

## Detailed Scope of Work

### Effectiveness of Bioretention in Reducing Stormwater Flows, Pollutants and Toxicity

#### A. Background

Bioretention facilities are increasingly being incorporated in stormwater management designs because of their demonstrated effectiveness in controlling flows and reducing contaminant loadings to receiving waters. However, recent studies in Western Washington have demonstrated that there are still significant uncertainties regarding the effectiveness of bioretention facilities. In this study, we propose to evaluate the effectiveness of two bioretention facilities and a wetland pond complex that have been included in a retrofit to treat stormwater runoff from a heavily-urbanized drainage in Federal Way, WA. The Federal Way stormwater retrofit, known as the South 356<sup>th</sup> Street Project, provides an excellent opportunity to assess the performance of regionally representative stormwater BMPs. The bioretention facilities were designed to treat runoff from a 23-acre commercial drainage basin, and were engineered so that flow meters and auto-samplers could be deployed at both the inlet and the outlet of each bioretention facility. This design allows us to measure changes in stormwater flow dynamics (e.g., peak flows), water quality and toxicity as the runoff flows through each independent bioretention facility. In addition to evaluating the effectiveness of the individual bioretention facilities, we will evaluate how a wetland pond complex (consisting of a regional storm detention facility built in 1997 and a new wetland pond built in 2013-2014) treats stormwater from a 189-acre basin. An evaluation of water quality in the creek, as well as the inflows and outflows of the bioretention facilities and the wetland pond complex, will provide a comprehensive assessment of the effectiveness of two types of stormwater BMPs to alter the flow, quality and toxicity of stormwater runoff from a heavily-urbanized drainage. The results of this effort will inform which combinations of BMPs in commercial basins will remove a variety of pollutants, and how collective installations may help protect receiving waters.

This scope of work describes the work to be completed for each task, with the total estimated cost and schedule. Note that the schedule is dependent on the date of signature of the project Interagency Agreement between King County and Ecology and is subject to change. Deliverables not requiring Ecology approval (e.g., agendas, data summary tables, photos) will be delivered only as part of a semi-annual billing package as needed to provide documentation of work performed. (i.e., “Documenting Progress” deliverables shown below). “Documenting Progress” deliverables will be delivered in the month following period end (e.g., if activities were completed by the end of December, the deliverable documenting the progress would be sent in January). Deliverables needing Ecology approval will be submitted as completed. All deliverable costs are included within the cost of each task.

Target budget percentages are estimates provided for Ecology planning purposes only and do not represent a maximum allowable limit. Amounts billed above these estimates will be not result in an increase in total project cost.

#### B. Scope of Work

##### **Task 1: Planning and the Development of the Quality Assurance Project Plan (QAPP) (\$24,812: November 2014 – February 2015)**

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This task will include activities related to the development, revision and submission of the QAPP. Planning meetings will cover project design details, including confirmation of sampling criteria, roles and

responsibilities of team members, and logistics for sampling. Sampling plans will be coordinated among laboratories (King County Environmental Laboratory [KCEL] and PCB congener contract lab) and with City of Federal Way. The QAPP will be prepared following Ecology guidelines and will include details of the study design, sampling and analysis methods and quality assurance and quality control procedures. KCEL staff and our partners at Federal Way will review the draft QAPP before it is sent to Ecology for review. Once the final QAPP is approved, equipment will be installed and data collection will begin.

### **Task 1 Deliverables:**

D1.1. Draft QAPP – Target: end of January 2015; target budget: 75% of task total

D1.2. Final QAPP – Target: March 2015; target budget: 25% of task total

*If the target completion date is not met, interim documentation of progress during the prior six months will include: draft summary tables of sample numbers by sampling location, equipment specifications, analytical methods, and other relevant details resulting from discussions with KCEL staff and Federal Way staff*

### **Task 2: Field Sampling, Data Collection and Analysis (\$754,525; March 2015 – December 2017)**

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This task focuses on activities relating to the installation of monitoring equipment and the collection of flow data and samples for water chemistry and toxicity tests.

#### **Install Equipment**

- 2a) Install and maintain flow meters at 7 points within the retrofit system. These include the bioretention facility inlets and outlets (4), the inlet and outlet of the wetland pond complex (2), and in the North Fork of West Hylebos Creek (1). Flow data will be used to quantify continuous discharges into and out of each bioretention facility; during sampling periods, the discharge volume will be used to estimate pollutant loadings.
- 2b) Install water level data loggers in stand pipes in both bioretention facilities and in the wetland pond complex. Water level data will be used to determine the frequency and duration of overflows.

