

Memorandum

July 9, 2014

To: Stormwater Work Group and King County Water & Land Resources Division

From: Brandi Lubliner, Washington State Department of Ecology

RE: Ecology engineering review of the RSMP effectiveness study proposal entitled: *Effectiveness of Bioretention in Reducing Stormwater Flows, Pollutants and Toxicity*

Ecology was asked to provide comments on the initial four RSMP Effectiveness studies listed below:

- A. Effectiveness of LID Retrofits for Treating Highway Runoff to Echo Lake. Project Manager: Carly Greyell, King County.
- B. Effectiveness of Bioretention in Reducing Stormwater Flows, Pollutants and Toxicity. Project Manager Kate Macneale.
- C. Testing the effectiveness of bioretention at reducing the toxicity of urban stormwater to coho salmon. Project Manager: Jay Davis, USFWS
- D. Paired Urban Small Stream Watershed Restoration Effectiveness Study. Project Manager: Andy Rheume, City of Redmond.

This memo discusses the proposal for Effectiveness of Bioretention in Reducing Stormwater Flows, Pollutants and Toxicity (*June 9, 2104 version*). The RSMP Coordinator, Brandi Lubliner, organized a review team made of to the following Ecology staff: Brandi Lubliner, Ed O'Brien, Doug Howie, Amanda Heye, Bobb Nolan, and Randall Marshall. The comments were compiled in this memo. Thanks for the opportunity to comment.

Overall Comments for Federal Way Retrofit Study

1. The study lays out the need to gather BMP effectiveness monitoring data from actual field implemented BMPs, particularly from pollutants that weren't tested for under the TAPE program. There is also an interest to gather additional in-stream data to measure BMP effects to the headwaters of a small stream.
2. In this proposal, there is still some confusion on exactly what BMP is in place, which needs to be sorted out before any monitoring is funded. Without certainty and adherence to quality control, the study results will have limited to no transferability to other sites, and the effort would fail to satisfy the 'regionally' applicable focus of the larger monitoring effort.
 - a. The BMPs in this project and the project title was changed between the March 20 and May 6 2014 Effectiveness studies workshops from being a rain garden study to a bioretention study.
 - b. Several of Ecology's engineers were familiar with this project because it received Retrofit and LID grant funds. We looked up the pre-design report to get a more detailed description of the BMPs planned and site conditions. The Pre-design report describes the east and west bioretention facilities were to be designed and constructed to the 2012 LID Manual (draft at the time). Can you verify whether that occurred? If so, they are not rain gardens.
3. In the March workshop this project was part of the rain garden topic table. Because this is a retrofit project to treat stormwater the concerns brought up at the retrofit table are mentioned here.
 - a. Some permittees felt retrofits aren't useful to permit modifications and have limited utility for spending \$. They wanted to know if these efforts can inform future permits. This point was heavily debated among permittees at the retrofit table. Other permittees want to gather information on retrofits even if they've been modified from existing BMPs in the manual.
 - i. Ecology's response is that BMP effectiveness information can inform the manual if the BMP is built to a known BMP specification. Other BMPs can be monitored but it's still of utmost importance to know exactly how they were built.
4. In the May workshop there was interest in the constructed wetland.
 - a. Ecology poses a question to the SWG: is there still interest to monitor the "wetland pond" as described by this project? The BMP (per the pre-design report and conversation with Kate M.) is a combined detention pond and treatment wetland (wetland pond). This pond receives stormwater that has already either passed through an upgradient, much larger wetland pond, or that overflows from one of the bioretention facilities. Additionally, it only receives flows below a certain flow rate that is discharged from the upgradient wetland pond. This is an unusual operational mode. Data gathered about this pond's performance may be of limited value to other design applications.

Bioretention BMPs

5. It's important to be clear with stormwater BMP terminology as it relates to the manual in Washington. Clear communication will alleviate confusion, misconception and time spent discussing what is being built and studied. At a minimum, proponents will need to clarify with the construction/design engineers on what BMPs are actually built. Ecology suggests the proposal for this study include a detailed review by a King County stormwater engineering.
 - a. "Bioretentions" is a made up noun and adds confusion. In the manual bioretention is a descriptor word to nouns such as: areas, facilities, cells or swales.
6. As described in 2b above the pre-design report sent to Ecology describes the east and west BMPs as bioretention facilities. In the pre-design report, the west bioretention facility was not underdrained but the east bioretention facility was planned to be underdrained. This effectiveness study proposal describes both bioretention facilities as underdrained. This will need to be confirmed with the engineers.
 - a. Bioretention facilities that are underdrained are not considered LID devices. The underdrain removes the majority of the flow control function. They do still provide a treatment function.
 - b. It is still unclear from the pre-design if the bioretention facilities are lined. The geotechnical section in the pre-design report said groundwater was ~13feet below ground. If not lined, the effluent monitored from the underdrain may not accurately represent the treatment achieved from the bioretention soil mix. There should be an assessment of the potential for groundwater intrusion into the underdrain(s).
7. Based on existing studies on bioretention soils, we know that it's very important to know the source material for the compost in the soil media. Can you verify that the compost source material? In particular, can you verify that manure or biosolids were not used?
Note: We are learning that bioretention soil media leach phosphorus for an extended time.
8. Despite their large drainage area (23 acres) the bioretention facilities would still be undersized if the new and redevelopment criteria applied. This opinion should not prevent monitoring these BMPs and is a reality of the retrofit space available. However they should be noted as non-standard size. Comments for inclusion in the QAPP and report:
 - a. Bioretention as treatment usually is designed to treat 91% of the drainage volume.
 - b. As described in the proposal, monitoring should be done to produce data on how much water and pollution is processed over time. This includes delivery and exiting flow rates, frequency of by-pass, infiltration rate over time, and concentrations of pollutants in/out over time.

