Eastern Washington
Stormwater Effectiveness Studies

Final Technical Evaluation Report

Non-Vegetated Filtration Swale Stormwater Effectiveness Study

Study Classification:

☑ Structural BMP ☐ Operational BMP ☐ Education & Outreach

Study Objective(s):

☑ Evaluate Effectiveness ☐ Compare Effectiveness
☑ Develop Modified BMP ☐ Develop New BMP

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Publication Information

The QAPP and TER will be available to the public on the City of West Richland website (https://www.westrichland.org/189/Stormwater).

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Document History

The study was conducted following Ecology's approval of the QAPP, which can be accessed at this site: https://www.westrichland.org/189/Stormwater. The data collection started in August 2022, and the last data was collected in January 2023. The draft Technical Evaluation Report (TER) was presented and submitted to the TAC in March 2023 for review and comment. **Appendix A** of the TER contains a summary of the TAC's comments along with a summary of the consultants' responses to the comments, including how they were addressed in the document. The final TER was completed in April 2023.

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[2] TAC Member was not involved in the review of the TER.

Table of Contents

Executive Summary

A non-vegetated filtration swale is a sloped, rock-lined swale that is similar to the biofiltration swale (BMP T5.40) defined in the Eastern Washington Ecology Stormwater Manual (SWMMEW, 2019), except that treatment in the proposed BMP occurs as runoff flows through a layer of rock instead of grass. Constructing a non-vegetated filtration swale is highly desirable for locations with hot and dry summers such as Eastern Washington, which has a semi-arid climate and requires irrigation to maintain the vegetation between storm events. Vegetation requires irrigation, and the cost to construct and operate irrigation systems adds to the overall life-cycle expense of the BMP. In theory, the non-vegetated filtration swale could reduce maintenance costs in comparison to the biofiltration swale and limit water usage while meeting basic treatment performance goals. The goal of this study was to evaluate the effectiveness of a non-vegetated filtration swale BMP. Effectiveness was based on whether the BMP was able to provide basic treatment (80% reduction of total suspended solids [TSS]) in accordance with Ecology treatment performance goals as defined in the Technology Assessment Protocol – Ecology (TAPE) Guidance Document (Ecology, 2018).

The objectives of the study were achieved by conducting controlled field experiments that simulated five years of storm events (and TSS loading) using synthetic stormwater, from which water quality samples were collected. The test site was located at the West Richland Municipal Services Building. Controlled field experiments were conducted starting in August 2022 and ending in October 2022 to limit the chance of precipitation occurring at the site during field testing. Four non-vegetated filtration swale alternatives were installed with impermeable liners to limit the influence of soils at the site. Six simulated water quality design storm events were conducted for each swale alternative.

During the simulated storm events, water quality samples were collected to measure TSS pollutant removal efficiency at eight locations spaced at 25-foot intervals along the swale. The hydraulic residence time was measured (travel time through the swale) and velocity was calculated. For each simulated event, water quality samples were collected from synthetic stormwater with an average concentration of 136 mg/L of TSS, then an approximate annual loading of TSS was delivered to the swale to simulate one year between each storm event. The water quality sample results were used to determine whether the basic treatment performance goals were met for each alternative and assess what length of swale was needed to meet that goal, as well as estimate the maintenance frequency of the non-vegetated filtration swale based on performance changes. The results of the controlled field experiments were used to identify the best-performing alternative, which was installed without a liner to further evaluate the treatment performance and refine the design and maintenance guidance for that alternative. The selected alternative was then tested using simulated storm events equivalent to three years of TSS loading (based on performance of alternatives) following the same procedures as the other four alternatives.

Objectives and Results

The following paragraphs summarize the results of the study, organized by objective. The results discussed are for the final swale design alternative.

Objective #1: Define the draft BMP design and maintenance guidance and refine the BMP design and maintenance guidance using data collected during the study.

The draft BMP design guidance was developed for the study QAPP. Data collected in the field from this study was used to refine the draft BMP design and maintenance guidance. The updated guidance is included in **Appendix B**.

Objective #2: Determine the TSS pollutant removal efficiency of the BMP by measuring and comparing pollutant concentrations in the synthetic influent to eight sample locations in each test swale.

Water quality (TSS) grab samples were collected at the influent and eight sample locations along the swale. Because the samples were collected shortly after flow arrived at the sample locations, the concentrations were expected to be higher than an event mean concentration which is typically used to evaluate the treatment performance of BMPs. The initial percent removals were calculated from the concentrations and indicated that 84.5-87.8% removal of TSS is achieved for the first simulated year. However, percent removal decreased for Event 3 and 5 (27.8% and 49.9%, respectively), and slightly decreased for Events 4 and 6 (70.5% and 72.8%, respectively). The decrease in percent removal was due to the installation of a weir during testing. The weir was installed prior to Event 3 and reinstalled prior to Event 5 to limit erosion at the downstream end of the swale that was occurring due to a grade break that was part of the experimental design. The concentrations at the sample location at the downstream end of the swale increased after each weir installation, indicating that installation of the weir likely introduced sediment into the treatment rock layer, despite washing the rock following each weir installation. To understand how the swale would have behaved if the weirs were not installed, trendlines were developed for each simulated year during testing and concentrations measured at the end of the swale were excluded from the analysis. The trendlines were expected to best describe how the swale would perform in a field installation as TSS accumulates in the swale cross-section. The concentrations and percent removal calculated from the trendlines indicated that the percent removal for the swale meets treatment performance goals for the first two years and would require maintenance to restore treatment performance sometime between the second and third year.

Objective #3: Determine the hydraulic residence time and design velocity for which the BMP provides treatment by measuring flow depth at the upstream and downstream end of each swale as well as the travel time through the swale and then calculating velocity.

The hydraulic residence time measured in the field was 50 minutes, from which a design velocity of 0.07 ft/sec was calculated.

Objective #4: Determine whether the treatment performance goals were achieved by comparing study results to TAPE treatment criteria and requirements.

The percent removal results were compared to the TAPE treatment performance goals for TSS using the bootstrap statistical analysis and the trendline data to predict the treatment performance without the issues from the weir observed in the field. The results indicated the swale would meet the TAPE treatment performance goal for all three simulated years.

Recommendations

Based upon the results, recommendations were developed to better understand the performance and maintenance requirements of the non-vegetated filtration swale. The first of which is that the swale be approved for a Conditional Level Use Designation, so the performance of the swale can be further evaluated in the field for actual storm events. Additionally, more field testing will help to better understand the maintenance cycle and action items for the swale. Effective maintenance actions to restore the swale treatment performance every two to three years would need to be evaluated. The maintenance actions to be evaluated would also include more minor, frequent action items such as removal of sediment and debris from inlets, weed control, etc. and the frequency at which those should be performed. Lastly, additional testing of the BMP in the field would provide an opportunity to understand the impact that a catch basin or forebay would have on treatment performance and maintenance cycle of the swale.

1. Introduction

1.1 Introduction to the Structural BMP

The focus of this study was to evaluate the effectiveness of a non-vegetated filtration swale. A non-vegetated filtration swale is a sloped, rock-lined swale as shown in **Figure 1-1**. The proposed Best Management Practice (BMP) is similar to the biofiltration swale (BMP T5.40) defined in the 2019 Eastern Washington Ecology Stormwater Management Manual (SWMMEW), except treatment in the proposed BMP occurred as runoff flowed through a layer of rock instead of grass. The proposed BMP was designed so that runoff from the water quality event would flow through the rock rather than over it, to maximize the filtration provided by the rock. During a precipitation event, stormwater would enter the non-vegetated biofiltration swale, either through the head of the swale or along the length of the swale. Stormwater flows through the layer of rock (treatment rock layer) and discharges into another stormwater BMP (if other types of treatment or flow control are needed), drywell, or catch basin connected to the storm drain network.

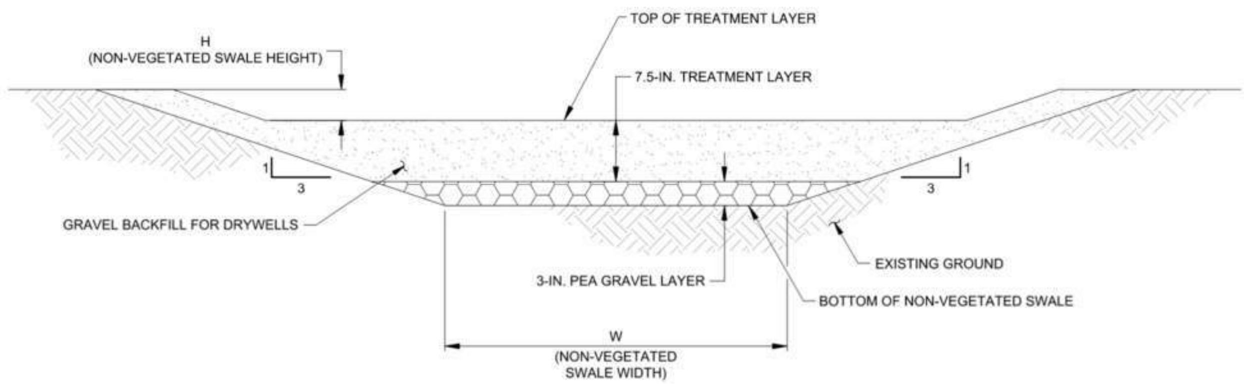


Figure 1-1 Non-vegetated filtration swale cross-section

The recommended design process for the non-vegetated filtration swale is defined in **Appendix B**. It was developed using the design guidance for a biofiltration swale in the SWMMEW and modified based on the results of this study and to consider guidance from both Eastern and Western Washington, as described in **Section 5** and **Appendix B**. The non-vegetated filtration swale is a runoff treatment BMP and is sized for the water quality design flow rate according to Section 2.7.6 of the SWMMEW. The width of the proposed BMP is sized using one of the approved water quality design storms in Section 2.7.6, which includes the Rational Method 2-year storm, short duration (3-hour) 6-month storm, and the SCS Type II 6-month 24-hour storm event. The SWMMWW requires that the BMP be sized to treat the water quality design flow rate, which is determined through continuous simulation models. In both manuals, the width (and treatment rock layer depth) is sized to contain the water quality design flow within the treatment rock layer (water flowed through the pore spaces). Any storm events larger than the water quality design storm will flow above the treatment rock layer. As such, the non-vegetated filtration swales are sized to provide freeboard for conveyance to the outlet during design events up to the 25-year event.

Differences between the proposed non-vegetated filtration swale and the existing biofiltration swale design are summarized in **Table 1-1.** The parameters listed in the column titled Proposed Non-Vegetated Filtration Swale were determined from field testing of the non-vegetated filtration swale (see **Section 4** and **Section 5**). The primary difference between the existing biofiltration swale design in the manuals and the proposed non-vegetated filtration swale design was that the proposed BMP had a treatment rock layer and did not require the planting, seeding of vegetation, or irrigation and mowing.

Table 1-1. Comparison of SWMMEW biofiltration swale and non-vegetated filtration swale

Swale Parameters	Existing Biofiltration Swale (SWMMEW, 2019)	Proposed Non-Vegetated Filtration Swale
BMP Cover	**Grass**	**Rock**
Longitudinal Slope	>1% and <5%	≥1% and <5%
Shape of Swale	Trapezoidal	Trapezoidal
Manning's n (Water Quality Event)	0.3	0.77/0.58[1,5]
Flow Depth (y)	≤ 4 inches	3 inches[2]
Bottom Width (B)	≤ 2–10 feet[3]	2–10 feet
Side Slopes	3:1 or flatter	3:1 or flatter
Length (L)	100 ft[4]	200 ft[1]
Hydraulic Residence Time	9 minutes	50 minutes[1]
Maximum Velocity During Water Quality Event	<1 ft/sec	≤0.066 ft/sec[1]

1. These parameters were determined during field testing as discussed in **Section 4** and **Section 5**.
2. The effective depth is the flow depth if it were unobstructed by the treatment rock layer.
3. The SWMMEW specifies ≤ 10 feet; however, it should be 2–10 feet. Per Ecology, this change will be made in the next manual update.
4. The SWMMEW specifies a minimum 200-foot length for swales; however, it should be a minimum of 100 feet. Per Ecology, this change will be made in the next manual update.
5. Manning's n is 0.77 for flow through the treatment rock layer. Manning's n is 0.58 for flow above the pea gravel layer, which is used to determine the swale width.

This study evaluated the effectiveness of four different configurations of non-vegetated filtration swale designs by assessing whether they met the basic treatment performance goal (80% removal of TSS). The four proposed BMP designs are described in detail in Section 3.3 of the study QAPP. The primary treatment mechanisms for a non-vegetated filtration swale include filtration and gravity separation, which occurs when runoff flows through the treatment rock layer. Gravity separation relies on variations in material density for pollutant removal: pollutants denser than water (e.g., TSS and gross solids) descend and settle within the treatment rock layer. Filtration occurs as TSS is physically trapped in pore spaces (Hunt & Lord, 2006; Minton, 2012), which is anticipated to occur as stormwater flows through the treatment rock layer.

1.2 Problem Description

Constructing a non-vegetated filtration swale is highly desirable for locations with hot and dry summers such as Eastern Washington, which has a semi-arid climate and requires irrigation to maintain the vegetation between storm events. Additionally, grasses planted in filtration swales in Western Washington may become dormant during the summer when monthly precipitation is lower. A non-vegetated BMP will benefit multiple Washington State Permittees by providing a BMP option that does not require a supplemental water source. Vegetation requires irrigation, and the cost to construct and operate irrigation systems adds to the overall life-cycle expense of the BMP and consumes water that could have a higher beneficial use. Maintenance recommendations for the non-vegetated BMP along with an estimated life-cycle cost comparison between a vegetated and non-vegetated swale are discussed in detail in **Appendix B** and **Appendix G**.

This study was conducted to support the implementation of NPDES permit-required municipal stormwater programs, specifically the NPDES Municipal Separate Storm Sewer System (MS4) Phase II Permit described in **Section 1.4**. Additionally, the study was intended to inform a modification to the Ecology-approved biofiltration swale design guidance to include as an option for non-vegetated filtration swales. This would support Permittees by providing water quality treatment for runoff on-site and conveying the 25-year storm event as required in the SWMMEW (based on BMP T5.40). This applies to: EWA Phase II Section S5.5 Post Construction Stormwater Water Management for the New Development and Redevelopment; WWA Phase II Section S5.C.6 Controlling Runoff from New Development, Redevelopment, and Construction Sites; and the WWA Phase I Section S5.C.5 Controlling Runoff from New Development, Redevelopment, and Construction Sites. The study evaluated the BMP against Ecology's basic treatment goal of 80% TSS removal, to demonstrate whether the BMP was functionally equivalent to a grass-lined biofiltration swale and establish the length of swale required to provide that treatment. The findings of the study are discussed in **Section 4**.

1.3 Project Goals and Objectives

The goal of this study was to evaluate the effectiveness of a non-vegetated filtration swale BMP. Effectiveness was based upon whether the BMP could provide basic treatment (80% reduction of TSS) in accordance with Ecology treatment performance goals (Ecology, 2018). If this treatment performance goal was achieved, the study results would be used to justify that a non-vegetated filtration swale is functionally equivalent to a biofiltration swale and to request a modified BMP. The goals for this study were achieved by meeting the following objectives:

- Define the draft BMP design and maintenance guidance for the study (included in the QAPP). Finalize the BMP design and maintenance guidance based on the results of field testing (final design and maintenance guidance is included in **Appendix B**).
- Determine the TSS pollutant removal efficiency of the BMP by measuring and comparing pollutant concentrations in the synthetic influent to eight sample locations in each test swale.
- Determine the hydraulic residence time and design velocity for which the BMP provides treatment by using the average flow depth (measured at the upstream and downstream end of each swale) as well as the travel time through the swale and then calculating velocity and flow rate.
- Determine whether the treatment performance goals were achieved by comparing study results to TAPE treatment criteria and requirements.
- Provide recommendations for future action based on the study results.

1.4 Project Overview

Four swale design alternatives were developed (and described in detail in the study QAPP) for field testing in order to determine the best alternative for meeting basic treatment goals. Field testing of the four swale design alternatives started with retrofitting an existing swale at the test site. Two swale design alternatives, each 200 feet long, were installed within the footprint of the existing 430-foot-long swale at a time for testing. Each alternative was installed with an impermeable liner and sloped toward a catch basin installed at the end of each swale (middle of the existing swale). Once testing was complete for the first two swale design alternatives, the swale design alternatives were removed, and the remaining two swale design alternatives were installed for testing. Once the four swale design alternatives were tested, the swale design alternative with the best treatment performance was installed within the footprint of the existing swale. The swale configuration was modified from what had previously been tested to include a layer of washed pea gravel below the treatment rock layer instead of an impermeable liner. The pea gravel was used in place of the liner to allow for infiltration into the existing ground while also limiting intrusion of underlying soil into the treatment rock layer. The data collected from the final swale installation was then used to evaluate the treatment performance and refine the design and maintenance guidance. The site was returned to its original condition (one 430-foot-long swale) following the completion of testing.

An overview of the steps for testing of the swale design alternatives is described below. A detailed description of the process can be found in the study QAPP.

- An initial 25-year flow rate was sent through the swale to confirm that the rock did not move during this event, as described in the study QAPP. The 25-year flow was comprised of potable water and did not include Sil-Co-Sil®. In addition, a leaf blower was also used to assess rock movement because this is a common maintenance practice and rock being displaced or leaving the swale creates extra work for the maintenance crew.
- Following the simulated 25-year storm event, each of the first four swale design alternatives received six batches of synthetic stormwater (simulated storm event—see Section 7.5 of the study QAPP), which represented a water quality storm event, and samples were collected. Following each simulated storm event, except the sixth event, a batch of water mixed with 14 pounds of TSS (five total batches) was run through the swales to represent approximately one year of TSS loading. The target TSS concentration and loading are described in the study QAPP.
- The final swale alternative received six batches of synthetic stormwater to represent water quality storm events. After every two water quality events the equivalent of one year of TSS loading was run through the swale, for a total of three simulated years of loading. This allowed additional data to be gathered before the final swale design alternative was expected to need maintenance (based on results from field testing alternatives 1–4).
- Grab samples were collected during the simulated water quality storm event at the influent and at eight evenly spaced locations (every 25 feet) in each 200-foot-long swale design alternative (nine samples per event, per swale). Because the grab samples were collected shortly after flow arrived at the sample locations, the samples represent first flush conditions within the swale. As such, the concentrations collected at the sample locations in the swale are expected to be higher than typical event mean concentrations.
- The time for flow to travel between the start of the swale and each sample location was measured to estimate the velocity of the flow through the treatment layer. This was used to inform the design guidance.

- Flow from each event was collected in a catch basin at the downstream end of each swale by a submersible pump and dispersed to the adjacent hillside, away from the test swale.
- Samples collected during the simulated water quality event were analyzed for TSS by an analytical laboratory, and the data from the samples was used to evaluate whether the swale design alternatives meet Ecology's basic treatment performance goals as defined in TAPE. Results of the water quality samples are discussed in **Section 4**.

1.5 Study Location

The study took place in the City of West Richland, a city in southeast Washington that has a semi-arid climate. The test site was located on the City of West Richland Public Works property, south of the Municipal Services Building and adjacent to a gravel parking lot. The parking lot serves as overflow parking for the building and has a low trip end count. An existing swale that is designed to collect runoff from the parking lot was retrofitted to contain the swale design alternatives. The existing swale is a 430-foot-long non-vegetated swale with a 6.5-foot bottom width, 12–18-inch depth, and 3:1 side slopes. The surrounding soils and soil in the swale were anticipated to have high infiltration rates, based on observations provided by the City of West Richland (no water was observed in the swale during or after precipitation events). **Figure 1-2** provides an aerial view of the test site location.

Figure 1-2. City of West Richland test site

2. Sampling Procedures

This section provides an overview of the data collected and sampling procedures followed during the study. A detailed description of the sampling procedures can be found in Sections 7.0 and 8.0 of the study QAPP.

2.1 Types of Data Collected

Data collection began in August 2022 and ended in January 2023. **Table 2-1** provides a summary of the types of data collected, including the equipment used, collection frequency, and total number of samples. **Appendix E** of this report contains the raw data collected from each simulated storm event during the study.

Table 2-1. Summary of the types of data collected

Data Type	How Data Was Collected	Frequency	Total # of Samples	# of Samples Per Swale	# of Samples Per Event
Influent Flow Rate	In-line flow meter; between pump and inlet to swale	Recorded 3 times during each event (6 events per swale design alternative)	90	18	3
Water Quality (TSS) Grab Samples	Grab sample; 3 at influent and 1 at each of eight effluent locations in the swale spaced 25 feet apart	Once per simulated storm event	330	66	11
Residence Time/Velocity	Stopwatch; recorded time for water to reach each effluent sample location	Recorded each simulated storm event	240	48	8
Infiltration Rate	Single ring infiltrometer; recorded time for water to fall one inch; concluded test after less than 5% difference between 3 measurements	One time	1	N/A	N/A
Final Swale Gradations[1]	Composite sample of gravel backfill for drywells and pea gravel from rock washed at West Richland facility	One time	1	N/A	N/A
Porosity	Composite sample of gravel backfill for drywells	One time	1	N/A	N/A

[1] Gradations were measured for the gravel backfill for drywells and pea gravel used in the final swale alternative, as requested by Ecology.

2.2 Sample Collection Process

Data for the study was collected following the standard operating procedures (SOPs) defined in the study QAPP. The procedures are summarized in this section along with information about the audit and monitoring equipment. More detailed information regarding each SOP can be found in Section 8.0 of the study QAPP.

2.2.1 SOP Overview

The following are a summary of the SOPs used during data collection:

- **Site Preparation for Simulated Storm Event:** The purpose of this SOP was to define the procedures for preparing the site for a simulated storm event. This SOP was conducted before each simulated storm event.
- **Simulate Water Quality Storm Event:** The purpose of this SOP was to define the procedures for simulating a water quality storm event at the site. This SOP was performed during each simulated storm event.
- **Grab Sample Collection and Processing:** The purpose of this SOP was to define the procedures for collecting and processing TSS samples for delivery to the analytical laboratory. This SOP was performed when water quality samples were collected.

2.2.2 Influent (Synthetic Stormwater) Distribution System and Sample Equipment Overview

An influent distribution system was used to mix and distribute synthetic stormwater to the swale at the water quality design flow rate. The influent distribution system is shown in **Figure 2-1**, **Figure 2-2**, and **Figure 2-3**. Prior to each simulated storm event, 1,000 gallons was added to the 1,500-gallon tank using a water truck (**Figure 2-1**). A high-flow pump was used inside the tank to mix the water as premeasured Sil-Co-Sil® was added to the tank to keep the synthetic TSS in suspension. A second pump in the tank directed flow through a pipe network to a 50-gallon barrel located at the start of the test swale. Slots were cut into the 50-gallon barrel to help dissipate energy leaving the pipe network and entering the swale (**Figure 2-3**). An in-line flow meter was located upstream of the barrel and was used to measure flow rate and verify that flow delivered to the swale met the water quality design flow rate.

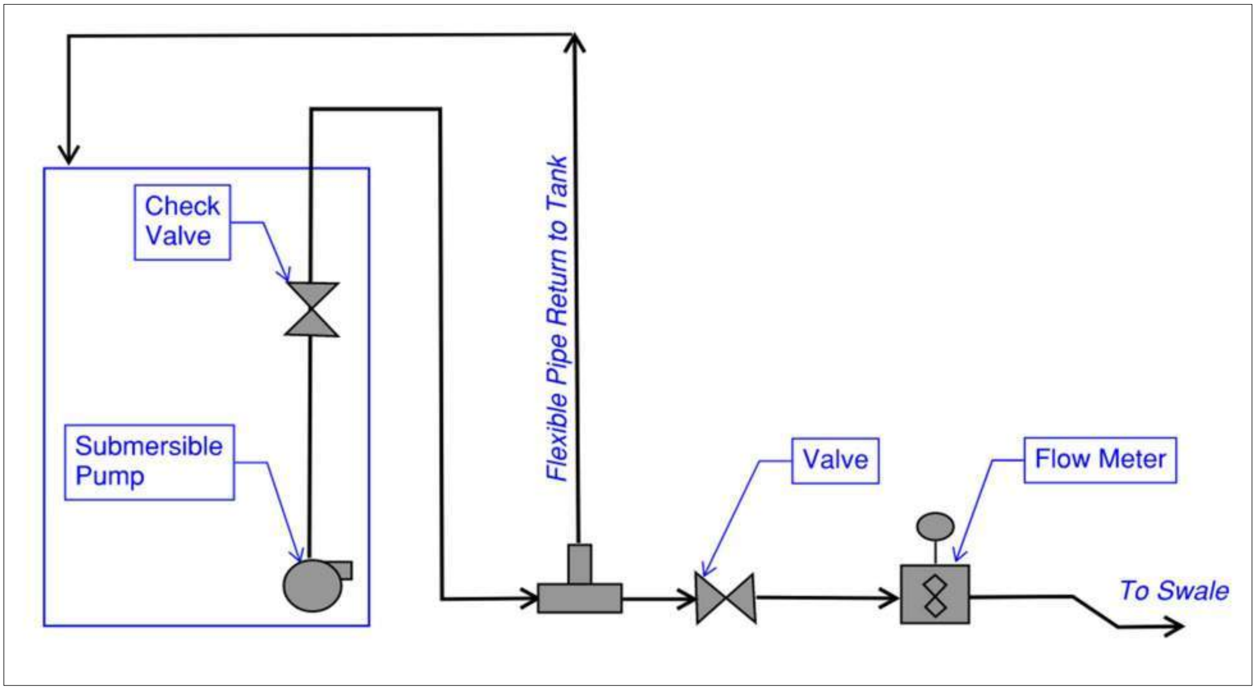


Figure 2-1. Simple diagram of influent distribution system

Figure 2-2. Influent distribution system during testing of final swale alternative
(Photo credit: Evergreen StormH2O)

Figure 2-3. In-line flow meter and barrel used for energy dissipation
(Photo credit: Brian Morgenroth, City of Walla Walla)

As flow traveled through the swale, samples were collected in sample ports located every 25 feet in the swale. The ports consisted of capped PVC pipe buried in the ground below the swale so the open end of the pipe was flush with the top of the liner. The PVC pipe was duct-taped to the liner in order to limit flow below the liner. Wire mesh was staked into place around the port to keep the treatment rock layer from entering the sample port. Once water reached each sample port, grab samplers were held so the opening of the sampler was approximately 1 inch above the top of the sample port. The grab samplers were held in place until they filled with synthetic stormwater. **Figure 2-4** shows a close-up of one of the sample ports without a grab sampler and with a grab sampler held in place by wire.

Figure 2-4. Empty sample port (left) and sample port containing grab sampler (right)
(Left photo credit: Evergreen StormH2O — Right photo credit: Brian Morgenroth, City of Walla Walla)

2.2.3 Audit Overview

An audit was conducted by a participating entity as part of the data quality assessment to verify whether staff followed the SOPs during the study. Results of the audit indicated that the SOPs were followed for the duration of the study or modified, and that no quality assurance issues related to the SOPs were identified. Any deviations in the SOPs from those in the study QAPP are summarized in the audit findings (**Appendix C.4**) and detailed in the summary of deviations from the QAPP (**Appendix C.5**). Deviations primarily included SOPs that were not used because an alternative method was more appropriate.

3. Data Quality Assessment

A data quality assessment was performed to determine whether data collected during the study met Data Quality Indicators (DQIs) and Measurement Performance Criteria (MPCs) that were defined in the study QAPP. DQIs are qualitative and quantitative measures that characterize the aspects of quality data. MPCs are the acceptance criteria for DQIs, which specify the standard for data to meet the data quality objectives for the project. The assessment of whether MPCs were met for each DQI is summarized in **Appendix C.1**. As part of the data quality assessment, a data verification and data usability assessment were performed. The data verification is summarized in the following section and supporting materials are included in **Appendix C.2** and **Appendix C.4**. The data usability assessment is summarized in **Section 3.2** and supporting materials are included in **Appendix C.1**–**Appendix C.5**.

3.1 Data Verification

Data verification involves a review of data collected in the field and data provided by the analytical laboratory. Both sets of data were reviewed to verify that the raw data and data entries were consistent, correct, and complete, with no errors or omissions. The review for consistency, correctness, and completeness is summarized in **Appendix C.4**.

The review of field data indicated that flow and time measurements were within acceptable ranges as defined in Section 6.0 of the QAPP. The data verification process found 10 instances where residence time measurements were missing. None of the flow monitoring measurements were missing. These data points are summarized in **Table 3-1**.

Table 3-1. Summary of missing field data

Swale Alternative	Storm	Missing Data Type	Number of Missing Data
1	1	Time / Velocity	Location 1–7
2	1	Time / Velocity	Location 1
2	6	Time / Velocity	Location 1
Final	2	Time / Velocity	Location 8

The review of analytical laboratory data is documented in the Quality Assurance (QA) Worksheets in **Appendix C.2**. The worksheets were completed for each batch of samples sent to the analytical laboratory and contain results of laboratory QC tests (reference QAPP Section 6.0 for detailed description) to determine whether water quality data are acceptable. The information summarized in the QA worksheets includes:

- Parameter
- Method
- Chain of Custody Issues
- Completeness/Methodology
- Holding Times
- Temperature of Samples Received at Lab

- Laboratory Method Blank Results
- Laboratory Standard Analysis Results
- Laboratory Duplicates Results
- Laboratory Notes on Instrument Calibration/Performance
- Action (if needed)

The data verification process found that no method blank results or laboratory standard analyses exceeded control limits, seven QC batches contained laboratory duplicates, which exceeded control limits, and no samples or sample results were missing. A summary of QC batches that did not meet QA/QC tests is included in **Table 3-2**. Based on discussion with the laboratory, the samples associated with these QC batches were determined to be valid. Usability of these samples is discussed in detail in **Section 3.2**.

Table 3-2. Summary of laboratory data outside of control limits

QC Batch	Swale Alternative[1]	Storm	Location of Sample[2]	Parameter Outside of Control Limits
LB014	3	1	Influent 1–3, Locations 1–8	Lab Duplicates
LB014	1	1	Influent 1–3, Locations 1–4	Lab Duplicates
LB022	3	6	Location 8, end	Lab Duplicates
LB023	4	1	Locations 6–8, end	Lab Duplicates
LB024	2	1	Influent 1–3, Locations 1–8, end	Lab Duplicates
LB034	Final	1	Influent 1–3, Locations 1–8	Lab Duplicates
LB034	Final	2	Influent 1–3, Locations 1–6	Lab Duplicates
LB035	Final	2	Background Locations 1–2, Location 8	Lab Duplicates
LB038	Final	4	Influent 1–3, Locations 1–8	Lab Duplicates

[1] See study QAPP or **Appendix D** for descriptions of Swale Alternatives.
[2] See **Figure 4-1** and **Figure 4-2** for plan and profile view of sample locations at the test site.

3.2 Data Usability Assessment

The data usability assessment consists of a review of QA/QC materials for the study to determine whether each MPC for the study is met. The materials are reviewed in terms of precision, bias, representativeness, completeness, and comparability. The usability assessment also includes a discussion of limitations on use of measurement data, whether the quality assurance objectives were met, and the resulting impact on decision-making. The materials reviewed include:

- Results of field and lab data verification (**Section 3.1**)
- Data Quality Assessment results in terms of precision, bias, representativeness, completeness, comparability, and sensitivity (**Appendix C.2**)
- Copies of field forms used to document SOPs being followed (**Appendix C.3**)
- Results of technical system audits (**Appendix C.4**)

- Changes and deviations from QAPP (**Appendix C.5**)

Following review of the materials, all data was determined to be usable. The limitations of the data that were identified included missing time measurement data and laboratory duplicates outside of control limits. Missing time measurement data consisted of less than 5% (missing data was calculated to be 4.2%) of the entire time measurement dataset, and as a result was not expected to impact the analysis of the data. From discussion with the analytical laboratory, laboratory duplicates that exceeded control limits do not indicate that the associated sample results are invalid. Instead, duplicates that exceeded control limits would serve as error bars indicating the range of uncertainty. Water quality results are therefore reported in **Section 4.2** in terms of actual sample results (**Table 4-1**), as well as lower and upper error limits (**Table 4-2**).

Review of the field forms, technical system audits, and changes and deviations from the QAPP indicated that MPCs were met for all DQIs. A detailed assessment for each DQI is included in **Appendix C.1**. The review of field forms and technical system audits suggested the SOPs were followed for the duration of the study; where modifications were made, they were noted in the audit form (**Appendix C.4**) and summary of deviations from the QAPP (**Appendix C.5**). Reasons for modifications included: revising procedures to provide a benefit to data quality or data collection (i.e., cleaning all components of grab samplers after each simulated storm event, adjusting field measurement of velocity to rely on time measurements instead of piezometer readings); revision of steps following guidance provided by the analytical laboratories (i.e., procedures for transport and delivery of samples); and revision of steps following use of equipment in the field and experiencing field conditions (i.e., pre-chilling sample bottles was not effective while waiting for water to flow through the swale in full sun and 90–100ºF heat). No significant quality assurance problems were identified.

4. Data Summaries and Analysis

This section provides a detailed discussion of the findings for the final swale alternative. The final swale alternative was developed from testing and evaluating the data from the four swale design alternatives, which are discussed in detail in **Appendix D**. The data analysis performed for the four swale alternatives and final swale alternative is contained in **Appendix E** – Data Analysis. Details about the study design are described in the study QAPP.

4.1 Introduction to Water Quality Results

This section provides an overview of the water quality results that are described in **Section 4.3** to **Section 4.5** for the final swale alternative. Tables have been included that contain the TSS concentrations at the influent and eight effluent locations, which are called out in relation to the test swale as shown in **Figure 4-1 and Figure 4-2**, as well as the percent removal over the length of the test swale (influent to sample location 8). Percent removal was calculated using Equation 1, described in the following paragraph. The effluent concentrations in the tables are colored in some of the tables on a relative scale according to the range of values in the table: red is assigned to the highest concentrations, green indicates the lowest concentrations, and concentrations falling between those values are assigned shades between red and green. As mentioned in **Section 1.4**, the effluent concentrations in the tables are grab sample results that represent the first flush concentrations within the swale. As such, they are expected to be higher than an event mean concentration, which is typically used to evaluate the treatment performance of BMPs.

