 8am on August 25th.

In summary, innovative communities are finding ways to answer the challenge of cleaning up untreated street runoff without breaking the bank, and have found side benefits along the way that should improve pavement life cycle and lower the annualized cost. It’s simple.