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September 10, 2018

Ivar Ridgeway
Senior Environmental Scientist
Los Angles Regional Water Quality Control Board

RE: Comments on City of La Mirada Alternative Biofiltration Specification Request

Dear Mr. Ridgeway,

Thank you for the opportunity to comment on the request from the City of La Mirada for approval of the Modular Wetlands (MWS) as an alternative biofiltration specification pursuant to the Los Angeles County Municipal Stormwater Permit (LA MS4 Permit). We strongly support the approval of alternative biofiltration designs that have been demonstrated to match the pollutant load reduction capabilities of conventional biofiltration systems as described in Attachment H of the LA MS4 Permit. Operational feasibility of any alternative design and its consistency with the Low Impact Development standards set in the LA MS4 Permit is also important. While the framework presented in the Geosyntec report is technically sound, there are some important issues related to Modular Wetland performance and operational feasibility that must be addressed prior to approval.

Water Quality Performance

There are two studies referenced in the Geosyntec report submitted by the City of La Mirada that document MWS performance. The 2014 report authored by Herrera[1] reports on testing conducted in pursuit of verification through the Washington State Department of Ecology (Ecology). During this testing period, the design of the system was changed several times in response to rapid failure due to clogging from stormwater borne sediment[2]. The tested system initially used a "Solid BioMediaGREEN" prefilter but that clogged after less than a month of use. Two additional prefilter types were tested, but each quickly failed to pass the design treatment flow rate[3] of 41 gpm prior to bypass. Finally, on 10/27/2012 a "Cubed BioMediaGREEN" prefilter was installed. Within a month, this media also failed to pass the design treatment flow rate. However, in spite of its rapid failure, it has become the standard MWS pretreatment design.

Since the water quality data collected prior to 10/27/2012 was of a different design than is currently marketed, at a minimum, the water quality results used in the Geosyntec report should exclude data collected prior to that date. As will be discussed below, the system was atypical in other ways and there is a reasonable basis for rejecting this study altogether.

The second study was performed by the US Army at Fort Hood. The summary document referenced in the Geosyntec report is not publicly available, but a final report was issued by the US Army Corps of Engineers

[1] Herrera. (2014). Technical Evaluation Report Modular Wetland System Stormwater Treatment System Performance Monitoring. Prepared for Modular Wetland Systems, Inc. April 1, 2014.
[2] The various pretreatment design iterations, maintenance dates and peak treated flow rate for each storm with bypass flows is summarized in Table 6 on page 45 of the Herrera report.
[3] The design flow rate for the system is listed on page 47 of the Herrera report.

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(ACOE) in 2014[4]. It provides monitoring program design information and water quality results for three MWS systems that were installed at two locations. One location was a single MWS unit and the other location featured two MWS systems installed in series with the effluent of the first system treated again by the second system. All systems featured a solid BioMediaGREEN prefilter design which has been discontinued due to longevity issues. Unfortunately, no flow data was collected during the study so it is impossible to tell what operating rates samples were taken at during the testing period, or whether the MWS systems were able to treat the design flow rate prior to bypass. Without this information, utility of this data is limited and should not be the basis for regulatory decision making. Given the monitoring approach of initiating sampling at the onset of flow, and the frequent maintenance required on the site, it is likely that the flow rates monitored were very low compared to the design treatment capacity. This is important since media filters generally perform better at lower hydraulic loading rates.

Table C.3 of the Geosyntec report states that 18 TSS and Total Zinc sample pairs were generated at the Ft. Hood site. However, the ACOE report shows that there were only 9 storms monitored for TSS. This indicates that sample results for both the single MWS and the two stage MWS are included in the data set. There is no zinc data in the final report. Given the lack of flow data, the lack of zinc data in the final report, use of an obsolete prefilter design, and the apparent inclusion of data from a two stage MWS system, this data should be rejected.

