King County
Department of Transportation
Road Services Division
Roads Maintenance Section

Stormwater Professionals Speak Out!

King County Roads Maintenance Section (KCRMS) received funding assistance from the Washington State Department of Ecology (Ecology) to develop in-line ditch BMP options for treating stormwater pollutants &/or controlling flow, particularly those options that are innovative and could be applied throughout the region. Part of the project was to tap into local expertise to develop ideas that would add to a suite of effective ditch BMPs that are low cost, simple to install, and require minimal maintenance.

An email questionnaire was sent out in November 2008 by KCRMS asking local experts to take some time to think about how stormwater is currently conveyed in roadside ditches and provide comments, suggestions, and ideas for how roadside ditches could be modified to provide flexible application potential while providing water quality treatment and flow control benefits.

The following questions were presented to local experts:

1. **Existing BMP Studies and Research.**
   - What types of roadside ditch stormwater treatment studies have already been done and what were the results? Which ideas needs further study? Are you aware of any innovative & promising approaches to using retention, infiltration, and filtration for water quality treatment and flow control?
2. **Filter Media.**
   - What are the problematic/target pollutants that exist in roadside ditches carried by stormwater runoff? What available filter media, structures, technologies, or designs exist to treat target pollutants and/or flow control? (focusing on low cost, simple to install, low maintenance options)
3. **BMP Application.**
   - What site conditions would promote/prohibit effective BMP performance?
4. **BMP Costs and Performance.**
   - What would the most promising BMPs cost to install/maintain? Would their projected lifespan be sufficient to justify the cost of installation & maintenance?

Response from the Local Experts

- Avoid under drains when designing the stormwater study. Under drains are expensive, reduce treatment, reduce infiltration, and should only be used when surface flow is absolutely out of the question. Under drains are overused and are often not designed appropriately (e.g., installed at the bottom of the gravel bed instead of higher up), and can even tap into perched groundwater and essentially become a big I/I source.

- Be very careful with topsoil and compost selection when designing filter media. Metals export from composts used in BMPs can occur. It would be worth testing the materials for metals concentrations before ordering tons of it.

- Beware of unwanted tag along with any organic/compost matter including debris (glass, metal, plastic), nutrients, bacteria, and color (which is dissolved organic carbon that also may be a good thing in reducing metals toxicity).

- Check dams at the top of the cells are great for spreading out the flow. For infiltration systems, it is equally important to have a structure at the bottom of the treatment cell that will dam the water up in the cells to promote infiltration.

- The question is how to use filter media in such a way as to give the best performance and not blind off too fast. Blinding (or clogging) is an important consideration when choosing/developing filter media and/or water quality and flow control treatment designs. Saturated compost may restrict flow and geotextile/filter fabrics may tend to clog and reduce infiltration. Appropriate media and material selection will reduce the amount of maintenance needed and increase the life of the treatment cells.

- Layered filter media treatment systems can be far too complex and will be prone to clogging and maintenance needs. The various gradations between layers will encourage movement of material from one layer to the next and does require geotextiles to maintain integrity of layers.

- It is important to think about how much (depth) is enough compost amended soil to support plant growth over the long term.

- A side-by-side monitoring trial period is recommended to compare filter media and/or filter fabrics to determine what combination of materials provides the greatest water quality/flow control treatment (effectiveness) for the money.

- Think about buoyancy of any media used and potential for it to float and clog overflows or other drains. Compost, and other landscaping material transported or floated from placed areas can clog drains and create overflows and failures.

- Think about the opportunity to add hardness and potential carbonates for complexing metals by using calcitic rock for check dams, lining, etc. Several options range from limestone and marble gravel/spalls or even sand as well as oyster shells, which are being used at SeaTac airport. Around here, the oyster shells are relatively cheap. Findings have shown that metals removal was only part of the equation, adding hardness to the naturally very low hardness of rainfall/runoff can reduce toxicity. Sometimes it's not about removal, but about adding missing factors like this.

- The research indicates that the best treatment systems for road pollutants are plant soil systems. Not only is pollutant removal capability enhanced, but anecdotal observations indicate that plants are important for maintaining/improving infiltration rates when systems are exposed to sediment input (e.g. roadside ditches).

- Storage volume, improved pollutant removal, increased service life, and overall effectiveness of the BMP can be obtained by simply providing a sand compost mix used in bioretention. This will also save a bundle on materials and installation.

- It is recommended that a pure compost layer on the top not be used. Create a uniform mix that will create an excellent growing and filter media where plant roots can penetrate the entire profile (builds and maintains soil structure) and requires no filter fabric. Additionally, you WILL have high nitrogen (particularly nitrate) and phosphate export with the thick compost layer on top.