#### **Collect Data and Samples**

- 2c) Collect flow data, field data, and flow-weighted water samples at all 7 points for 4 storms in 2014-2015, 8 storms in 2015-2016, and 8 storms in 2016-2017. In addition, a field replicate will be collected at the inlet and outlet of one of the bioretention facilities during half of the storm events each year to help estimate variability at a sampling location. Temperature, pH and dissolved oxygen (DO) will be measured in the field at the time of sample collection. These data will be used to evaluate the performance of the bioretention facilities over a variety of storm event conditions.

#### **Analysis and Testing**

- 2d) Chemical Analysis - Stormwater runoff from these basins is expected to be representative of stormwater runoff from other urban basins. Therefore, we have focused analyses on metals, nutrients, PAHs, PCB congeners, bacteria as well as other conventional measures that are elevated in urban runoff (e.g., TSS, conductivity). All chemical analyses will be conducted by the KCEL except for PCB congeners which will be analyzed by a contract laboratory.

2e) Toxicity testing - Samples will be collected from all 7 points in the system for 2-4 storms each winter. Tests will include acute and chronic tests, using *Daphnia pulex* and *Ceriodaphnia dubia*, respectively. These data will be a biological measure of water quality. If untreated runoff is toxic to these invertebrates, we will be especially interested in determining whether toxicity is reduced by the bioretention facilities. All toxicity testing will be conducted by KCEL.

## **Task 2 Deliverables:**

D2.1. Documenting progress – Target: July 2015; target budget: 30% of task total

*This deliverable will include: summaries of activities, including but not limited to documentation of equipment installation, summary tables of the number and type of samples collected, status reports of sample analysis by analytical group, status of toxicity tests, and raw data from KCEL and contract laboratory, if available, to document progress during the prior 6-month period.*

D2.2. Documenting progress – Target: January 2016; target budget: 15% of task total

*See description of deliverable above*

D2.3. Documenting progress – Target: July 2016; target budget: 15% of task total

*See description of deliverable above*

D2.4. Documenting progress – Target: January 2017; target budget: 15% of task total

*See description of deliverable above*

D2.5. Documenting progress – Target: July 2017; target budget: 15% of task total

*See description of deliverable above*

D2.6. Documenting progress – Target: January 2018; target budget: 10% of task total

*See description of deliverable above*

## **Task 3: Final Report**

**(\$93,331; July 2017 – December 2018)**

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This task will include the management and analysis of data as needed for the preparation of the final report. The final report will describe the study design, methods and findings of the study. Analyses and discussion will focus on water dynamics through the systems, including determining the frequency and duration of overflow in the bioretention facilities and wetland pond complex, and evaluating the magnitude and timing of peak flows across the sampling sites. Water quality data analyses will include comparison of inflow and outflow concentrations of pollutants and other water quality parameters for each bioretention facility and the wetland pond complex and calculating % and absolute change in parameters for each storm event. Analyses will include calculation of loading estimates for nutrients, metals, PAHs, and PCB congeners at each sampling point, and a comparison of the relative contributions of the two bioretention facilities and the wetland pond complex on the creek for these parameters. Relevant data that have been collected by Federal Way will be included, such as continuous temperature and turbidity at old storm detention facility inlet and outlet; flow monitoring at outlet; and macroinvertebrate sampling (B-IBI) at two locations on the North Fork West Hylebos adjacent to the South 359<sup>th</sup> St. crossing. Finally, the report will compare the performance of the bioretention facilities and the wetland pond complex across storms. A draft report will be reviewed by King County and City of Federal Way and a final draft will be reviewed by Ecology. The final report will be submitted for approval by Ecology.

### **Task 3 Deliverables:**

D3.1. Documenting progress – Target: January 2018; target budget: 50% of task total

*This deliverable will include: outline for the entire report, summary tables and figures of water flow, chemistry, and toxicity data, and results of data analysis.*

D3.2. Draft Report – Target: September 2018; target budget: 35% of task total

D3.3. Final Report – Target: December 2018; target budget: 15% of task total

*If the target completion date is not met, interim documentation of progress during the prior six months will include: data analysis and draft text sections that were not included in the January 2018 documentation, review comments and responses on draft report components, final data tables, final figures and completed final text sections.*

### **Task 4: Dissemination of Findings (\$15,603; March 2015 – December 2018)**

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This task includes activities related to the distribution and communication of the findings of the study. This includes creating and maintaining a project website that will provide easy access to data and reports produced for this project, and presenting findings at one or more Stormwater Work Group meetings, and at least one regional water quality or LID conferences.