Flow capacity discrepancy

The MWS system monitored in the Herrera report was a MWS L-4-13, which has a stated capacity of 0.144 cfs (64.6 gpm) in Table 3 of the Geosyntec report and in MWS promotional literature. However, the design capacity of the system at the Ecology test site was listed as 0.091 cfs (41 gpm) in the Test System Description section on page 24 of the Herrera report. To limit the flow rate through the system, an external bypass weir was installed upstream of the system. As a result the Wetland Media was saturated to a depth of only 2.3 feet. This is not a typical configuration. Typically, peak flow exceeding the capacity of the prefilter and/or wetland cells is routed through an internal bypass originating in the first chamber of the MWS system and discharging untreated water to the discharge chamber of the same system. In the test system, these internal bypass routes were blocked.

The likely reason for this disparity between the design flow capacity of the tested MWS system and the standard design is that only a portion of the wetland media in the tested system was saturated during normal operation. It is assumed that the hydraulic loading rate on the wetland media is the same as their standard sizing. However, an explanation is not given in the Herrera report or in the subsequent Ecology approval. This should be clarified. In the absence of a reasonable justification, the design flow rate for the standard MWS L-4-13 should be 41 gpm and the treatment capacity of other models should be scaled accordingly.

Longevity

As was previously mentioned, there was no flow data reported in the Ft. Hood study. So, it is impossible to know whether the system was able to pass the design treatment flow rate prior to bypass. From the maintenance frequency information in the US ACOE report, we do know that the catch basin filter was changed monthly, and on a quarterly basis, the separation chamber was dewatered and cleaned and the prefilters were replaced. This presumably included a vacuum truck and followed confined space entry safety procedures. This

[4] United States Army Corps of Engineers. (2014) Demonstration of a Modular Wetland Treatment System for Stormwater Runoff. Public Works Technical Bulletin PWTB 200-1-149. Available online at: https://www.wbdg.org/FFC/ARMYCOE/PWTB/pwtb_200_1_149.pdf

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level of maintenance vigilance is likely to be far beyond what can be reasonably expected on a typical land development project. And, there is no evidence that it was adequate on this site.

We have more detailed information about the changing hydraulic capacity of the MWS system over time in the Herrera report. The peak treatment flow rate during storm events where bypass was experienced is reported in Table 6 of the Herrera report. During this study, new prefilters meeting the current MWS specifications were installed three times. The first time, the MWS operated at or near its 41 gpm capacity for 22 days, at which point the treatment capacity dropped more than 10% below design. When the second new prefilter was installed, the system failed to reach the design flow rate at all. Installation of the third prefilter brought treatment rates during bypass events back above 41 gpm for only 6 days.

Given that the treated flow rates listed in Table 6 of the Herrera report are "peak treated flow during bypass", not the treatment flow rate at the *initiation* of bypass flows, it is likely that the MWS system started to bypass prior to reaching the listed flow rates. The hydraulic capacity of the prefilters was clearly a limiting factor since the flow rate rebounded with each change. But, considering that new prefilters were installed on 1/27/2013 and the system still failed to reach its design flow capacity it is likely that the WetlandMedia in the wetland cell was also in need of maintenance. Even though the system once again briefly reached its design flow rate after the last prefilter maintenance, it may not have reached it prior to bypass. The fact that a new prefilter was installed and failed to bring the system capacity back up to design treatment flow rate has only two possible causes. Either the standard MWS prefilter in its new condition is sometimes incapable of treating the design flow rate, or it fails to protect the MWS WetlandMedia enough to avoid replacement of that media as well. Both root causes are inconsistent with MWS promotional materials and performance claims.

Biofiltration Definition

The MWS system as tested and described in the Herrera report is not a biofilter. A biofilter is generally defined as a system containing plants and soil. For example in the San Diego MS4 permit[5], biofiltration is defined as "Practices that use vegetation and amended soils to detain and treat runoff from impervious areas. Treatment is through filtration, infiltration, adsorption, ion exchange, and biological uptake of pollutants." Attachment H of the Los Angeles Region MS4 permit[6] contains design standards for bioretention/biofiltration design and soil that are intended to "allow a healthy vegetation layer", "provide a beneficial root zone" to encourage "healthy soil biota and vegetation" and to "provide sufficient retention of moisture and nutrients to support healthy vegetation". Clearly it is intended that biofiltration systems be living systems comprised of plants, soil and a thriving microbiological community.

