Report submitted for July – December 2012 reporting period

UTC Project Information	
Project Title	Media Filter Drain: Modified Design Evaluation and Existing Design Longevity Evaluation
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Funding Agencies	PacTrans: $60,000 WSDOT: $75,000
Agency ID or Contract Number	University of Washington Subcontract No. 739428 "PacTrans Region 10 University Transportation Center" WSU OGRD # 119395
Total Project Cost	$135,000
Start and End Dates	May 16, 2012 to November 1, 2013
Project Duration	16 months
Brief Description of Research Project	The Washington State Department of Transportation (WSDOT) wishes to modify the media filter drain (MFD) design by changing the crushed gravel specification used in the mix. In order to gain approval from the Washington State Department of Ecology (Ecology) and incorporate into their standard specifications, metal removal rates for the new design need to be compared to the old design based on current accepted stormwater doses. The first objective is to test the modified and existing design in laboratory experiments for dissolved metals removal and compare these results to determine if there is any statistical difference in the removal rates between the two. Thus, we will determine initial removal rates for the modified and existing design over a range of influent concentrations (Method #1). The second objective is to complete a life cycle analysis on the modified design based on estimated long term high loadings and expected capacities for the media (Method #2). This will provide WSDOT with a more representative design life of the MFD design. In addition, WSDOT wishes to evaluate the longevity of the existing MFD design as many of the installations have been in use for 10 or more years and initially, the estimated life of the media filter mix in the MFD was approximately 10 years. In order for Ecology to accept extended use of existing MFDs, there is a need for accelerated metal removal rate testing on existing media filter mixes using current accepted stormwater doses. WSDOT would also like to identify economical rehabilitation methods for MFDs that are no longer sufficiently removing metals. To determine the

longevity of the existing media, we will test the existing media filter mix design in laboratory experiments for extended dissolved metals removal in order to complete a life cycle analysis on the existing design based on estimated long term high loadings (Task or Method #3). We will also complete a comparative analysis on the existing design with and without minor new design media additions for estimated long term high loadings as a preliminary way to estimate minimal excavation rehabilitation methodologies (Task or Method #4). The last task is to investigate the metal loading stratification in the existing media filter mix (Task or Method #5).

Completed Tasks

Since the beginning of the project, we have determined experimental methods and obtained approval of the QAPP from Washington State Department of Ecology (Task #1). Existing media filter mixes have been collected from two sites, and infiltration rates were measured (Task #2). The testing of the proposed media filter design specifications (Method #2), testing of existing media (Task/Method #3) and existing media with 2 inches of additional new design filter media (Task/Method #4) has begun. As of December 12, 2012, 16 events have been completed for Method #2, 30 events have been completed for Method #3, and 26 events have been completed for Method #4. (An event represents a simulated accelerated or typical storm loading test run.) This project is currently on schedule.

Preliminary Results

Task #2. Media from the filters on site A (SR 167) and site B (244 St.) were collected. The media mix has been in place on SR 167 for approximately 12 years, and 244 St. for approximately 5 years. Table 1 shows the results of the infiltration tests using a minidisk infiltrometer. We were not able to obtain a reasonable infiltration rate using the single ring infiltrometer; we may need to redo these measurements. As is evident from the results, established sites with grass growing on the surface and sediment deposition from runoff have low infiltration rates. When the grass and dirt was cleared away at site A, infiltration rates increased substantially. All measured infiltration rates are close to the ecology embankment design infiltration rate of 50 in/hr initially and 28 in/hr over time (WSDOT, 2006).

Table 1. Measured infiltration rates at site A and site B using a minidisk infiltrometer

Location of infiltration test	Infiltration rate (in/hr)
Site A with grass and dirt layer on top	22.7
Site A, grass and dirt cleared away	31.6
Site B	16.6