Percent TSS removal was calculated for the four alternatives and final alternative (**Section 6** and **Appendix D**) using Equation 1. The equation uses the influent concentration and the concentration from each sample location to calculate the percent removal. The overall percent removal for each event was also calculated using the influent concentration and the concentration collected at sample location 8 (200 feet), which is the last sample location in the swale.

$$Percent\ Removal = 100\ X\ \frac{C_{in}-C_{eff}}{C_{in}} \qquad \text{Equation 1}$$

Where

C_{in} = influent concentration (mg/L)
C_{eff} = concentration measured at a sample location (mg/L)

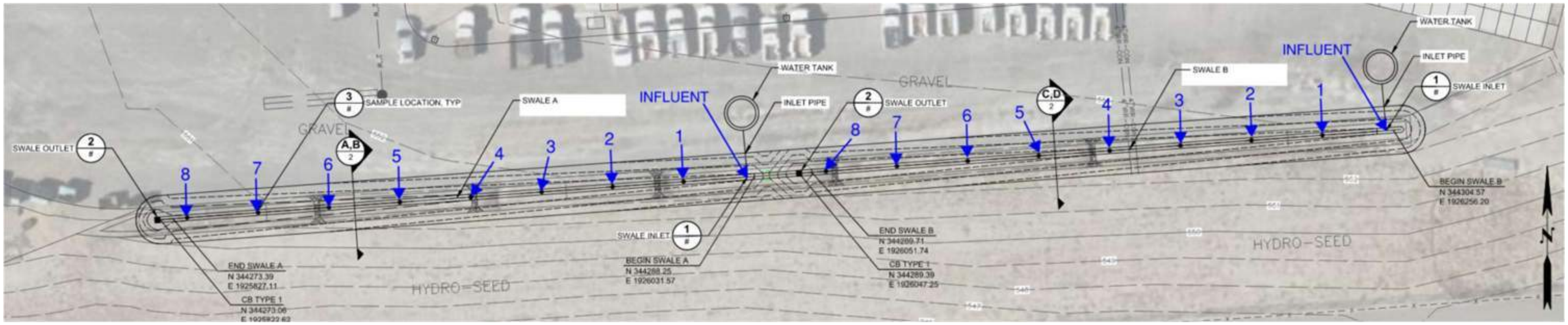


Figure 4-1. Influent and eight effluent sample locations in swale plan view

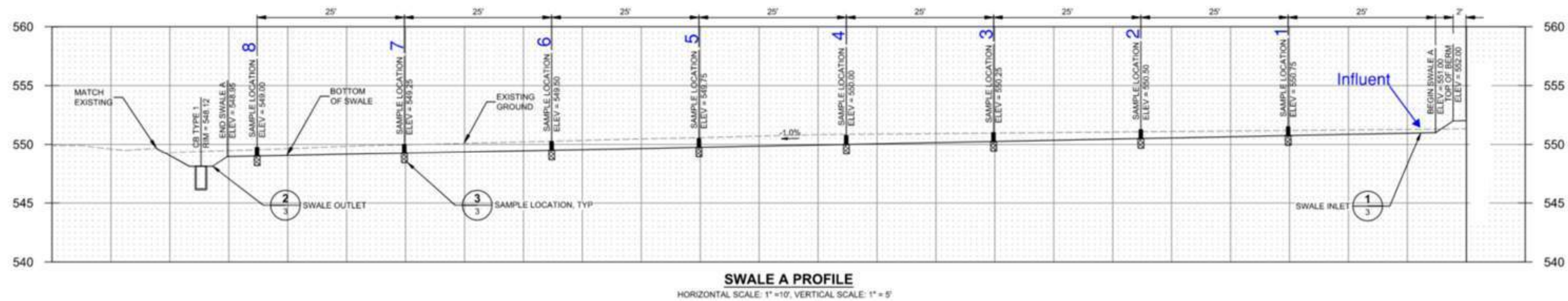


Figure 4-2. Influent and eight effluent sample locations in swale profile view

4.2 Recommendations for Final Swale Alternative

Based on the water quality results from testing of the four alternatives (**Appendix D**), the findings from the 25-year flow event and blower test, and potential availability of the rock, Alternative 3 gravel backfill for drywells was selected for the final swale alternative. As discussed, for Alternative 3 in **Appendix D**, the first simulated storm event suggested a similar swale design alternative may be successful with a more frequent (than 6 years) maintenance cycle, especially if the impermeable liner were replaced with a rougher or more permeable barrier between the treatment rock layer and the existing ground. The final swale alternative replaces the impermeable liner used in Alternative 3 with a 3-inch layer of pea gravel to limit migration of soils from the ground into the swale and allow for infiltration. Pea gravel is commonly used in stormwater BMPs as a choke stone layer instead of permeable liners (Hunt & Lord, 2006). 7.5 inches of gravel backfill for drywells, the same as used in Alternative 3, was placed on top of the pea gravel for the treatment layer. The remaining swale design alternatives were not selected due to the reasons described in **Sections 9.1.7.4, 9.1.8.4,** and **9.1.10.4** (**Appendix D)**.

4.3 Evaluation of Final Swale Alternative

The final swale alternative installed comprised 3 inches of pea gravel under 7.5 inches of gravel backfill for drywell. The final swale alternative was installed with the sample ports in the same locations as shown in **Figure 4-1 and Figure 4-2**. As discussed in **Section 4.1**, the purpose of the pea gravel layer was to limit migration of sediment along the bottom of the swale, especially from the existing ground, and to allow runoff to infiltrate. The rock was also washed prior to installation in the swale, to limit fines in the gravel backfill for drywells and subsequent background concentrations at the start of the test. The washing was done by spreading the rock out in a concrete decant basin at the City of West Richland's street waste facility and spraying the rock with an estimated 10,000 gallons of water. Comparing the background concentration in **Table 4-1** to the background concentration from the other four alternatives (**Appendix D**, see footnote 1 below the water quality result tables), the additional washing appears to have reduced the background concentration by at least half. Recommended rock washing practices are addressed further in **Section 5.1** and **Appendix B**.

Like the water quality data from the first four swale alternatives, the results in this section are from grab samples that represent first flush conditions within the swale. Some key points about the data noted in **Table 4-1** as well as **Figure 4-3** and **Figure 4-4** are as follows:

- As shown in **Table 4-1**, greater than 80% TSS removal was achieved for simulated storm events 1–2 and 4 and 6 when comparing the concentration from sample location 1 (25 feet) to the concentration from sample location 8 (200 feet).
- As shown in **Figure 4-3**, the TSS concentrations decreased as runoff traveled through the swale.
- As shown in **Table 4-1**, the TSS concentration at sample locations 1 (25 feet) and 2 (50 feet) is greater than the influent concentration for events 3 to 6. This is likely due to the annual load that was added to the swale following sample collection events 2 and 4 and right before sample collection for events 3 and 5. As shown in **Figure 4-4**, the higher TSS concentrations at these sample locations result in negative TSS removal rates for events 3 to 6. Since the annual load is typically distributed to a BMP over many storms throughout the year as opposed to all at once (as done for this study), these higher TSS concentrations were considered a stress test and not representative of conditions expected in the field. It should be noted that treatment performance appears to be recovering (improved pollutant reduction) as runoff travels through the swale.

- As shown in **Table 4-1** and **Figure 4-3**, the percent TSS removal drops to 27.8% and 49.9% during Events 3 and 5, respectively, when comparing the influent concentration to the concentration from sample location 8 (200 feet). The decrease in percent removal for Events 3 and 5, as well as the increase in concentration at sample location 8 (200 feet) for Events 3–6 were likely caused by the installation of weirs after the last sample location. The installation of the weirs and the reasons why they were installed are discussed following **Figure 4-4**.

As discussed in **Section 3.2**, several of the lab duplicates were outside of control limits (greater than 5%). From discussion with the analytical laboratory, the duplicates that exceeded control limits would serve as “error bars” indicating a range of uncertainty for each sample result (includes influent and effluent sample results). Water quality results were therefore adjusted to show the results at the lower and upper end of the error bar. The error associated with each storm event is included in **Table 4-2** along with the potential range of values given the respective uncertainty. The percent removal from influent to sample location 8 (200 feet) was also calculated for the range of values, and the potential range of percent removal is shown in **Table 4-2**. As shown, even with the error of ±11.4% for Event 1, the concentrations at the end of the swale only vary by ± 1.7 mg/L, and the percent removal from influent to the end of the swale ranges between 80.5–87.6%, which still meets the targeted removal for TSS. Additionally, the range of percent removal for Event 2 is 84.6–90.3%. The range of percent removal for Events 3–6 still does not meet the targeted percent removal likely due to the installation of weirs, as discussed after **Figure 4-4**. Because the ranges for Events 1 and 2 still meet the targeted 80% removal of TSS, and the same events shown in **Table 4-2** meet the targeted 80% removal from the influent to the end of the swale, the remaining data analysis will be based on the sample results in **Table 4-1**.

Table 4-1. Final swale design alternative water quality results

	Concentration mg/L						
	Background Sample	Year 1	Year 1	Year 2	Year 2	Year 3	Year 3
Location in Swale (ft)		**Event #1**	**Event #2**[1]	**Event #3**	**Event #4**[1]	**Event #5**	**Event #6**
Influent	9.42	108	119	106	123	148	126
25	58.0	55.1	108.3	249.2	447.3	493.4	305.9
50	22.3	32.3	54.1	99.5	137.1	268.5	167.0
75	32.9	27.3	43.2	80.1	88.9	92.3	95.1
100	29.2	25.8	30.7	55.2	96.7	82.5	76.4
125	19.8	19.8	28.1	52.5	51.9	100.6	55.6
150	30.7	27.4	22.3	34.8	48.0	68.5	40.3
175	30.8	26.4	16.8	41.0	29.5	51.2	35.4
200	37.4	16.7	14.6	76.3	36.2	74.3	34.5
% Removal from Influent to 200 feet	-	84.5	87.8	27.8[2]	70.5	49.9[2]	72.8
% Removal from Influent to 175 feet	-	75.5	85.9	61.2	75.9	65.4	72.0
% Removal from 25 feet to 200 feet	-	69.7	86.6	69.4[2] [61.9][3]	91.9 [81.9][3]	85.0[2] [62.9][3]	88.7 [82.8][3]

[1] An annual loading of TSS was added following Event 2 (end of Year 1) and Event 4 (end of Year 2) as described in the study QAPP.

[2] Results were impacted by the installation of a weir downstream of sample location 8 (200 feet) to limit erosion and to be able to collect sufficient sample at sample location 8.

[3] Per TAPE, influent concentrations that are greater than the influent range must be set to the value at the upper end of the range (200 mg/L for TSS). The value in the table reflects the change in concentration between the first sample location (25 feet from the influent) to sample location 8 (200 feet), and it uses 200 mg/L as the concentration at sample location 1 (25 feet) because the measured concentration at that location was greater than 200 mg/L.

Table 4-2. Final swale water quality results, including error

	Concentration mg/L					
	t=1 yr	**t=1 yr**	**t=2yr**	**t=2yr**	**t=3yr**	**t=3yr**
Location in Swale	Event #1	Event #2	Event #3	Event #4	Event #5	Event #6
Sample Result Error	11.40%	11.40%[1]	2.96%	7.30%	2.60%	2.96%
Influent Concentration	95.3-119.8	105.5-132.6	102.5-108.8	113.7-131.6	144.3-152.0	122.7-130.2
25	48.8-61.4	95.9-120.6	241.8-256.5	414.6-480.0	480.6-506.2	296.8-314.9
50	28.6-36.0	47.9-60.2	96.6-102.4	127.0-147.1	261.5-275.5	162.0-171.9
75	24.1-30.4	38.2-48.1	77.7-82.4	82.4-95.3	89.9-94.6	92.3-97.9
100	22.8-28.7	27.2-34.2	53.6-56.8	89.6-103.7	80.3-84.6	74.1-78.7
125	17.5-22.0	24.9-31.2	50.9-54.0	48.1-55.6	97.9-103.2	53.9-57.2
150	24.3-30.5	19.7-24.8	33.7-35.8	44.4-51.5	66.7-70.2	39.1-41.5
175	23.3-29.4	14.9-18.7	39.7-42.2	27.3-31.7	49.9-52.5	34.3-36.4
200	14.8-18.6	12.9-16.2	74.0-78.6	33.5-38.8	72.3-76.2	33.4-35.5
% Removal from Influent to 200 feet[2]	80.5-87.6	84.6-90.3	23.4-31.9	65.9-74.5	47.2-52.4	71.1-74.3
% Removal from Influent to 175 feet	69.2-80.5	82.3-88.8	58.9-63.5	72.2-79.2	63.6-67.2	70.3-73.6
% Removal from 25 feet to 200 feet	61.9-75.9	83.1-89.3	67.5-71.1 [60.7-63.0][3]	90.6-93.0 [80.6-83.2][3]	84.1-85.7 [61.9-63.8][3]	88.0-89.4 [82.3-83.3][3]

[1] Event 2 was split into two separate QC batches, as shown in **Appendix C.2**. The lab duplicate result shown for Event 2 was the highest value from the two QC batches and was associated with most of the samples (influent 1–3, sample locations 1–6).

[2] Percent removal range values reflect (a) the change between the influent concentration at the lower end of the error and the sample location 8 (200 feet) concentration at the upper end of the error (lower end of range) and (b) the change between the influent concentration at the upper end of the error and the sample location 8 (200 feet) concentration at the lower end of the error (upper end of range).

[3] Per TAPE, influent concentrations that are greater than the influent range must be set to the value at the upper end of the range (200 mg/L for TSS). The range in the table reflects the change in concentration between the first sample location (25 feet from the influent) to sample location 8 (200 feet), and it uses 200 mg/L as the concentration at sample location 1 (25 feet) because the measured concentration at that location was greater than 200 mg/L.

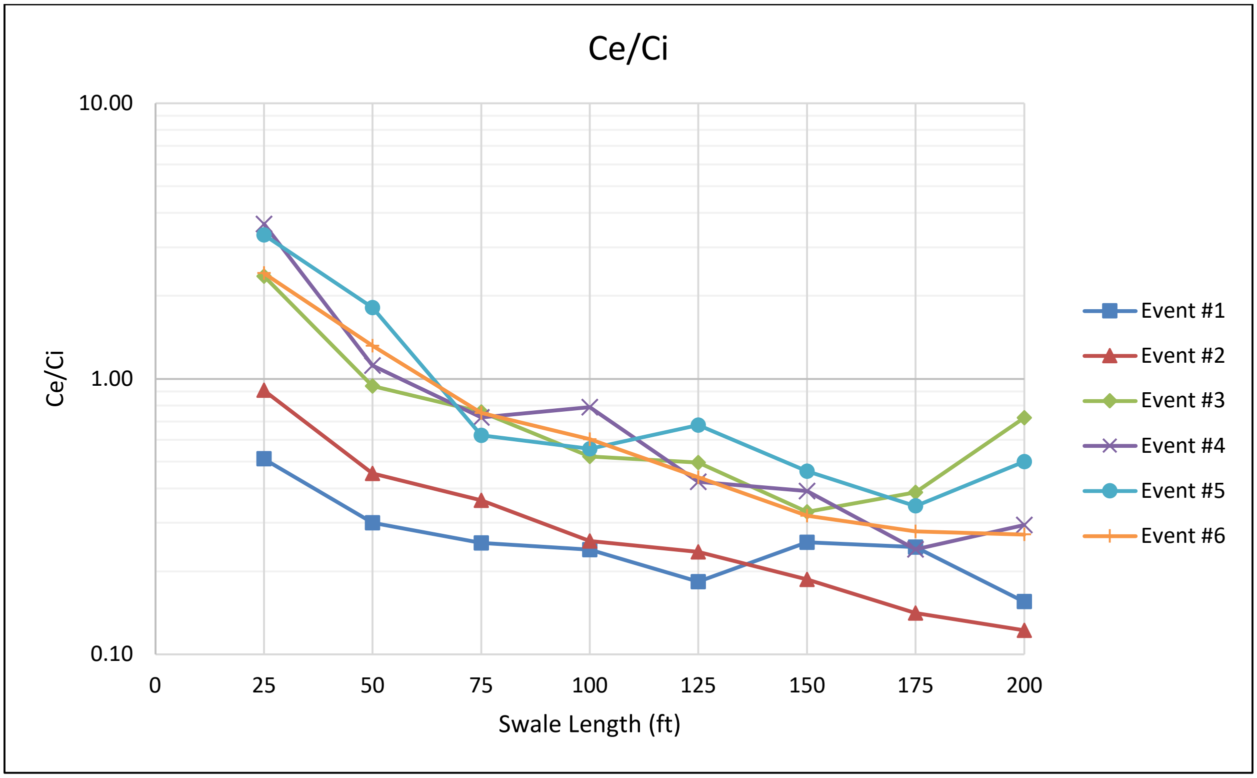


Figure 4-3. Final swale effluent to influent concentration ratio

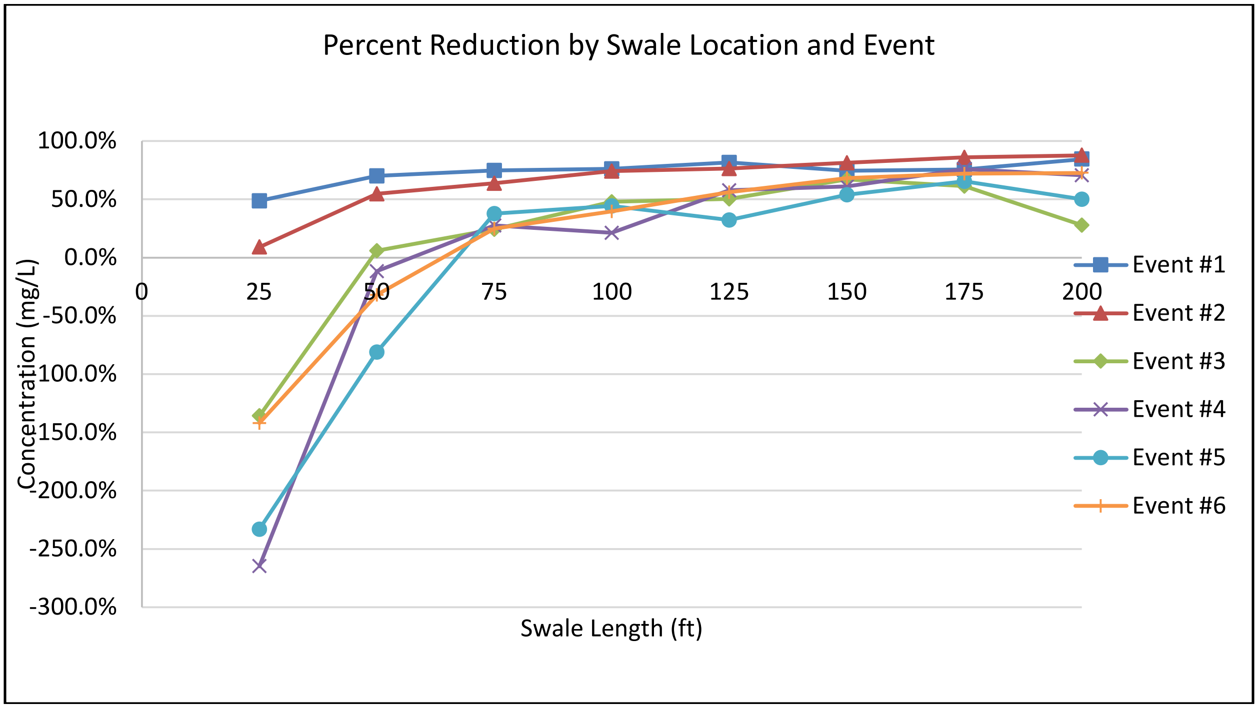


Figure 4-4. Final swale percent reduction by location and event

Following Event 2, erosion was observed downstream of sample location 8 (200 feet). If allowed to continue, the erosion would have likely impacted the sample collected at location 8 and potentially migrated up the swale as testing continued. Based on field observations, the erosion appeared to be due to the grade break immediately after the end of the test swale down to the catch basin, shown in **Figure 4-5** and **Figure 4-6** (also see Appendix D of study QAPP for design drawings). The grade break was added to direct runoff that discharges the swale toward a catch basin that was installed a few feet below the end of the swale to prevent any ponded water from flowing back into the swale and impacting water quality results. To stop erosion during future sample events, a weir was installed 1–2 feet downstream of sample location 8. The weir spanned the width of the bottom of the swale and was installed so the top of the weir was even with the existing ground below the pea gravel. However, following Event 4, observations indicated that flow was eroding around the sides of the weir and was beginning to bypass the sample port. As a result, a larger weir was installed prior to Event 5. The second weir was constructed so the top of the weir was even with the top of the pea gravel, and wing walls were added to limit flow eroding around the weir. The opening between the wing walls was 2 feet wide. **Figure 4-7** shows the second weir installed during testing of the final swale alternative. The sediment on the impermeable liner in the figure was one of the indicators that erosion was occurring.

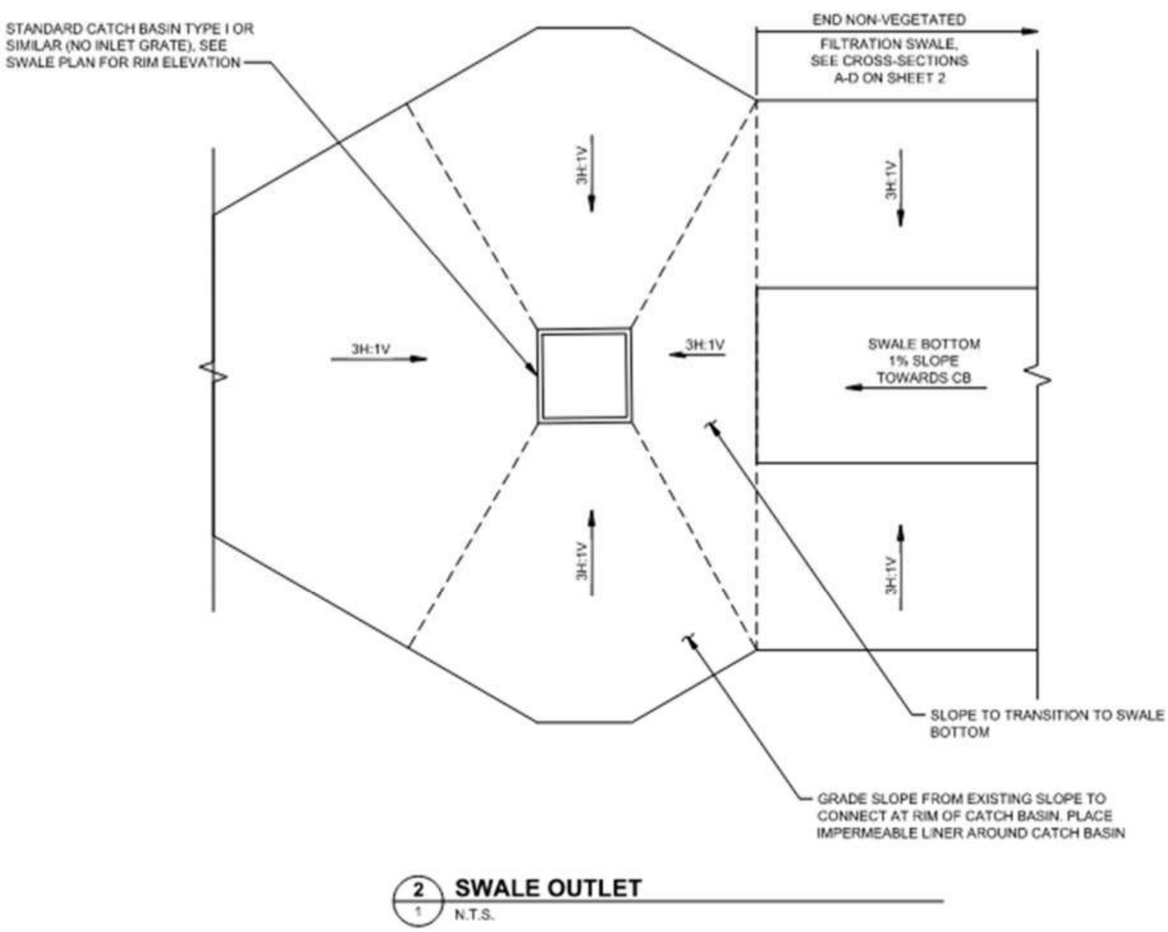


Figure 4-5. Detail showing change of grade from end of swale to catch basin

Figure 4-6. Facing downgrade from end of swale to catch basin
(Left photo credit: Evergreen StormH2O – Right photo credit: Drew Woodruff, City of West Richland)

Figure 4-7. Weir installed following Event 4, facing upstream
(Photo credit: Drew Woodruff, City of West Richland)

After each weir was installed, the rock around sample location 8 (200 feet) was washed with water to reduce the potential impact of sediment from digging downstream of the swale. The sample port was also cleaned prior to the following simulated storm event as required by the study SOPs (see Section 8.1 of study QAPP).

Despite the additional washing, and based on the water quality results, it appears that the installation of the weirs impacted concentrations and TSS removal at sample location 8 (200 feet) for the remaining events, in particular Events 3 and 5, and that the data at sample location 8 would inaccurately skew the water quality performance of the swale. Reasons for this conclusion are as follows:

- The TSS concentration generally decreased as runoff flowed through the swale. However, for Events 3 and 5, the concentration at sample location 8 (200 feet) increased by 35 and 23 mg/L (respectively) from concentrations at sample location 7 (175 feet). Increases in concentration occurred between other sample locations during testing; however, the increases were typically between 5–10 mg/L, with one increase of 18 mg/L during Event 5 (likely due to the annual TSS loading). Additionally, concentrations at sample location 8 (see **Table 4-1**) still increase or are roughly the same as the concentrations at sample location 7 (175 feet) for Events 4 and 6. The local increase in concentration suggests the impacts are limited to the area adjacent to where the weir was installed.
- As shown in **Table 4-1**, the percent removal at sample location 8 (200 feet) decreases for Events 3 and 5 (compared to the other events). These events occurred immediately after each weir installation and appear to be due to the increased concentrations described in the previous bullet.
- **Figure 4-8** to **Figure 4-11** are trendlines to fit two groups of data: all the positive percent removal data from each event and all the positive percent removal data from each event except the concentration at sample location 8 (200 feet). All four figures show the trend in percent TSS removal as runoff flows through the swale. Important observations noted on these figures include:
    - **Figure 4-8** and **Figure 4-10:** For Events 3 and 5, when the percent removal at sample location 8 is included, this data point skews the trendlines which is shown by the lower R-squared value compared to the trendline without this data point. The reduced slope in the trendline indicates a decrease in the overall swale treatment performance even though the decrease (percent removal) only occurred at sample location 8.
    - **Figure 4-9** and **Figure 4-11:** For Events 4 and 6, when the percent removal at sample location 8 is included, the data point skews the trendlines, which is shown by the lower R-squared value compared to the trendline without this data point. However, the skew in **Figure 4-9** and **Figure 4-11** is less than the skew in **Figure 4-8** and **Figure 4-10,** and there is an increase in the slope of the trend line with the percent removal at sample location 8 improving from Events 3 to 4 and from Events 5 to 6. The improved percent removals and less-skewed (increased pollutant removal) trendline for Events 4 and 6 suggest that the TSS treatment performance was recovering since Events 3 and 5.

Because of the impact the installation of the weirs appears to have had on the data collected at the end of the swale, it was anticipated that at least the data from sample location 8 for Events 3–6 would be discarded. Trendlines were developed to understand how the swale would have behaved without the impacts of the weir installation, as well as determine whether any additional data should be discarded.

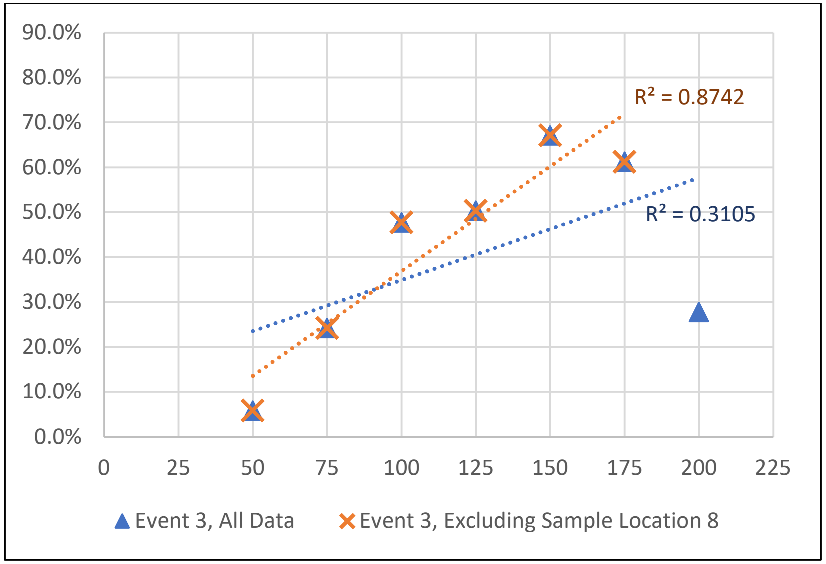


Figure 4-8. Event 3 percent removal and trendline

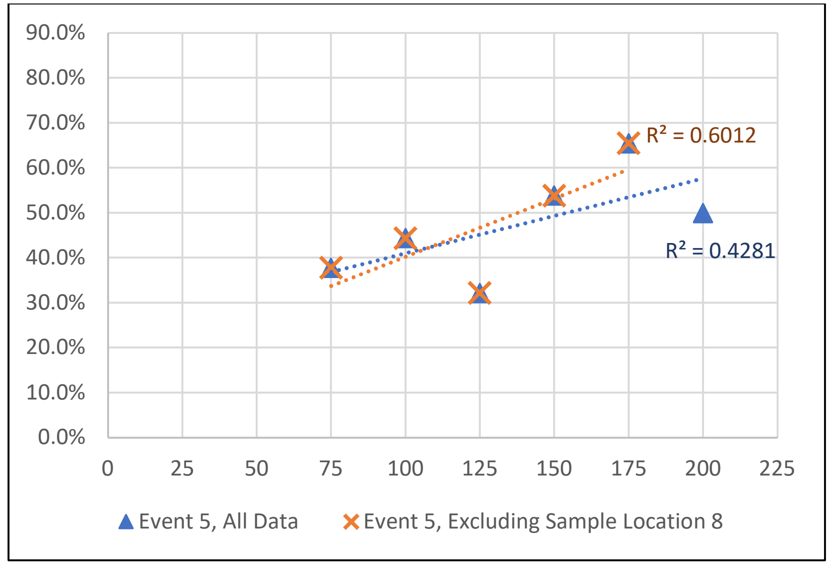


Figure 4-10. Event 5 percent removal and trendline

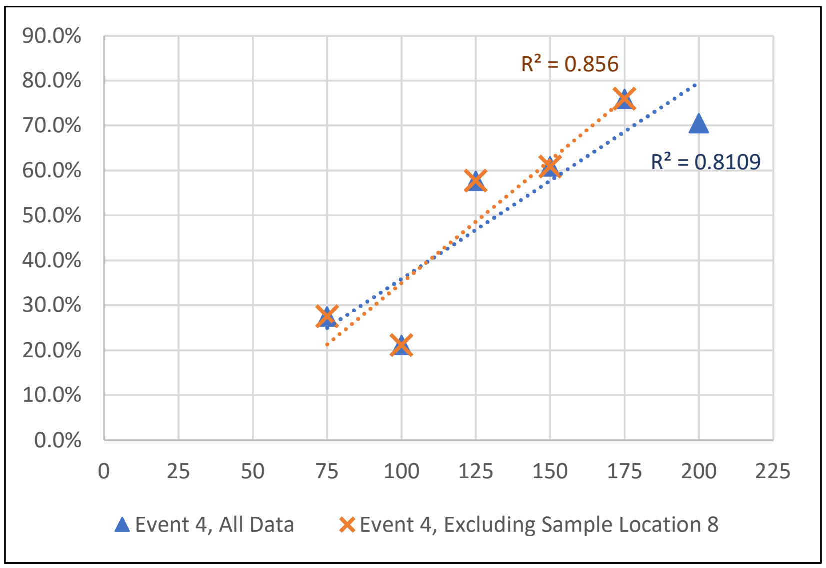


Figure 4-9. Event 4 percent removal and trendline

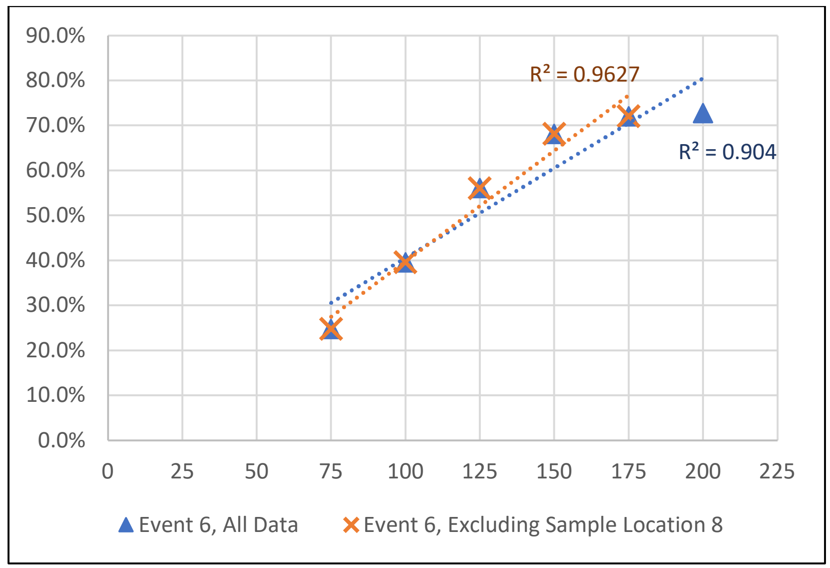


Figure 4-11. Event 6 percent removal and trendline

Multiple trendlines were created to identify patterns in the data and understand the potential swale treatment performance without the impacts due to the weir installation. This included plotting the percent removal along the swale and grouping data from different events. Only positive percent removal data was plotted, as the annual TSS loads delivered to the swale created increases in TSS concentrations near the start of the swale (resulting in negative percent removal at the first and sometimes second sample location). Since the annual load is typically distributed to a BMP over many storms throughout the year as opposed to all at once (as done for this study), these higher TSS concentrations were considered a stress test and not representative of conditions expected in the field. Since the annual load would not be applied all at once in the field, these data points were removed. Linear trendlines were used as opposed to other trendline options because the linear trendlines provided a better fit, as indicated by the R-squared values, and the other options overestimated or underestimated concentrations at the beginning or end of the swale. Trendline lines use a regression analysis to determine how well the data fits a line, with R-squared values closest to 1 or -1 having the best fit.