The Modular Wetland system does not contain soil. The WetlandMedia substrate is described as an expanded shale material on page B-2 of the ACOE report. The BioMediaGREEN material used in the prefilter appears to be a rockwool like material. Neither have an appreciable organic content. Both function primarily as filtration media. Although the system described in the Herrera report did include plants, the report states on page 10

[5] California Regional Water Quality Control Board, San Diego Region. (2015). National Pollutant Discharge Elimination System (NPDES) Permit and Waste Discharge Requirements from the Municipal Separate Storm Sewer Systems (MS4s) Draining the Watersheds within the San Diego Region. Order No. R9-2013-0001, as Amended by Order Nos. R9-2015-0001 and R9-2015-0100. NPDES NO. CAS0109266. Page C-2

[6] California Regional Water Quality Control Board, Los Angeles Region. 2015. Waste Discharge Requirements for Municipal Separate Storm Sewer System (MS4) Discharges within the Coastal Watersheds of Los Angeles County, Except Those Discharges Originating from the City of Long Beach. Order No. R4-2012-0175 as amended by Order WQ 2015-0075. Attachment H.

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that "Based upon the observations of plant growth rate and root establishment rates for the variety of the plants utilized, it was determined that the roots did not reach the active treatment zone during at least the first years of testing from April 2012 to April 2013." This section of the report has been used throughout Southern California to justify installation of the MWS system without plants on the basis that the plants were irrelevant to the performance achieved.

This inclusion of plants and soil in the definition of biofiltration set it apart as a BMP classification from other media filters that don't contain plants and may not contain organic media. Organic media and vegetation are known to be important for both pollutant removal during a storm and for transformation and uptake of pollutants between storms[7]. The microbiological community is much more diverse and numerous in systems containing plants and organic media[8]. This community and the roots themselves are critical to extending the maintenance frequency of biofiltration systems as they improve soil structure and help regenerate its pollutant removal capabilities.

Redefining biofiltration to include non-vegetated media filters without soil opens the door to equivalency applications for media filters like the StormFilter, which has been documented to provide similar performance as compared to the MWS system or conventional biofiltration[9]. Although Contech is open to this outcome, it would seem to be a major departure from the Low Impact Development (LID) based land development program requirements in the current Los Angeles MS4 permit. As such, the decision to approve the MWS on the basis of a field test where plants played no role in stormwater treatment should be taken cautiously.

Recommendations

Based on the preceding information, the application for approval of the Modular Wetlands system as an alternative biofiltration specification should be rejected until the following conditions are met.

- Field monitoring data should be provided at a minimum of two sites and for a minimum of 30 storms.
- Field monitoring should be conducted following the Technology Assessment Protocol – Ecology (TAPE)[10], the Sacramento Stormwater Quality Partnership protocol[11] or a similarly robust protocol.
- Each MWS system tested should be a standard model designed with the claimed treatment capacity for that model and with a typical bypass configuration.
- Detailed inspection results and maintenance activities during the testing period should be included with each final testing report.

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[7] Soil and Water Conservation Society (SWCS). 2000. Soil Biology Primer. Rev. ed. Ankeny, Iowa: Soil and Water Conservation Society.

[8] Coyne, Mark. 1999. Soil Microbiology: An Exploratory Approach. Delmar Publishers. Albany, NY

[9] The StormFilter and other media filters have received use level designations for metals, phosphorus and TSS from the Ecology. Current approvals are listed on the Ecology web page for Emerging stormwater treatment technologies at: https://ecology.wa.gov/Regulations-Permits/Guidance-technical-assistance/Stormwater-permittee-guidance-resources/Emerging-stormwater-treatment-technologies

[10] Ecology. 2011. Technical Guidance for Evaluating Emerging Stormwater Treatment Technologies: Technology Assessment Protocol - Ecology (Tape). Publication No. 11-10-061, Washington State Department of Ecology, Olympia, Washington.