Method #2. 16 events with accelerated loading metal concentrations have been applied to the 6 columns with laboratory prepared media using the proposed media

	design. Influent and effluent samples have been collected for each event. We are currently waiting for results from the Geoanalytical Laboratory for these tests. ***Methods #3 and 4.*** Figures 1 and 2 show results from both site A (SR 167) and site B (244 St.) for the first 12 accelerated loading events applied to 6 columns for method #3 and the first 9 accelerated loading events applied to 6 columns for method #4 (we are currently waiting for results from the Geoanalytical Laboratory for the remaining events). For method #3, the media mix collected at both sites were put into columns and loaded with stormwater at concentrations 8 times the observed high concentration (800 μg/L copper and 4000 μg/L zinc). Due to an error in making the stormwater, influent concentrations are approximately half for events 6-12. The error has been fixed and applied stormwater will be closer to the 8 times concentration for the remaining events. Nonetheless, the applied loading is still high enough to show significant removal of copper and zinc. For the first few events, results were highly variable. This may be due to channelization that was observed during testing. After the columns had been loaded 3-5 times, the media became more evenly compacted and channelization no longer occurred. The pH of the influent was approximately 5.9 and the effluent was approximately 5.85. For method #4, the media mix collected at both sites were put into columns with an additional 2-inch layer of gypsum, dolomite, and pearlite at 10 times the amount in the media filter mix. Stormwater was applied at concentrations 8 times the observed high concentration (800 μg/L copper and 4000 μg/L zinc). Due to an error in making the stormwater, influent concentrations are approximately half for events 2-9. The error has been fixed and applied stormwater will be closer to the 8 times concentration for the remaining events. Results were highly variable at the beginning, and became more constant after 6 events. The pH of the influent was approximately 5.77 and the effluent was approximately 5.72.

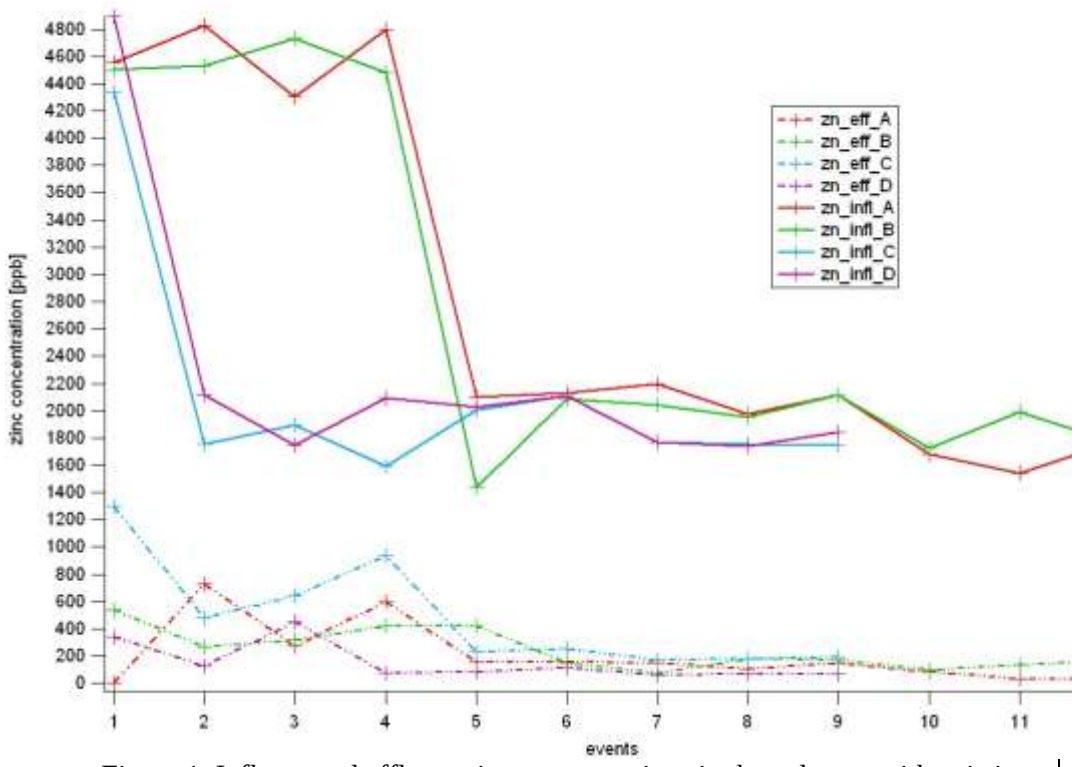

Figure 1: Influent and effluent zinc concentrations in the columns with existing media from site A and B for Methods #3 and #4. A = columns using media from site A, B = columns using media from site B, C = columns using media from site A + 2-inch layer, D = columns using media from site B + 2-inch layer