- **Figure 4-12:** To start, all the percent removal data from each event was plotted. As shown by the R-squared value (0.3203), there was not a strong correlation between the data and the trendline.
  - **Figure 4-14.** Percent removal correlation for events 3 and 5; location 8 removed

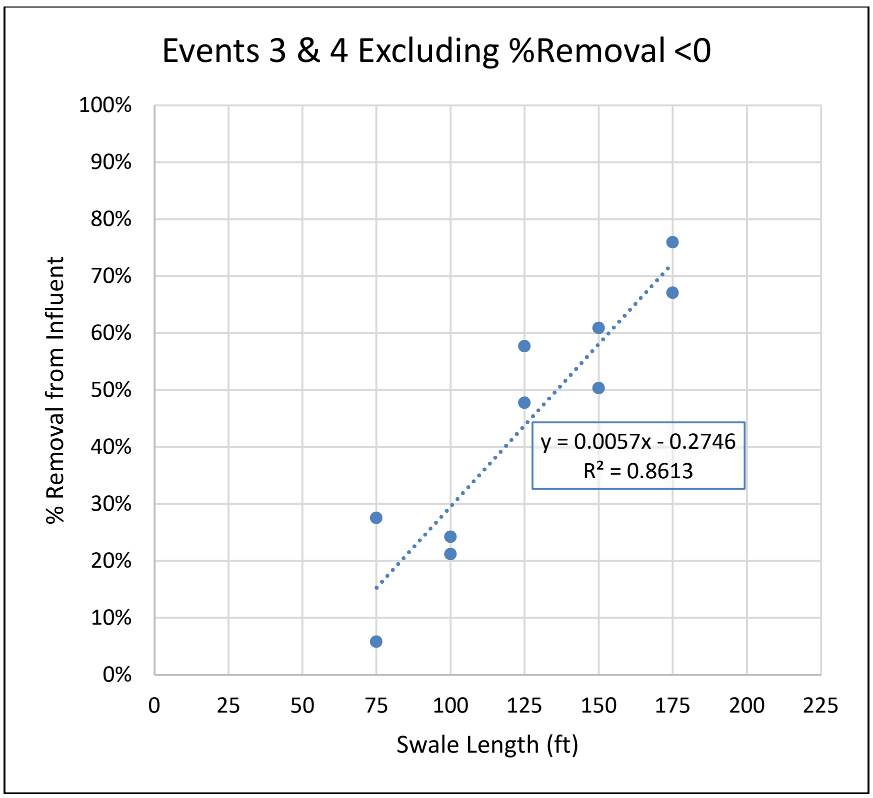
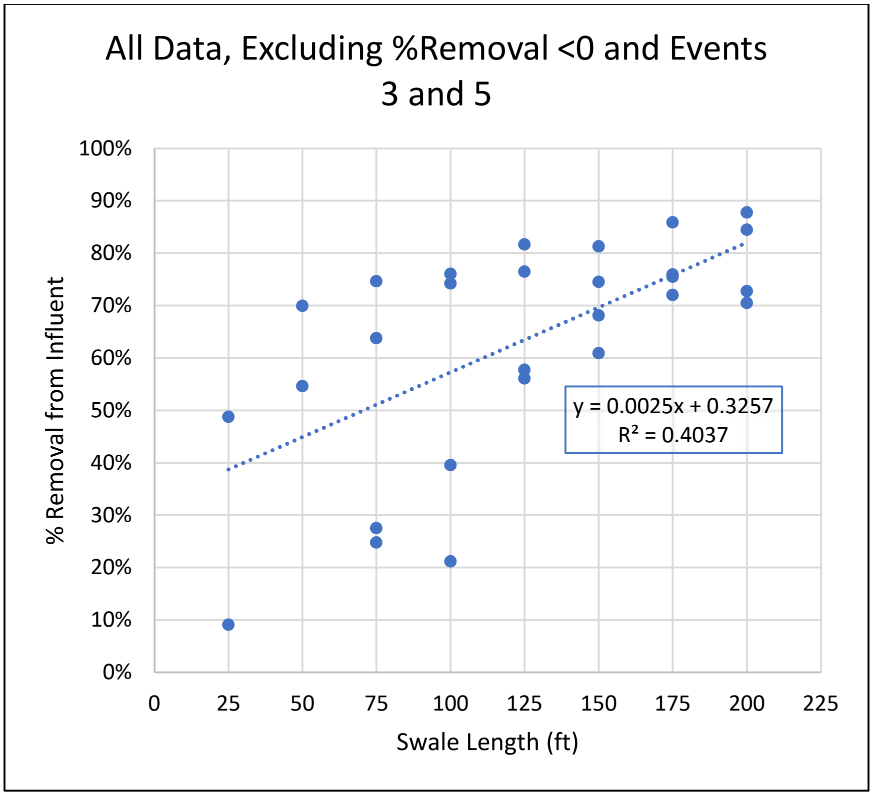


Figure 4-15. Percent removal correlation for events 3 and 4



- **:** Because of the impact the weir had on TSS concentrations and removal rates at sample location 8 during events 3 and 5 (**Table 4-1**, **Figure 4-9** and **Figure 4-11**), these two data points were removed to see if the R-squared value would improve. The resulting trendline and R-squared value (0.3215) was not significantly different than all the data in **Figure 4-14.** Percent removal correlation for events 3 and 5; location 8 removed

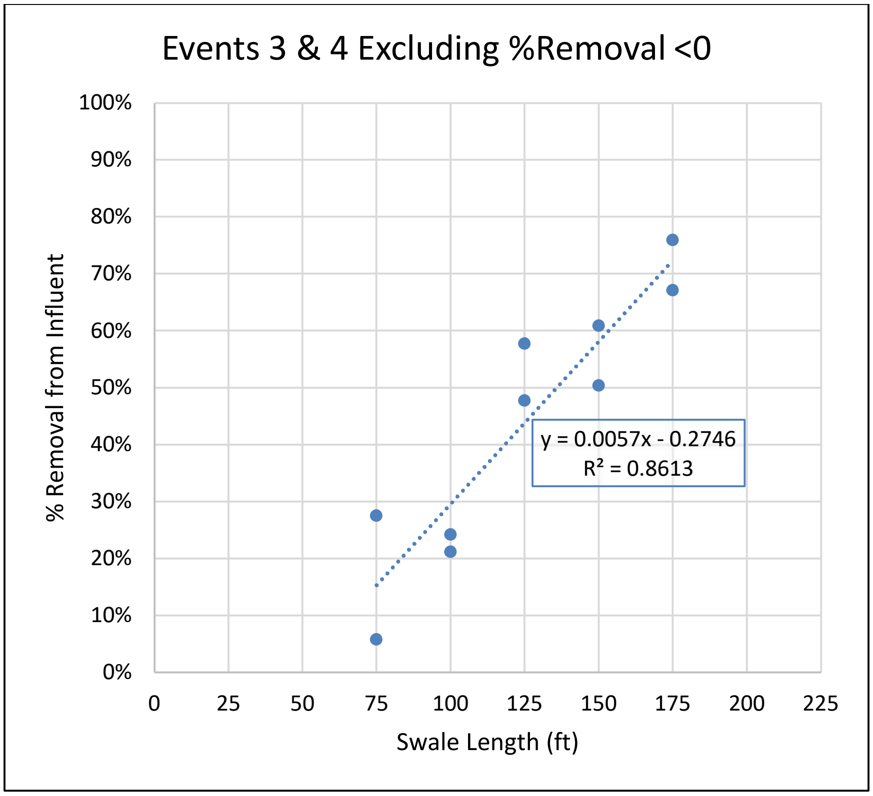
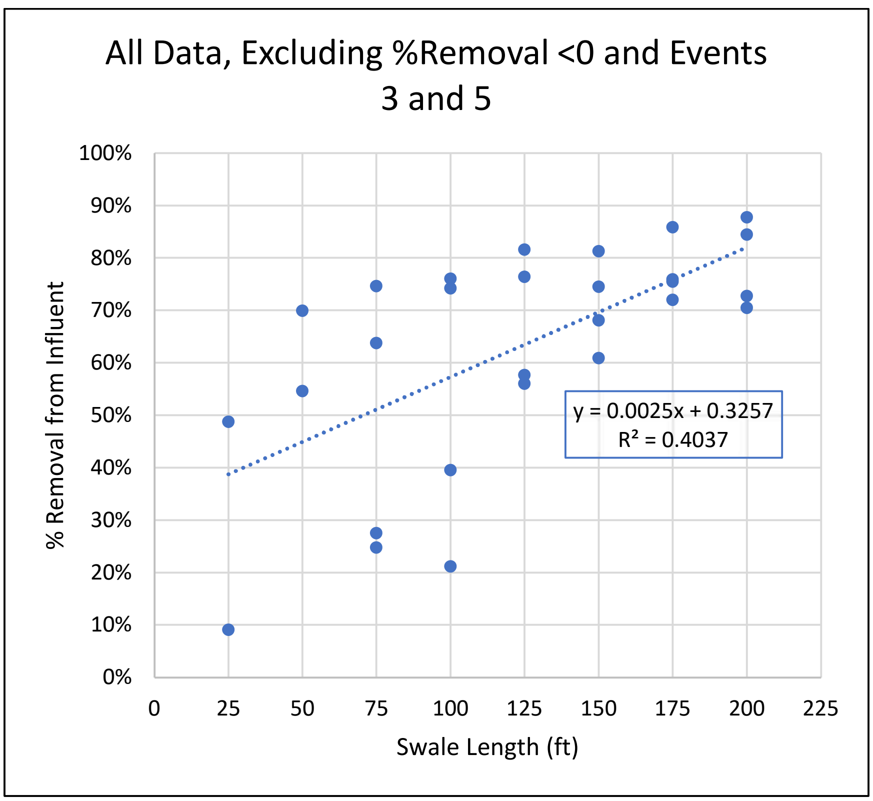


Figure 4-15. Percent removal correlation for events 3 and 4



- .

- **Figure 4-16:** Next, all the data from Events 3 and 5 were removed to assess whether all the data from those storms would need to be discarded. This increased the R-squared value for the trendline to 0.4037, which still does not indicate a strong correlation between the data and trendline. As the data in Events 3 and 5 (except for location 8) appears to be within the range of the other results received for the final swale alternative and there were no data quality concerns with the samples collected from sample locations 1–7, it was determined that the entire events should not be discarded.
- **Figure 4-13** to **Figure 4-17:** As plotting all of the data (**Figure 4-12**) did not result in a strong correlation between the data and the trendline, data was grouped by simulated year, because it was anticipated that water quality data collected during the same simulated year (and before or the annual load was added for that year) would create a stronger correlation between the data and trendline. In addition, it is anticipated that over time the treatment performance will decline as the swale TSS accumulation rates increase in the rock layers and these data groupings likely best describe how the swale would perform in a field installation. Since the percent removal data at sample location 8 (200 feet) appeared to skew the trendlines shown in **Figure 4-8** through **Figure 4-11**, the data from sample location 8 was omitted for Events 3–6 (**Figure 4-15** and **Figure 4-17**).

The trendlines shown in **Figure 4-13**, **Figure 4-15**, and **Figure 4-17** were selected to predict how the swale would perform in a field installation without the impact of the weir or the annual loading. These trendlines were selected because they had the highest R-squared values and because the groupings of data likely best reflect the declining treatment performance of a field installation over time. The resulting water quality concentrations and percent removals from the trendline analysis are included in **Table 4-3**, **Table 4-4**, and **Table 4-5**. As field installations of the final swale design alternative would not involve installation of a weir, the final swale design alternative is expected to meet the targeted 80% removal of TSS by the end of the swale (200 feet) for the first two years, and maintenance would be required at some point between years two and three (maintenance frequency and approaches to extend the frequency are discussed further in **Section 7**). The bootstrap statistical analysis (**Table 4-5**) also suggests treatment performance may be able to be extended into year 3, though the analysis relies on the three percent removal results at sample location 8 (200 feet).

The data shown in **Table 4-3**–**Table 4-5** provide an indication for typical performance of the non-vegetated filtration swale. Additional field testing is still recommended due to the impact of the weir installation, how the annual loading was simulated, and the use of grab samples to evaluate the treatment performance during the study. The field testing would help to verify whether the results discussed (trendline data) in this section would occur in a typical installation and are expected to provide additional insight that could assist with refining the maintenance cycle of the BMP. Recommendations for additional testing are described further in **Section 6**.

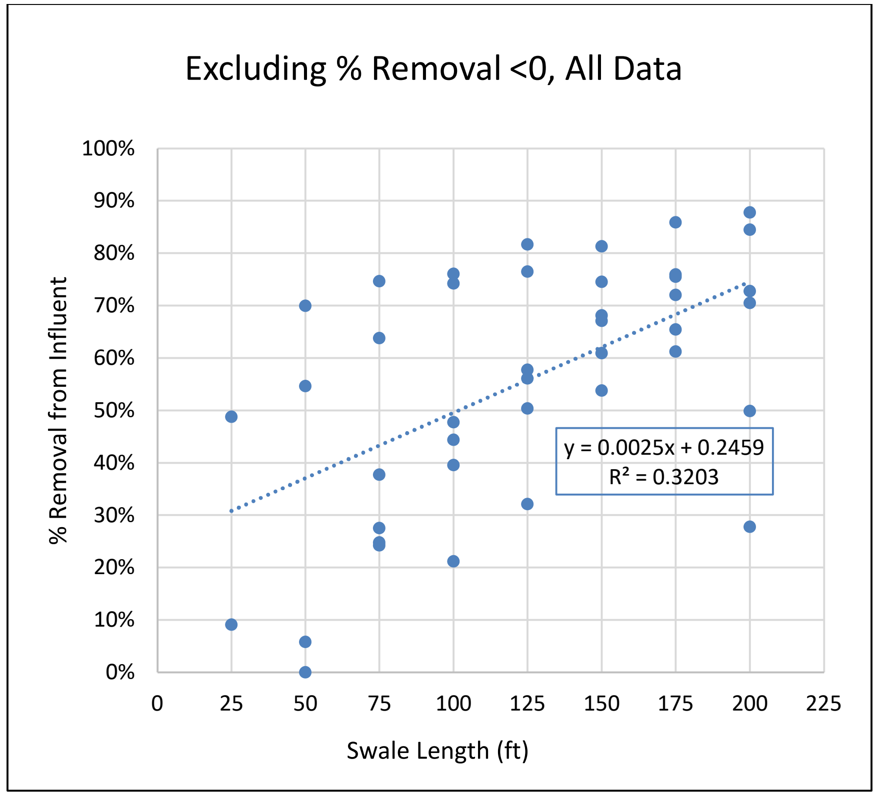


Figure 4-12. Percent removal correlation for all events

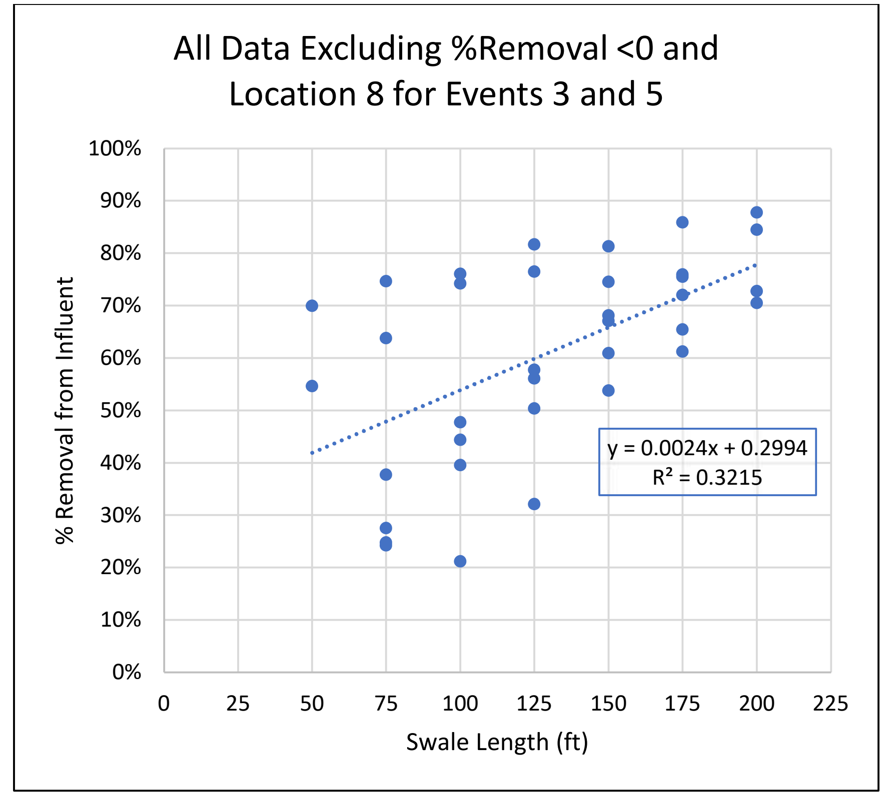


Figure 4-14. Percent removal correlation for events 3 and 5; location 8 removed

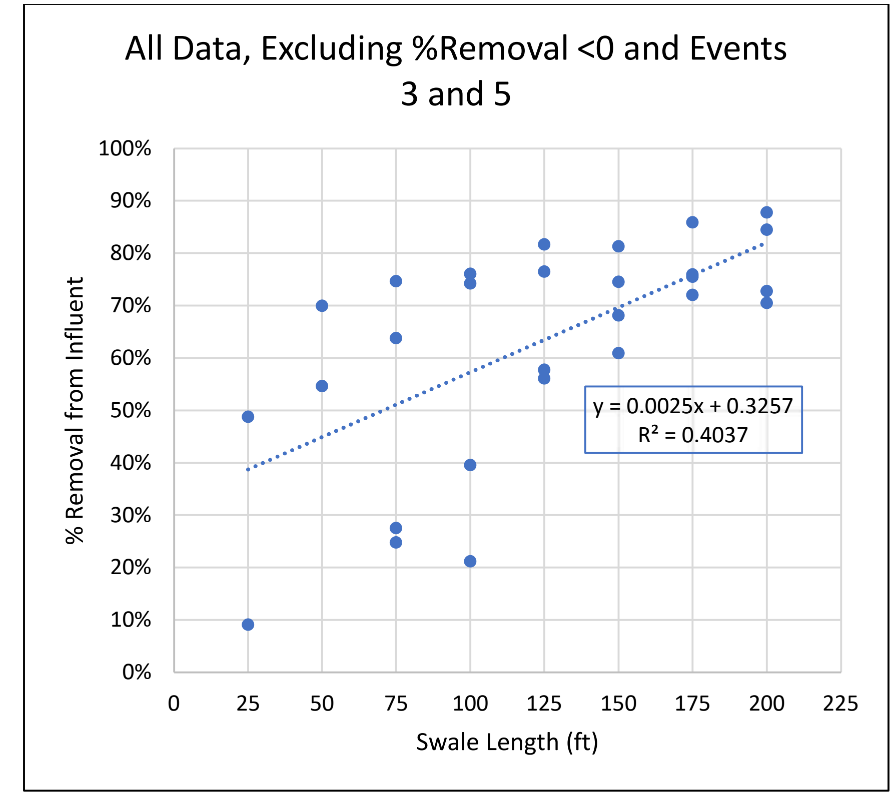


Figure 4-16. Percent removal efficiency excluding events 3 and 5

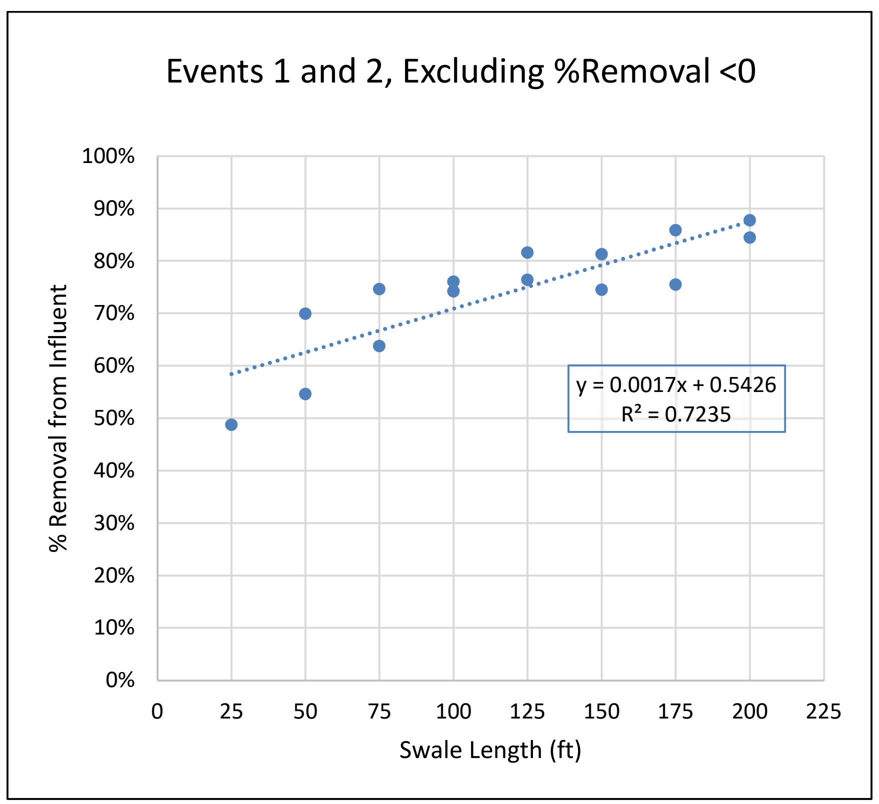


Figure 4-13. Percent removal correlation for events 1 and 2

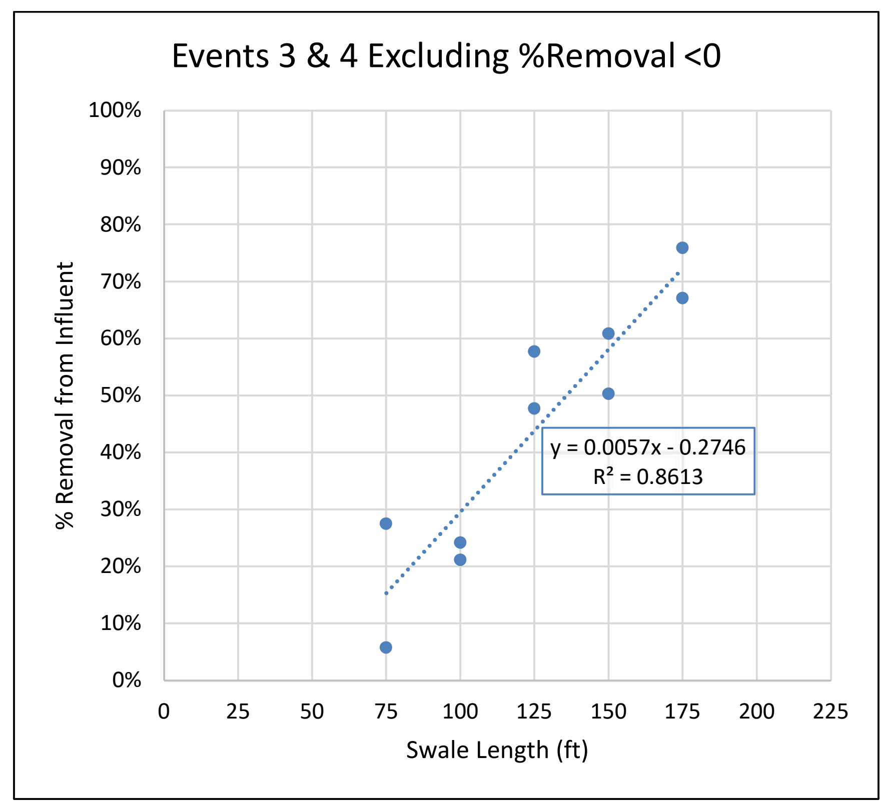


Figure 4-15. Percent removal correlation for events 3 and 4

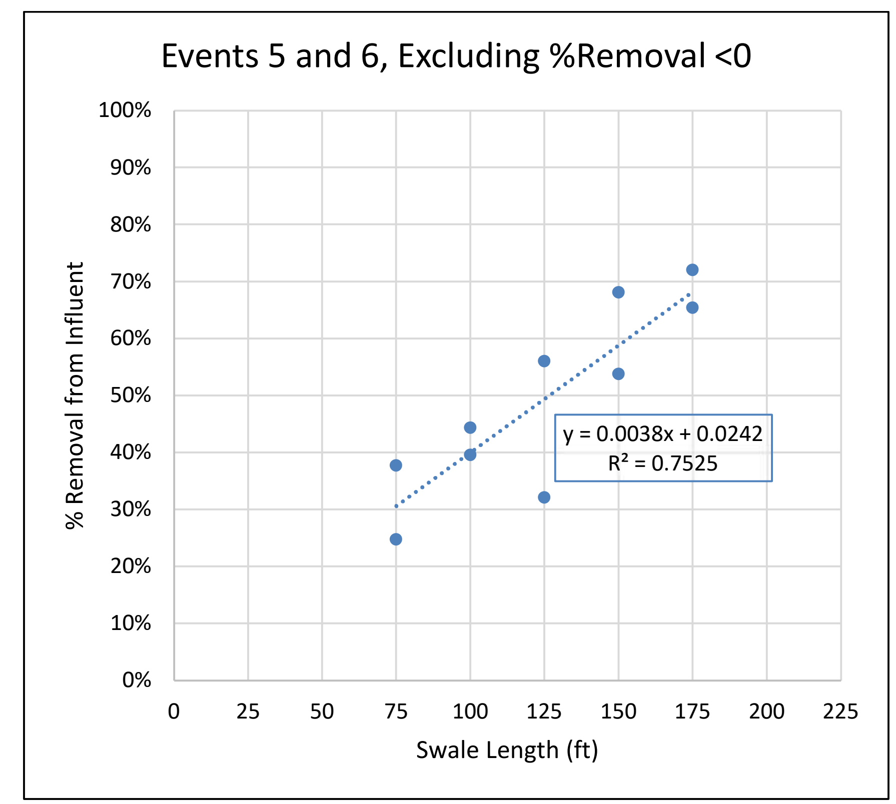


Figure 4-17. Percent removal efficiency for events 5 and 6

Table 4-3. Final swale design alternative water quality results from trendline analysis

	Concentration mg/L		
Location in Swale	**Year 1**	**Year 2**	**Year 3**
Influent	113	114	137
25	47.0	129.2	120.9
50	42.2	112.9	107.9
75	37.4	96.7	94.8
100	32.6	80.4	81.8
125	27.7	64.1	68.8
150	22.9	47.9	55.7
175	18.1	31.6	42.7
200	13.3	15.4	29.6
% Removal from Influent	88.3%	86.5%	78.4%
% Removal from Location 1	71.7%	88.1%	75.5%

Table 4-4. Final swale design alternative removal efficiency results from trendline analysis

Location in Swale	Year 1	Year 2	Year 3	Average
25	58.5%	-13.2%	11.9%	19.1%
50	62.8%	1.00%	21.4%	28.4%
75	67.0%	15.3%	30.9%	37.7%
100	71.3%	29.5%	40.4%	47.1%
125	75.5%	43.8%	49.9%	56.4%
150	79.8%	58.0%	59.4%	65.7%
175	84.0%	72.3%	68.9%	75.1%
200	88.3%	86.5%	78.4%	84.4%

4.4 Statistical Comparison of Pollutant Concentrations

A statistical analysis was performed to assess whether there was a statistically significant difference in the analytical results between the influent and effluent TSS concentrations at each sample location (8 total). The following paragraphs include a more detailed description of the analysis as well as the results of the analysis. Output from the statistical analysis can be found in **Appendix E**.

The data evaluation included evaluating the concentrations from the influent data set and each effluent data set (for each sample collection location) separately. First the data was evaluated using the Ryan-Joiner test to determine whether the data was normally distributed, which would determine the method for the statistical analysis. Normality was assumed if the test produced a p-value greater than 0.05. From the Ryan-Joiner test it was found that all of the data sets were normally distributed as such, the two-sample t-test was selected to conduct the statistical analysis. This test uses a 95% confidence interval (α=0.05) to decide whether to accept the null (H_o) hypothesis or reject the null hypothesis and accept the alternative (H_a) hypothesis. The specific null hypothesis (H_o) and alternative hypothesis (H_a) evaluated for this study are as follows:

- H_o: Effluent pollutant concentrations from a given sample location are equal to the influent concentrations entering the swale
- H_a: Effluent concentrations from a given sample location are less or greater than the influent concentrations entering the swale.

Results from the statistical analysis indicated that the difference between the influent and concentrations was statistically insignificant for samples collected within the first 50 feet of the swale but statistically significant for samples collected from 75 feet to the end of the swale (200 feet). It is worth noting that sample locations 1 (25 feet) and 2 (50 feet) is where the highest concentrations of TSS were observed (higher than the influent concentrations due to the annual loading) and where Sil-Co-Sil® was visually observed to settle out the most in the swale during testing as shown in **Figure 4-18**. The results of the statistical analysis are summarized in **Table 4-5**.

The statistical analysis relied on eighteen influent concentration data points and six concentration data points for each sample location in the swale. If a larger amount of data for each sample location were obtained, whether the sample location was statistically significant from the influent is not expected to change, as most of the p-values shown in **Table 4-5** are well above or below 0.05 (greater than 0.05 indicates the difference is insignificant). With additional data, the statistical means and 95% confidence intervals used to determine whether a statistically significant difference exists may be refined.

Table 4-5. Summary of influent and effluent location concentrations statistical comparison

Location in Swale	Normally Distributed?	Statistical Method	Statistically Significant Difference?	P value (>0.05 Statistically Insignificant)
Influent	Yes	Two-Sample T-Test	–	–
25 feet	Yes	Two-Sample T-Test	No	0.085
50 feet	Yes	Two-Sample T-Test	No	0.897
75 feet	Yes	Two-Sample T-Test	Yes	0.007
100 feet	Yes	Two-Sample T-Test	Yes	0.003
125 feet	Yes	Two-Sample T-Test	Yes	0.001
150 feet	Yes	Two-Sample T-Test	Yes	0.000
175 feet	Yes	Two-Sample T-Test	Yes	0.000
200 feet	Yes	Two-Sample T-Test	Yes	0.000

Figure 4-18. Left: Settled Sil-Co-Sil® at influent of test swale (photo from initial testing); and Right: Settled Sil-Co-Sil® in pea gravel and gravel backfill for drywells at influent
(Left and right photo credit: Drew Woodruff, City of West Richland)

The statistical comparison of pollutant concentrations confirms observations in the field (**Figure 4-18**) that the TSS is settling out in the first 50 feet of the swale. The p-value at sample location 1 (25 feet) was close to 0.05, suggesting that concentrations in the swale were consistently high enough to almost create a statistically significant difference from influent concentrations. At sample location 2 (50 feet), measured concentrations were close enough to the influent concentrations that the p-value increased to 0.897, which indicated an increased likelihood that no significant difference between influent and effluent concentrations. If additional storm events had been simulated, those concentrations would likely have been above the influent concentration (as TSS continued to settle), and the p-value may have indicated a statistically significant difference at sample location 1 (25 feet). This information could help crews understand where maintenance should be focused in a field installation of the swale.

Additionally, the statistically significant difference between influent and effluent concentrations for sample locations 3 (75 feet) to 8 (200 feet) further confirms (in addition to the analysis discussed in **Section 4.2**) TSS concentrations are decreasing through the swale. The decreasing p-value for these sample locations indicates an increasing confidence that the concentrations at the sample locations are declining as stormwater flows through the swale.

4.5 Water Quality Treatment Performance

A bootstrapping analysis was conducted as described in 14.1.3 of the study QAPP. The removal efficiencies estimated in **Table 4-5** were used in this analysis and were compared to the Ecology treatment performance goals for TSS. As influent concentrations during testing were between 100–200 mg/L (**Table 4-1**), the lower one-sided 95% confidence interval around the mean removal efficiency was calculated for the removal efficiencies and evaluated against the TAPE Basic treatment performance goal of ≥80% TSS removal. The lower one-sided 95% confidence interval around the mean removal efficiency was calculated for results generated during simulated years 1 and 2 as well as for results generated for years 1–3. Years 1 and 2 represent the performance of the swale before maintenance is needed. However, only two data points are available for each location, resulting in the lower one-sided 95% confidence interval around mean removal efficiency being equivalent to the lower of the two removal efficiencies. The evaluation of removal efficiencies calculated for years 1–3 adds one data point to each location in the swale and is included for comparison. Both evaluations suggest the swale meets the Basic treatment performance goal for a 200 foot swale length and for influent concentrations between 100-200 mg/L, though more data points should be collected to verify the performance of the swale in the field (see **Section 6**). **Table 4-6** contains the results of the evaluation.

Table 4-6. Final swale treatment performance

Location in Swale	Years 1 and 2		Years 1, 2, and 3	
	Lower One-Sided 95% Confidence Interval of Mean Removal Efficiency[1]	Treatment Performance Goal Achieved[2]	Lower One-Sided 95% Confidence Interval of Mean Removal Efficiency[3]	Treatment Performance Goal Achieved[2]
25 feet	-13.2%	No	-4.84%	No
50 feet	1.00%	No	7.83%	No
75 feet	15.3%	No	20.5%	No
100 feet	29.5%	No	33.2%	No
125 feet	43.8%	No	45.8%	No
150 feet	58.0%	No	58.5%	No
175 feet	72.3%	No	70.0%	No
200 feet	86.5%	Yes	81.1%	Yes

[1] Bootstrapping evaluation includes removal efficiency data only from years before maintenance is required (Years 1 and 2 from **Table 4-4)**.
[2] The TAPE treatment performance goal was met if the lower one-sided 95% confidence interval around the mean concentration was greater than 80%.
[3] Bootstrapping evaluation includes removal efficiency data from all three simulated years (**Table 4-4**).

5. Construction, Design, and Operation and Maintenance Considerations

This section describes considerations for construction, design, and operation and maintenance for the non-vegetated filtration swale, based on findings from testing of the four swale design alternatives and the final swale design alternative.

5.1 Construction Considerations

As discussed in **Section 4.2** and **Appendix D**, background concentrations of TSS in the four swale design alternatives likely impacted the performance of the swales. Further, the additional washing performed for the final swale design alternative (described in **Section 4.2**) was not a desirable step in construction of the non-vegetated filtration swale. To address both concerns, the Central Washington Asphalt (CWA) plant in Benton City, Washington, was visited to discuss potential washing procedures done before rock is used in a non-vegetated filtration swale. The findings of the visit are summarized below.

- The #200 sieve specification for the gravel backfill for drywells produced at the CWA plant is 0–1.5%, and what was recently produced was tested and found to be in the ranges of 0.2% to 0.5%. If the #200 sieve specification range were reduced, it would likely be difficult for plants to produce.
- If rock is stored for a period of time (estimated one week or longer) at the facility, the #200 results would likely increase, due to blowing dust or operations at the plant (e.g., if a pile of rock is downwind of a crusher). The samples collected to test whether rock meets specifications are taken shortly after production, so they have not quantified how much the fines increase over time when rock sits at the plant.
- Rock can be washed a second time in a rinse plant for an estimated additional cost of $5–$20 per ton, depending on the quantity of rock washed at a time. Larger quantities of rock will result in a lower additional cost per ton. CWA recommended that rock be washed a second time shortly before it is picked up, to reduce the fines in the rock from typical plant operations.

Based on the findings, it is recommended that a second wash be requested for the gravel backfill for drywells and pea gravel included in the non-vegetated filtration swale before pick-up from the supplier, and that rock be protected during construction from operations that produce large amounts of dust or fines. Additionally, once the rock is placed in the swale, the swale should be protected until the surrounding area is stabilized, similar to other BMPs. Additional information is included in **Appendix B**.

5.2 Design Recommendations

This section describes recommendations for the design of a non-vegetated filtration swale, based on data collected during the study. The recommendations include minimum swale length, minimum hydraulic residence time, and appropriate Manning's n for the swale.

5.2.1 Length of Swale and Hydraulic Residence Time

The minimum recommended length of the non-vegetated filtration swale is 200 feet. The length was determined based on the water quality performance of the constructed final swale alternative at different sample locations (as discussed in **Section 4**). Specifically, the sample location where basic treatment was met (before maintenance would be required) was determined to be the minimum length for the swale. Based on the predicted treatment performance using the data from the trendlines, it appears that the basic treatment performance goal can be achieved at 200 feet as discussed in **Section 4.3**. This recommendation is included in the design guidance in **Appendix B**.

If there is not enough room to construct a 200-foot-long swale at a project site, it is anticipated that the swale configuration could be modified as long as the recommended hydraulic residence time is met. The recommended hydraulic residence time is 50-minutes, which is what was measured when the final swale alternative was tested in the field (summarized in **Appendix B**) as shown in **Table 5-1**. Adjustments made to the final swale design alternative dimensions to accommodate different configurations are shown in **Table 5-2**. These configurations provide examples of how dimensions could be adjusted while meeting the minimum hydraulic residence. Additional testing will be needed to confirm the performance of the different configurations (see **Section 6**).

Note: The hydraulic residence time results of the other four swale design alternatives are included in **Appendix D**.

Table 5-1. Final swale alternative hydraulic residence time measurements

Event	Time (hh:mm:ss) at Each Location								
	Start	25 FT	50 FT	75 FT	100 FT	125 FT	150 FT	175 FT	200 FT
1	0:00:00	0:03:40	0:08:45	0:14:00	0:20:15	0:26:25	0:33:22	0:40:43	0:51:15
2	0:00:00	0:03:53	0:08:27	0:13:51	0:19:42	0:25:38	0:32:24	0:39:32	–
3	0:00:00	0:03:50	0:09:04	0:14:30	0:20:44	0:27:14	0:34:42	0:42:59	0:52:36
4	0:00:00	0:03:36	0:08:26	0:13:45	0:19:37	0:25:41	0:32:26	0:39:34	0:46:41
5	0:00:00	0:03:39	0:08:32	0:13:57	0:19:57	0:26:04	0:33:02	0:40:33	0:48:47
6	0:00:00	0:03:40	0:08:32	0:13:57	0:19:57	0:26:04	0:32:58	0:40:21	0:48:58
Average	**–**	**0:03:42**	**0:08:37**	**0:14:05**	**0:20:08**	**0:26:24**	**0:33:33**	**0:41:14**	**0:50:10**

Table 5-2. Alternative swale configurations for final swale alternative

Configuration[1]	Swale Bottom Width	Approximate Swale Length (ft)[2]
1	2	200
2	5	141.5
3	10	95.5
4	15	74
5	20	61.5

[1] The configurations represent a design with a 1% slope.