[11] Sacramento Stormwater Quality Partnership. (2014). Comprehensive Protocol for Performance Evaluation of Proprietary Stormwater Control Products. Available online at: http://www.beriverfriendly.net/docs/files/File/NewDev/PropDevices-%20Protocol_revised-Mar2014.pdf

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- Bypass flow rates should be monitored as well as treatment flow rates and maintenance should be performed if bypass is initiated prior to the MWS prefilter or wetland cell reaching its design treatment capacity.

If and when approval is granted, the following conditions should apply:

- The Modular Wetland system should include plants in all applications. Failure to include plants with roots established in the active treatment zone of the wetland cell should disqualify the system from being classified as a biofilter and should instead result in classification of the system as a non-LID media filter.
- The minimum maintenance frequency of the prefilter should be at least 1 year given typical rainfall patterns in the Los Angeles area. If maintenance is required at a more frequent rate in field studies, the load retained per prefilter prior to hydraulic failure should be calculated. Future MWS systems should be sized with adequate prefilter capacity to handle the expected influent solids load during a typical rain year with prefilter maintenance occurring no more frequently than annually.

In summary, although the modeling approach and design logic presented in the Geosyntec report are sound, the performance data provided for the Modular Wetlands is inadequate to justify approval. The total number of storms referenced in the Geosyntec report where the MWS system was operating at design capacity with the current specification prefilters is four[12]. In contrast, there were 32 separate studies analyzed for conventional biofiltration in the Geosyntec report with between 184 and 384 sample pairs available for parameters of interest. The Filterra data set previously submitted by Los Angeles County and others and approved by the Los Angeles Regional Board[13] included data from 7 separate field studies and between 34 and 165 sample pairs for pollutants of interest. A minimum of two field studies including flow weighted composite sampling for 30 storms is recommended as the minimum threshold for data completeness for the MWS system or any other biofilter for which a finding of equivalency is desired. Collecting this water quality and hydraulic data on typically designed and sized biofilters will help us to more fully understand their capabilities and limitations.

Currently submitted field performance data suggests that pollutant removal rates similar to conventional biofiltration may be possible by the MWS, but only at the expense of hydraulic capacity. The testing data provided highlights the Achilles heel of the MWS system, which is that the BioMediaGREEN prefilter component is unable to handle typical influent solids loads without rapidly clogging, and yet, less robust pretreatment would jeopardize the longevity of the WetlandMedia which would be very expensive and disruptive to replace. Compared to conventional biofiltration, maintenance demands are unreasonably onerous and widespread use of the MWS would reduce the robustness of the entire MS4.

It should be clear that a non-vegetated MWS system is inconstant with the Los Angeles Regional MS4 Permit emphasis on using Low Impact Development design principles to manage stormwater runoff. Since the standard system contains no soil and the plants in the tested system were more ornamental than functional, it is questionable whether the system meets the Low Impact Development design intent of the permit at all. Approving the system on the basis of the data presented thus far would open up the biofiltration equivalency process to other non-vegetated media filters that have so far been excluded from the LID toolbox.

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[12] Storm dates: 10/28/2012, 10/29/2012, 10/31/2012 and 5/16/2013.

[13] Los Angeles Regional Water Quality Control Board. (2017). Approval of Alternative Biofiltration Specification (Filterra Bioretention System) Pursuant to Part VI.D.7.c.iii(1)(b)(i) of the Los Angeles County Municipal Separate Storm Sewer System (MS4) Permit (NPDES Permit NO. CAS004001; ORDER NO. R4-2012-0175)

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Given these shortcomings in MWS system design and data completeness, we strongly recommend rejection of the La Mirada application until such time as additional data becomes available demonstrating that the current MWS design can provide adequate water quality benefits while maintaining the design treatment capacity for a reasonable period of time.

Sincerely,

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