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**2010 Monitoring Status Report  
For King County Flow  
Reduction BMP Monitoring  
Under S8.F.7 of the NPDES  
Phase 1 Municipal Permit  
WAR04-4501  
(Issued February 2007)**

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**King County**

Department of Natural Resources and Parks  
Water and Land Resources Division

**Science Section**

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# **2010 Monitoring Status Report For King County Flow Reduction BMP Monitoring Under S8.F.7 of the NPDES Phase 1 Municipal Permit WAR04-4501 (Issued February 2007)**

**Submitted by:**

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**King County**

Department of  
Natural Resources and Parks

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# APPROVALS

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## **Certification**

I certify under penalty of law, that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for willful violations.

## **Distribution List**

Rachael McCrae

Washington Department of Ecology



## 1.0. INTRODUCTION

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The Washington State Phase I Municipal Stormwater Permit (Phase I Permit) applies to all entities in Washington State required to have permit coverage under current (Phase I) U.S. Environmental Protection Agency (EPA) and Washington State Department of Ecology (Ecology) stormwater regulations, which includes cities and unincorporated portions of counties whose populations exceed 100,000. The Phase I Permit includes requirements to conduct stormwater-related monitoring in Special Condition 8 (S8). The required monitoring program detailed in S8 includes three components:

- S8.D Stormwater Monitoring
- S8.E Targeted Stormwater Management Program Effectiveness Monitoring
- S8.F Stormwater Treatment and Hydrologic Management Best Management Practice (BMP) Evaluation Monitoring

Reporting for all three monitoring components is required as part of Special Condition S8.H and S9. These sections require Permittees to complete an annual report for each component, to be submitted no later than March 31, detailing monitoring that occurred during the previous water year. A water year starts on October 1 and ends on September 30 of the following year.

This document serves as King County's (County) water year 2010 (WY2010) Flow Reduction BMP Monitoring Status Report, and documents the flow reduction BMP monitoring conducted under S8.F.7 of the Phase I Permit during WY2010. The BMP monitoring is intended to evaluate the effectiveness of one flow reduction strategy that is in use or planned for installation in the Permittee's jurisdiction.

The permit requirement for the flow reduction BMP is to conduct continuous rainfall and surface runoff monitoring for the BMP. The flow reduction BMP effectiveness should be monitored through either a paired site study or against a predicted outcome. To date, monitoring of the flow reduction BMP is not complete. Therefore, this document serves as a status report rather than a final flow reduction BMP report.

## 2.0. SUMMARY OF THE PURPOSE, DESIGN, AND METHODS OF THE MONITORING PROGRAM

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The following sections provide background information for the flow reduction BMP effectiveness monitoring effort. A general description of the monitoring approach and locations of the two monitoring sites is provided. In addition, a summary the data collection and analysis effort is included.

### 2.1 Overview

Stormwater monitoring, to fulfill requirements of the Phase I Permit (per Permit §S8.F.7), was performed by King County in accordance with the project quality assurance project plan (QAPP) issued in February 2007, updated November 2010 (King County, 2010) and approved by the Ecology on April 27, 2009. The permit requires each Permittee to monitor one flow reduction strategy BMP, either using a paired study or by comparing against a predicted outcome. King County is conducting a paired sampling study and is monitoring the flow reduction efficacy of soil amended with organic compost.

### 2.2 Description of Flow Reduction Strategy

The flow reduction BMP being evaluated is compost-amended soils. Specifically, the compost-amended soils of the Redmond Ridge urban planned development. The addition of organic compost to native soils is intended to not only absorb more stormwater than un-composted soil, but also enhance the growth of the planted landscape for a further reduction in runoff.

A paired site study is being used to assess the flow reduction efficacy of compost-amended soils. For this study, paired stormwater basins were selected, one basin in each of the Redmond Ridge and Trilogy urban planned developments near Novelty Hill Rd (Figures 1 and 2, respectively). Both developments (and stormwater basins) consist of single family homes on approximately 7,000 square-foot lots. However, the Redmond Ridge stormwater basin has compost-amended soils and in the adjacent Trilogy basin, compost-amended soils are not present.

Soil treatment for the Redmond Ridge development was conducted after construction was complete. The treatment involved the addition of approximately eight inches of organic compost to the remaining native soils. For the Trilogy development, soil amendment was not completed because the development's stormwater mitigation plan did not require soil amendment.



**Figure 1. Redmond Ridge Organic-Compost Soil Amended Basin**



**Figure 2. Trilogy Non-Amended Soils**

## 2.3 Sampling Design & Procedures

For the flow reduction BMP effectiveness study, paired monitoring sites in two different stormwater basins were selected; a basin with treated (compost-amended) soils and another basin with no soil amendments (that is, non-treated soils). The following sections summarize the data collection effort for each basin and the potential approaches for data analysis.