[2] The swale lengths associated with each swale bottom width maintain a hydraulic residence time of 50 minutes through the swale.

5.2.2 Manning's n Verification

Residence time measurements collected in the field and resulting velocity calculations were used to verify the Manning's n for the treatment rock layer in the final swale alternative. Manning's n was estimated at the start of the project to include in draft design guidance for the non-vegetated swale (Appendix A of study QAPP), to represent flow through the treatment rock layer and to calculate dimensions of a swale using Manning's equation. The Manning's n used in the draft design guidance (0.4) was based on the values found in the design guidance for the Biofiltration Swale design guidance in the SWMMEW and SWMMWW as well as TAC input. The Manning's n was updated to represent flow through the treatment rock layer and over the pea gravel layer. The updated Manning's n values are expected to accurately calculate swale dimensions that could handle water quality design flow rates for the final swale alternative.

Treatment Rock Layer Manning's n

To calculate the Manning's n for the treatment rock layer, the average velocity of flow in the treatment rock was calculated from the length of the swale divided by the average time (from 6 events) for flow to travel through the swale. Table 7-1 contains the average time for water to travel through the swale (hydraulic residence time = 50 minutes). Manning's equation was rearranged to solve for n using the swale dimensions and average velocity. The full calculation is included in **Appendix D**, and the updated Manning's n was calculated as 0.77. The design guidance, found in **Appendix B**, contains instructions on how to use the updated manning's n to size a swale.

As the Manning's n for flow through the treatment rock layer is higher than what was originally included in the draft design guidance, and because the roughness represents flow through rock, which is not a typical application of the Manning's equation, literature was reviewed to understand how the calculated Manning's compared with other similar n values and if this method is appropriate for sizing the non-vegetated filtration swale. A visual reference guide (Yochum, Comiti, Wohl, David, & Mao, 2014) of Manning's n for streams under low flow conditions was reviewed to compare the findings of the Manning's n verification to similar roughness conditions (stream flow through rock and other obstructions) and to understand whether the 0.77 Manning's n value was reasonable. **Figure 5-1** includes images of streams from the guide with similar or higher Manning's n values than the non-vegetated filtration swale. Because similar or higher Manning's n values were observed in the guidance, the magnitude of the Manning's n calculated for the swale was assumed to be reasonable.

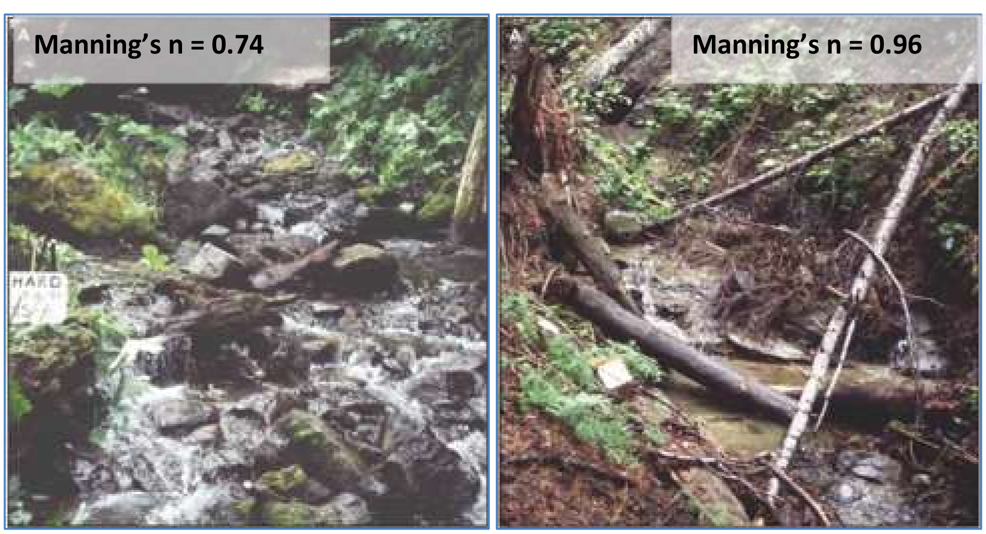


Figure 5-1. Low flow stream channel Manning's n Values (Yochum, Comiti, Wohl, David, & Mao, 2014)

A report (Mulqueen, 2005) studying the flow through gravels was also reviewed, and it indicated "that coarser aggregates exhibit flow characteristics similar to rough-walled pipes." Coarse aggregates in the study included aggregate falling under No. 4, or a size range of 9.5 to 25.4mm (0.37 to 1 inch), which is roughly the same size as the gravel backfill for drywells used in the final swale design alternative. As Manning's n can be used to describe rough-walled pipes, it was assumed that the use of Manning's n to describe flow through the gravel in the non-vegetated filtration swale would be appropriate.

Pea Gravel Layer Manning's n

In addition to Manning's n to represent flow through the treatment rock layer, Manning's n to represent flow over the pea gravel was also determined. The Manning's n representing flow over the pea gravel was needed to calculate the width of the swale at the base of the gravel backfill for drywells and is included in the design guidance in **Appendix B**. The n value was determined by solving for n in Manning's Equation using the dimensions of the test swale and other variables measured during testing. The resulting Manning's n value is 0.58.

5.3 Operation and Maintenance Considerations

Operation and maintenance of an installed non-vegetated filtration swale is based on the water quality treatment performance of the swale as discussed in **Section 4**. The results of the analysis indicate that maintenance to restore the treatment performance would be needed for the 200-foot-long swale every two to three years. The frequency of maintenance may be extended for longer swales, or with inclusion of a catch basin at the upstream end of the swale (to collect sediment before it enters the swale). At the time of this final report, insufficient data is available to estimate the change in frequency for longer swale lengths and the addition of a catch basin upstream. Additionally, the actions and scale of the actions needed to restore the swale treatment performance, which could include flushing the swale to remove TSS and the quantity of water needed to flush the swale, are unknown. The focus of the study was to understand the treatment performance and estimate the maintenance cycle of the non-vegetated filtration swale. The effectiveness of specific maintenance actions in restoring treatment performance was not evaluated during the study. These unknowns are discussed further in **Section 6**. This operation and maintenance information as well as other actions are summarized in the design guidance in **Appendix B**.

Routine maintenance practices, such as sediment removal (in inlets), trash pickup, and weed control, would need to be performed more frequently depending on location. The following practices are recommended for the non-vegetated filtration swale:

- Clean curb cuts when soil and/or any vegetation buildup interferes with flow into the swale.
- Remove litter to keep the non-vegetated filtration swale free of external pollution.
- Perform weed control practices to limit vegetation growth in the swale (see **Section 6**).
- Inspect swale for damage or deposition of sediment or debris after periods of heavy runoff. Remove sediment or debris and make any necessary repairs.

Given the construction and operation and maintenance considerations for the non-vegetated filtration swale, a life cycle cost comparison was developed comparing the non-vegetated filtration swale and biofiltration swale from the SWMMEW. While maintenance costs were not able to be compared as maintenance actions to restore treatment of the non-vegetated filtration swale were not determined, the construction costs indicated that a biofiltration swale may be more costly than a non-vegetated filtration swale to install, especially if an irrigation system is needed to establish grass. The results of the cost comparison are found in **Appendix G**.

6. Future Action Recommendations

Based upon the results, the following topics should be studied further to better understand the performance and maintenance requirements of the non-vegetated filtration swale:

- Based on the treatment performance described in **Section 4**, the non-vegetated filtration swale is recommended for conditional use level approval, in order to better understand the treatment performance in field installations, as well as gather data for the research gaps described in the subsequent bullets.
- Per **Section 5**, the maintenance actions to restore treatment performance at the end of the maintenance cycle require additional study. In particular, research into which actions most effectively restore treatment performance as well as consume the least time and resources is needed.
- As the final swale alternative was installed for a few weeks during the dry season in West Richland, no vegetation or weeds grew in the footprint of the swale. More long-term installations, or installations in locations that receive more rainfall, should be observed for establishment of weeds, and maintenance actions to limit or remove vegetation growth should be evaluated.
- As controlled tests were performed and the final swale alternative was installed for a short period (see previous bullet), the frequency for minor maintenance actions, such as removal of sediment or debris in inlets, was not evaluated. More long-term installations should be observed to understand how quickly deposition of sediment and debris occurs, and how frequently maintenance is needed.
- While not previously mentioned in this report, it is unknown what impact a catch basin or forebay located at the upstream end of the swale would have on the treatment performance and maintenance frequency required for the non-vegetated filtration swale. It is hypothesized that the use of a catch basin or forebay at the upstream end of a non-vegetated filtration swale may improve the performance and lengthen the maintenance cycle for the BMP by allowing sediment to settle out before stormwater flows through the swale.
- It is hypothesized that alternative configurations for the swale (increased bottom width to reduce length) would provide sufficient treatment if the minimum hydraulic residence time is met. However, it is unknown whether the treatment performance achieved is due to gravity separation, which correlates to residence time, or filtration through the rock, which would depend on the swale length. As such, additional testing is needed to confirm that alternative configurations would provide Basic treatment.
- As discussed previously, the samples collected during the study were grab samples collected shortly after flow reached each sample location. As such, they reflect first flush conditions of the swale system, and the concentrations in the swale, as reported in **Section 4**, are anticipated to be higher than if a composite sample were collected (which are typically used to evaluate BMP treatment performance). Additional study would be necessary to understand the treatment performance of the non-vegetated swale during natural storm events.
- Additional testing using actual storm events is recommended to better understand the swale treatment performance. Moreover, while trendlines predicted 200 feet is sufficient, it is recommended that future test swales use a 250 feet length in case additional length is needed

to consistently achieve 80% TSS reduction. The additional length may also extend the maintenance cycle of the swale.

7. Conclusions

The purpose of this study was to evaluate the effectiveness of a non-vegetated filtration swale BMP. Effectiveness is based upon whether the BMP can provide basic treatment (80% reduction of TSS) in accordance with Ecology treatment performance goals (Ecology, 2011). The purpose of this study was achieved by meeting the objectives outlined in the QAPP, the results of which are summarized in the following paragraphs.

Objective #1: Define the draft BMP design and maintenance guidance and refine the BMP design and maintenance guidance using data collected during the study.

The draft BMP design guidance was developed for the study QAPP which was created using the biofiltration swale guidance defined in SWMMEW and edited based on a review of literature for conditions expected with a rock lined swale. Data collected in the field from this study was used to refine the draft BMP design and maintenance guidance. The updated guidance is included in **Appendix B**.

Objective #2: Determine the TSS pollutant removal efficiency of the BMP by measuring and comparing pollutant concentrations in the synthetic influent to eight sample locations in each test swale.

Water quality (TSS) samples were measured at the influent and eight sample locations in the swale. The samples collected are grab sample results, which represent the first flush concentrations through the swale. As such, they are expected to be higher than an event mean concentration, which is typically used to evaluate the treatment performance of BMPs. The following paragraphs describe the results of the water quality data analysis.

The initial sample results indicate that 84.5–87.8% removal of TSS is achieved for the first simulated year for a 200-foot-long swale. However, percent removal decreases for Events 3 and 5 (27.8% and 49.9%, respectively), and slightly decreases for Events 4 and 6 (70.5% and 72.8%, respectively). Events 3 and 4 represented the second simulated year, and Events 5 and 6 represented the third simulated year.

During testing, the installation of weirs at the downstream end of the swale likely caused the decrease in percent removal for Events 3–6. The weirs were installed because erosion was observed at the end of the swale. The erosion was due to a grade break that was part of the experimental design; it was only present for the final swale alternative as the impermeable liner included in the four alternative designs protected the existing ground. The weirs were installed before Events 3 and 5 and were intended to prevent the erosion from impacting sample collection. To understand how the swale would have behaved if the weirs were not installed, trendlines were developed to fit the initial sample results.

A trendline was developed for each simulated year during testing, which is anticipated to describe how the swale would perform in a field installation as TSS accumulates in the swale cross-section without some of the issues that occurred during testing. The resulting concentrations are shown in **Table 4-3**. Using the predicted concentrations, the calculated percent removal for the swale meets treatment performance goals for the first two years and would require maintenance to restore treatment performance sometime between the second and third year.

Objective #3: Determine the design flow rate and velocity for which the BMP provides treatment by measuring flow depth at the upstream and downstream end of each swale as well as the travel time through the swale and then calculating velocity and flow rate.

The hydraulic residence time measured in the field was 50 minutes, from which a design velocity of 0.07 ft/sec was calculated. The hydraulic residence time for the swale was measured by timing the flow of water as it travelled to each sample location. The velocity was then calculated by dividing the length of the swale by the hydraulic residence time. The calculations are discussed in **Section 5.2** and **Appendix E**.

Objective #4: Determine whether the treatment performance goals were achieved by comparing study results to TAPE treatment criteria and requirements.

The percent removal results in **Table 4-4** were compared to the TAPE treatment performance goals for TSS using the bootstrap statistical analysis using the trendline data to predict the treatment performance without the issues observed in the field. Years 1 and 2 represent the performance of the swale before maintenance is needed. However, only two data points were available, resulting in the lower one-sided 95% confidence interval around mean removal efficiency being equivalent to the lower of the two removal efficiencies. The evaluation of removal efficiencies calculated for years 1–3 added one data point and indicated the swale would meet the TAPE treatment performance goal for all three simulated years.

7.1 Recommendations

Based upon the results, the following topics should be studied further to better understand the performance and maintenance requirements of the non-vegetated filtration swale:

- Based on the treatment performance of the non-vegetated filtration swale, the BMP is recommended for conditional use level approval.
- Additional study is needed to understand what maintenance actions will most effectively restore treatment performance at the end of the maintenance cycle.
- Any long-term installations of the swale should be observed for establishment of weeds, and maintenance actions to limit or remove vegetation growth should be evaluated.
- Any long-term installations should be observed to understand how quickly deposition of sediment and debris occurs, and how frequently maintenance is needed.
- Additional study is needed to understand what impact a catch basin or forebay would have on the treatment performance and maintenance frequency required for the swale.
- As samples collected during the study reflect first flush conditions in the swale, additional study would be necessary to understand the treatment performance of the non-vegetation swale for the duration of an entire storm event.
- Additional testing using actual storm events is recommended to better understand the swale treatment performance.

8. References

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9. Appendices

Appendix A – Ecology and TAC Comments

Comment #	Commenter Initials	TAC or ECY	Page *listed (actual)*	Section	Comment Text	Response
1	CG	TAC	ii (3)	Acknowledgements	summer of 2022?	Revised year to 2022.
2	AFW	TAC	ii (3)	Acknowledgements	smoke from summer PNW forest fires	Added text regarding smoke from forest fires during testing.
3	AFW	TAC	ii (3)	Acknowledgements	Summer 2022	Revised year to 2022.
4	AFW	TAC	ii (3)	Document History	should this state at the City of West Richland weblink on the previous page?	Replaced "the link on the previous page" with the weblink.
5	AJ	ECY	iii (4)	Signature Page	Update	Revised City of Walla Walla Contact.
6	AJ	ECY	iii (4)	Signature Page	No signature from Brandi in TER, check with Doug Howie on any additional signatures from TAPE review	Removed Brandi; added Mark Melton as a Reviewing Engineer.
7	AFW	TAC	iv (5)	Distribution List	Is this the new Walla Walla contract	Yes, Steve Kelley is the new contact for City of Walla Walla.
8	AFW	TAC	3 (8)	2	Something does not read right in this sentence.	Revised to improve sentence structure.
9	AFW	TAC	3 (8)	2	Should it also be mentioned that there were 5 1-year loading events?	The five years of TSS loading are described in the following paragraph; will leave in that paragraph to avoid repetition.
10	AFW	TAC	3 (8)	2	then	Kept original text for readability.
11	AFW	TAC	3 (8)	2	The 5th swale was loaded slightly different than the first 4 swales.	Added to sentence to indicate the number of simulated years was three instead of five.
12	AFW	TAC	3 (8)	2	Should there be a table that shows the rock layers that were tested in the executive summary?	Typically the executive summary does not include tables or other graphics.
13	AFW	TAC	4(9)	2	I think there should be a brief statement on why the installation of the weir impacted the results.	Added text explaining why weir installations impacted results.
14	AFW	TAC	4(9)	2	which was installed to..	Revised sentence and add suggested text.
15	AJ	ECY	5(10)	3.1	SWMMEW or WWA?	The intent was to develop guidance that could be used on both sides of the state. Added text to clarify.
16	AFW	TAC	5(10)	3.1	what is being referred to as "existing"?	Existing was meant to refer to the biofiltration swale design in the manuals. Added text to clarify.
17	AJ	ECY	8 (13)	3.4	washed pea gravel	Revised to match suggested text.
18	AFW	TAC	8 (13)	3.4	This does not seem to be read right or correct.	Revised to clarify when and how many batches were delivered to the swale.
19	AJ	ECY	12(17)	4.2.2	pre-measured/weighed?	Added "pre-measured" to text.
20	AFW	TAC	13(18)	4.2.2	What is "ADD"	This is a placeholder to add photo credits to each image. These have been replaced throughout the document.
21	AFW	TAC	16(21)	5.1	There were this many missing time readings?	Yes. The original plan to measure velocity did not include measuring time for flow to reach each sample port. This was revised during the first sample event, which is why the first 7 points are missing. Occasionally, something would come up during testing which would result in missing a time measurement (i.e., erosion at the downstream end of the swale). This is why the remaining three data points were missed.
22	AJ	ECY	22(27)	6.3	This sentence is confusing. Please reword	Revised sentence to clarify meaning.
23	AJ	ECY	22(27)	6.3	I'm trying to figure out what you do with these values beyond using them in your ranges in the tables. Are they represented in figures 62 and 63? What does your QAPP say to do with them?	In talking with the lab, they recommended that the duplicate results be used as error bars to understand the potential range of each concentration. Because the ranges of concentrations did not change whether each sample event did/did not reach the targeted 80% removal, and because trendlines were developed in place of using the original water quality to udnerstand swale performance, the ranges in the tables were only reported in Table 6.2. The QAPP does not clarify what to do with values above the ±5%
24	AJ	ECY	25(30)	6.3	why aren't you showing a range here?	Will add a range of values to final row of the table.
25	AJ	ECY	29(34)	6.3	incomplete statement?	Removed unnecessary incomplete statement.
26	AFW	TAC	33 (38)	6.3	no label on y axis?	Will add label to y-axis.

Comment #	Commenter Initials	TAC or ECY	Page *listed (actual)*	Section	Comment Text	Response
27	AFW	TAC	42(47)	7.3	Shouldn't this be filtration swale and not biofiltration swale?	Yes, will revise to non-vegetated filtration swale.
28	AJ	ECY	44 (49)	9	This is for 200 feet of swale length, please specify.	Added text to clarify that the results achieved were for a 200-foot-long swale.
29	AFW	TAC	44 (49)	9	observed when no liner was in place. I think this helps explain why we observed erosion during this testing compared to previous test.	Added text to clarify that the liner was not in place and that erosion was only observed during the final swale alternative.
30	JEB	TAC	42 (47)	7.3	reference appendix F, not G	Revised to reference Appendix G.
31	JEB	TAC	Appendix G, pg 1		cost per ton includes extra washing of rock?	Will revise cost of rock to include average extra cost ($12.5 per ton) to wash rock.
32	AFW	TAC	Appendix G, pg 1	Appendix G	Many of these systems will need to be fed water from city domestic water. There is a cost associated with the installation of a water meter and connection frees that have to be paid that is not represented in this. For example, if there was a water main right at the site, our cost to install a full 1" service and meter would be $2370 (and this would not include any costs that might be associated with repairing any asphalt if by chance the install required this). There would also be a Water System Development Fee of $6089 just to connect to the City water for a total minimum cost of $8459. This service would also require a double check valve assembly to be installed and tested annually at a cost.	Added footnote indicating additional costs associated with irrigation system.
33	AFW	TAC	Appendix G, pg 1	Appendix G	I don't have a good bid to compare the price for this but just looking at the total to supply and install sod, it seems low.	Revised cost after expanding Unit Bid Analysis search.
34	AFW	TAC	Appendix G, pg 1	Appendix G	May want to add a note that this assumes battery operated timer or assumes power is readily available for the controller. If a power service is needed to just power a timer, that could add another $5k just to get a power service.	Included in footnote that power would be an additional cost associated with irrigation system.
35	AFW	TAC	Appendix G, pg 1	Appendix G	Does this included the added cost for the extra washing of the rock?	Will revise cost of rock to include average extra cost ($12.5 per ton) to wash rock.
36	AFW	TAC	Appendix G, pg 1	Appendix G	Does this include the added cost for the extra washing of the rock?	Will revise cost of rock to include average extra cost ($12.5 per ton) to wash rock.
37	AFW	TAC	Appendix G, pg 1	Appendix G	If you are comparing maintenance costs related to costs, the water use has an associated cost.	Because the cost of maintenance for the non-vegetated swale was not able to be estimated, the costs were left out for the vegetated filtration swale. Will add a footnote to Table G.2 to indicate there is an additional cost related to water usage.
38	AFW	TAC	Appendix G, pg 2	Appendix G	Could also be linked to overwatering and excessive soil saturation of the bio swale.	Added text to check for overwatering or soil saturation in the swale.
39	AFW	TAC	Appendix G, pg 2	Appendix G	I agree with Mark. This would probably be due to the swale being too flat, failing infiltration of the swale bottom, or failure and/or blockage of the outfall infrastructure if there was one	Added text to maintenance action items for the non-vegetated swale.
40	AFW	TAC	Appendix B, pg 1	Appendix B	Is this statement correct? The length is based on the design width and obtaining a 50-min residence time. Should 200' be stated here?	Added reference to design procedure for alternative configurations (widening the swale to reduce the length).

Comment #	Commenter Initials	TAC or ECY	Page *listed (actual)*	Section	Comment Text	Response
41	AFW	TAC	Appendix B, pg 1	Appendix B	What is the purpose of this?	This is a device included in the manuals to spread flow across the swale when the bottom width is greater than 10ft. Added reference to distribution header to this bullet; a distribution header would need to be designed in future versions of the swale.
42	AFW	TAC	Appendix B, pg 3	Appendix B	"Install a"	Will add suggested text.
43	AFW	TAC	Appendix B, pg 3	Appendix B	"provide"	Will revise to suggested text.
44	MPN	TAC	Appendix B, pg 4	Appendix B	Add who's Standard Spec. looks like WSDOT	This is the title of the specifications. Will add WSDOT before the title.
45	MPN	TAC	Appendix B, pg 5	Appendix B	add units for porosity (%)	Added (%) as unit for porosity
46	MPN	TAC	Appendix B, pg 6	Appendix B	revise line spacing and tabs in calculation steps 5, 6, and 7.	Revised spacing to be consistent.
47	AFW	TAC	Appendix B, pg 8	Appendix B	Care should be taken when gathering, transporting and placement of rock to avoid contamination of the treatment rock.	Will add suggested text to bullet.
48	MPN	TAC	Appendix B, pg 8	Appendix B	Possible technique: Flushing with clear potable water should be continued until the outflow reaches a turbidity of less than XXX NTUs. Turbid wash water should be collected and decanted or otherwise kept from surface water or groundwater facilities.	Left description of flushing less specific according to following comment. Added detail regarding what would be flushed through the swale.
49	MPN	TAC	Appendix B, pg 8	Appendix B	The last comment "flushing" may be too specific without testing. You may disregard it.	Left description of flushing less specific according to comment. Added detail regarding what would be flushed through the swale.
50	AFW	TAC	Paraphrased from TAC Meeting	Appendix B	Add option to install distribution header at inlet instead of swale divider if bottom width >10 feet	Added option to install distribution header at inlet instead of swale divider.
51	AFW	TAC	Paraphrased from TAC Meeting	7.2.1	Add a note somewhere that the configurations shown in table 7-2 represent a design with 1% slope.	Added a note below Table 7-2 that describes the configurations represent a design with a 1% slope.
52	AFW	TAC	Paraphrased from TAC Meeting	Appendix G	Include with biofiltration swale estimate the additional cost for water meter and connection fee associated with domestic water and cost associated with access to power.	Added footnotes to cost estimate table reflecting water meter, connection fee, and cost to provide power.
53	MM/HL	ECY	(13)	3.4	It was not clear to us from the description if the initial 25-year flow is intended to be clean water or synthetic stormwater.	Added note clarifying that 25-year flow was comprised of potable water and did not include SilCoSil.
54	MM/HL	ECY	(24)	6.1	In figure 6-1 the plan view shows swales A and B, however the profile is only for Swale A. The way the profile is lined up with the plan view it makes it appear as if the profile is supposed to represent the entire plan view. Additionally there is a note in the plan view for Swale B which says see profile below for elevations which adds further confusion. Consider revising to add some clarity.	Separated Figure 6-1 into two separate figures to help clarify. Removed note in the plan view for Swale B to reduce confusion.
55	MM/HL	ECY	(29-30)	6.3	For Tables 6-1 and 6-2 consider adding a footnote or modify the table in a way that identifies that an annual loading of TSS was added at the end of years 1 and 2.	Added footnote at end of Tables 6-1 and 6-2 to clarify that an annual loading of TSS was added following Event #2 (end of Year 1) and Event #4 (end of Year 2).
56	MM/HL	ECY	(29-30)	6.3	With the uncertainty added to events #3 and #5 for sample location #8 it seems like an additional row should be added to the tables that includes % removal from influent to 175 feet.	Added row to table displaying original water quality concentrations (for final swale) indicating the percent removal from the influent to 175 feet.

Comment #	Commenter Initials	TAC or ECY	Page *listed (actual)*	Section	Comment Text	Response
57	MM/HL	ECY	(45)	7.2.1	How can we be sure sediment removal efficiency is due to the gravity separation which correlates to residence time and not the filtration through the amount of rock which would depend on the swale length? Would a very wide and short swale need its own testing?	This would require further testing. Added a note where different configurations are mentioned that indicates additional testing is needed to confirm the performance of the different configurations.
58	MM/HL	ECY	N/A	N/A	Within the TER can you describe how the 1000 gallon simulated storm volume and TSS concentrations were decided upon.	This is described in the study QAPP.
59	MM/HL	ECY	N/A	N/A	The QAPP description of the simulated design storm indicated that an annual load of TSS would be added at the end of each design storm however the final evaluation only included annual TSS loading at the end of years 1 and 2. What led to the change from the procedure in the QAPP?	This procedure was changed after discussions with the participating entities and Ecology. The procedure was changed as initial testing of gravel backfill for drywells indicated the rock would potentially require maintenance to restore testing sometime in year 2-3. Additionally, there was a desire to collect more data during the time the gravel backfill for drywells would be meeting treatment performance, to have more data points to use in data analyses. This has been added in Appendix C.5 Deviations from QAPP.
60	MM/HL	ECY	N/A	N/A	Can you please better describe in the TER how the annual TSS load was applied.	This is described in the study QAPP.
61	MM/HL	ECY	N/A	7.2.2, Appendix B	We believe we found a discrepancy between the design procedure in the design guidance document and the TER. The design procedure specifies using a Manning's of 0.58 for the flow above the pea gravel. In the TER it says that 0.58 should be used for flow through the pea gravel and additionally specifies that the Manning's through the treatment layer should be 0.77. Please revise as necessary.	There are two separate Manning's n. The Manning's n of 0.58 is for flow above the pea gravel. The Manning's n of 0.77 is for flow through the treatment layer. Revised language in TER to make consistent with the design guidance.

Appendix B – Non-Vegetated Filtration Swale BMP Design Guidance

This document was developed by editing the SWMMEW BMP T5.40: Biofiltration Swale Design Guidance based on the results from the study described in this document.

A non-vegetated filtration swale is a sloped, rock-lined swale that provides both conveyance and runoff treatment for stormwater runoff. This BMP is similar to a biofiltration swale except treatment occurs as runoff flows through a layer of rock in the swale instead of grass. The use of rock instead of grass eliminates the need for irrigation during dry periods. The swale bottom width and rock depth are sized to provide Basic (TSS) treatment during the water quality design storm (See Chapter 4 of the SWMMEW, Hydrologic Analysis and Design). It does not provide flow control but can convey runoff to Best Management Practices (BMPs) designed for that purpose.

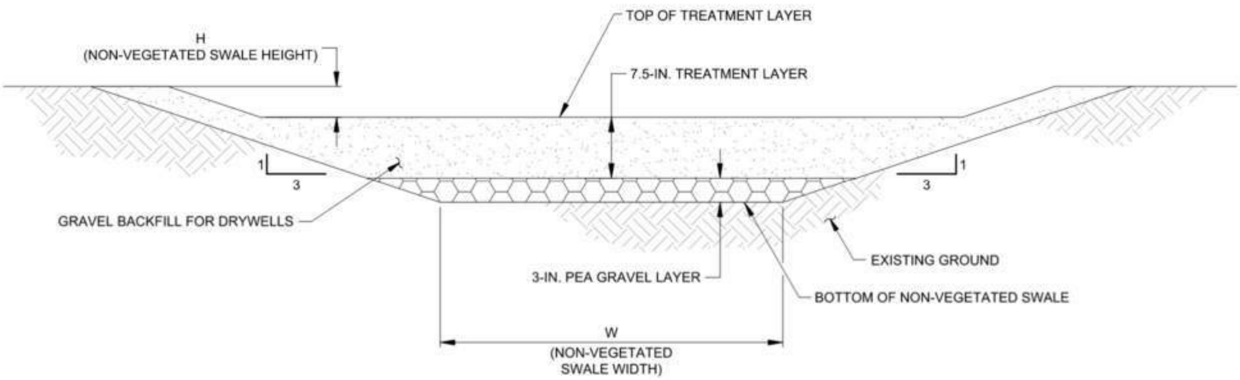

Figure B 9-1: Non-vegetated filtration swale cross section

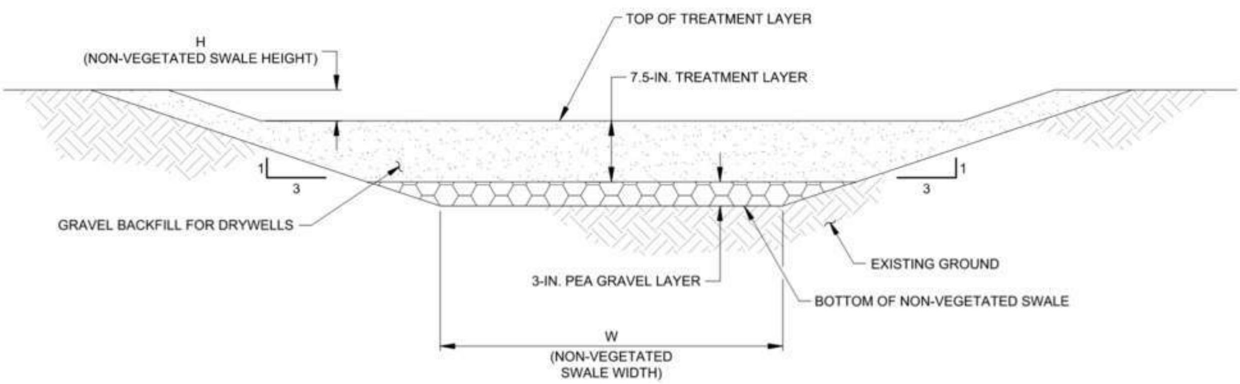

Figure B 9-1 shows a typical cross-section of a non-vegetated filtration swale. The swale bottom width (W) is measured at the bottom of the pea gravel layer, below the treatment layer depth, where the rock meets the existing ground. The treatment layer depth provides removal of sediment and TSS through filtration as runoff flows through the treatment layer and sedimentation, as the rock reduces the runoff velocities and sediment settles in the rock layer. The treatment layer depth is designed to contain the depth of the runoff from water quality flow rate. As such, higher flow rates would be partially conveyed above the surface of the treatment layer.

9.1.1 General Criteria

This section provides design considerations and limits for the non-vegetated filtration swale. Specific criteria and steps to size a non-vegetated filtration swale can be found in **Section 9.1.3**, Design Procedure.

- The swale length is determined using a 50-minute hydraulic residence time through the swale with a minimum length of 200 feet. If a 200-foot length is not available, alternative configurations are described in Step 9 of the Design Procedure. These configurations require additional testing to confirm the performance is not impacted by changes in swale length.
- Calculate the bottom width using Design Criteria. The minimum allowed bottom width of the swale is 2 feet. If the bottom width of the swale is 10 feet or more, either a swale divider (as shown in Figure V-7.2 in the SWMMWW) or a distribution header is required.
- The channel slope shall be greater than or equal to 1% and less than or equal to 5%.
- Size the swale as a runoff treatment BMP using the methods in Chapter 4 of the SWMMEW, Hydrologic Analysis and Design, and as a conveyance BMP to pass the peak hydraulic flows of the 25-year storm if it is located "online."
- The cross section of the swale shall be a trapezoid with side slopes no steeper than 3:1.
- If the swale has a continuous inflow, begin the minimum swale length from the last input, while maintaining the 50-minute hydraulic residence time.
- If runoff enters the swale through one location, a forebay or pre-settling chamber is recommended upstream or at the inlet of the swale to reduce gross solids from entering the swale and reduce swale maintenance. Depending on how the flow enters the swale, the forebay or pre-settling chamber can also be replaced with a standard catch basin inlet at the upstream end of the swale. Examples of forebays are shown in **Figure B 9-2** and **Figure B 9-3** and are defined in the Glossary of the SWMMWW and SWMMEW.

Figure B 9-2: Curb extension with concrete forebay (City of Portland, n.d.)

Figure B 9-3: Rock-Lined Forebay in Swale (Sustainable Technologies Evaluation Program, 2020)

- If flow is to be introduced through curb cuts, curb cuts should be ≥ 12 inches wide to prevent clogging.
- The non-vegetated filtration swale should not receive runoff until areas of exposed soil in the contributing drainage catchment have been sufficiently stabilized. If runoff is not able to be re-directed, pre-settling of sediments should be provided. (See BMP C240E: Sediment Trap and BMP C241E: Sediment Pond [Temporary]). Such filtration BMPs should be evaluated for the need to remove sediments, with the understanding that restoration of the treatment rock layer may still be necessary following construction. The maintenance of pre-settling basins or sumps is critical to their effectiveness as pretreatment devices. (See Element 13 Protect Low Impact Development BMPs of the Stormwater Pollution Prevention Plan.)
- Where runoff diversion is not possible during construction, and runoff is directed to the swale, cover the rock with BMP C123/C123E Plastic Covering (SWMMWW and SWMMEW) or similar covering, and protect exposed soils with suitable erosion control measures.
- Prior to and following installation, stockpiled rock should be protected from dust using BMP C123/C123E Plastic Covering (SWMMWW and SWMMEW) or similar covering.

9.1.2 Rock Sizing Criteria

- Install a 3-inch layer of pea gravel along the bottom of the swale to allow for infiltration into the existing ground and limit the intrusion of existing soils from the ground into the gravel backfill for drywells. The pea gravel shall meet the gradation in **Table B 9-1**.
- Install a 7.5-inch layer of gravel backfill for drywells above the pea gravel to provide treatment of TSS. Cover the side slopes of the swale with the gravel backfill for drywells (see **Figure B 9-1**). Gravel backfill for drywells shall meet the gradation in **Table B 9-1**.
- If additional stabilization is needed above the gravel backfill for drywells, a 2-inch or larger coarse gravel should be used to limit rock movement during flows between the water quality event and the 25-year flow. The coarse gravel should be placed at a depth of 2.5 inches above the treatment rock in swales with a 2.5% to 5% longitudinal slope.
- The contractor must obtain a grain size analysis from the supplier to certify that the highest sieve size and the No. 200 sieve requirements are met for each gravel used.
- Request that each gravel be washed at the supplier, less than one week prior to pick up. This reduces the possibility of fines accumulating in the rock at the plant. Additional discussion on the washing of the gravel is included in **Section 9.1.4**, Construction Criteria.