Wetland pond(s) or Constructed Wetlands

9. In the pre-design report and monitoring QAPP for the grant project, the existing regional detention facility (RFD) (old wetland pond) was built in 1997 as a combined detention and wet

pond with an oil water separator at the head. It's unclear if this facility has been maintained. The status of this facility should be clearly known and described.

10. The new "wetland pond" (combined detention pond and treatment wetland) may have been designed under BMP T10.40 (combined detention and wetpool facilities), but from this proposal and pre-design report it does not appear to have a wetpool or settling cell as a "wet pond" (BMP T10.10), or treatment wetland (BMPT10.30) designs would call for. This is likely due to the new wetland pond being situated in series with the older 1997 RFD. This is okay, but makes this site more complicated and this needs to be reported so that applicability to other sites is stated forthright.
11. Detention ponds, wetponds and constructed wetlands are considered long detention time BMPs, therefore the monitoring program should for wetland pond(s) should follow the long detention time BMP monitoring protocol.

Toxicity

Ecology recommends not taking water samples from BMP effluents for toxicity for several reasons.

12. Chemical and physical measurements are much better for evaluating treatment system effectiveness. Suspended solids reduction, metals removal, TPH reduction, etc. are relatively easy to determine and immediately meaningful.
 - a. Toxicity is an effect and not a substance. The major toxic stormwater pollutants (metals and PAHs) are already known. The usual toxic substances in stormwater have steep concentration-response relationships.
 - b. The best use of a toxicity test is to screen for unknown toxicants or mixtures. A toxicity evaluation aims to identify toxicants and requires that the same water quality be available for each iterative test to identify the contaminant(s). However this can be very difficult with stormwater discharges because they are weather dependent, intermittent and variable. Getting an adequate sample volume that is representative for the purposes of the study is difficult. Having test organisms of the right age and number ready when that sample arrives at the lab is difficult. Getting weather forecasts accurate enough for short-term planning is difficult.
 - c. Toxicity testing is most meaningful for receiving stream samples. It will integrate the potential effects to stream organisms from all sources and substances. Toxicity identification evaluations will be worth the effort when applied to figuring out the cause of receiving stream toxicity.
 - d. Resource constraints appear to have influenced plans to sample stormwater for toxicity testing from only half of the storms. It would be better to focus limited resources on an initial stream toxicity test to verify a problem.
13. Cautions about the Ceriodaphnia chronic test include:
 - a. Three samples are required over 7 days.
 - b. Higher hardness can increase reproduction. Stormwater can be low in hardness. Dilution water often has moderate hardness. The combination can make test results look toxic.

- c. Feeding is needed for the reproduction endpoint to work. The food binds metals. The 48-hour daphnid acute test can be more sensitive for this reason.

North Fork West Hylebos Creek Receiving Water

14. The monitoring of influent/effluent from BMPs is the portion of the proposal that may be able to influence Ecology's SWMMWW manual and the use of the BMPs in retrofit situations. The effectiveness of those BMPs in improving water quality within the receiving small stream is site specific information; Ecology does not see the usefulness in the receiving water study and suggests the SWG re-consider funding this portion of the proposed project. If stream monitoring is pursued then the following comments are provided.
15. The monitoring described in the effectiveness study proposal was funded by the Ecology retrofit and LID grant. Since these BMPs likely constitute a major influence on the creek at this location, continued monitoring in-stream is considered useful to this particular site and stream.
 - a. Based on 7/2/2014 conversation with Kate M., this site is believed to be the uppermost free-flowing part of the headwaters for the NF West Hylebos Creek. This is also stated in the QAPP for the grant monitoring. Kate said the creek water depth was only ~1inch on 7/1/14, which comes from old pond (the 1997 RDF), which is located under words "east bioretention" in figure 1a. The old pond treats the 189 acres of the watershed above that point.
16. Kate asked if she should design for composite sampling at creek too. The contaminant monitoring of the stream (if proposed) should only occur near the outfall from the east bioretention and ponds. Information on the percentage of the drainage area above the existing macroinvertebrate sites was not presented in the proposal. Ecology suspects there is too large of difference between the "treatment area" and the watershed at that point to encourage any additional stream contaminant monitoring at the lower site (as part of this project).
 - a. The city is encouraged to maintain their WQ and BIBI monitoring for a longer term trend analysis to build a more robust site specific effectiveness story.
17. Ecology suspects the stream's hydrology will experience minor modifications (primarily timing of low flow delivery) for the following reasons:
 - a. the bioretention facilities are underdrained
 - b. Per the pre-design report, the new wetland pond adds only 18% more live storage volume (8.3 acre-feet)
 - c. Per the pre-design report, the new pond was designed to attenuate the lower more frequent flows. The old pond would be retrofitted with a small outlet orifice, and high flows from the old pond would be diverted around the new pond to the stream. However, this is still a point of confusion and needs to be verified.