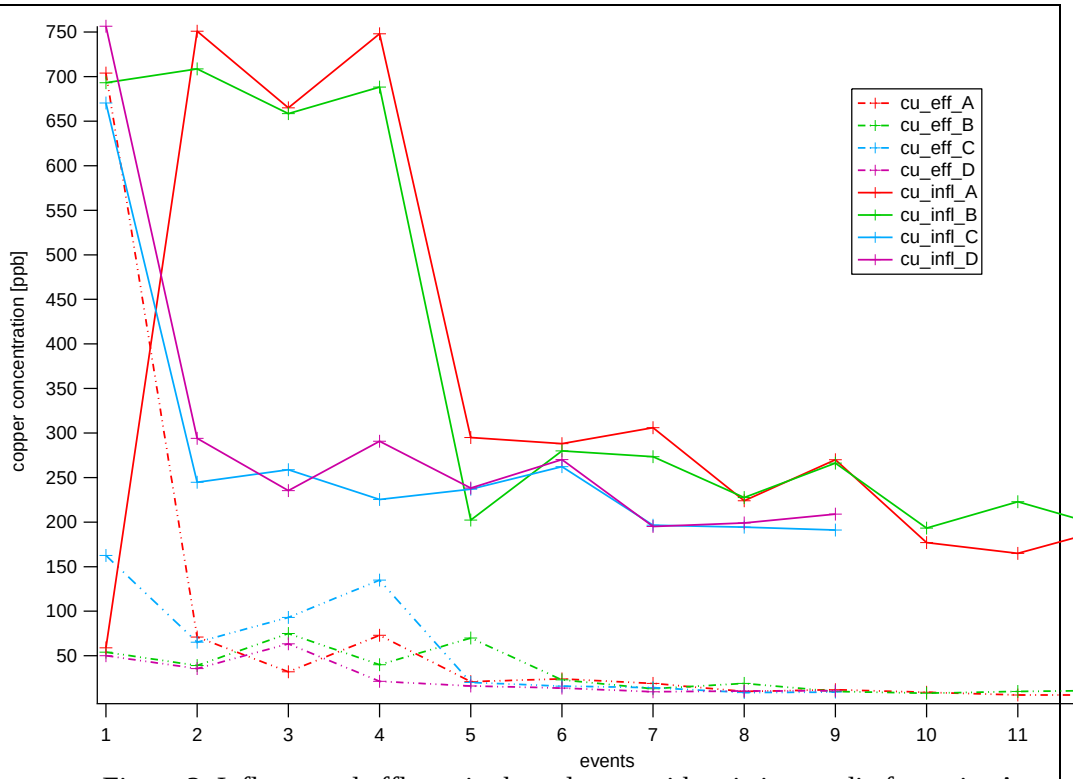

Figure 2: Influent and effluent in the columns with existing media from site A and B for Methods #3 and #4. A = columns using media from site A, B = columns using media from site B, C = columns using media from site A + 2-inch layer, D = columns using media from site B + 2-inch layer

On average, removal rates are high for the existing media (average 90% for both copper and zinc), and significantly higher than results from the WSDOT monitoring study, where the median removal rates were 80.8% for zinc and 40.8% for copper (WSDOT, 2006). Note that to date, our results are only from the accelerated events with very high concentrations compared to typical. Frequently removal percents are high for higher concentrations than for the lower concentrations where it may be difficult to remediate the low concentrations. These results indicate that after 12 accelerated loading events, the existing media from SR 167 (which has been in place for 12 years) and 244 St. (which has been in place for 5 years) are still removing substantial amounts of metals. In addition, there appears to be no significant difference between removal efficiency in the columns with and without the addition 2-inch layer of gypsum, dolomite, and pearlite. Since the existing media is still removing zinc and copper effectively, a difference may not be observed until after several additional tests.

Tasks to be Completed

We are continuing tests for methods 2, 3, and 4, and will start tests for methods 1 (comparing old and new media mix specifications) and 5 (testing top, middle, and bottom layers of the media from the two sites) in the spring. Testing will be complete by the end of the summer and a final report will be completed and submitted to WSDOT by October of 2013.

Describe Implementation of Research Outcomes (or why not implemented) Place Any Photos Here	We are still in the process of testing and evaluating results. Thus we have not implemented research outcomes.
Impacts/Benefits of Implementation (actual, not anticipated)	We are still in the process of testing and evaluating results. Thus we currently have no impacts/benefits of implementation.
Web Links • Reports • Project Website	Media Filter Drain: Modified Design Evaluation http://depts.washington.edu/pactrans/wp-content/uploads/2012/12/PacTrans-21-739428-Haselbach-Liv-Small-Project.pdf