Table B 9-1: Rock gradations for swale alternatives

Sieve Size	Sieve Size (mm)	Gravel Backfill for Drywells[1]	Pea Gravel[2]
1 ½”	37.5	99-100	
1 1/4"	31.5		
1”	25	50-100	
¾”	19	0-20	
5/8"	16		
½”	12.5		99-100
3/8”	9.5	0-2	85-100
#4	4.75		10-30
#8	2.36		0-10
#16	1.18		0-5

[1] Matches WSDOT *Standard Specifications for Road, Bridge, and Municipal Construction* 9-03.12(5).
[2] Matches AASHTO #8.

9.1.3 Design Procedure

The stepwise procedure for designing non-vegetated filtration swales for runoff treatment includes the following:

1. Determine the water quality design flow rate to the swale. (See Chapter 4 of the SWMMEW, Hydrologic Analysis and Design.)
2. Determine the slope of the swale.
3. Use a trapezoidal shape for the swale, with side slopes of 3:1.
4. Use Manning's Equation to estimate the width of the swale at the base of the gravel backfill for drywells layer. Use y=0.25 ft for the equivalent depth of flow in the treatment rock layer[1]. Manning's Equation for English units is as follows:

Equation 5.1: Manning's Equation

$$Q = (1.486 * A * R^{0.667} * S^{0.5})/n$$

where:

Q = flow (cfs)
A = cross-sectional area of flow (square feet [sf])
R = hydraulic radius of flow cross section (feet [ft])
S = longitudinal slope of swale (feet per foot [ft/ft])
n = Manning's roughness coefficient

Use n = 0.58 for the water quality design flow rate to represent flow above the pea gravel layer.

For a trapezoid, Equation 5.1: Manning's Equation cannot be directly solved for width of the swale. However, for trapezoidal channels that are flowing very shallow, size the hydraulic radius to be equal to the depth of flow. Using this assumption, the typical Manning's Equation, Equation 5.1, was altered to Equation 5.2 to solve for the width at the base of the gravel backfill for drywells layer.

Equation 5.2: Swale Bottom Width

$$B = \frac{\left(\left[\frac{n}{1.486}\right] * Q\right)}{(y^{1.667} * S^{0.5})} - (Z * y)$$

where:

B = bottom width of the swale (ft)
Q = flow (cfs)

[1] The depth of gravel backfill for drywells was sized to contain a maximum effective flow depth of 3 inches. The effective depth is the flow depth if it were unobstructed by the treatment rock layer and is based on the porosity of the treatment rock layer. If measured in the treatment rock layer, the flow depth would exceed 3 inches as flow travels through the pore spaces in the rock.

y = equivalent depth of flow in the treatment rock layer[2] (ft); the maximum allowed depth is 3 inches
S = longitudinal slope of swale (ft/ft)
Z = the side slope of the swale in the form of z:1 (use a side slope of 3:1)

If the width calculated is less than 2.6 feet, assume a bottom width (at the base of the gravel backfill for drywells layer) of 2.6 feet.

5. Using the side slope of 3:1 and a pea gravel depth of 3 inches, calculate the bottom width of the swale below the pea gravel. The minimum width below the pea gravel shall be at least 2 feet.

   Use the porosity of the treatment rock layer to determine the depth of the treatment layer needed. Divide y from Equation 5.2 by the porosity of the treatment layer rock. Use 40% porosity.

Equation 5.3: Treatment Rock Layer Depth

$$D = \frac{y}{\emptyset}$$

where:
D = depth of treatment rock layer (inches)
y = equivalent depth of flow in the treatment rock layer (ft) used in Equation 5.2
Ø = porosity of the treatment rock layer (%)

6. Calculate the velocity of flow in the channel. Use Equation 5.1 with a Manning's n of 0.77 to determine the velocity at the water quality flow rate through the treatment rock layer. If the average velocity is ≥ 0.066 ft/sec when using this water quality design flow rate, the swale will not function correctly. Increase the bottom width and recalculate the velocity.

7. Use the average velocity found in step 6 to calculate the length of the swale using a hydraulic residence time of 50-minutes (3000 seconds).

Equation 5.5: Treatment Rock Layer Depth

$$L = V_{avg} * T$$

where:
T = 50-minute (3000 second) hydraulic residence time
V_{avg} = Average velocity (Step 6)
L = Length of swale

[2] The depth of gravel backfill for drywells was sized to contain a maximum effective flow depth of 3 inches. The effective depth is the flow depth if it were unobstructed by the treatment rock layer and is based on the porosity of the treatment rock layer. If measured in the treatment rock layer, the flow depth would exceed 3 inches as flow travels through the pore spaces in the rock.

8. Select a location where a filtration swale with the calculated bottom width and length will fit. If the calculated length is not possible, consider the following solutions:
    - Divide the site drainage to flow to multiple non-vegetated filtration swales.
    - Use infiltration or dispersion upstream of the bioswale to provide lower flow into the swale.
    - Reduce the developed surface area to gain space for the swale.
    - Increase the bottom width to decrease the length of the swale, while maintaining the 50-minute hydraulic residence time. This option requires additional testing to confirm the performance is not impacted by changes in swale length.
    - Reduce the longitudinal slope by meandering the biofiltration swale.
    - Nest the biofiltration swale within or around another stormwater BMP.

9. Determine the total depth of channel, to include freeboard above the depth of flow during the 25-year 24-hour storm. Using Manning's equation and the swale dimensions determined by previous steps, iteratively solve for the depth of flow using the composite Manning's n for the 25-year flow (n=0.25). The calculated depth will be an effective depth, so the depth of flow over the top of the swale during the 25-year event is equal to the difference between the calculated 25-year flow depth and 0.25 feet (water quality design flow depth). The swale must be able to convey the 25-year flow rate without overtopping.

10. Check the maximum velocity during the 25-year event in the total depth of the channel to ensure the velocity above the treatment layer does not cause movement of rock. The maximum velocity must be less than 1.8 ft/sec for longitudinal slopes of 1%–2.5% and less than 2.5 ft/sec for longitudinal slopes of 2.5%–5%. This step is skipped if all storms larger than the short-duration water quality storm bypass the filtration swale.

Table B 9-2 summarizes the methods and assumptions for the above steps for sizing non-vegetated filtration swales.

Table B 9-2: Sizing methods and assumptions for non-vegetated filtration swales

Steps	Variable	Methods and Assumptions
1	Water Quality Design Flow Rate (Q)	See Chapter 4 – Hydrologic Analysis and Design of the SWMMEW or Volume III-2 of the SWMMWW for methods for computing design storms.
2	Bottom Slope (S)	Minimum = 1% Maximum = 5%
3	Shape of Swale	Trapezoidal
4	Manning's n	• Use a Manning's n of 0.58 to represent flow over the pea gravel layer during the water quality design storm. • Use a Manning's n of 0.77 to represent flow through the treatment rock layer during the water quality design storm. • The Manning's n for the 25-year flow is 0.25. This value is an estimate based on field data, and as such requires further verification.
4,5	Flow Depth (y)	Default/Maximum of 3 inches of effective depth. This depth is contained in the depth of rock based on porosity estimates of the gradations proposed.
4,5,7	Bottom Width (B)	• Use Manning's Equation (Equation 5.2 Manning's Equation) to solve for bottom width (B) Minimum = 2 feet Maximum = 10 feet • For larger bottom widths, parallel swales should be used in conjunction with a device that splits the flow and directs the proper amount to each swale. • For very low flow rates, Manning's Equation may generate a negative value for B. B should be set to 2 feet in these cases.
7	Length (L)	Minimum = 200 feet If minimum length is not possible, increase the bottom width (B) so that the bottom area of the swale divided by the bottom width (B) is equal to the minimum length.
9	Freeboard	Minimum = able to convey the 25-year flow without overtopping
10	Velocity at Total Depth of Channel (V_{max})	• Maximum velocity in treatment layer of 0.071 ft/sec • For swales with a slope of 1% to 2.5%, Vmax above gravel backfill for drywells ≤ 1.8 ft/sec • For swales with a slope of 2.5% to 5%, Vmax above stabilizing gravel layer ≤ 2.5 ft/sec

9.1.4 Construction Criteria

Prior to delivery and installation of the rock needed for the non-vegetation filtration swale, additional steps are required to limit the dust or fine sediment in the rock, which can impact the treatment performance of the gravel.

- Rock shall be washed in a rinse plant prior to being picked up from the supplier. The rock shall be washed a second time less than a week prior to pick up to reduce the fines in the rock due to impacts of plant operations.
- Rock stockpiled at the construction site should be placed away from construction operations that produce large amounts of dust or fines to prevent contamination of the rock. The rock shall be protected from dust generated from construction operations, if the rock cannot be placed in an area free from dust and will be protected from windblown dust using BMP C123/C123E Plastic Covering (SWMMWW and SWMMEW) or similar covering. Care should also be taken when gathering, transporting, and placing rock on-site to avoid contamination of the treatment rock. Refer to the WSDOT *Standard Specifications for Road, Bridge, and Municipal Construction* 3-02.3(1) for additional steps to protect rock and stormwater during construction.

During construction, the non-vegetated filtration swale should not be put into operation until areas of exposed soil in the contributing drainage catchment have been sufficiently stabilized. Deposition of eroded soils can impede the flow of water in the swale and reduce swale treatment effectiveness. Thus, erosion and sediment control measures as defined in the SWMMWW or SWMMEW should remain in place until the swale is constructed per plans (see Chapter 7 of the SWMMEW, Construction Stormwater Pollution Prevention, for erosion and sediment control BMPs). In addition, avoid compacting the swale during construction and grade swales to attain uniform (no grade breaks in the swale) longitudinal and lateral slopes.

9.1.5 Operation and Maintenance Criteria

The following bullets list basic operation and maintenance actions for the non-vegetated filtration swale. See **Table B 9-3**: Maintenance criteria for non-vegetated filtration swales for detailed recommended maintenance criteria.

- Inspect non-vegetated filtration swales periodically, especially the 25 feet downstream of an inlet and upstream of an outlet, as well as after periods of heavy runoff. Look for damage and remove sediment, trash, and debris to keep swales free of external pollution.
- Clean curb cuts when soil and vegetation buildup interfere with flow into the swale.
- Perform weed control practices to limit vegetation growth in the swale.
- It is anticipated that maintenance will be required to restore the swale treatment performance, which could include flushing the swale with clear potable water to remove TSS. However, the exact actions and quantity of water needed for flushing will require more research.

Table B 9-3: Maintenance criteria for non-vegetated filtration swales

Maintenance Component	Defect or Problem	Condition When Maintenance is Needed	Recommended Maintenance to Correct Problem
General	**Sediment Accumulation**	Indicators of sediment accumulation include: • Flow above the surface of the rock during the water quality or smaller storm event • Vegetation growing in the swale • Pay special attention to the first 25 feet and last 25 feet of the swale	Remove the sediment and treatment rock layer around the indicator or throughout the swale as applicable. Replace with clean rock to match original rock gradations and depth.
	Standing Water	When water stands in the swale between storms and does not drain freely.	Check the outlet of the swale for any debris or blockage.
	Poor Rock Coverage	When rock-eroded channels occur in >10% of the swale bottom.	Assess why channel eroded and correct that condition. Add new rock to fix the eroded channel.
	Vegetation	When grass or weeds become visually present in the swale.	Remove grass or weeds so that flow is not impeded. Check the treatment rock layer for sediment buildup below the surface by removing rock down to the pea gravel and/or down to the subsoil. If sediment is found in the rock, remove affected rock and replace with new clean rock to match original rock gradations and depth.
	Inlet/Outlet	Inlet/outlet areas clogged with sediment and/or debris.	Remove material so that there is no clogging or blockage in the inlet and outlet area.
	Trash and Debris Accumulation	Trash and debris accumulated in the swale.	Remove trash and debris from swale.
	Erosion/Scouring	Eroded or scoured swale bottom due to flow channelization or higher flows.	For ruts < 12 inches wide, repair the damaged area by replacing with the applicable rock gradations. If ruts are large, generally > 12 inches wide, the swale should be regraded in the area. Consider increasing the size of/adding a layer of 2.5" coarse cobbles at a depth of 2.5 inches on top of the existing rock if erosion or scouring occurred during flow 25-year or small event.[1]

[1] If erosion is observed during smaller storms than the 25-year event, additional investigation may be needed to determine the cause of the erosion before the rock gradation is upsized. For example, it is possible that additional area has been diverted to the swale or that the land cover or basin area upstream has changed.

Appendix C – Data Quality Assessment

Appendix C.1 – Quality Objectives Assessment

This appendix describes the findings of the quality objective assessment. The assessment was performed to determine whether data collected during the study met Data Quality Indicators (DQIs) and Measurement Performance Criteria (MPCs) that were defined in the study QAPP. DQIs are qualitative and quantitative measures that characterize the aspects of quality data (Bias, Precision, Representativeness, Completeness, Comparability, Sensitivity). MPCs are the acceptance criteria for DQIs that specify the standard for data to meet the data quality objectives for the project. Each DQI is defined and the approach to addressing the DQIs as well as the MPC for that approach is listed below each DQI. Whether each MPC was met is addressed under the "Assessment" headings.

Bias *– A systematic error that results in sample values that are consistently distorted in one particular direction from the "true" or known value (EPA, 2006; Erickson, Weiss, & Gulliver, 2013). Bias can result from improper data collection, poorly calibrated analytical or sampling equipment, or limitations or errors in analytical methods and techniques (Ecology, 2011).*

DQI Approach #1: Staff will verify that the influent flow meter is working properly prior to beginning each synthetic storm event.

MPC #1: The influent flow meter reading will be verified prior to each storm event according to the SOPs outlined in Section 8.1 of the study QAPP.

Assessment: The influent flow meter reading was verified prior to each storm event for the first several days of testing. After no variation was observed, the flow meter reading was verified at the start of each day. No inconsistencies between the flow meter reading and estimated flow rate (see Section 8.1 of study QAPP for SOPs) were observed. As such, the flow meter data was assumed to not be biased.

DQI Approach #2: Manufacturers' recommendations for equipment and/or instrument maintenance will be followed.

MPC #2: An audit (Section 12.0 of the study QAPP) will be conducted to verify that sampling staff are following the SOPs outlined in Section 8.1 of the study QAPP (written to match manufacturer's specifications). Data will be considered acceptable if the sampling staff are consistently following the SOPs.

Assessment: Staff consistently followed the SOPs outlined in Section 8.1 of the study QAPP. Modifications that were made during testing to improve data collection are documented with the two audits (**Appendix C.4**) that were conducted and in **Appendix C.5**. No quality assurance issues were identified during the audits.

DQI Approach #3: SOPs will be developed and consistently followed for collecting samples and measuring data.

MPC #3: An audit (Section 12.0 of the study QAPP) will be conducted to verify that sampling staff are following the SOPs outlined in Section 8.1 of the study QAPP. Data will be considered acceptable if the sampling staff are consistently following the SOPs.

Assessment: Staff consistently followed the SOPs outlined in Section 8.1 of the study QAPP. Modifications that were made during testing to improve data collection are documented with the two audits (**Appendix C.4**) that were conducted and in **Appendix C.5**. No quality assurance issues were identified during the audits.

DQI Approach #4: Laboratory method blanks and lab standards will be analyzed to check for bias.

MPC #4: Sample results will be accepted if the resultsof the method blanks and lab standard analyses are below the limits in Section 6.2 and Table 6.2 of the study QAPP.

Assessment: Method blank and lab standard analyses were within the limits in the study QAPP.

Precision *– A measure of agreement among repeated measurements of the same property taken under identical or substantially similar conditions (EPA, 2002a; EPA, 2006; Erickson, Weiss, & Gulliver, 2013). Data is considered precise when the measured values are consistently the same and imprecise when the measured values are consistently different (Erickson, Weiss, & Gulliver,2013). Random error is a common cause of imprecise data and is always present because of normal variability in the many factors that affect measurement results. For example, variability in sampling or data collection procedures and/or variations of the actual concentrations in the media being sampled (Ecology, 2011).*

DQI Approach #1: SOPs will be developed and consistently followed for collecting samples and measuring data.

MPC #1: An audit (Section 12.0 of the study QAPP) will be conducted to verify that sampling staff are following the SOPs. Data will be considered acceptable if the sampling staff are consistently following the SOPs.

Assessment: Staff consistently followed the SOPs outlined in Section 8.1 of the study QAPP. Modifications that were made during testing to improve data collection are documented with the two audits (**Appendix C.4**) that were conducted and in **Appendix C.5**. No quality assurance issues were identified during the audits.

DQI Approach #2: Laboratory analytical duplicates will be reviewed to check that analyzed data is consistent.

MPC #2: If the results of the laboratory duplicates meet the relative percent difference (RPD) listed in Table 6.2 of the study QAPP, the results of the analytical testing will be considered acceptable.

Assessment: Seven of the quality control batches had lab duplicates that exceeded the percent recovery limit (0-5). According to the analytical laboratory, the sample results associated with a lab duplicate exceeding the control limits are valid. As two duplicate tests were run per QC batch, an average duplicate percent recovery could be calculated and added to sample results as error bars. The highest average duplicate percent recovery for the data collected was 11.46%. The remaining QC batches produced laboratory duplicates that met the relative percent difference control limits.

DQI Approach #3: Staff will verify that the influent flow meter is providing consistent flow measurements prior to beginning each synthetic storm event.

MPC #3: The influent flow meter reading will be verified prior to each storm event according to the SOPs outlined in Section 8.1 of the study QAPP. Data will be considered acceptable if readings are consistent.

Assessment: The influent flow meter reading was verified prior to each storm event for the first several days of testing. After no variation was observed, the flow meter reading was verified at the start of each day. No inconsistencies between the flow meter reading and estimated flow rate (see Section 8.1 of study QAPP for SOPs) were observed during testing. As such, the flow meter data was assumed to be accurate.

Representativeness *– A qualitative term that expresses the degree to which the data accuratelyand precisely represents the conditions being evaluated (EPA, 2002a). Common variables considered when determining the degree of representativeness include the selected sampling locations, sampling frequency and duration, and sampling methods (Ecology, 2011).*

DQI Approach #1: The location selected for this study is representative of a typical location where a non-vegetated filtration swale could be installed. The non-vegetated filtration swales were installed in an existing swale, which is not currently irrigated, behind the City of West Richland Municipal Services Building and adjacent to a parking lot.

MPC #1: These conditions reflect the characteristics of a location where a non-vegetated filtration swale would be installed: a semi-arid location or area where irrigation is not desired for part of the year; where basic treatment is required; and along a parking lot or roadway.

Assessment: The swale design alternatives and final swale were installed and monitored in West Richland, behind the City of West Richland Municipal Services Building. The site is expected to accurately represent a typical site where a non-vegetated filtration swale would be installed.

DQI Approach #2: Hydrologic conditions tested at the site should be representative of the water quality design event.

MPC #2: Hydrologic conditions will be considered acceptable if the peak flow rate for which the non-vegetated swale is designed is matched.

Assessment: The peak flow rate for the water quality design storm was matched during testing of the swale design alternatives and final swale installation. Hydrologic conditions are considered acceptable.

DQI Approach #3: Water quality samples should be collected to accurately represent conditions in the rock treatment layer.

MPC #3: The sampling design was developed to limit settling of TSS where samples are collected, thereby representing typical TSS removal by a non-vegetated filtration swale.

Assessment: Sampling was conducted according to the study QAPP. No Sil-Co-Sil® (TSS) was observed to be settling out where samples were collected. As such, water quality samples were assumed to accurately represent conditions in the rock treatment layer.

DQI Approach #4: Equipment at the site will be installed per manufacturer specifications.

MPC #2: Data will be considered acceptable if equipment at the site will be installed per manufacturer specifications.

Assessment: Equipment was installed per manufacturer specifications. For example, the in-line flow meter was installed with manufacturer-recommended distances between upstream and downstream bends or other junctions in the pipe.

Completeness *– The amount of valid data needed to be obtained during the study to meet the project objectives (Lombard & Kirchmer, 2004).*

DQI Approach #1: Nine samples (one influent and eight effluent samples, spaced 25 feet along the length of the swale) will be collected for 6 simulated storm events for each swale design described in Section 3.3 of the study QAPP.

MPC #1: The data will be considered acceptable if less than 10% is missing or invalid. At least 5 of 6 samples at any sample location will need to be valid to determine whether treatment performance goals are being met.

Assessment: None of the influent or eight effluent samples from the swale were missing or invalid. An additional two influent samples were taken during each simulated storm event to estimate the average influent concentration entering the swale.

DQI Approach #2: A minimum of 95% of the samples analyzed by the lab must be considered valid prior to the end of the study.

MPC #2: 95% of the samples must be accompanied by valid laboratory duplicates, method blanks, and lab standards, and results which are valid. Additionally, the samples must be received and analyzed within the appropriate holding times.

Assessment: All of the samples were accompanied by laboratory duplicates, method blanks, and lab standards. All method blanks and lab standard analyses were within quality control limits. Seven of the quality control batches had lab duplicates that exceeded the percent recovery limit (0–5). According to the analytical laboratory, the sample results associated with a lab duplicate exceeding the control limits are valid. As two duplicate tests were run per QC batch, an average duplicate percent recovery could be calculated and added to sample results as error bars. The highest average duplicate percent recovery for the data collected was 11.46%. The remaining QC batches produced laboratory duplicates that met the relative percent difference control limits. All samples were analyzed within holding times.

DQI Approach #3: Define procedures for handling missing data, use appropriate coding for missing data, and report missing data with the results.

MPC #3: Procedures for handling missing data and coding missing data are defined in Section 11.0 of the study QAPP. The Final Technical Report for this study will include consideration for how missing data could limit the completeness of the data set.

Assessment: Missing data was limited to time measurements for estimating velocity in the swale. The missing data is summarized in **Section 5.1** and comprises less than 5% of the total data collected. The missing measurements are not expected to impact the completeness of the data set.

DQI Approach #4: Conduct maintenance for and verify equipment is working properly at the site, in accordance with SOPs outlined in Section 8.0 of the study QAPP, to limit the possibility of missing or invalid data.

MPC #4: An audit (Section 12.0 of the study QAPP) will be conducted to verify that sampling staff are following the SOPs outlined in Section 8.0 of the study QAPP (written to match manufacturer's specifications). Data will be considered acceptable if the sampling staff are consistently following the SOPs.

Assessment: Staff consistently followed the SOPs outlined in Section 8.1 of the study QAPP. Modifications that were made during testing to improve data collection are documented with the two audits (**Appendix C.4**) that were conducted and in **Appendix C.5**. No quality assurance issues were identified during the audits.

DQI Approach #5: An equipment checklist and Chain of custody forms will be used to prevent loss of data resulting from missing containers, inoperable delivery and collection apparatus or sample delivery.

MPC #5: The data will be considered acceptable if lessthan 10% is missing or invalid.

Assessment: Less than 10% of the data collected was missing or invalid (see **Section 5**). Chain of custody forms are included with laboratory reports (Appendix E of the study QAPP). Chain of custody forms were reviewed for issues as noted in Quality Assurance Worksheets (**Appendix C.2**) and no issues were identified.

Comparability *– A qualitative term that expresses the measure of confidence that one data set can be compared to another and can be combined or contrasted for the decision(s) to be made. Data are comparable if sample collection techniques, measurement procedures, analytical methods, and reporting are equivalent for samples within a sample set and meet acceptance criteria between sample sets.*

DQI Approach #1: The test site is an existing swale, which is not currently irrigated, located behind the City of West Richland Municipal Services Building.

MPC #1: The process for selecting the study area is defined in Section 7.2 of the study QAPP: the process focused onhaving a test site that is representative of locations where the non-vegetated filtration swale will be installed.

Assessment: The swale design alternatives and final swale were installed and monitored in West Richland, behind the City of West Richland Municipal Services Building. The site is expected to accurately represent a typical site where a non-vegetated filtration swale would be installed.

DQI Approach #2: SOPs will be developed, and all data and sample collection will be conducted in accordance with the SOPs outlined in Section 8.0 of the study QAPP.

MPC #2: An audit (Section 12.0 of the study QAPP) will be conducted to verify that sampling staff are following the SOPs outlined in Section 8.0 of the study QAPP (written to match manufacturer's specifications). Data will be considered acceptable if the sampling staff are consistently following the SOPs.

Assessment: Staff consistently followed the SOPs outlined in Section 8.1 of the study QAPP. Modifications that were made during testing to improve data collection are documented with the two audits (**Appendix C.4**) that were conducted and in **Appendix C.5**. No quality assurance issues were identified during the audits.

DQI Approach #3: Standard testing methods will be used to analyze samples submitted to the lab.

MPC #3: SM 2540D will be used to conduct analysis of samples for TSS.

Assessment: SM 2540D was used to analyze all water quality samples for TSS.

Sensitivity *– Denotes the rate at which the analytical response (e.g., absorbance, volume, meter reading) varies with the concentration of the parameter being determined. In a specialized sense, it has the same meaning as the detection limit (EPA, 2002a). The capability of a method or instrument to discriminate between measurement responses representing different levels of the variable of interest.*

DQI Approach #1: Analytical results for water quality samples will be reported if they are above the reporting limit.

MPC #1: Reporting limits for TSS are listed in Table 6.2 of the study QAPP. Data reported as below the detection limit will be calculated using the reporting limit shown in Table 9.1 of the study QAPP.

Assessment: No samples contained a TSS concentration below the detection limit. As such, none of the data was calculated based on the reporting limit (1 mg/L) in the study QAPP.

DQI Approach #2: All water quality testing methods selected have detection limits below the expected range of results.

MPC #2: The expected range of results and respective reporting limit were compared in Table 9.1 of the study QAPP.

Assessment: The detection limits were below the range of TSS results during testing.

DQI Approach #3: Instruments capable of accurately measuring variables at the site will be used during the study.

MPC #2: The sensitivity of instruments at the site is included with the equipment specifications in Appendix E of the study QAPP.

Assessment: Instruments used at the site (flow meter) were sufficiently sensitive to collect data.

Appendix C.2 – Quality Assurance Worksheets

This appendix contains the Quality Assurance (QA) Worksheets used to document and review analytical laboratory report findings. The worksheets were completed for each batch of samples sent to the analytical laboratory and contain results of laboratory QC tests (reference study QAPP Section 6.0 for detailed description) to determine whether water quality data are acceptable. **Sections 3.1** and **3.2** contain discussions on acceptable data for the study.

Data Quality Form

Sample, Swale, Storm ID: GBD - Storm 1 - Inf 1-3, Loc 1-8

QC Batch: LB014			
Parameters	**Units**	**Goal**	**Reported**
Method	-	SM 2540D	SM 2540D
Chain of Custody Issue?	-	None	None
Completeness/Methodology	-	No Missing Data	No Missing Data
Holding Times (days)	days	7	4-5
Cooler Temperature	degrees Celsius	6	2.8
Method Blanks	-	-1	-0.23
Lab Standard Analysis	%	77.1-110	85.9
Lab Duplicate #1	%	0-5	17.1804
Lab Duplicate #2	%	0-5	5.7365
Lab Duplicates - Average	%	0-5	11.45845
Lab Notes on Instrument Calibration/Performance	Duplicate RPD outside acceptable range of <5%. A sample and its replicate may vary due to sample matrix and concentration. Other QC within acceptable range. Samples reported without qualification.		
Action	None		

Data Quality Form

Sample, Swale, Storm ID: GBD - Storm 2 - Inf 1-3, Loc 1-8

QC Batch: LB016			
Parameters	**Units**	**Goal**	**Reported**
Method	-	SM 2540D	SM 2540D
Chain of Custody Issue?	-	None	None
Completeness/Methodology	-	No Missing Data	No Missing Data
Holding Times (days)	days	7 days	5
Cooler Temperature	degrees Celsius	6	2.8
Method Blanks	-	-1	-0.11
Lab Standard Analysis	%	77.1-110	88.45
Lab Duplicate #1	%	0-5	3.2076
Lab Duplicate #2	%	0-5	0.8634
Lab Duplicates - Average	%	0-5	2.0355
Lab Notes on Instrument Calibration/Performance	None		
Action	None		

Data Quality Form

Sample, Swale, Storm ID: GBD - Storm 3 - Loc3-8			
QC Batch: LB017			
Parameters	**Units**	**Goal**	**Reported**
Method	-	SM 2540D	SM 2540D
Chain of Custody Issue?	-	None	None
Completeness/Methodology	-	No Missing Data	No Missing Data
Holding Times (days)	days	7	4
Cooler Temperature	degrees Celsius	6	N/A - samples delivered same day
Method Blanks	-	-1	-0.71
Lab Standard Analysis	%	77.1-110	96.9
Lab Duplicate #1	%	0-5	1.9497
Lab Duplicate #2	%	0-5	0.0343
Lab Duplicates - Average	%	0-5	0.992
Lab Notes on Instrument Calibration/Performance	None		
Action	None		

Data Quality Form

Sample, Swale, Storm ID: GBD - Storm 3 - Inf 1-3, Loc 1-2			
QC Batch: LB016			
Parameters	**Units**	**Goal**	**Reported**
Method	-	SM 2540D	SM 2540D
Chain of Custody Issue?	-	None	None
Completeness/Methodology	-	No Missing Data	No Missing Data
Holding Times (days)	days	7	5
Cooler Temperature	degrees Celsius	6	Not Recorded (Delivered on Ice)
Method Blanks	-	-1	-0.11
Lab Standard Analysis	%	77.1-110	88.45
Lab Duplicate #1	%	0-5	3.2076
Lab Duplicate #2	%	0-5	0.8634
Lab Duplicates - Average	%	0-5	2.0355
Lab Notes on Instrument Calibration/Performance	None		
Action	None		

Data Quality Form

Sample, Swale, Storm ID: GBD - Storm 4 - Inf 1-3			
QC Batch: LB017			
Parameters	**Units**	**Goal**	**Reported**
Method	-	SM 2540D	SM 2540D
Chain of Custody Issue?	-	None	None
Completeness/Methodology	-	No Missing Data	No Missing Data
Holding Times (days)	days	7	4
Cooler Temperature	degrees Celsius	6	N/A - samples delivered same day
Method Blanks	-	-1	-0.71
Lab Standard Analysis	%	77.1-110	96.9
Lab Duplicates	%	0-5	1.9497
Lab Duplicates	%	0-5	0.0343
Lab Duplicates (Average)	%	0-5	0.992
Lab Notes on Instrument Calibration/Performance	None		
Action	None		

Data Quality Form

Data Quality Form			
Sample, Swale, Storm ID: GBD - Storm 4 - Loc 1-8			
QC Batch: LB018			
Parameters	**Units**	**Goal**	**Reported**
Method	-	SM 2540D	SM 2540D
Chain of Custody Issue?	-	None	None
Completeness/Methodology	-	No Missing Data	No Missing Data
Holding Times (days)	days	7 days	2
Cooler Temperature	degrees Celsius	6	N/A - samples delivered same day
Method Blanks	-	-1	-0.14
Lab Standard Analysis	%	77.1-110	103.05
Lab Duplicate #1	%	0-5	0.9179
Lab Duplicate #2	%	0-5	1.3431
Lab Duplicates - Average	%	0-5	1.1305
Lab Notes on Instrument Calibration/Performance	None		
Action	None		

Data Quality Form

Sample, Swale, Storm ID: GBD - Storm 5 - Inf2, Inf 3, Loc1

QC Batch: LB019

Parameters	Units	Goal	Reported
Method	-	SM 2540D	SM 2540D
Chain of Custody Issue?	-	None	None
Completeness/Methodology	-	No Missing Data	No missing data
Holding Times (days)	days	7	3
Cooler Temperature	degrees Celsius	6	N/A - samples delivered same day
Method Blanks	-	-1	-0.57
Lab Standard Analysis	%	77.1-110	96
Lab Duplicate #1	%	0-5	3.9123
Lab Duplicate #2	%	0-5	1.1984
Lab Duplicates - Average	%	0-5	2.55535
Lab Notes on Instrument Calibration/Performance	None		
Action	None		

Data Quality Form

Sample, Swale, Storm ID: GBD - Storm 5 -Loc2-8

QC Batch: LB020

Parameters	**Units**	**Goal**	**Reported**
Method	-	SM 2540D	SM 2540D
Chain of Custody Issue?	-	None	None
Completeness/Methodology	-	No Missing Data	No Missing Data
Holding Times (days)	days	7	3
Cooler Temperature	degrees Celsius	6	N/A - samples delivered same day
Method Blanks	-	-1	-0.42
Lab Standard Analysis	%	77.1-110	88.45
Lab Duplicate #1	%	0-5	1.103
Lab Duplicate #2	%	0-5	3.9582
Lab Duplicates - Average	%	0-5	2.5306
Lab Notes on Instrument Calibration/Performance	None		
Action	None		

Data Quality Form

Sample, Swale, Storm ID: GBD - Storm 5 - Inf 1			
QC Batch: LB018			
Parameters	**Units**	**Goal**	**Reported**
Method	-	SM 2540D	SM 2540D
Chain of Custody Issue?	-	None	None
Completeness/Methodology	-	No Missing Data	No Missing Data
Holding Times (days)	days	7	2
Cooler Temperature	degrees Celsius	6	N/A - samples delivered same day
Method Blanks	-	-1	-0.14
Lab Standard Analysis	%	77.1-110	103.05
Lab Duplicate #1	%	0-5	0.9179
Lab Duplicate #2	%	0-5	1.3431
Lab Duplicates - Average	%	0-5	1.1305
Lab Notes on Instrument Calibration/Performance	None		
Action	None		

Data Quality Form

Sample, Swale, Storm ID: GBD - Storm 6 - Inf1-3, Loc1-7

QC Batch: LB021

Parameters	Units	Goal	Reported
Method	-	SM 2540D	SM 2540D
Chain of Custody Issue?	-	None	None
Completeness/Methodology	-	No Missing Data	No Missing Data
Holding Times (days)	days	7	3
Cooler Temperature	degrees Celsius	6	N/A - samples delivered same day
Method Blanks	-	-1	0.15
Lab Standard Analysis	%	77.1-110	84
Lab Duplicate #1	%	0-5	0.406
Lab Duplicate #2	%	0-5	0.0314
Lab Duplicates - Average	%	0-5	0.2187
Lab Notes on Instrument Calibration/Performance	None		
Action	None		

Data Quality Form

Sample, Swale, Storm ID: GBD - Storm 6 - Loc8, end

QC Batch: LB022

Parameters	Units	Goal	Reported
Method	-	SM 2540D	SM 2540D
Chain of Custody Issue?	-	None	None
Completeness/Methodology	-	No Missing Data	No Missing Data
Holding Times (days)	days	7	7
Cooler Temperature	degrees Celsius	6	N/A - samples delivered same day
Method Blanks	-	-1	-0.36
Lab Standard Analysis	%	77.1-110	107.15
Lab Duplicate #1	%	0-5	1.0118
Lab Duplicate #2	%	0-5	15.91
Lab Duplicates - Average	%	0-5	8.4609
Lab Notes on Instrument Calibration/Performance	Duplicate RPD outside acceptable range of <5%. A sample and its replicate may vary due to sample matrix and concentration. Other QC within acceptable range. Samples reported without qualification.		
Action	None		