#### **Task 4 Deliverables:**

D4.1. Posting of QAPP to web site – Target: March 2015; target budget: 10% of task total

D4.2. Copies of presentations - Target: December 2018; target budget: 60% of task total

D4.3. Submit data to EIM - Target: December 2018; target budget: 20% of task total

D4.4. Posting final report to website – Target: December 2018; target budget: 10% of task total

### **Task 5: Project Management (\$29,165; October 2014 – December 2018)**

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Project management will take place throughout the project and include coordination with Federal Way staff, with KCEL staff in the field and laboratory, budget management and staff management. Semi-annual project reports will be created and submitted to Ecology to communicate project status.

#### **Task 5 Deliverables**

D5.1. Semi-annual project report – January 2015; target budget: 12% of task total

- D5.2. Semi-annual project report – July 2015; target budget: 11% of task total
- D5.3. Semi-annual project report – January 2016; target budget: 11% of task total
- D5.4. Semi-annual project report – July 2016; target budget: 11% of task total
- D5.5. Semi-annual project report – January 2017; target budget: 11% of task total
- D5.6. Semi-annual project report – July 2017; target budget: 11% of task total
- D5.7. Semi-annual project report – January 2018; target budget: 11% of task total
- D5.8. Semi-annual project report – July 2018; target budget: 11% of task total
- D5.9. Semi-annual project report – January 2019; target budget: 11% of task total

**Task 6: Optional Sampling for Long Detention BMP Monitoring**  
**(Additional \$169,994, September 2015 – January 2018)**

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This task would be implemented if the flow monitoring in the first year suggests retention times of several hours or more in the bioretention facilities and/or the wetland pond complex. This task would include increasing the number of storms sampled in the 2015-2016 and 2016-2017 seasons to potentially 12-14 storms each season (instead of the 8 planned). To maximize our chances of capturing as many storms as possible, we would not necessarily attempt to pair the inflow and outflow samples for these additional events. TAPE protocol for Long Detention BMP Monitoring would be followed as closely as possible for sampling methods and data analysis. Chemistry analysis for these additional samples would be limited to nutrients, metals and conventionals. KCEL will conduct all chemical analysis.

**Task 6 Deliverables (if implemented):**

- D6.1. Documenting progress – Target: January 2016; target budget: 20% of task total  
*This deliverable will include: description of the flow data that supports the use of the TAPE protocol, summaries of quantity of samples collected at each location, status of sample analysis by analytical group, and raw data from KCEL, if available, to document progress during the prior 6-month period.*
- D6.2. Documenting progress – Target: July 2016; target budget: 20% of task total  
*See description of deliverable above.*
- D6.3. Documenting progress – Target: January 2017; target budget: 20% of task total  
*See description of deliverable above.*
- D6.4. Documenting progress – Target: July 2017; target budget: 20% of task total  
*See description of deliverable above.*
- D6.5. Documenting progress – Target: January 2018; target budget: 20% of task total  
*See description of deliverable above.*

**C. Schedule for tasks and deliverables**



**D. Budget by Task**

	<b>Task 1</b>	<b>Task 2</b>	<b>Task 3</b>	<b>Task 4</b>	<b>Task 5</b>	<b>Optional Task 6</b>	<b>Grand Total (without Task 6)</b>	<b>Grand total (with task 6)</b>
<b>Federal Way salary and benefits</b>	\$4,449	\$30,120	\$12,955		\$5,739		\$53,263	\$53,263
<b>Field equipment</b>		\$113,520					\$113,520	\$113,520
<b>KCEL analyses</b>		\$221,026				\$84,200	\$221,026	\$305,226
<b>KCEL field labor and KCEL administration</b>		\$187,674				\$85,794	\$187,674	\$273,468
<b>King County WLR salary and benefits</b>	\$16,291	\$89,718	\$64,301	\$12,483	\$18,741		\$201,533	\$201,533
<b>King County WLR staff indirect costs</b>	\$4,073	\$22,430	\$16,076	\$3,121	\$4,685		\$50,384	\$50,384
<b>Subcontracts</b>		\$90,038					\$90,038	\$90,038
<b>Grand Total</b>	<b>\$24,812</b>	<b>\$754,525</b>	<b>\$93,331</b>	<b>\$15,603</b>	<b>\$29,165</b>	<b>\$169,994</b>	<b>\$917,437</b>	<b>\$1,087,431</b>