### 2.3.1 Data Collection

For the data collection effort, rainfall and flow monitoring sites were established in the two paired stormwater basins, the Redmond Ridge development (treated with compost-amended soils) and Trilogy (non-treated soils). Each basin is similar in size, housing density, and impervious area percentage and was built at approximately the same time using similar building techniques. Thus, the treated and non-treated basins are appropriate sites for this paired-study. Naming conventions for the monitored sites are:

- Redmond Ridge (treated with compost-amended soils) – ECW2-1
- Trilogy (non-treated soils) – SEDI

For each monitored stormwater basin, rainfall and runoff data are being collected. The flow monitoring equipment for each basin is installed upstream of the stormwater detention ponds (Figures 1 and 2). Rain gauges are located within each basin, to record local rainfall for each flow monitoring station.

Continuous flow monitoring data and rainfall data collection began in March 2009 for both sites and data collection is currently active. Once a complete data set has been collected for both basins, the effectiveness of the flow reduction BMP (compost-amended soils) will be evaluated by comparing the paired rainfall and runoff data sets.

### 2.3.2 Data Analysis

The data collection effort for the paired basins is scheduled to continue through 2011. Once data collection is complete, numerical models will be developed and calibrated using observed conditions for each of the drainage areas. The numerical models will be designed in such a way to facilitate the isolation of pervious land segments and the underlying soil characteristic effects on hydrology. In addition to the numerical models, metrics like the two listed below may be used in the analysis to evaluate site conditions' effect on the hydrologic regime.

#### **Metric 1: Test if volume from the treated basin is less than the untreated basin**

Mean monthly discharge will be calculated and normalized to discharge per acre foot of rainfall for each basin. Each monitored month will result in a pair of values (basin discharge per acre foot of rainfall). A non parametric sign test statistic on paired results will be computed (Helsel, D.R. and R. M. Hirsch, 2002. **Statistical Methods in Water Resources** Techniques of Water Resources Investigations, Book 4, chapter A3. U.S. Geological Survey.)

The hypothesis is that runoff volume from the basin with amended soils (x) will be less than that from the untreated basin (y): Probability  $[x > y] < 0.5$ . The result of the test will be

compared to a standard binomial probability distribution for the number of samples at a 0.1 significance.

**Metric 2: Test the effect of the amended soil on the runoff hydrograph**

To test the effect of the amended soil on the runoff hydrograph, the  $T_{Q_{mean}}$  would be calculated using the proportion of the annual 15 minute discharge values above the mean annual flow. The  $T_{Q_{mean}}$  is defined as the percentage of time (or days per year) in a given water-year that the daily-time-step hydrograph was above the year's average forested flow-rate (King County, 2005). A less flashy stream will have a larger proportion of the 15 minute values above the annual mean. The result will be considered significant if the treated basin  $T_{Q_{mean}}$  is more than 10 percent higher than the untreated basin for both monitoring years.

## 3.0. STATUS OF MONITORING PROGRAM & DATA COLLECTION

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Provided below is a description of the WY2010 activity for the flow reduction BMP effectiveness study. Activities included monitoring equipment installations, data collection, and site maintenance.

### 3.1 Program Status

#### 3.1.1 Data Collection

Monitoring at the flow reduction BMP study sites commenced March 11, 2009. At site ECW2-1 pond inlet (Redmond Ridge, treated site), a Solinst model 3001 F15 sealed pressure logger was installed in the inlet catch basin. Water level is being recorded at five minute intervals and converted to runoff flow rate and volume. A Solinst Barologger was installed to record barometric pressure at 5-minute intervals. In addition, an eight inch diameter 0.01” tipping bucket rain gauge was installed on February 26, 2009. The time of each tip is recorded as well as 15-minute totals by a Campbell Scientific CR200 data logger.

On March 11, 2009 a Solinst model 3001 F15 sealed pressure logger was installed in a catch basin leading to pond SED1 in the east (untreated) site at the Trilogy development. Water level is being recorded at five minute intervals and converted to runoff flow rate and volume. On March 5, 2009 an eight inch diameter 0.01” tipping bucket rain gauge was installed on an inlet structure in pond SED1. Rainfall is recorded with an Onset HOBO Pendant event recorder.

Site visits have been made on 12 week intervals to download data and verify monitoring instruments are functioning properly. A delay in the scheduled visit resulted in a loss of data for the period March 17, 2010 – April 15, 2010. In addition, the rain gauge at pond SED1 became plugged with plant debris on two occasions. The screen system was improved in October 2010 apparently solving the problem.

#### 3.1.2 Data Analysis

Data collection will continue through 2011. Once data collection is complete data analysis will begin.

### 3.2 Key Personnel, Program, and Station Changes

No changes have been made to the sampling program, land use, drainage area, or monitoring stations that could affect the hydrology of the monitoring sites and/or the performance of the monitored flow reduction BMP. In addition, no changes have been made to key project personnel.

## 4.0. PROJECTED WORK

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King County is continuing to collect continuous rainfall and surface runoff data from each flow reduction BMP monitoring site through 2011. Once data collection has been completed at each site, the effect of the amended soil on the hydrograph will be analyzed and a final flow reduction BMP report will be produced.

## 5.0. REFERENCES

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- Ecology, 2007. Washington State Department of Ecology. Phase 1 Municipal Stormwater Permit. Olympia WA. January 17, 2007
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