Data Quality Form

Sample, Swale, Storm ID: GBD - Storm 6 - Inf 1-3, Loc 1-5

QC Batch: LB036			
Parameters	**Units**	**Goal**	**Reported**
Method	-	SM 2540D	SM 2540D
Chain of Custody Issue?	-	None	None
Completeness/Methodology	-	No Missing Data	No Missing Data
Holding Times (days)	days	7	1
Cooler Temperature	degrees Celsius	6	N/A - samples delivered same day
Method Blanks	-	-1	-0.2
Lab Standard Analysis	%	77.1-110	90.85
Lab Duplicate #1	%	0-5	0.3532
Lab Duplicate #2	%	0-5	4.8465
Lab Duplicates - Average	%	0-5	2.59985
Lab Notes on Instrument Calibration/Performance	None		
Action	None		

Data Quality Form

Sample, Swale, Storm ID: GBD - Storm 6 - Loc 6-8

QC Batch: LB037

Parameters	**Units**	**Goal**	**Reported**
Method	-	SM 2540D	SM 2540D
Chain of Custody Issue?	-	None	None
Completeness/Methodology	-	No Missing Data	No Missing Data
Holding Times (days)	days	7	1
Cooler Temperature	degrees Celsius	6	N/A - samples delivered same day
Method Blanks	-	-1	0.23
Lab Standard Analysis	%	77.1-110	92.55
Lab Duplicate #1	%	0-5	3.4082
Lab Duplicate #2	%	0-5	2.5126
Lab Duplicates - Average	%	0-5	2.9604
Lab Notes on Instrument Calibration/Performance	None		
Action	None		

Data Quality Form

Sample, Swale, Storm ID: HMA - Storm 1 - Inf 1-3, Loc 1-4

QC Batch: LB014

Parameters	Units	Goal	Reported
Method	-	SM 2540D	SM 2540D
Chain of Custody Issue?	-	None	None
Completeness/Methodology	-	No Missing Data	No Missing Data
Holding Times (days)	days	7	4-5
Cooler Temperature	degrees Celsius	6	2.8
Method Blanks	-	-1	-0.23
Lab Standard Analysis	%	77.1-110	85.9
Lab Duplicate #1	%	0-5	17.1804
Lab Duplicate #2	%	0-5	5.7365
Lab Duplicates - Average	%	0-5	11.45845
Lab Notes on Instrument Calibration/Performance	None		
Action	None		

Data Quality Form

Sample, Swale, Storm ID: HMA - Storm 1 - Loc 5-8

QC Batch: LB016			
Parameters	**Units**	**Goal**	**Reported**
Method	-	SM 2540D	SM 2540D
Chain of Custody Issue?	-	None	None
Completeness/Methodology	-	No Missing Data	No Missing Data
Holding Times (days)	days	7	5
Cooler Temperature	degrees Celsius	6	2.8
Method Blanks	-	-1	-0.11
Lab Standard Analysis	%	77.1-110	88.45
Lab Duplicate #1	%	0-5	3.2076
Lab Duplicate #2	%	0-5	0.8634
Lab Duplicates - Average	%	0-5	2.0355
Lab Notes on Instrument Calibration/Performance	None		
Action	None		

Data Quality Form

Sample, Swale, Storm ID: HMA - Storm 2- Inf1-3, Loc 1-8

QC Batch: LB017

Parameters	**Units**	**Goal**	**Reported**
Method	-	SM 2540D	SM 2540D
Chain of Custody Issue?	-	None	None
Completeness/Methodology	-	No Missing Data	No Missing Data
Holding Times (days)	days	7	2
Cooler Temperature	degrees Celsius	6	Not Recorded (Delivered on Ice)
Method Blanks	-	-1	-0.71
Lab Standard Analysis	%	77.1-110	96.9
Lab Duplicate #1	%	0-5	1.9497
Lab Duplicate #2	%	0-5	0.0343
Lab Duplicates - Average	%	0-5	0.992
Lab Notes on Instrument Calibration/Performance	None		
Action	None		

Data Quality Form

Sample, Swale, Storm ID: HMA - Storm 3- Inf 1-3, Loc 1-8

QC Batch: LB018

Parameters	Units	Goal	Reported
Method	-	SM 2540D	SM 2540D
Chain of Custody Issue?	-	None	None
Completeness/Methodology	-	No Missing Data	No Missing Data
Holding Times (days)	days	7	2
Cooler Temperature	degrees Celsius	6	N/A - samples delivered same day
Method Blanks	-	-1	-0.14
Lab Standard Analysis	%	77.1-110	103.05
Lab Duplicate #1	%	0-5	0.9179
Lab Duplicate #2	%	0-5	1.3431
Lab Duplicates - Average	%	0-5	1.1305
Lab Notes on Instrument Calibration/Performance	None		
Action	None		

Data Quality Form

Sample, Swale, Storm ID: HMA - Storm 4 - Inf1-3, Loc 1-8

QC Batch: LB020

Parameters	Units	Goal	Reported
Method	-	SM 2540D	SM 2540D
Chain of Custody Issue?	-	None	None
Completeness/Methodology	-	No Missing Data	No Missing Data
Holding Times (days)	days	7	2
Cooler Temperature	degrees Celsius	6	N/A - samples delivered same day
Method Blanks	-	-1	-0.42
Lab Standard Analysis	%	77.1-110	88.45
Lab Duplicate #1	%	0-5	1.103
Lab Duplicate #2	%	0-5	3.9582
Lab Duplicates - Average	%	0-5	2.5306
Lab Notes on Instrument Calibration/Performance	None		
Action	None		

Data Quality Form			
Sample, Swale, Storm ID: HMA - Storm 5 - Inf3, Loc1-8, End			
QC Batch: LB021			
Parameters	**Units**	**Goal**	**Reported**
Method	-	SM 2540D	SM 2540D
Chain of Custody Issue?	-	None	None
Completeness/Methodology	-	No Missing Data	No Missing Data
Holding Times (days)	days	7	3
Cooler Temperature	degrees Celsius	6	N/A - samples delivered same day
Method Blanks	-	-1	0.15
Lab Standard Analysis	%	77.1-110	84
Lab Duplicate #1	%	0-5	0.406
Lab Duplicate #2	%	0-5	0.0314
Lab Duplicates - Average	%	0-5	0.2187
Lab Notes on Instrument Calibration/Performance	None		
Action	None		

Data Quality Form

Sample, Swale, Storm ID: HMA - Storm 5 - Inf1,2

QC Batch: LB020

Parameters	**Units**	**Goal**	**Reported**
Method	-	SM 2540D	SM 2540D
Chain of Custody Issue?	-	None	None
Completeness/Methodology	-	No Missing Data	No Missing Data
Holding Times (days)	days	7	2
Cooler Temperature	degrees Celsius	6	N/A - samples delivered same day
Method Blanks	-	-1	-0.42
Lab Standard Analysis	%	77.1-110	88.45
Lab Duplicate #1	%	0-5	1.103
Lab Duplicate #2	%	0-5	3.9582
Lab Duplicates - Average	%	0-5	2.5306
Lab Notes on Instrument Calibration/Performance	None		
Action	None		

Data Quality Form

Sample, Swale, Storm ID: HMA - Storm 6 - Inf1-3, Loc1-8, end

QC Batch: LB022

Parameters	Units	Goal	Reported
Method	-	SM 2540D	SM 2540D
Chain of Custody Issue?	-	None	None
Completeness/Methodology	-	No Missing Data	No Missing Data
Holding Times (days)	days	7	7
Cooler Temperature	degrees Celsius	6	N/A - samples delivered same day
Method Blanks	-	-1	0.15
Lab Standard Analysis	%	77.1-110	84
Lab Duplicate #1	%	0-5	0.406
Lab Duplicate #2	%	0-5	0.0314
Lab Duplicates - Average	%	0-5	0.2187
Lab Notes on Instrument Calibration/Performance	None		
Action	None		

Data Quality Form

Sample, Swale, Storm ID: PG - Storm 1- Inf 1-3, Loc 1-8, end

QC Batch: LB024

Parameters	Units	Goal	Reported
Method	-	SM 2540D	SM 2540D
Chain of Custody Issue?	-	None	None
Completeness/Methodology	-	No Missing Data	No Missing Data
Holding Times (days)	days	7	1
Cooler Temperature	degrees Celsius	6	N/A - samples delivered same day
Method Blanks	-	-1	-0.3
Lab Standard Analysis	%	77.1-110	83.05
Lab Duplicate #1	%	0-5	1.6032
Lab Duplicate #2	%	0-5	9.6609
Lab Duplicates - Average	%	0-5	5.63205
Lab Notes on Instrument Calibration/Performance	Duplicate RPD outside acceptable range of <5%. A sample and its replicate may vary due to sample matrix and concentration. Other QC within acceptable range. Samples reported without qualification.		
Action	None		

Data Quality Form

Sample, Swale, Storm ID: PG - Storm 2- Inf 1-3, Loc 1-8, end

QC Batch: LB025

Parameters	Units	Goal	Reported
Method	-	SM 2540D	SM 2540D
Chain of Custody Issue?	-	None	None
Completeness/Methodology	-	No Missing Data	No Missing Data
Holding Times (days)	days	7	1
Cooler Temperature	degrees Celsius	6	N/A - samples delivered same day
Method Blanks	-	-1	-0.65
Lab Standard Analysis	%	77.1-110	78.1
Lab Duplicate #1	%	0-5	2.899
Lab Duplicate #2	%	0-5	1.3153
Lab Duplicates - Average	%	0-5	2.107
Lab Notes on Instrument Calibration/Performance	None		
Action	None		

Data Quality Form

Sample, Swale, Storm ID: PG - Storm 3- Inf 1-3, Loc 1-8, end

QC Batch: LB026

Parameters	Units	Goal	Reported
Method	-	SM 2540D	SM 2540D
Chain of Custody Issue?	-	None	None
Completeness/Methodology	-	No Missing Data	No Missing Data
Holding Times (days)	days	7	1
Cooler Temperature	degrees Celsius	6	N/A - samples delivered same day
Method Blanks	-	-1	-0.14
Lab Standard Analysis	%	77.1-110	93.4
Lab Duplicate #1	%	0-5	1.9297
Lab Duplicate #2	%	0-5	2.6329
Lab Duplicates - Average	%	0-5	2.2813
Lab Notes on Instrument Calibration/Performance	None		
Action	None		

Data Quality Form

Sample, Swale, Storm ID: PG - Storm 4 - Inf1-3, Loc1-5

QC Batch: LB026

Parameters	Units	Goal	Reported
Method	-	SM 2540D	SM 2540D
Chain of Custody Issue?	-	None	None
Completeness/Methodology	-	No Missing Data	No Missing Data
Holding Times (days)	days	7	1
Cooler Temperature	degrees Celsius	6	N/A - samples delivered same day
Method Blanks	-	-1	-0.14
Lab Standard Analysis	%	77.1-110	93.4
Lab Duplicate #1	%	0-5	1.9297
Lab Duplicate #2	%	0-5	2.6329
Lab Duplicates - Average	%	0-5	2.2813
Lab Notes on Instrument Calibration/Performance	None		
Action	None		

Data Quality Form

Sample, Swale, Storm ID: PG - Storm 4 - Loc6-8, end

QC Batch: LB027			
Parameters	**Units**	**Goal**	**Reported**
Method	-	SM 2540D	SM 2540D
Chain of Custody Issue?	-	None	None
Completeness/Methodology	-	No Missing Data	No Missing Data
Holding Times (days)	days	7	1
Cooler Temperature	degrees Celsius	6	N/A - samples delivered same day
Method Blanks	-	-1	-0.29
Lab Standard Analysis	%	77.1-110	89.2
Lab Duplicate #1	%	0-5	2.3516
Lab Duplicate #2	%	0-5	4.7223
Lab Duplicates - Average	%	0-5	3.53695
Lab Notes on Instrument Calibration/Performance	None		
Action	None		

Data Quality Form

Sample, Swale, Storm ID: PG - Storm 5- Inf 1-3, Loc 1-8, end

QC Batch: LB029

Parameters	Units	Goal	Reported
Method	-	SM 2540D	SM 2540D
Chain of Custody Issue?	-	None	No
Completeness/Methodology	-	No Missing Data	No Missing Data
Holding Times (days)	days	7	4
Cooler Temperature	degrees Celsius	6	N/A - samples delivered same day
Method Blanks	-	-1	0.07
Lab Standard Analysis	%	77.1-110	87.65
Lab Duplicate #1	%	0-5	3.4636
Lab Duplicate #2	%	0-5	4.8433
Lab Duplicates - Average	%	0-5	4.1535
Lab Notes on Instrument Calibration/Performance	None		
Action	None		

Data Quality Form

Sample, Swale, Storm ID: PG - Storm 6- Inf 1-3, Loc 1-8, end

QC Batch: LB030

Parameters	Units	Goal	Reported
Method	-	SM 2540D	SM 2540D
Chain of Custody Issue?	-	None	No
Completeness/Methodology	-	No Missing Data	No Missing Data
Holding Times	days	7	4
Cooler Temperature	degrees Celsius	6	N/A - samples delivered same day
Method Blanks	-	-1	-0.14
Lab Standard Analysis	%	77.1-110	96.2
Lab Duplicate #1	%	0-5	0.5473
Lab Duplicate #2	%	0-5	2.234
Lab Duplicates - Average	%	0-5	1.391
Lab Notes on Instrument Calibration/Performance	None		
Action	None		

Data Quality Form

Data Quality Form			
Sample, Swale, Storm ID: SPG - Storm 1 - Inf 1-3, Loc 1-5			
QC Batch: LB025			
Parameters	**Units**	**Goal**	**Reported**
Method	-	SM 2540D	SM 2540D
Chain of Custody Issue?	-	None	No
Completeness/Methodology	-	No Missing Data	No Missing Data
Holding Times (days)	days	7	1
Cooler Temperature	degrees Celsius	6	N/A - samples delivered same day
Method Blanks	-	-1	-0.65
Lab Standard Analysis	%	77.1-110	78.1
Lab Duplicate #1	%	0-5	2.899
Lab Duplicate #2	%	0-5	1.3153
Lab Duplicates - Average	%	0-5	2.107
Lab Notes on Instrument Calibration/Performance	None		
Action	None		

Data Quality Form

Sample, Swale, Storm ID: SPG - Storm 1 - Loc 6-8, end			
QC Batch: LB023			
Parameters	Units	**Goal**	**Reported**
Method	-	SM 2540D	SM 2540D
Chain of Custody Issue?	-	SM 2540D	No
Completeness/Methodology	-	None	
Holding Times (days)	days	No Missing Data	1
Cooler Temperature	degrees Celsius	7	N/A - samples delivered same day
Method Blanks	-	6	0.01
Lab Standard Analysis	%	-1	81.7
Lab Duplicate #1	%	0-5	2.8129
Lab Duplicate #2	%	0-5	19.0476
Lab Duplicates - Average	%	0-5	10.9303
Lab Notes on Instrument Calibration/Performance	Duplicate RPD outside acceptable range of <5%. A sample and its replicate may vary due to sample matrix and concentration. Other QC within acceptable range. Samples reported without qualification.		
Action	None		

Data Quality Form

Sample, Swale, Storm ID: SPG - Storm 2- Inf 1-3, Loc 1-8, end			
QC Batch: LB027			
Parameters	**Units**	**Goal**	**Reported**
Method	-	SM 2540D	SM 2540D
Chain of Custody Issue?	-	None	No
Completeness/Methodology	-	No Missing Data	No Missing Data
Holding Times (days)	days	7	1
Cooler Temperature	degrees Celsius	6	N/A - samples delivered same day
Method Blanks	-	-1	-0.29
Lab Standard Analysis	%	77.1-110	89.2
Lab Duplicate #1	%	0-5	2.3516
Lab Duplicate #2	%	0-5	4.7223
Lab Duplicates - Average	%	0-5	3.5370
Lab Notes on Instrument Calibration/Performance	None		
Action	None		

Data Quality Form

Sample, Swale, Storm ID: SPG - Storm 3- Inf1-3, Loc1-5			
QC Batch: LB029			
Parameters	**Units**	**Goal**	**Reported**
Method	-	SM 2540D	SM 2540D
Chain of Custody Issue?	-	None	No
Completeness/Methodology	-	No Missing Data	No Missing Data
Holding Times (days)	days	7	4
Cooler Temperature	degrees Celsius	6	N/A - samples delivered same day
Method Blanks	-	-1	0.07
Lab Standard Analysis	%	77.1-110	87.65
Lab Duplicate #1	%	0-5	3.4636
Lab Duplicate #2	%	0-5	4.8433
Lab Duplicates - Average	%	0-5	4.1535
Lab Notes on Instrument Calibration/Performance	None		
Action	None		

Data Quality Form

Sample, Swale, Storm ID: SPG - Storm 3- Loc6-8, end			
QC Batch: LB030			
Parameters	**Units**	**Goal**	**Reported**
Method	-	SM 2540D	SM 2540D
Chain of Custody Issue?	-	None	No
Completeness/Methodology	-	No Missing Data	No Missing Data
Holding Times (days)	days	7	4
Cooler Temperature	degrees Celsius	6	N/A - samples delivered same day
Method Blanks	-	-1	-0.14
Lab Standard Analysis	%	77.1-110	96.2
Lab Duplicate #1	%	0-5	0.5473
Lab Duplicate #2	%	0-5	2.234
Lab Duplicates - Average	%	0-5	1.391
Lab Notes on Instrument Calibration/Performance	None		
Action	None		

Data Quality Form

Sample, Swale, Storm ID: SPG - Storm 4- Inf 1-3, Loc 1-8, end			
QC Batch: LB028			
Parameters	**Units**	**Goal**	**Reported**
Method	-	SM 2540D	SM 2540D
Chain of Custody Issue?	-	None	No
Completeness/Methodology	-	No Missing Data	No Missing Data
Holding Times (days)	days	7	3
Cooler Temperature	degrees Celsius	6	Not Recorded (Delivered on Ice)
Method Blanks	-	-1	-0.33
Lab Standard Analysis	%	77.1-110	95.35
Lab Duplicate #1	%	0-5	4.8295
Lab Duplicate #2	%	0-5	0.4935
Lab Duplicates - Average	%	0-5	2.6615
Lab Notes on Instrument Calibration/Performance	None		
Action	None		

Data Quality Form

Data Quality Form			
Sample, Swale, Storm ID: SPG - Storm 5- Inf 1-3, Loc 1-5			
QC Batch: LB028			
Parameters	**Units**	**Goal**	**Reported**
Method	-	SM 2540D	SM 2540D
Chain of Custody Issue?	-	None	No
Completeness/Methodology	-	No Missing Data	No Missing Data
Holding Times (days)	days	7	3
Cooler Temperature	degrees Celsius	6	N/A - samples delivered same day
Method Blanks	-	-1	-0.33
Lab Standard Analysis	%	77.1-110	95.35
Lab Duplicate #1	%	0-5	4.8295
Lab Duplicate #2	%	0-5	0.4935
Lab Duplicates - Average	%	0-5	2.6615
Lab Notes on Instrument Calibration/Performance	None		
Action	None		

Data Quality Form

Sample, Swale, Storm ID: SPG - Storm 5- Loc 6-8, end			
QC Batch: LB031			
Parameters	**Units**	**Goal**	**Reported**
Method	-	SM 2540D	SM 2540D
Chain of Custody Issue?	-	None	No
Completeness/Methodology	-	No Missing Data	No Missing Data
Holding Times (days)	days	7	2
Cooler Temperature	degrees Celsius	6	N/A - samples delivered same day
Method Blanks	-	-1	-0.3
Lab Standard Analysis	%	77.1-110	79.25
Lab Duplicate #1	%	0-5	1.2068
Lab Duplicate #2	%	0-5	3.7001
Lab Duplicates - Average	%	0-5	2.4535
Lab Notes on Instrument Calibration/Performance	None		
Action	None		

Data Quality Form

Sample, Swale, Storm ID: SPG - Storm 6- Inf 1-3, Loc 1-2			
QC Batch: LB031			
Parameters	**Units**	**Goal**	**Reported**
Method	-	SM 2540D	SM 2540D
Chain of Custody Issue?	-	None	No
Completeness/Methodology	-	No Missing Data	No Missing Data
Holding Times (days)	days	7	7
Cooler Temperature	degrees Celsius	6	N/A - samples delivered same day
Method Blanks	-	-1	-0.3
Lab Standard Analysis	%	77.1-110	79.25
Lab Duplicate #1	%	0-5	1.2068
Lab Duplicate #2	%	0-5	3.7001
Lab Duplicates - Average	%	0-5	2.4535
Lab Notes on Instrument Calibration/Performance	None		
Action	None		

Data Quality Form

Data Quality Form			
Sample, Swale, Storm ID: SPG - Storm 6- Loc 3-8, end			
QC Batch: LB032			
Parameters	**Units**	**Goal**	**Reported**
Method	-	SM 2540D	SM 2540D
Chain of Custody Issue?	-	None	No
Completeness/Methodology	-	No Missing Data	No Missing Data
Holding Times (days)	days	7	7
Cooler Temperature	degrees Celsius	6	N/A - samples delivered same day
Method Blanks	-	-1	0
Lab Standard Analysis	%	77.1-110	88.45
Lab Duplicate #1	%	0-5	1.9327
Lab Duplicate #2	%	0-5	N/A
Lab Duplicates - Average	%	0-5	N/A
Lab Notes on Instrument Calibration/Performance	None		
Action	None		

Data Quality Form

Sample, Swale, Storm ID: #1-8

QC Batch: LB035

Parameters	Units	Goal	Reported
Method	-	SM 2540D	SM 2540D
Chain of Custody Issue?	-	None	No
Completeness/Methodology	-	No Missing Data	No Missing Data
Holding Times (days)	days	7	6
Cooler Temperature	degrees Celsius	6	Not Recorded (Delivered on Ice)
Method Blanks	-	-1	-0.63
Lab Standard Analysis	%	77.1-110	109.2
Lab Duplicate #1	%	0-5	8.9767
Lab Duplicate #2	%	0-5	2.5083
Lab Duplicates - Average	%	0-5	5.7425
Lab Notes on Instrument Calibration/Performance	None		
Action	None		

Data Quality Form

Sample, Swale, Storm ID: Background reports #1-2			
QC Batch: LB014			
Parameters	**Units**	**Goal**	**Reported**
Method	-	SM 2540D	SM 2540D
Chain of Custody Issue?	-	None	No
Completeness/Methodology	-	No Missing Data	No Missing Data
Holding Times (days)	days	7	4-5
Cooler Temperature	degrees Celsius	6	Not Recorded (Delivered on Ice)
Method Blanks	-	-1	-0.23
Lab Standard Analysis	%	77.1-110	85.9
Lab Duplicate #1	%	0-5	17.1804
Lab Duplicate #2	%	0-5	5.7365
Lab Duplicates - Average	%	0-5	11.4585
Lab Notes on Instrument Calibration/Performance	Duplicate RPD outside acceptable range of <5%. A sample and its replicate may vary due to sample matrix and concentration. Other QC within acceptable range. Samples reported without qualification.		
Action	None		

Data Quality Form

Sample, Swale, Storm ID: GBD2 - Storm 1 - Inf 1-3, Loc 1-8

QC Batch: LB034

Parameters	**Units**	**Goal**	**Reported**
Method	-	SM 2540D	SM 2540D
Chain of Custody Issue?	-	None	No
Completeness/Methodology	-	No Missing Data	No Missing Data
Holding Times (days)	days	7	3
Cooler Temperature	degrees Celsius	6	Not Recorded (Delivered on Ice)
Method Blanks	-	-1	0.1
Lab Standard Analysis	%	77.1-110	109.6
Lab Duplicate #1	%	0-5	11.3604
Lab Duplicate #2	%	0-5	11.5119
Lab Duplicates - Average	%	0-5	11.4362
Lab Notes on Instrument Calibration/Performance	Duplicate RPD outside acceptable range of <5%. A sample and its replicate may vary due to sample matrix and concentration. Other QC within acceptable range. Samples reported without qualification.		
Action	None		

Appendix C.3 – Field Forms

This appendix contains copies of field forms used in the field to document that the SOPs in the study QAPP (Section 8.1) were followed during data collection. The field forms were used in the data usability analysis described in **Section 3.2**.

Note:
The names on the forms in this section are handwritten and typically only include the first name. The individuals who helped with field data collection are typed below for clarity.

<u>City of West Richland Staff:</u>
Drew Woodruff
Don Klages
Jeremy Gwinn
Chris Hogan
Jared Rheinschmidt

<u>TAC Members:</u>
Brian Morgenroth (City of Walla Walla)
Brian Pope (City of Richland)
Chuck Geissel (Walla Walla County)
Brad Mitchell (City of Moses Lake)
Michael Henao (City of Pasco)

Site Preparation Field Forms

Site Preparation Field Form

Field staff names: Taylor H.B., Don, Jeremy, Drew	**Date:** 8/24/2022 **Time:** 11:30a
SOP Name and Notes during site inspection (surrounding area, tank, pump, pipes, sample port, other equipment): 8.1.1, First event GBD Storm 1	
Site Preparation for Stimulated event	
Notes (circle text as appropriate):	
Remove grab sampler ports and confirm that the samplers are empty and clean Y N	
Rinse out Sampler Y N N/A, first event	
Confirm that the piezometers are empty and clean Y N	
Influent flow meter verification performed? Y N	
If flow meter readings appear to be consistenly biased, what is the difference?	N/A, ~~[illegible]~~ ~~[illegible]~~ flow verified
Water level meter verification performed? Y N	
If water level meter readings are off, by how much?	N/A

$38.2 \frac{gal}{min} \frac{min}{60 s} = 0.64 \frac{gal}{s}$ → ~ 7-8 s to fill 5 gal bucket

1.67 lb for 200 $\frac{mg}{L}$ → 1 lb 10.7 oz

Site Preparation Field Form

Field staff names: Taylor H-B, Dan, Jared, Brian M	**Date:** 8/25/2020 **Time:** 12:40p
SOP Name and Notes during site inspection (surrounding area, tank, pump, pipes, sample port, other equipment): GBD, Storm 2 Prep	
Site Preparation for Stimulated event	
Notes (circle text as appropriate):	
Remove grab sampler ports and confirm that the samplers are empty and clean Y N	
Rinse out Sampler Y N	
Confirm that the piezometers are empty and clean Y N	
Influent flow meter verification performed? Y N performed this am, flow verified	
If flow meter readings appear to be consistenly biased, what is the difference?	N/A
Water level meter verification performed? Y N performed this am, depth verified	
If water level meter readings are off, by how much?	N/A

Site Preparation Field Form

Field staff names: Don, Chris, Drew W, Taylor 14-B	**Date:** 8/26 **Time:** 7:00 a
SOP Name and Notes during site inspection (surrounding area, tank, pump, pipes, sample port, other equipment): GBD Storm 3	
Site Preparation for Stimulated event	
Notes (circle text as appropriate):	
Remove grab sampler ports and confirm that the samplers are empty and clean Y N	
Rinse out Sampler Y N	
Confirm that the piezometers are empty and clean Y N	
Influent flow meter verification performed? Y N 7-8s to fill 5 gal bucket	
If flow meter readings appear to be consistenly biased, what is the difference?	
Water level meter verification performed? Y N no difference	
If water level meter readings are off, by how much?	

Site Preparation Field Form

Field staff names: Brian P, Chuck Go, Drew, Taylor WB	Date: 8/29/2022 Time:
SOP Name and Notes during site inspection (surrounding area, tank, pump, pipes, sample port, other equipment): GBD Storm 4	
Site Preparation for Stimulated event	
Notes (circle text as appropriate):	
Remove grab sampler ports and confirm that the samplers are empty and clean Y N	
Rinse out Sampler Y N	
Confirm that the piezometers are empty and clean Y N	
Influent flow meter verification performed? Y N	
If flow meter readings appear to be consistenly biased, what is the difference?	N/A
Water level meter verification performed? Y N N/A	
If water level meter readings are off, by how much?	N/A

Site Preparation Field Form

Field staff names: Brian P, Chuck G, Drew, Taylor H-B	Date: 8/29/22 Time:
SOP Name and Notes during site inspection (surrounding area, tank, pump, pipes, sample port, other equipment): GBD Storm 5	
Site Preparation for Stimulated event	
Notes (circle text as appropriate):	
Remove grab sampler ports and confirm that the samplers are empty and clean Y N	
Rinse out Sampler Y N	
Confirm that the piezometers are empty and clean Y N	
Influent flow meter verification performed? Y N done earlier in day	
If flow meter readings appear to be consistenly biased, what is the difference?	
Water level meter verification performed? Y N done earlier in day	
If water level meter readings are off, by how much?	

Site Preparation Field Form

Field staff names:	**Date:** 8/30 **Time:** 10:12a
SOP Name and Notes during site inspection (surrounding area, tank, pump, pipes, sample port, other equipment): OBD Storm 6	
Site Preparation for Stimulated event	
Notes (circle text as appropriate):	
Remove grab sampler ports and confirm that the samplers are empty and clean Y N	
Rinse out Sampler Y N	
Confirm that the piezometers are empty and clean Y N	
Influent flow meter verification performed? Y N performed @ earlier @ day	
If flow meter readings appear to be consistenly biased, what is the difference?	
Water level meter verification performed? Y N N/A	
If water level meter readings are off, by how much?	

pg 1 of 2

Site Preparation Field Form

Field staff names: Taylor HB, Jared, Don, Brian M, Drew W, Andrea)	**Date:** 8/25/2022 **Time:** 8:00am
SOP Name and Notes during site inspection (surrounding area, tank, pump, pipes, sample port, other equipment): HMA pre Storm 1	
Site Preparation for Stimulated event	
Notes (circle text as appropriate):	
Remove grab sampler ports and confirm that the samplers are empty and clean Y N	
Rinse out Sampler Y N	
Confirm that the piezometers are empty and clean Y N	
Influent flow meter verification performed? Y N	
If flow meter readings appear to be consistenly biased, what is the difference?	
Water level meter verification performed? Y N reading properly	
If water level meter readings are off, by how much?	N/A

Site Preparation Field Form

Field staff names: Don, Drew W, Taylor H-B	**Date:** 8/26 **Time:**
SOP Name and Notes during site inspection (surrounding area, tank, pump, pipes, sample port, other equipment): HMA Storm 2	
Site Preparation for Stimulated event	
Notes (circle text as appropriate):	
Remove grab sampler ports and confirm that the samplers are empty and clean Y N	
Rinse out Sampler Y N	
Confirm that the piezometers are empty and clean Y N	
Influent flow meter verification performed? Y N performed during previous test, same day	
If flow meter readings appear to be consistenly biased, what is the difference?	
Water level meter verification performed? Y N performed for previous test, same day	
If water level meter readings are off, by how much?	

Site Preparation Field Form

Field staff names: Anirudh G, Brian P, Drew, Taylor 1A-1B	**Date:** 8/29/22 **Time:**
SOP Name and Notes during site inspection (surrounding area, tank, pump, pipes, sample port, other equipment): HMX Storm 3	
Site Preparation for Stimulated event	
Notes (circle text as appropriate):	
Remove grab sampler ports and confirm that the samplers are empty and clean Y N	
Rinse out Sampler Y N	
Confirm that the piezometers are empty and clean Y N	
Influent flow meter verification performed? Y N	
If flow meter readings appear to be consistenly biased, what is the difference?	
Water level meter verification performed? Y N	
If water level meter readings are off, by how much?	

Site Preparation Field Form

Field staff names:	**Date:** 8/30 **Time:** 8:00
SOP Name and Notes during site inspection (surrounding area, tank, pump, pipes, sample port, other equipment): HMA Storm 4	
Site Preparation for Stimulated event	
Notes (circle text as appropriate):	
Remove grab sampler ports and confirm that the samplers are empty and clean Y N	
Rinse out Sampler Y N	
Confirm that the piezometers are empty and clean Y N	
Influent flow meter verification performed? Y N	
If flow meter readings appear to be consistently biased, what is the difference?	N/A 7.85 to 8.4, as typ
Water level meter verification performed? Y N N/A	
If water level meter readings are off, by how much?	

Site Preparation Field Form

Field staff names: Don, Jeremy, Chris, Taylor H-B, Drew	**Date:** 8/30 **Time:** 12:20
SOP Name and Notes during site inspection (surrounding area, tank, pump, pipes, sample port, other equipment): HMA Storm 5	
Site Preparation for Stimulated event	
Notes (circle text as appropriate):	
Remove grab sampler ports and confirm that the samplers are empty and clean Y N	
Rinse out Sampler Y N	
Confirm that the piezometers are empty and clean Y N	
Influent flow meter verification performed? Y N performed earlier	
If flow meter readings appear to be consistenly biased, what is the difference?	
Water level meter verification performed? Y N N/A	
If water level meter readings are off, by how much?	