- For the higher gradient/velocity ditches, increased check dam frequency might work well. Use a bioretention soil mixture, place a rock mulch to protect soil mix from erosion, and plant through the rock.

- The plants are critical here and will perform maintenance of the soil structure 24/7.

- Consider settling areas that minimize sediment inputs to the entire system and allow for easy, centralized removal.

- Plants and the system should not be mutually exclusive. Typically, roadside ditch systems do not offer soil conditions that support plant establishment opportunities. It is important to find designs, products, and/or technologies that provide suitable conditions for plant establishment.

- A uniform media mix would be good both from a plant perspective and from a constructability perspective. Using compost socks with very coarse compost would be a better check dam than trying to reinvent an alternative. Compost socks are an accepted BMP that will do double duty by helping plants grow. Specification of the compost is very important in those two situations.

- Studies have shown that most BMPs can effectively treat TSS, TP, total metals, and hydrocarbons (the Easy Ones). The real trick, as we all know, is reducing the Tough Ones: dissolved metals and nutrients, and bacteria. The funny part is, unimproved embankments and unimproved roadside ditches (i.e., engineered for nothing but conveyance and convenience) do just as well at removing the Easy Ones as any engineered BMP and they provide flow control.

- Found that there is considerable treatment in roadside embankments that receive dispersed flow, thus it is imperative to not put ditches behind a curb. Emphasis should be on treating runoff as dispersed flow since it is much easier to treat than treating it once it has concentrated into a stream.

- Wherever feasible your ditches should receive the majority of their flow from dispersed roadway runoff rather than piped in. Studies show most of the treatment in roadside ditches happens during filtration in the embankment before water gets to the ditch. If this is the primary pathway that water will be entering roadside ditches, consider having a filter media installed parallel to the roadway (Ecology Embankments but without the underdrain), or at the least maintain the road shoulder so that an organic curb does not build up and route water away from the ditch or concentrate it to one location.

- One problem is maintaining sheet flow [to the roadside ditch] if grass is grown up to the edge of the pavement. This problem may occur especially after road sanding, a micro-berm (for lack of a better term) can build up along the edge of the grass, and cause at least some subsequent runoff to bypass the infiltration strip (observed at the CAVFS site). This could possibly happen as a result of passive (i.e. not deliberate) siltation, perhaps over a longer buildup period. An intervening gravel strip may allow sand/silt dispersion, so sheet flow is maintained.

- Monitoring of vegetated embankments and swales has shown that they tend to do well for most parameters except dissolved metals. Targeting dissolved metals with a filter media such as the WSDOT Ecology-mix (2008 WSDOT Highway Runoff Manual on page 5-74 and 5-75: http://www.wsdot.wa.gov/Publications/Manuals/M31-16.htm) or other proprietary mixes is a good approach.

Related Links:

WSDOT water quality section research on different stormwater BMPs.
http://www.wsdot.wa.gov/Environment/WaterQuality/Research/default.htm

WSDOT BMPs in the Highway Runoff Manual in chapter 5 - CAVFS, Bioswales, and Filter Media Strips/Ecology Embankments.
http://www.wsdot.wa.gov/publications/manuals/fulltext/M31-16/HighwayRunoff.pdf

Link to the TER for WSDOTs Ecology Embankment (now called "media filter drain"):
http://www.wsdot.wa.gov/NR/rdonlyres/3D73CD62-6F99-45DD-B004-D7B7B4796C2E/0/EcologyEmbankmentTEER.pdf
Page 5 has a physical description of the BMP and talks about the "Ecology-mix", a blend of crushed rock, dolomite, gypsum, and perlite. This report has monitoring results as well.

Thesis completed by Cameron Chapman evaluating the performance of the 110th Cascade. The results presented in the thesis document the impact on WQ from the reduction in stormwater volume due to infiltration and the biofiltration component of the system.
http://www.ci.seattle.wa.us/util/About_SPU/Drainage_&_Sewer_System/Natural_Drainage_Systems/110th_Cascade_Project/SPU_001799.asp

Caltrans has tested roadside BMPs around Lake Tahoe and looking at their how systems might be useful. Caltrans has an exhaustive BMP manual that covers hundreds of types and configurations.
http://www.healthysoil.org/images/Caltrans_Compost_Use-Larimore.ppt#256,1,The Compost Solution Workshop

http://www.owp.csus.edu/research/projects/fullscale.php

http://www.fs.fed.us/r5/ltbmu/documents/ecd/2006%20LTBMU%20Urban%20Stormwater%20BMP%20Effectiveness%20Monitoring%20Synthesis%20Report.pdf

http://www.towerbridge.dot.ca.gov/hq/env/stormwater/annual_report/2007/Annual_Report_05-06/Attachments/SWMonitoringBMPStatusReport.pdf