Site Preparation Field Form

Field staff names: Don, Jeremy, Taylor H-B	**Date:** 8/31/2022 **Time:** 6:55a
SOP Name and Notes during site inspection (surrounding area, tank, pump, pipes, sample port, other equipment): None, HMA Storm 6	
Site Preparation for Stimulated event	
Notes (circle text as appropriate):	
Remove grab sampler ports and confirm that the samplers are empty and clean Y N	
Rinse out Sampler Y N	
Confirm that the piezometers are empty and clean Y N	
Influent flow meter verification performed? Y N 7-85	
If flow meter readings appear to be consistenly biased, what is the difference?	N/A
Water level meter verification performed? Y N N/A	
If water level meter readings are off, by how much?	N/A

Site Preparation Field Form

Field staff names: Drew, Brad M, Jeremy, Taylor	**Date:** 9/12 **Time:** 9:30a
SOP Name and Notes during site inspection (surrounding area, tank, pump, pipes, sample port, other equipment): Pre-Storm 1, Pea Gravel	
Site Preparation for Stimulated event	
Notes (circle text as appropriate):	
Remove grab sampler ports and confirm that the samplers are empty and clean Y N	
Rinse out Sampler Y N	
Confirm that the piezometers are empty and clean Y N N/A	
Influent flow meter verification performed? Y N → prior to 25-yr @ same swale this am (7-8a)	
If flow meter readings appear to be consistenly biased, what is the difference?	N/A
Water level meter verification performed? Y N N/A	
If water level meter readings are off, by how much?	N/A

pea gravel 25-yr performed 1st thing, ~8:30a
pea gravel-sand 25-yr performed after, ~9:30a
WQ event done after lunch because still draining ~11am
first for PG

Site Preparation Field Form

Field staff names: Chuck W, Jeremy, Drew, Taylor	**Date:** 9/13 **Time:** 7:30a
SOP Name and Notes during site inspection (surrounding area, tank, pump, pipes, sample port, other equipment): PG Storm 2	
Site Preparation for Stimulated event	
Notes (circle text as appropriate):	
Remove grab sampler ports and confirm that the samplers are empty and clean Y N	
Rinse out Sampler Y N	
Confirm that the piezometers are empty and clean Y N N/A	
Influent flow meter verification performed? Y N 7-8S	
If flow meter readings appear to be consistenly biased, what is the difference?	NA
Water level meter verification performed? Y N N/A	
If water level meter readings are off, by how much?	N/A

Site Preparation Field Form

Field staff names: Brian P, Drew, Jeremy, Taylor	**Date:** 9/14 **Time:** 7:00a
SOP Name and Notes during site inspection (surrounding area, tank, pump, pipes, sample port, other equipment): Pea Gravel Storm 3	
Site Preparation for Stimulated event	
Notes (circle text as appropriate):	
Remove grab sampler ports and confirm that the samplers are empty and clean Y N	
Rinse out Sampler Y N	
Confirm that the piezometers are empty and clean Y N N/A	
Influent flow meter verification performed? Y N ~7 s	
If flow meter readings appear to be consistenly biased, what is the difference?	N/A
Water level meter verification performed? Y N N/A	
If water level meter readings are off, by how much?	N/A

Site Preparation Field Form

Field staff names: Brian P, Drew, Jeremy, Taylor	**Date:** 9/14 **Time:**
SOP Name and Notes during site inspection (surrounding area, tank, pump, pipes, sample port, other equipment): PG Storm 4	
Site Preparation for Stimulated event	
Notes (circle text as appropriate):	
Remove grab sampler ports and confirm that the samplers are empty and clean Y N + cleaned immed before sample taken (seeping)	
Rinse out Sampler Y N	
Confirm that the piezometers are empty and clean Y N N/A	
Influent flow meter verification performed? Y N performed earlier in day	
If flow meter readings appear to be consistenly biased, what is the difference?	N/A
Water level meter verification performed? Y N N/A	
If water level meter readings are off, by how much?	N/A

Th	Fr	Mo	Tu
PG 5 SPG 3 PG 6	SPG4	SPG5	SPG6

Site Preparation Field Form

Field staff names: Jeremy, Drew, Taylor	Date: 9/15 Time: 7:20a
SOP Name and Notes during site inspection (surrounding area, tank, pump, pipes, sample port, other equipment): PG Storm 5	
Site Preparation for Stimulated event	
Notes (circle text as appropriate):	
Remove grab sampler ports and confirm that the samplers are empty and clean Y N	
Rinse out Sampler Y N	
Confirm that the piezometers are empty and clean Y N N/A	
Influent flow meter verification performed? Y N ~75	
If flow meter readings appear to be consistently biased, what is the difference?	
Water level meter verification performed? Y N N/A	
If water level meter readings are off, by how much?	N/A

Site Preparation Field Form

Field staff names: Drew Jeremy Taylor	Date: [illegible] Time: 12:30p
SOP Name and Notes during site inspection (surrounding area, tank, pump, pipes, sample port, other equipment): P6 Storm 6	
Site Preparation for Stimulated event	
Notes (circle text as appropriate):	
Remove grab sampler ports and confirm that the samplers are empty and clean Y N vacuumed out immed. before sampling	
Rinse out Sampler Y N	
Confirm that the piezometers are empty and clean Y N N/A	
Influent flow meter verification performed? Y N performed earlier in day	
If flow meter readings appear to be consistenly biased, what is the difference?	N/A
Water level meter verification performed? Y N N/A	
If water level meter readings are off, by how much?	N/A

Site Preparation Field Form

Field staff names:	**Date:** 9/13 **Time:**
SOP Name and Notes during site inspection (surrounding area, tank, pump, pipes, sample port, other equipment): SPG Storm 1	
Site Preparation for Stimulated event	
Notes (circle text as appropriate):	
Remove grab sampler ports and confirm that the samplers are empty and clean Y N	
Rinse out Sampler Y N	
Confirm that the piezometers are empty and clean Y N N/A	
Influent flow meter verification performed? Y N earlier in day	
If flow meter readings appear to be consistenly biased, what is the difference?	N/A
Water level meter verification performed? Y N N/A	
If water level meter readings are off, by how much?	N/A

Tu	Wed	Th	Fri	Mon
PG2	PG4	PG6	~~SPG4~~	SPG6
SPG1	SPG2	SPG3	SPG5	
PG3	PG5	SPG4		

✓1, 3, 6, 7, 8

Tu	Wed	Th	Fri	Mon	Tu
PG2	PG3	PG4	PG5	PG6	SPG6
SPG1	SPG2	SPG3	SPG4	SPG5	

Site Preparation Field Form

Field staff names: Drew, Brian P, Jeremy, Taylor	Date: 9/14 Time: 9:15

SOP Name and Notes during site inspection (surrounding area, tank, pump, pipes, sample port, other equipment):

SPG Storm 2

Site Preparation for Stimulated event

Notes (circle text as appropriate):

Remove grab sampler ports and confirm that the samplers are empty and clean Y N	
Rinse out Sampler Y N	
Confirm that the piezometers are empty and clean Y N	N/A
Influent flow meter verification performed? Y N	performed earlier in day (PG Storm 2)
If flow meter readings appear to be consistenly biased, what is the difference?	N/A
Water level meter verification performed? Y N	N/A
If water level meter readings are off, by how much?	N/A

Wed	Th	Fri	Mon	Tu
PG3	PG5	SPG4	SPG5	SPG6
SPG2	SPG3			
PG4	PG6			

Site Preparation Field Form

Field staff names: Drew, Jeremy, Taylor	Date: 9/15 Time: 9:40a
SOP Name and Notes during site inspection (surrounding area, tank, pump, pipes, sample port, other equipment): SPG Storm 3	
Site Preparation for Stimulated event	
Notes (circle text as appropriate):	
Remove grab sampler ports and confirm that the samplers are empty and clean Y N	
Rinse out Sampler Y N	
Confirm that the piezometers are empty and clean Y N N/A	
Influent flow meter verification performed? Y N performed earlier in day (PG Storm 5)	
If flow meter readings appear to be consistenly biased, what is the difference?	N/A
Water level meter verification performed? Y N N/A	
If water level meter readings are off, by how much?	N/A

Site Preparation Field Form

Field staff names: Jeremy Taylor	**Date:** 9/16 **Time:** 2:03 → Start [illegible] → 7:15 for pickup
SOP Name and Notes during site inspection (surrounding area, tank, pump, pipes, sample port, other equipment): SPG Storm 4	
Site Preparation for Stimulated event	
Notes (circle text as appropriate):	
Remove grab sampler ports and confirm that the samplers are empty and clean Y N	
Rinse out Sampler Y N	
Confirm that the piezometers are empty and clean Y N N/A	
Influent flow meter verification performed? Y N yes, 7-8 s	
If flow meter readings appear to be consistenly biased, what is the difference?	N/A
Water level meter verification performed? Y N N/A	
If water level meter readings are off, by how much?	N/A

monday, alle
whud to drain

Site Preparation Field Form

Field staff names: ~~[illegible]~~ Drew, Don, Aimee, Taylor	Date: 9/19/2022 Time:
SOP Name and Notes during site inspection (surrounding area, tank, pump, pipes, sample port, other equipment): SPG Storm 5	
Site Preparation for Stimulated event	
Notes (circle text as appropriate):	
Remove grab sampler ports and confirm that the samplers are empty and clean Y N	
Rinse out Sampler Y N	
Confirm that the piezometers are empty and clean Y N N/A	
Influent flow meter verification performed? Y N ~7 S	
If flow meter readings appear to be consistenly biased, what is the difference?	~/A
Water level meter verification performed? Y N N/A	
If water level meter readings are off, by how much?	N/A

Site Preparation Field Form

Field staff names: Same as rinse	Date: 10/17 Time: 1:50p
SOP Name and Notes during site inspection (surrounding area, tank, pump, pipes, sample port, other equipment): Pre-Storm 1	
Site Preparation for Stimulated event	
Notes (circle text as appropriate):	
Remove grab sampler ports and confirm that the samplers are empty and clean Y N	
Rinse out Sampler Y N	
Confirm that the piezometers are empty and clean Y N N/A	
Influent flow meter verification performed? Y N earlier in day	
If flow meter readings appear to be consistenly biased, what is the difference?	N/A
Water level meter verification performed? Y N N/A	
If water level meter readings are off, by how much?	

Site Preparation Field Form

Field staff names: Same as previous	**Date:** 10/17 **Time:** 3:30
SOP Name and Notes during site inspection (surrounding area, tank, pump, pipes, sample port, other equipment): pre Storm-2	
Site Preparation for Stimulated event	
Notes (circle text as appropriate):	
Remove grab sampler ports and confirm that the samplers are empty and clean Y N	
Rinse out Sampler Y N	
Confirm that the piezometers are empty and clean Y N N/A	
Influent flow meter verification performed? Y N performed earlier in day	
If flow meter readings appear to be consistenly biased, what is the difference?	N/A
Water level meter verification performed? Y N N/A	
If water level meter readings are off, by how much?	N/A

Site Preparation Field Form

Field staff names:	**Date:** 10/18 **Time:** [illegible]
SOP Name and Notes during site inspection (surrounding area, tank, pump, pipes, sample port, other equipment): pre storm 3	
Site Preparation for Stimulated event	
Notes (circle text as appropriate):	
Remove grab sampler ports and confirm that the samplers are empty and clean Y N	
Rinse out Sampler Y N	
Confirm that the piezometers are empty and clean Y N N/A	
Influent flow meter verification performed? Y N ~75 to 62	
If flow meter readings appear to be consistenly biased, what is the difference?	
Water level meter verification performed? Y N N/A	
If water level meter readings are off, by how much?	N/A

Site Preparation Field Form

Field staff names:	**Date:** 10/18 **Time:**
SOP Name and Notes during site inspection (surrounding area, tank, pump, pipes, sample port, other equipment): pre Storm 4	
Site Preparation for Stimulated event	
Notes (circle text as appropriate):	
Remove grab sampler ports and confirm that the samplers are empty and clean Y N	
Rinse out Sampler Y N	
Confirm that the piezometers are empty and clean Y N N/A	
Influent flow meter verification performed? Y N performed earlier in day	
If flow meter readings appear to be consistenly biased, what is the difference?	NA
Water level meter verification performed? Y N N/A	
If water level meter readings are off, by how much?	N/A

Site Preparation Field Form

Field staff names: Drew, Jeremy, Taylor	**Date:** 10/19 **Time:**
SOP Name and Notes during site inspection (surrounding area, tank, pump, pipes, sample port, other equipment): before annual loading and Storm 5 (SPG)	
Site Preparation for Stimulated event	
Notes (circle text as appropriate):	
Remove grab sampler ports and confirm that the samplers are empty and clean Y N	
Rinse out Sampler Y N	
Confirm that the piezometers are empty and clean Y N N/A	
Influent flow meter verification performed? Y N ~ 7+5	
If flow meter readings appear to be consistenly biased, what is the difference?	N/A
Water level meter verification performed? Y N N/A	
If water level meter readings are off, by how much?	N/A

Site Preparation Field Form

Field staff names: Drew, Chris, Jeremy, Taylor	**Date:** 10/19/22 **Time:**
SOP Name and Notes during site inspection (surrounding area, tank, pump, pipes, sample port, other equipment): pre - Storm 6	
Site Preparation for Stimulated event	
Notes (circle text as appropriate):	
Remove grab sampler ports and confirm that the samplers are empty and clean Y N	
Rinse out Sampler Y N	
Confirm that the piezometers are empty and clean Y N N/A	
Influent flow meter verification performed? Y N performed earlier in day	
If flow meter readings appear to be consistently biased, what is the difference?	N/A
Water level meter verification performed? Y N N/A	
If water level meter readings are off, by how much?	N/A

Simulated Storm Event Field Forms

Simulate Storm Event Field Form

Field staff names: Don, Jeremy, Drew, Taylor		**Date:** 8/24/22 **Time:** 12:15
SOP Name and Notes during site inspection (surrounding area, tank, pump, pipes, sample port, other equipment): 8.1.2 GBD Storm 1		

Simulated Event Information						
Notes (circle text as appropriate): 200 mg/L event						
Record Influent Flow Rate:	Time #1		Time #2		Time #3	
	38.6 - 39		38.8 - 39.3		38.6 - 39.1	
Record Depth at Upstream and Downstream Piezometers:	Time #1, US	Time #1, DS	Time #2, US	Time #2, DS	Time #3, DS	Time #3, DS
	5.4, 12:35	5.2, 12:41	2.9, 12:50	8.2, 1:05	7.7 1:07	7.3, 1:10

7.0 1:13

Were automatic grab samplers placed in the swale after the influent flow rate reached the water quality design flow rate? Y N

Were samples collected from the influent and eight sample locations? Y N

Note any issues encountered or observations made during the event:

start ~ 12:30

US (+ 1' for all)

8.9	9.5	9.9
1:18	1:24	1:32

DS (" ")

6.9	7.0	7.3
1:19	1:26	1:33

DS = 23.5" deep

1:04 water reached

last sample

1:06 left ponding swale

~1:51 US empty

Simulate Storm Event Field Form

Field staff names: same as reverse (Dan, Jared, Brian M, Taylor)	**Date:** 8/25/2020 **Time:** 12:58p
SOP Name and Notes during site inspection (surrounding area, tank, pump, pipes, sample port, other equipment): GBD Storm 2	

Simulated Event Information						
Notes (circle text as appropriate):						
Record Influent Flow Rate:	Time #1		Time #2		Time #3	
	39.3 - 39.5		39.3 - 40.0		38.8 - 39.3	
Record Depth at Upstream and Downstream Piezometers:	Time #1, US 1:37p	Time #1, DS 1:3[illegible]	Time #2, US	Time #2, DS	Time #3, US	Time #3, DS
	1.66	1.721	1.80 @ 1:47	1.67 @ 1:45	1.76 @ 1:57	1.68 @ 1:55

→ pump already started for next test

Were automatic grab samplers placed in the swale after the influent flow rate reached the water quality design flow rate? Y N

Were samples collected from the influent and eight sample locations? Y N

Note any issues encountered or observations made during the event:

ended ~300 gal because hydraulic pump ~~[illegible]~~ caused other pump to tip over + not provide constant Q
restart after fixed @ WQ flow rate

Start pump 12:58p
pump flow 1:00pm (Brian M note)

end ~1:15p
pump restart 1:22p
end 1:26p

port	flow
#1	1:00pm
#2	1:04pm
#3	1:08p
#4	1:12p
#5	1:16p
#6	1:21p
#7	1:26p
#8	1:32p

Swale West
PM testing 8/25/22
Test start 12:58pm
lpm Pump Flow
Rate Calibrated 39.3

Port #1 Flow 1:00pm
Port #2 Flow 1:04pm
Port #3 Flow 1:08pm
Port #4 Flow 1:12 pm
Port #5 Flow 1:16 pm
Port #6 Flow 1:21 pm
Port #7 Flow 1:26pm
Port #8 Flow 1:30pm

#1
D.S. @ 1.73' @ 1:35
U.S. @ 1.66' @ 1:37
#2
D.S @ 1.67' @ 1:45
U.S. @ 1.80' @ 1:47

#3
DS @ 1.68 @ 1:55
US @ 1.76 @ 1:57
pump already
started for next
test.

Simulate Storm Event Field Form

Field staff names: Same as reverse (Don, Chris, Drew, Taylor)	**Date:** 8/26 **Time:** 7:27a
SOP Name and Notes during site inspection (surrounding area, tank, pump, pipes, sample port, other equipment): GBD Storm 3	

Simulated Event Information

Notes (circle text as appropriate):

	Time #1		Time #2		Time #3	
Record Influent Flow Rate:	39.5 - 39.7		38.8 - 39.3		38.4 - 39.5	
Record Depth at Upstream and Downstream Piezometers:	Time #1, US	Time #1, DS	Time #2, US	Time #2, DS	Time #3, US	Time #3, DS

Were automatic grab samplers placed in the swale after the influent flow rate reached the water quality design flow rate? Y N

Were samples collected from the influent and eight sample locations? Y N

Note any issues encountered or observations made during the event:

7:48 pump stop
7:27 Pump START

8:52a pump end

port #1 2:11
#2 5:48
#3 10:15
#4 14:15
#5 18:57
#6 23:58
#7 28:40
#8 33:25

Simulate Storm Event Field Form

Field staff names:						**Date:**
						Time:
SOP Name and Notes during site inspection (surrounding area, tank, pump, pipes, sample port, other equipment): GBD Storm 4						
Simulated Event Information						
Notes (circle text as appropriate):						
Record Influent Flow Rate:	Time #1		Time #2		Time #3	
Record Depth at Upstream and Downstream Piezometers:	Time #1, US	Time #1, DS	Time #2, US	Time #2, DS	Time #3, US	Time #3, DS
Were automatic grab samplers placed in the swale after the influent flow rate reached the water quality design flow rate? Y N						
Were samples collected from the influent and eight sample locations? Y N						
Note any issues encountered or observations made during the event:						

PORT	TIME
1	2:31.16
2	3:43.20
3	4:33.16
4	4:14 .52
5	4:45.48
6	5:17.74
7	4:55.35
8	5:14.60

Simulate Storm Event Field Form

Field staff names:	**Date:** 8/29 **Time:** 7:30a
SOP Name and Notes during site inspection (surrounding area, tank, pump, pipes, sample port, other equipment): GBD Stormw 200mg/L	

Simulated Event Information

Notes (circle text as appropriate):

	Time #1		Time #2		Time #3	
Record Influent Flow Rate:	39.5 - 40		39.3 - 39.5		39.1 - 39.5	
	Time #1, US	Time #1, DS	Time #2, US	Time #2, DS	Time #3, US	Time #3, DS
Record Depth at Upstream and Downstream Piezometers:	1.77 8:17	1.76 8:16	1.86 8:25	1.70 8:22	1.89 8:28	1.68 8:2[illegible]

Were automatic grab samplers placed in the swale after the influent flow rate reached the water quality design flow rate? Y N

Were samples collected from the influent and eight sample locations? Y N

Note any issues encountered or observations made during the event:

7:32 sal const

7:38:50 start pump

7:58 stop pump to 150 gal

Simulate Storm Event Field Form

Field staff names: Brian P, Chuck G, Drew, Taylor H-B

Date: 8/29
Time:

SOP Name and Notes during site inspection (surrounding area, tank, pump, pipes, sample port, other equipment):
GBD Storm 5

Simulated Event Information

Notes (circle text as appropriate):

Record Influent Flow Rate:	Time #1		Time #2		Time #3	
Record Depth at Upstream and Downstream Piezometers:	Time #1, US	Time #1, DS	Time #2, US	Time #2, DS	Time #3, US	Time #3, DS

Were automatic grab samplers placed in the swale after the influent flow rate reached the water quality design flow rate? Y N

Were samples collected from the influent and eight sample locations? Y N

Note any issues encountered or observations made during the event:

PORT	TIME	
1	2:07.30	
2	3:28.10	
3	4:03.03	
4	4:07.77	
5	4:39.51	Ball valve stuck on sample bottle for 20 s.
6	4:42.91	
7	4:38.96	
8	4:25.90	

8/29/22

GBD Storm 5
pg 2 of 2

11:53a start mix
12:00p start pump
12:31p end pump
12:34p end of swale

influent #1	#2	#3
39.1 - 40.2	39.5 - 40.2	39.1 - 39.3

Simulate Storm Event Field Form

Field staff names: Don, Jeremy, Chris, Drew, Taylor H-B	Date: 8/30 Time: 12:15
SOP Name and Notes during site inspection (surrounding area, tank, pump, pipes, sample port, other equipment): GBD Storm 6	

Simulated Event Information						
Notes (circle text as appropriate):						
Record Influent Flow Rate:	Time #1		Time #2		Time #3	
Record Depth at Upstream and Downstream Piezometers:	Time #1, US	Time #1, DS	Time #2, US	Time #2, DS	Time #3, US	Time #3, DS
Were automatic grab samplers placed in the swale after the influent flow rate reached the water quality design flow rate? Y N						
Were samples collected from the influent and eight sample locations? Y N						
Note any issues encountered or observations made during the event:						

start pump

port #1 2:09
#2 5:46
#3 10:08
#4 14:10
#5 18:44
#6 23:36
#7 28:11
#8 32:57

PUMPED FOR EXACTLY 20 MIN
≈ 150 GAL LEFT IN TANK.
CALCS OUT FOR PUMPING @ 40 GPM
TO BE 800 GAL. IN 20 MIN.
IF ASSUME 850 GALLONS WERE PUMPED
FOR 20 MIN ⇒ 42.5 GPM RATE

Simulate Storm Event Field Form

Field staff names:						**Date:** 8/30 **Time:** 10:15
SOP Name and Notes during site inspection (surrounding area, tank, pump, pipes, sample port, other equipment): GBD Storm 6						
Simulated Event Information						
Notes (circle text as appropriate):						
Record Influent Flow Rate:	Time #1		Time #2		Time #3	
	39.5 - 40.0		39.3 - 39.7		39.3 - 40.0	
Record Depth at Upstream and Downstream Piezometers:	Time #1, US	Time #1, DS	Time #2, US	Time #2, DS	Time #3, US	Time #3, DS
Were automatic grab samplers placed in the swale after the influent flow rate reached the water quality design flow rate? Y N						
Were samples collected from the influent and eight sample locations? Y N						
Note any issues encountered or observations made during the event:						

Simulate Storm Event Field Form

Field staff names: same as reverse (Don, Jared, Brian M, Taylor) Drew, Andrea						**Date:** 8/25/2022 **Time:** 9:07a
SOP Name and Notes during site inspection (surrounding area, tank, pump, pipes, sample port, other equipment): HMA 200 mg/L Storm 1						
Simulated Event Information						
Notes (circle text as appropriate):						
Record Influent Flow Rate:	Time #1		Time #2		Time #3	
	38.6 – 39.1		38.6 – 39.7		38.4 – 39.5	
Record Depth at Upstream and Downstream Piezometers:	Time #1, US 10:00	Time #1, DS	Time #2, US 10:[illegible]	Time #2, DS	Time #3, US	Time #3, DS
	1.80'	1.89'	1.89'	1.72'	1.93'	1.8'
Were automatic grab samplers placed in the swale after the influent flow rate reached the water quality design flow rate? Y N						
Were samples collected from the influent and eight sample locations? Y N						
Note any issues encountered or observations made during the event: for						

10:27
1.86' 1.78'

9:07 am start
9:15 a port #2
9:25 pump stop
9:20 port #3
9:26 port #4
9:31 port #5
9:38 port #6
9:47 port #7
9:56 end of swale + port #8

200 gal $\frac{200\ mg}{L}$ $\frac{L}{0.264\ gal}$ $\frac{2.205 \times 10^{-6}\ lbs}{mg}$

↳ 5.3 oz left in tank if drained to 200 gal

Simulate Storm Event Field Form

Field staff names: Dan, Drew, Taylor	**Date:** 8/26 **Time:** 9:43

SOP Name and Notes during site inspection (surrounding area, tank, pump, pipes, sample port, other equipment):

HMA Storm 2

Simulated Event Information

Notes (circle text as appropriate):

	Time #1		Time #2		Time #3	
Record Influent Flow Rate:	38.6 - 39.7		38.8 39.4		39.1 39.7	
Record Depth at Upstream and Downstream Piezometers:	Time #1, US	Time #1, DS	Time #2, US	Time #2, DS	Time #3, US	Time #3, DS

Were automatic grab samplers placed in the swale after the influent flow rate reached the water quality design flow rate? Y N

Were samples collected from the influent and eight sample locations? Y N

Note any issues encountered or observations made during the event:

IAMA Event #2

Simulate Storm Event Field Form

Field staff names:	**Date:** 8/26
	Time:
SOP Name and Notes during site inspection (surrounding area, tank, pump, pipes, sample port, other equipment):	

Simulated Event Information

Notes (circle text as appropriate):

	Time #1		Time #2		Time #3	
Record Influent Flow Rate:						
Record Depth at Upstream and Downstream Piezometers:	Time #1, US	Time #1, DS	Time #2, US	Time #2, DS	Time #3, US	Time #3, DS
	1.85 10:44	1.78 10:42	1.90 10:49	1.70 10:47	1.92 10:56	1.67 10:55

Were automatic grab samplers placed in the swale after the influent flow rate reached the water quality design flow rate? Y N

Were samples collected from the influent and eight sample locations? Y N

Note any issues encountered or observations made during the event:

water @ surface about 25' from where enters port when pump is running, then begins to lag behind

Start pump 1:50p

port #1 2:38

#2 7:10

#3 12:28

#4 18:15

#5 24:15

#6 30:30

#7 37:53

#8 46:15

end pump

US pipe = 1.98' deep

DS pipe = 1.98 deep

pg 1 of 2

Simulate Storm Event Field Form

Field staff names: Chuck G, Brian P, Drew, Taylor H-B					**Date:** 8/24/22	
					Time:	
SOP Name and Notes during site inspection (surrounding area, tank, pump, pipes, sample port, other equipment): HMA Storm 3						
Simulated Event Information						
Notes (circle text as appropriate):						
Record Influent Flow Rate:	Time #1		Time #2		Time #3	
Record Depth at Upstream and Downstream Piezometers:	Time #1, US	Time #1, DS	Time #2, US	Time #2, DS	Time #3, US	Time #3, DS
Were automatic grab samplers placed in the swale after the influent flow rate reached the water quality design flow rate? Y N						
Were samples collected from the influent and eight sample locations? Y N						
Note any issues encountered or observations made during the event:						

PORT	TIME
1	3:02.96
2	4:38.32
3	5:25.59
4	6:00.15
5	5:51.09
6	6:32.49
7	7:58.94
8	9:15.73

pg 2 of 2

Simulate Storm Event Field Form

Field staff names:						
					Date: 8/29/2022	
SOP Name and Notes during site inspection (surrounding area, tank, pump, pipes, sample port, other equipment): HMA Storm 3					Time:	
Simulated Event Information						
Notes (circle text as appropriate):						
Record Influent Flow Rate:	Time #1		Time #2		Time #3	
	39.5 - 39.7		39.5 - 40.2		39.1 - 38.6	
Record Depth at Upstream and Downstream Piezometers:	Time #1, US	Time #1, DS	Time #2, US	Time #2, DS	Time #3, US	Time #3, DS
	1.90 10:22	~~[illegible]~~ 10:[illegible]	1.91 10:28	1.68 10:26	1.92 10:31	1.68 10:29
Were automatic grab samplers placed in the swale after the influent flow rate reached the water quality design flow rate? Y N						
Were samples collected from the influent and eight sample locations? Y N						
Note any issues encountered or observations made during the event: 1.73						

9:17 mix tank

9:43 stop pump

inf grab samples taken
1) ~at start, after got to flow rate
2) ~600 gal
3) ~300 gal
↳ also when record Q range

Extra Notes Page

Site Preparation Field Form

Field staff names:	**Date:** 8/29/22
	Time:
SOP Name and Notes during site inspection (surrounding area, tank, pump, pipes, sample port, other equipment): HMA Storm 3	

Site Preparation for Stimulated event	
Notes (circle text as appropriate):	
Remove grab sampler ports and confirm that the samplers are empty and clean Y N	
Rinse out Sampler Y N	
Confirm that the piezometers are empty and clean Y N	
Influent flow meter verification performed? Y N	
If flow meter readings appear to be consistenly biased, what is the difference?	
Water level meter verification performed? Y N	
If water level meter readings are off, by how much?	

noted before test that duct tape not sealing liner to post
↳ possible sediment contam in samples

windy during wind (prior to test)
↳ likely sediment/sand deposit

Simulate Storm Event Field Form

Field staff names: Don, Jeremy, Chris, Drew, Taylor 14-B						Date: 8/30 Time: 8:15
SOP Name and Notes during site inspection (surrounding area, tank, pump, pipes, sample port, other equipment): HMA Storm 4						
Simulated Event Information						
Notes (circle text as appropriate):						
Record Influent Flow Rate:	Time #1		Time #2		Time #3	
	38.4	39.7	39.3	40.4	39.1	39.7
Record Depth at Upstream and Downstream Piezometers:	Time #1, US	Time #1, DS	Time #2, US	Time #2, DS	Time #3, US	Time #3, DS
Were automatic grab samplers placed in the swale after the influent flow rate reached the water quality design flow rate? Y N						
Were samples collected from the influent and eight sample locations? Y N						
Note any issues encountered or observations made during the event:						

pg 2 of 2

Simulate Storm Event Field Form

Field staff names:	Date: 8/30/22 Time: 8:19a

SOP Name and Notes during site inspection (surrounding area, tank, pump, pipes, sample port, other equipment):

HMA Storm 4

Simulated Event Information

Notes (circle text as appropriate):

Record Influent Flow Rate:	Time #1		Time #2		Time #3	
Record Depth at Upstream and Downstream Piezometers:	Time #1, US	Time #1, DS	Time #2, US	Time #2, DS	Time #3, US	Time #3, DS

Were automatic grab samplers placed in the swale after the influent flow rate reached the water quality design flow rate? Y N

Were samples collected from the influent and eight sample locations? Y N

Note any issues encountered or observations made during the event:

water entering next (2nd) (4th) port when water at surface is ~5' past prev port (1st)
is ~ at previous port (3rd)
before prev port (4th + after pump shut off)

8:18:54 start pump to swale (t=0)
8:20/21:50 port 1
8:26:20 port 2
8:31:43 port 3
8:37:34 port 4
8:43:30 port 5
8:50:20 port 6
8:57:34 port 7
9:05:49 port 8
9:06:23 end

endpump to swale: ~8:40

no ponding @ surface
after 4th/after pump shut off

9:18 a start loading

Pg 1 of 2

Simulate Storm Event Field Form

Field staff names:						**Date:** 8/20/22 **Time:** 12:25
SOP Name and Notes during site inspection (surrounding area, tank, pump, pipes, sample port, other equipment): AMA Storm 5						
Simulated Event Information						
Notes (circle text as appropriate):						
Record Influent Flow Rate:	Time #1		Time #2 38.6. 39.1		Time #3 38.6. 39.3	
Record Depth at Upstream and Downstream Piezometers:	Time #1, US	Time #1, DS	Time #2, US	Time #2, DS	Time #3, US	Time #3, DS
Were automatic grab samplers placed in the swale after the influent flow rate reached the water quality design flow rate? Y N						
Were samples collected from the influent and eight sample locations? Y N						
Note any issues encountered or observations made during the event:						

pg 2 of 2

Simulate Storm Event Field Form

Field staff names:						**Date:** 8/30/22 **Time:** 12:25
SOP Name and Notes during site inspection (surrounding area, tank, pump, pipes, sample port, other equipment): HMA Storm 5						
Simulated Event Information						
Notes (circle text as appropriate):						
Record Influent Flow Rate:	Time #1		Time #2		Time #3	
	397-402					
Record Depth at Upstream and Downstream Piezometers:	Time #1, US	Time #1, DS	Time #2, US	Time #2, DS	Time #3, US	Time #3, DS
Were automatic grab samplers placed in the swale after the influent flow rate reached the water quality design flow rate? Y N						
Were samples collected from the influent and eight sample locations? Y N						
Note any issues encountered or observations made during the event:						

start pump 12:29:18
stop pump
port #1 12:31:56
#2 12:36:10
#3 12:41:12
#4 12:46:46 hand pushed in sample (some seepage still in these areas)
#5 12:52:05 pulled some seepage in sample, dumped
#6 12:58:07
#7 1:04:43
#8 1:12:31

Simulate Storm Event Field Form

Field staff names:	**Date:** 8/31 **Time:** 7:00
SOP Name and Notes during site inspection (surrounding area, tank, pump, pipes, sample port, other equipment): HMA Storm 6	

Simulated Event Information

Notes (circle text as appropriate):

Record Influent Flow Rate:	Time #1		Time #2		Time #3	
	39.3 – 39.5		39.3	39.7	39.5	40.0
Record Depth at Upstream and Downstream Piezometers:	Time #1, US	Time #1, DS	Time #2, US	Time #2, DS	Time #3, US	Time #3, DS

Were automatic grab samplers placed in the swale after the influent flow rate reached the water quality design flow rate? Y N

Were samples collected from the influent and eight sample locations? Y N

Note any issues encountered or observations made during the event:

Simulate Storm Event Field Form

Field staff names: Michael H, Dan, Jeremy, Taylor A-B	Date: 8/31 Time: 7a
SOP Name and Notes during site inspection (surrounding area, tank, pump, pipes, sample port, other equipment): HMA Storm 6	

Simulated Event Information						
Notes (circle text as appropriate):						
Record Influent Flow Rate:	Time #1		Time #2		Time #3	
Record Depth at Upstream and Downstream Piezometers:	Time #1, US	Time #1, DS	Time #2, US	Time #2, DS	Time #3, US	Time #3, DS
Were automatic grab samplers placed in the swale after the influent flow rate reached the water quality design flow rate? Y N						
Were samples collected from the influent and eight sample locations? Y N						
Note any issues encountered or observations made during the event:						

Start pump ~~7:01:00~~ 7:01:00a
Stop pump
port 1 missed
port 2 7:09:08 → may not have been vacuumed? or slight low spot or where sediment is jammed up? (DS of #2, should see in #3) — verbally told had been vacuumed
port 3 7:13:28
port 4 7:20:28 → last before pump shut off
port 5 7:26:05
port 6 7:32:23
port 7 7:39:58
port 8 7:48:40

Simulate Storm Event Field Form

Field staff names: same as reverse		Date: 9/12
		Time:

SOP Name and Notes during site inspection (surrounding area, tank, pump, pipes, sample port, other equipment):
\# Pea Gravel Storm 1

Simulated Event Information

Notes (circle text as appropriate):

	Time #1		Time #2		Time #3	
Record Influent Flow Rate:						
Record Depth at Upstream and Downstream Piezometers:	Time #1, US	Time #1, DS	Time #2, US	Time #2, DS	Time #3, US	Time #3, DS

Were automatic grab samplers placed in the swale after the influent flow rate reached the water quality design flow rate? Y N

Were samples collected from the influent and eight sample locations? Y N

Note any issues encountered or observations made during the event:

Start pump 12:34
Loc #1 3:39
#2 7:42
#3 11:59
#4 15:34
#5 20:19
#6 25:28
#7 31:35
#8 39:25
end 41:38

stop pump 21:05 12:56

pg 2 > 2

Simulate Storm Event Field Form

Field staff names:	Date: Time: 12:34
SOP Name and Notes during site inspection (surrounding area, tank, pump, pipes, sample port, other equipment): PG Storm 1	

Simulated Event Information

Notes (circle text as appropriate):

	Time #1		Time #2		Time #3	
Record Influent Flow Rate:	39.1-39.5		39.5-40.2		39.5-39.7	
	Time #1, US	Time #1, DS	Time #2, US	Time #2, DS	Time #3, US	Time #3, DS
Record Depth at Upstream and Downstream Piezometers:						

Were automatic grab samplers placed in the swale after the influent flow rate reached the water quality design flow rate? Y N

Were samples collected from the influent and eight sample locations? Y N

Note any issues encountered or observations made during the event:

pg 1 o 2

Simulate Storm Event Field Form

Field staff names: Chuck W, Drew, Jeremy, Taylor					Date: 9/13	
					Time:	
SOP Name and Notes during site inspection (surrounding area, tank, pump, pipes, sample port, other equipment): PG Storm 2						
Simulated Event Information						
Notes (circle text as appropriate):						
	Time #1		Time #2		Time #3	
Record Influent Flow Rate:						
	Time #1, US	Time #1, DS	Time #2, US	Time #2, DS	Time #3, US	Time #3, DS
Record Depth at Upstream and Downstream Piezometers:						
Were automatic grab samplers placed in the swale after the influent flow rate reached the water quality design flow rate? Y N						
Were samples collected from the influent and eight sample locations? Y N						
Note any issues encountered or observations made during the event:						

Start
#1 ~~7:54~~ - 3:58
#2 - 8:14
#3 - 12:44
#4 - 16:50
#5 - 21:38
#6 - 27:19
#7 - 34:46
#8 - 44:21
end

end/stop pump
7:51 8:12.25

pg 2 of 2

Simulate Storm Event Field Form

Field staff names:					**Date:**	
					Time:	
SOP Name and Notes during site inspection (surrounding area, tank, pump, pipes, sample port, other equipment): PG Storm 2						
Simulated Event Information						
Notes (circle text as appropriate):						
Record Influent Flow Rate:	Time #1		Time #2		Time #3	
	39.5 - 40.0		39.3 - 39.5		39.5 - 39.7	
Record Depth at Upstream and Downstream Piezometers:	Time #1, US	Time #1, DS	Time #2, US	Time #2, DS	Time #3, US	Time #3, DS
Were automatic grab samplers placed in the swale after the influent flow rate reached the water quality design flow rate? Y N						
Were samples collected from the influent and eight sample locations? Y N						
Note any issues encountered or observations made during the event:						

page 1 o 2

Simulate Storm Event Field Form

Field staff names: Brian P, Drew, Jeremy, Taylor						**Date:** 9/14 **Time:**
SOP Name and Notes during site inspection (surrounding area, tank, pump, pipes, sample port, other equipment): Pea Gravel Storm 3						
Simulated Event Information						
Notes (circle text as appropriate):						
Record Influent Flow Rate:	Time #1		Time #2		Time #3	
Record Depth at Upstream and Downstream Piezometers:	Time #1, US	Time #1, DS	Time #2, US	Time #2, DS	Time #3, US	Time #3, DS
Were automatic grab samplers placed in the swale after the influent flow rate reached the water quality design flow rate? Y N						
Were samples collected from the influent and eight sample locations? Y N						
Note any issues encountered or observations made during the event:						

Start pump 7:40am

stop pump 8:01 am

#1 3:30.75

#2 4:07.44

#3 4:32.44

#4 3:47.01

#5 4:53.04

#6 6:03.24

#7 7:40.22

#8 9:51.52

page 2 o 2

Simulate Storm Event Field Form

	Date: 9/14
	Time: 7:36 a
Field staff names: same as pg 1	
SOP Name and Notes during site inspection (surrounding area, tank, pump, pipes, sample port, other equipment):	
PG Storm 3	

Simulated Event Information

Notes (circle text as appropriate):

	Time #1		Time #2		Time #3	
Record Influent Flow Rate:	38.8 - 39.7		39.3 - 40.2		39.3 - 38.8	
	Time #1, US	Time #1, DS	Time #2, US	Time #2, DS	Time #3, US	Time #3, DS
Record Depth at Upstream and Downstream Piezometers:						

Were automatic grab samplers placed in the swale after the influent flow rate reached the water quality design flow rate? Y N

Were samples collected from the influent and eight sample locations? Y N

Note any issues encountered or observations made during the event:

pg 1 of 2

Simulate Storm Event Field Form

Field staff names: Brian P, Drew, Jeremy, Taylor					**Date:** 9/14 **Time:** 12:54
SOP Name and Notes during site inspection (surrounding area, tank, pump, pipes, sample port, other equipment): P6 Storm 4					
Simulated Event Information					
Notes (circle text as appropriate):					
Record Influent Flow Rate:	Time #1		Time #2		Time #3
	40.4 - 40.6		40 - 40.4		39.1 - 39.7
Record Depth at Upstream and Downstream Piezometers:	Time #1, US	Time #1, DS	Time #2, US	Time #2, DS	Time #3, US / Time #3, DS
Were automatic grab samplers placed in the swale after the influent flow rate reached the water quality design flow rate? Y N					
Were samples collected from the influent and eight sample locations? Y N					
Note any issues encountered or observations made during the event:					

pump stopped 1:19:10 pm

Simulate Storm Event Field Form

Field staff names:					**Date:** 9/14	
					Time:	
SOP Name and Notes during site inspection (surrounding area, tank, pump, pipes, sample port, other equipment): PG Storm 4						
Simulated Event Information						
Notes (circle text as appropriate):						
Record Influent Flow Rate:	Time #1		Time #2		Time #3	
Record Depth at Upstream and Downstream Piezometers:	Time #1, US	Time #1, DS	Time #2, US	Time #2, DS	Time #3, US	Time #3, DS
Were automatic grab samplers placed in the swale after the influent flow rate reached the water quality design flow rate? Y N						
Were samples collected from the influent and eight sample locations? Y N						
Note any issues encountered or observations made during the event:						

PUMP START: 1258

PUMP END: 1318

PORT	
1	3:39.87
2	4:03.68
3	4:18.44
4	3:37.22
5	5:03 50
6	9:24.74
7	5:23 33
8	8:26.14

Simulate Storm Event Field Form

Field staff names:						**Date:** 9/15 **Time:** 7:39 a
SOP Name and Notes during site inspection (surrounding area, tank, pump, pipes, sample port, other equipment): PG Storm 5						
Simulated Event Information						
Notes (circle text as appropriate):			38.6 - 39.3 in sep 5s interval			
	Time #1		Time #2		Time #3	
Record Influent Flow Rate:	40.2 - 40.6		39.7 - 40.0		39.7 - 40.0	
	Time #1, US	Time #1, DS	Time #2, US	Time #2, DS	Time #3, US	Time #3, DS
Record Depth at Upstream and Downstream Piezometers:						
Were automatic grab samplers placed in the swale after the influent flow rate reached the water quality design flow rate? Y N						
Were samples collected from the influent and eight sample locations? Y N						
Note any issues encountered or observations made during the event: since 9/14, seems to be slightly wider variation in meter readings maybe be TAB turned mixer up higher than prev tests						

– start mix

8:09 stop pump

noticed accum of silt/soil in barrel after annual wash likely ~0.5 lb, if that, based on visual estim.

Simulate Storm Event Field Form

Field staff names: Jeremy, Drew, Taylor						Date: 9/15 Time:
SOP Name and Notes during site inspection (surrounding area, tank, pump, pipes, sample port, other equipment): PG Storm 5						
Simulated Event Information						
Notes (circle text as appropriate):						
Record Influent Flow Rate:	Time #1		Time #2		Time #3	
Record Depth at Upstream and Downstream Piezometers:	Time #1, US	Time #1, DS	Time #2, US	Time #2, DS	Time #3, US	Time #3, DS
Were automatic grab samplers placed in the swale after the influent flow rate reached the water quality design flow rate? Y N						
Were samples collected from the influent and eight sample locations? Y N						
Note any issues encountered or observations made during the event:						

Start pump 7:48 Am

end pump 8:09 Am

#1 3.40
#2 7.44
#3 12.00
#4 15.56
#5 21.03
#6 26.22
#7 33.28
#8 43.05
end 44.46 - 8:33 Am

pg 1 of 2

Simulate Storm Event Field Form

Field staff names: Drew Jeremy Taylor						**Date:** 9/15 **Time:** 12:46
SOP Name and Notes during site inspection (surrounding area, tank, pump, pipes, sample port, other equipment): PB Storm 6						
Simulated Event Information						
Notes (circle text as appropriate):						
Record Influent Flow Rate:	Time #1		Time #2		Time #3	
	39.1 – 40.0		39.5 – 39.7		39.1 – 39.3	
Record Depth at Upstream and Downstream Piezometers:	Time #1, US	Time #1, DS	Time #2, US	Time #2, DS	Time #3, US	Time #3, DS
Were automatic grab samplers placed in the swale after the influent flow rate reached the water quality design flow rate? Y N						
Were samples collected from the influent and eight sample locations? Y N						
Note any issues encountered or observations made during the event:						

→ Start mix

Stop pump 1:11:17

pg 2 of 2

Simulate Storm Event Field Form

Field staff names:						**Date:** 9/15
						Time:
SOP Name and Notes during site inspection (surrounding area, tank, pump, pipes, sample port, other equipment): PG Storm 6						
Simulated Event Information						
Notes (circle text as appropriate):						
Record Influent Flow Rate:	Time #1		Time #2		Time #3	
Record Depth at Upstream and Downstream Piezometers:	Time #1, US	Time #1, DS	Time #2, US	Time #2, DS	Time #3, US	Time #3, DS
Were automatic grab samplers placed in the swale after the influent flow rate reached the water quality design flow rate? Y N						
Were samples collected from the influent and eight sample locations? Y N						
Note any issues encountered or observations made during the event:						

Start pump 12:50 pm

end pump 1:11 pm

#1 3:30

#2 7.14

#3 11.13

#4 14.39

#5 19.27

#6 24.00

#7 29.13

#8 37.43

end 38.38 1:29 pm

Simulate Storm Event Field Form

Field staff names: Chuck W, Drew, Jeremy, Don, Taylor						**Date:** 9/13 **Time:**
SOP Name and Notes during site inspection (surrounding area, tank, pump, pipes, sample port, other equipment): SPG Storm 1						
Simulated Event Information						
Notes (circle text as appropriate):	Time #1		Time #2		Time #3	
Record Influent Flow Rate:						
	Time #1, US	Time #1, DS	Time #2, US	Time #2, DS	Time #3, US	Time #3, DS
Record Depth at Upstream and Downstream Piezometers:						
Were automatic grab samplers placed in the swale after the influent flow rate reached the water quality design flow rate? Y N						
Were samples collected from the influent and eight sample locations? Y N						
Note any issues encountered or observations made during the event:						

start pump - 10:52 end pump - 11:14

#1 - 2.47
#2 - 5.52
#3 - 8.30
#4 - 11.27
#5 - 14.43
#6 - 17.10
#7 - 20.35
#8 - 23.14
end -

Simulate Storm Event Field Form

Field staff names: Same as page 1						**Date:** 9/13 **Time:**
SOP Name and Notes during site inspection (surrounding area, tank, pump, pipes, sample port, other equipment): SPG Storm 1						
Simulated Event Information						
Notes (circle text as appropriate):						
Record Influent Flow Rate:	Time #1		Time #2		Time #3	
	39.1		39.5		39.1 - 39.5	
Record Depth at Upstream and Downstream Piezometers:	Time #1, US	Time #1, DS	Time #2, US	Time #2, DS	Time #3, US	Time #3, DS
Were automatic grab samplers placed in the swale after the influent flow rate reached the water quality design flow rate? Y N						
Were samples collected from the influent and eight sample locations? Y N						
Note any issues encountered or observations made during the event:						

pg 1 o 2

Simulate Storm Event Field Form

Field staff names: Brian P, Jeremy, Drew, Taylor					**Date:** 9/14 **Time:** 9:23a	
SOP Name and Notes during site inspection (surrounding area, tank, pump, pipes, sample port, other equipment): SP6 Storm 8						
Simulated Event Information						
Notes (circle text as appropriate):						
	Time #1		Time #2		Time #3	
Record Influent Flow Rate:	39.1 - 40.2		39.1 - 39.5		39.3 - 40.0	
	Time #1, US	Time #1, DS	Time #2, US	Time #2, DS	Time #3, US	Time #3, DS
Record Depth at Upstream and Downstream Piezometers:						
Were automatic grab samplers placed in the swale after the influent flow rate reached the water quality design flow rate? Y N						
Were samples collected from the influent and eight sample locations? Y N						
Note any issues encountered or observations made during the event:						

9:48a stop pump

Simulate Storm Event Field Form

Field staff names: Brian P, Jeremy, Taylor, Drew						**Date:** 9/14 **Time:**
SOP Name and Notes during site inspection (surrounding area, tank, pump, pipes, sample port, other equipment): SPG Storm 2						
Simulated Event Information						
Notes (circle text as appropriate):						
Record Influent Flow Rate:	Time #1		Time #2		Time #3	
Record Depth at Upstream and Downstream Piezometers:	Time #1, US	Time #1, DS	Time #2, US	Time #2, DS	Time #3, US	Time #3, DS
Were automatic grab samplers placed in the swale after the influent flow rate reached the water quality design flow rate? Y N						
Were samples collected from the influent and eight sample locations? Y N						
Note any issues encountered or observations made during the event:						

PUMP START: 0927 PUMP END: 0948

PORT	
1	2:41.14
2	3:00.12
3	2:25.55
4	3:00.88
5	3:06.33
6	2:26.91
7	3:15.02
8	2:36.64

Simulate Storm Event Field Form

Field staff names:						Date: 9/15 Time: 10:00a → Start mix
SOP Name and Notes during site inspection (surrounding area, tank, pump, pipes, sample port, other equipment): SP6 Storm 3						
Simulated Event Information						
Notes (circle text as appropriate):						
	Time #1		Time #2		Time #3	
Record Influent Flow Rate:	39.3-39.7		39.5-39.7		38.8-39.5	
	Time #1, US	Time #1, DS	Time #2, US	Time #2, DS	Time #3, US	Time #3, DS
Record Depth at Upstream and Downstream Piezometers:						
Were automatic grab samplers placed in the swale after the influent flow rate reached the water quality design flow rate? Y N						
Were samples collected from the influent and eight sample locations? Y N						
Note any issues encountered or observations made during the event:						

10:29:28 pump stop

MJ 202

Simulate Storm Event Field Form

Field staff names: Drew Jeremy Taylor					**Date:** 9/15 **Time:**	
SOP Name and Notes during site inspection (surrounding area, tank, pump, pipes, sample port, other equipment): SPG Storm 3						
Simulated Event Information						
Notes (circle text as appropriate):						
	Time #1		Time #2		Time #3	
Record Influent Flow Rate:						
	Time #1, US	Time #1, DS	Time #2, US	Time #2, DS	Time #3, US	Time #3, DS
Record Depth at Upstream and Downstream Piezometers:						
Were automatic grab samplers placed in the swale after the influent flow rate reached the water quality design flow rate? Y N						
Were samples collected from the influent and eight sample locations? Y N						
Note any issues encountered or observations made during the event:						

start pump 10:04 AM

stop pump 10:24 AM

#1 2.32
#2 5.32
#3 7.51
#4 10.44
#5 13.42
#6 16.02
#7 19.09
#8 21.37
end 22.00 - 10:26AM

pg 1 o 2

Simulate Storm Event Field Form

Field staff names: Jeremy Taylor						**Date:** 9/16 **Time:** 7:33 → start mix
SOP Name and Notes during site inspection (surrounding area, tank, pump, pipes, sample port, other equipment): SPG Storm 4						
Simulated Event Information						
Notes (circle text as appropriate):						
Record Influent Flow Rate:	Time #1 39.3 - 39.5		Time #2 39.3 - 39.5		Time #3 39.3 - 39.7	
Record Depth at Upstream and Downstream Piezometers:	Time #1, US	Time #1, DS	Time #2, US	Time #2, DS	Time #3, US	Time #3, DS
Were automatic grab samplers placed in the swale after the influent flow rate reached the water quality design flow rate? Y N						
Were samples collected from the influent and eight sample locations? Y N						
Note any issues encountered or observations made during the event:						

7:42

Stop 8:04:12

Simulate Storm Event Field Form

Field staff names: Jeremy Taylor					**Date:** 9/16	
					Time:	
SOP Name and Notes during site inspection (surrounding area, tank, pump, pipes, sample port, other equipment): SPG Storm 4						
Simulated Event Information						
Notes (circle text as appropriate):						
	Time #1		Time #2		Time #3	
Record Influent Flow Rate:						
Record Depth at Upstream and Downstream Piezometers:	Time #1, US	Time #1, DS	Time #2, US	Time #2, DS	Time #3, US	Time #3, DS
Were automatic grab samplers placed in the swale after the influent flow rate reached the water quality design flow rate? Y N						
Were samples collected from the influent and eight sample locations? Y N						
Note any issues encountered or observations made during the event:						

Start pump 7:42

#1 2:40
#2 5:47
#3 8:11
#4 11:14
#5 14:20
#6 16:50
#7 20:02
#8 22:35

Stop pump 8:03

END 23 min

8:05

Simulate Storm Event Field Form

Field staff names: Drew, Dan, Aimee, Taylor					Date: 9/19/2020	
					Time: 9:38 start mix	
SOP Name and Notes during site inspection (surrounding area, tank, pump, pipes, sample port, other equipment): SPG Storm 5						
Simulated Event Information						
Notes (circle text as appropriate):						
Record Influent Flow Rate:	Time #1		Time #2		Time #3	
	39.8	40.2	39.5	40.4	39.3	40.0
~~Record Depth at Upstream and Downstream Piezometers:~~	~~Time #1, US~~	~~Time #1, DS~~	~~Time #2, US~~	~~Time #2, DS~~	~~Time #3, US~~	~~Time #3, DS~~
	N					
Were automatic grab samplers placed in the swale after the influent flow rate reached the water quality design flow rate? Y N						
Were samples collected from the influent and eight sample locations? Y N						
Note any issues encountered or observations made during the event:						

Stop pump 10:02:49

Site Preparation Field Form

Field staff names: Drew, Don, Aimee, Taylor	**Date:** 9/19/2022 **Time:**
SOP Name and Notes during site inspection (surrounding area, tank, pump, pipes, sample port, other equipment): SPG Storm 5	
Site Preparation for Stimulated event	
Notes (circle text as appropriate):	
Remove grab sampler ports and confirm that the samplers are empty and clean Y N	
Rinse out Sampler Y N	
Confirm that the piezometers are empty and clean Y N	
Influent flow meter verification performed? Y N	
If flow meter readings appear to be consistenly biased, what is the difference?	
Water level meter verification performed? Y N	
If water level meter readings are off, by how much?	

start pump

#1 0:00 9:42:43
#2 2:30
#3 5:24
#4 7:45
#5 10:35
#6 13:37
#7 1557
#8 19:06
end 21:38

stop pump

Henry

Simulate Storm Event Field Form

Field staff names: Drew, Don, Chuck W, Chris, Taylor					**Date:** 10/17	
					Time: 2:00p	
SOP Name and Notes during site inspection (surrounding area, tank, pump, pipes, sample port, other equipment): Storm #1 Final						
Simulated Event Information						
Notes (circle text as appropriate):						
	Time #1		Time #2		Time #3	
Record Influent Flow Rate:	39.7 - 40.2		40.0 - 40.8		39.7 - 40.2	
Record Depth at Upstream and Downstream Piezometers:	Time #1, US	Time #1, DS	Time #2, US	Time #2, DS	Time #3, US	Time #3, DS
Were automatic grab samplers placed in the swale after the influent flow rate reached the water quality design flow rate? Y N						
Were samples collected from the influent and eight sample locations? Y N						
Note any issues encountered or observations made during the event:						

2:25p pump stop

Simulate Storm Event Field Form

Field staff names:						**Date:**
						Time:
SOP Name and Notes during site inspection (surrounding area, tank, pump, pipes, sample port, other equipment): Storm #1						
Simulated Event Information						
Notes (circle text as appropriate):						
Record Influent Flow Rate:	Time #1		Time #2		Time #3	
Record Depth at Upstream and Downstream Piezometers:	Time #1, US	Time #1, DS	Time #2, US	Time #2, DS	Time #3, US	Time #3, DS
Were automatic grab samplers placed in the swale after the influent flow rate reached the water quality design flow rate? Y N						
Were samples collected from the influent and eight sample locations? Y N						
Note any issues encountered or observations made during the event:						

Start 2:01
#1 3m 40s
#2 8m 45s
#3 14m 0s
#4 20m 15s
#5 26m 25s
#6 33m 22s
#7 40m 43s
#8 51m 15s
end 2:23

Simulate Storm Event Field Form

Field staff names:	**Date:** 10/17 **Time:**
SOP Name and Notes during site inspection (surrounding area, tank, pump, pipes, sample port, other equipment): Storm #2	

Simulated Event Information

Notes (circle text as appropriate):

	Time #1		Time #2		Time #3	
Record Influent Flow Rate:	39.7	40.2	39.1	39.7	39.5	40.0
	Time #1, US	Time #1, DS	Time #2, US	Time #2, DS	Time #3, US	Time #3, DS
Record Depth at Upstream and Downstream Piezometers:						

Were automatic grab samplers placed in the swale after the influent flow rate reached the water quality design flow rate? Y N

Were samples collected from the influent and eight sample locations? Y N

Note any issues encountered or observations made during the event:

3:33 start mix pg 2 of 2

Simulate Storm Event Field Form

Field staff names:						**Date:** 10/17 **Time:**
SOP Name and Notes during site inspection (surrounding area, tank, pump, pipes, sample port, other equipment): Storm #2						
Simulated Event Information						
Notes (circle text as appropriate):						
	Time #1		Time #2		Time #3	
Record Influent Flow Rate:						
	Time #1, US	Time #1, DS	Time #2, US	Time #2, DS	Time #3, US	Time #3, DS
Record Depth at Upstream and Downstream Piezometers:						
Were automatic grab samplers placed in the swale after the influent flow rate reached the water quality design flow rate? Y N						
Were samples collected from the influent and eight sample locations? Y N						
Note any issues encountered or observations made during the event:						

start 3:37 pm

#1 3:53s

#2 8:27

#3 13:51

#4 19:42

#5 25:38

#6 32:24

#7 39:32

#8

end 4:24 pm

end pump 3:54 p

pg 1 of 2
12:07p start

Simulate Storm Event Field Form

Field staff names:						Date: 10/18 Time:
SOP Name and Notes during site inspection (surrounding area, tank, pump, pipes, sample port, other equipment): Storm 3 Final						
Simulated Event Information						
Notes (circle text as appropriate):						
Record Influent Flow Rate:	Time #1		Time #2		Time #3	
Record Depth at Upstream and Downstream Piezometers:	Time #1, US	Time #1, DS	Time #2, US	Time #2, DS	Time #3, US	Time #3, DS
Were automatic grab samplers placed in the swale after the influent flow rate reached the water quality design flow rate? Y N						
Were samples collected from the influent and eight sample locations? Y N						
Note any issues encountered or observations made during the event:						

start 12:11
#1 3:50
#2 9:04
#3 14:30
#4 20:44
#5 27:14
#6 34:42
#7 42:59
#8 52:36
end 53:45

end pump

Simulate Storm Event Field Form

Field staff names:					**Date:** 10/18	
					Time:	
SOP Name and Notes during site inspection (surrounding area, tank, pump, pipes, sample port, other equipment): Storm 3 Final						
Simulated Event Information						
Notes (circle text as appropriate):						
Record Influent Flow Rate:	Time #1		Time #2		Time #3	
	40.2 -	40.6	39.3	40.2	39.7.	40.2
Record Depth at Upstream and Downstream Piezometers:	Time #1, US	Time #1, DS	Time #2, US	Time #2, DS	Time #3, US	Time #3, DS
Were automatic grab samplers placed in the swale after the influent flow rate reached the water quality design flow rate? Y N						
Were samples collected from the influent and eight sample locations? Y N						
Note any issues encountered or observations made during the event:						

pg 1 of 2

Simulate Storm Event Field Form

	Date: 10/18
	Time:
Field staff names:	
SOP Name and Notes during site inspection (surrounding area, tank, pump, pipes, sample port, other equipment): Storm 4 Final	

Simulated Event Information

Notes (circle text as appropriate):

	Time #1		Time #2		Time #3	
Record Influent Flow Rate:	39.7	40.1	39.5	40.0	39.3	39.7
	Time #1, US	Time #1, DS	Time #2, US	Time #2, DS	Time #3, US	Time #3, DS
Record Depth at Upstream and Downstream Piezometers:						

Were automatic grab samplers placed in the swale after the influent flow rate reached the water quality design flow rate? Y N

Were samples collected from the influent and eight sample locations? Y N

Note any issues encountered or observations made during the event:

Simulate Storm Event Field Form

Field staff names:					**Date:** 10/18	
					Time:	
SOP Name and Notes during site inspection (surrounding area, tank, pump, pipes, sample port, other equipment): Storm 4 Final						
Simulated Event Information						
Notes (circle text as appropriate):						
Record Influent Flow Rate:	Time #1		Time #2		Time #3	
Record Depth at Upstream and Downstream Piezometers:	Time #1, US	Time #1, DS	Time #2, US	Time #2, DS	Time #3, US	Time #3, DS
Were automatic grab samplers placed in the swale after the influent flow rate reached the water quality design flow rate? Y N						
Were samples collected from the influent and eight sample locations? Y N						
Note any issues encountered or observations made during the event:						

start 2:04 pm
#1 3:36
#2 8:26
#3 13:45
#4 19:37
#5 25:41
#6 32:26
#7 39:34
#8 46:41
end 47:36

stop pump 2:25

pg 1 of 2

9:24 Start mix

Simulate Storm Event Field Form

Field staff names: Drew, Jeremy, Taylor, Chris						**Date:** 10/19/22 **Time:**
SOP Name and Notes during site inspection (surrounding area, tank, pump, pipes, sample port, other equipment): Storm 5 Final						
Simulated Event Information						
Notes (circle text as appropriate):						
Record Influent Flow Rate:	Time #1		Time #2		Time #3	
Record Depth at Upstream and Downstream Piezometers:	Time #1, US	Time #1, DS	Time #2, US	Time #2, DS	Time #3, US	Time #3, DS
Were automatic grab samplers placed in the swale after the influent flow rate reached the water quality design flow rate? Y N						
Were samples collected from the influent and eight sample locations? Y N						
Note any issues encountered or observations made during the event:						

Start 9:33
#1 3:39
#2 8:32
#3 13:57
#4 19:57
#5 26:04
#6 33:02
#7 40:33
#8 48:47
end

stop pump
21:15

Simulate Storm Event Field Form

Field staff names:						**Date:** 10/19/22 **Time:**
SOP Name and Notes during site inspection (surrounding area, tank, pump, pipes, sample port, other equipment): Storm 5 Final						
Simulated Event Information						
Notes (circle text as appropriate):						
Record Influent Flow Rate:	Time #1		Time #2		Time #3	
	39.3 - 40.8		39.5 - 40.0		39.3 - 39.7	
Record Depth at Upstream and Downstream Piezometers:	Time #1, US	Time #1, DS	Time #2, US	Time #2, DS	Time #3, US	Time #3, DS
Were automatic grab samplers placed in the swale after the influent flow rate reached the water quality design flow rate? Y N						
Were samples collected from the influent and eight sample locations? Y N						
Note any issues encountered or observations made during the event:						

9:33 start
9:53 end

Pg 1 of 2

Simulate Storm Event Field Form

Field staff names: Drew, Chris, Jeremy, Taylor						Date: 10/19/22 Time:
SOP Name and Notes during site inspection (surrounding area, tank, pump, pipes, sample port, other equipment): Storm 6						
Simulated Event Information						
Notes (circle text as appropriate):						
Record Influent Flow Rate:	Time #1 39.5 - 39.7		Time #2 39.5-39.7		Time #3 39.5-40.2	
Record Depth at Upstream and Downstream Piezometers:	Time #1, US	Time #1, DS	Time #2, US	Time #2, DS	Time #3, US	Time #3, DS
Were automatic grab samplers placed in the swale after the influent flow rate reached the water quality design flow rate? Y N						
Were samples collected from the influent and eight sample locations? Y N						
Note any issues encountered or observations made during the event:						

11:59 a start

12:20p end pump

pg 2 of 2
10:58 start mix

Simulate Storm Event Field Form

Field staff names: Drew, Chris						Date:	
						Time:	
SOP Name and Notes during site inspection (surrounding area, tank, pump, pipes, sample port, other equipment): Storm 6							
Simulated Event Information							
Notes (circle text as appropriate):							
Record Influent Flow Rate:	Time #1		Time #2		Time #3		
Record Depth at Upstream and Downstream Piezometers:	Time #1, US	Time #1, DS	Time #2, US	Time #2, DS	Time #3, US	Time #3, DS	
Were automatic grab samplers placed in the swale after the influent flow rate reached the water quality design flow rate? Y N							
Were samples collected from the influent and eight sample locations? Y N							
Note any issues encountered or observations made during the event:							

Start 11:59
#1 3:40
#2 8:32
#3 13:57
#4 19:57
#5 26:04
#6 32:58
#7 40:21
#8 48:58

end pump
12:20

Simulate Storm Event Field Form

Field staff names: Drew, Dan, Chuck W, Taylor, Aimee						**Date:** 10/17 **Time:**
SOP Name and Notes during site inspection (surrounding area, tank, pump, pipes, sample port, other equipment): Rinse #1						
Simulated Event Information						
Notes (circle text as appropriate):						
Record Influent Flow Rate:	Time #1		Time #2		Time #3	
Record Depth at Upstream and Downstream Piezometers:	Time #1, US	Time #1, DS	Time #2, US	Time #2, DS	Time #3, US	Time #3, DS
Were automatic grab samplers placed in the swale after the influent flow rate reached the water quality design flow rate? Y N						
Were samples collected from the influent and eight sample locations? Y N						
Note any issues encountered or observations made during the event:						

start 9:19

#1 3m 39s
#2 8m 40s
#3 14m 10s
#4 20m 1s
#5 26m 48s
#6 34m 33s
#7 43m 25s
#8 No Water 1hr 8m 50s
end 9:41

End flow - 53m 10s

Simulate Storm Event Field Form

Field staff names: Drew, Don, Chuck W, Taylor, Aimee	Date: 10/17
	Time:

SOP Name and Notes during site inspection (surrounding area, tank, pump, pipes, sample port, other equipment):
Rinse #2

Simulated Event Information						
Notes (circle text as appropriate):						
Record Influent Flow Rate:	Time #1		Time #2		Time #3	
Record Depth at Upstream and Downstream Piezometers:	Time #1, US	Time #1, DS	Time #2, US	Time #2, DS	Time #3, US	Time #3, DS
Were automatic grab samplers placed in the swale after the influent flow rate reached the water quality design flow rate? Y N						
Were samples collected from the influent and eight sample locations? Y N						
Note any issues encountered or observations made during the event:						

Start 12:03
#1 3m 42s
#2 8m 32s
#3 14m 32s
#4 20m 50s
#5 27m 19s
#6 34m 55s
#7 42m 45s
#8 52m 40s
end

Outflow - 51m 20s

Infilltration Testing
October 19th

$\boxed{\%\ \text{chang}\ C = \frac{x_2 - x_1}{x_1}}$

Test # 1

35 m 11 s
.18 m

4.32 %

3.78 %

Test # 2

36 m 42 s
.7 m

-.51 %

Test # 3

36 m 31 s
.51 m

Internal pipe Diameter

11.75 inches

$\boxed{A = \pi r^2}$

$A = (3.14)(5.875)^2$

$A = (3.14)(34.52)$

$A = 108.38\ in^2$

sq in → sq ft $= \frac{A\ in.}{144}$

A sq ft = .753 ft^2

Appendix C.4 – Audit and QC Review

This appendix contains the forms used to complete the audits and a summary of the QC review that were required for the project. The audits were conducted to determine whether the SOPs were followed for the duration of the study and where modifications were made. The QC review was performed to check for consistency, correctness, and completeness of the data collected during the study. The results of the audits and QC review are discussed in **Sections 3.1** and **3.2**.

Audit Form

Auditor Name: DREW WOODRUFF			Date: 8/25/2022
Respondent Name: TAYLOR			Time: 6:50 AM
Question	**Response**		**Notes:**
8.1.1 Site Preparation for Simulated Storm Event			
Was the treatment rock layer rinsed prior to beginning the first simulated storm event?	Yes	No Modified	NUMEROUS TIMES
Was the tank filled with 1,000 gallons of water before each simulated storm event?	Yes	No Modified	
Were the piezometers and sample ports inspected prior to each simulated storm event?	Yes	No Modified	
Were the automatic grab samplers inspected and cleaned as needed prior to each simulated storm event?	Yes	No Modified	
Was the influent flow meter reading verified prior to each simulated storm event?	Yes	No Modified	
Was the influent synthetic stormwater system set up to deliver the water quality design flow rate prior to each simulated storm event?	Yes	No Modified	
Was the water level meter reading verified prior to each simulated storm event?	Yes	No Modified	
Was the information collected during site preparation recorded on the site preparation field form?	Yes	No Modified	
8.1.2 Site Preparation for Simulated Storm Event			
Was the appropriate amount of Sil Co Sil added to the 1,000 gallon tank for each Phase and mixed to ensure Sil Co Sil didn't settle out?	Yes	No Modified	
Was the influent flow meter displaying the water quality design flow rate prior to installing the automatic grab samplers during Phase 1 of the simulated storm event?	Yes	No Modified	
Were the automatic grab samplers installed after the water quality design flow rate was confirmed by the influent flow meter (during Phase 1)?	Yes	No Modified	
Were a total of three depth measurements taken at each piezometer in the swale during Phase 1 of the simulated storm event?	Yes	No Modified	
Were a total of three influent flow meter readings taken during Phase 1 of the simulated storm event?	Yes	No Modified	
Was the tank fully emptied during Phase 1 and all automatic grab samplers collected after each Phase 1 of the simulated storm events?	Yes	No Modified	
Were the sample ports closed (to limit TSS deposit into the sample ports) before Phase 2 begun?	Yes	No Modified	
Was the information collected during the simulated storm event recorded on the simulated storm event field form?	Yes	No Modified	
8.1.3 Site Preparation for Simulated Storm Event			
Were sample bottles placed in the fridge or cooler filled with ice prior to sampling to keep bottles cool?	Yes No	Modified	
Were sample bottles labeled with sample ID, location, sample date, and sample time?	Yes	No Modified	
Were samples shaken or swirled to homogenize the sample prior to transferring to sample bottles provided by the lab?	Yes No	Modified	
Were samples kept in a cooler filled with loose ice or fridge to keep the samples below a temperature of 6 degrees Celsius?	Yes	No Modified	
Was a Chain of Custody and any additional documentation filled out for the samples?	Yes	No Modified	

Audit Form

Auditor Name: Mark Maurer		**Date: 12/21/2022**
Respondent Name: Taylor Hoffman-Ballard		**Time: 3:00 PM**
Question	**Response**	**Notes:**
8.1.1 Site Preparation for Simulated Storm Event		
Was the treatment rock layer rinsed prior to beginning the first simulated storm event?	Yes	
Was the tank filled with 1,000 gallons of water before each simulated storm event?	Modified	At least 1000 gallons, but sometimes up to 1500 gallons.
Were the piezometers and sample ports inspected prior to each simulated storm event?	Modified	Did inspect the sample port prior to each event, but they pulled the piezometers because they were using time instead of depth.
Were the automatic grab samplers inspected and cleaned as needed prior to each simulated storm event?	Yes	Cleaned them regardless.
Was the influent flow meter reading verified prior to each simulated storm event?	Modified	It was for the first few events but then shifted to the start of each test day because they weren't seeing any drifting.
Was the influent synthetic stormwater system set up to deliver the water quality design flow rate prior to each simulated storm event?	Yes	
Was the water level meter reading verified prior to each simulated storm event?	Modified	Did verify when they were using the water level meter, but they stopped when they switched to time to measure velocity.
Was the information collected during site preparation recorded on the site preparation field form?	Yes	
8.1.2 Site Preparation for Simulated Storm Event		
Was the appropriate amount of Sil Co Sil added to the 1,000 gallon tank for each Phase and mixed to ensure Sil Co Sil didn't settle out?	Yes	
Was the influent flow meter displaying the water quality design flow rate prior to installing the automatic grab samplers during Phase 1 of the simulated storm event?	Yes	
Were the automatic grab samplers installed after the water quality design flow rate was confirmed by the influent flow meter (during Phase 1)?	Yes	
Were a total of three depth measurements taken at each piezometer in the swale during Phase 1 of the simulated storm event?	Modified	Did verify when they were using the water level meter, but they stopped when they switched to time to measure velocity.
Were a total of three influent flow meter readings taken during Phase 1 of the simulated storm event?	Yes	
Was the tank fully emptied during Phase 1 and all automatic grab samplers collected after each Phase 1 of the simulated storm events?	Modified	All automatic grab samplers were collected after Phase 1, but approximately 50 gallons of water was left in the tank because of pump capabilities.
Were the sample ports closed (to limit TSS deposit into the sample ports) before Phase 2 begun?	Yes	
Was the information collected during the simulated storm event recorded on the simulated storm event field form?	Yes	
8.1.3 Site Preparation for Simulated Storm Event		
Were sample bottles placed in the fridge or cooler filled with ice prior to sampling to keep bottles cool?	Modified	No, it was warm so the bottles would warm up before sampling began. However, the bottles were placed in the cooler immediately after pulling from swale.
Were sample bottles labeled with sample ID, location, sample date, and sample time?	Yes	
Were samples shaken or swirled to homogenize the sample prior to transferring to sample bottles provided by the lab?	Modified	Did not need to transfer samples to another bottle. The same bottles used to collect the samples were sent to the lab.
Were samples kept in a cooler filled with loose ice or fridge to keep the samples below a temperature of 6 degrees Celsius?	Modified	This was done if samples were taken on the previous day. The lab said that the samples did not need to be cooled if delivered the same day as the samples were taken.
Was a Chain of Custody and any additional documentation filled out for the samples?	Yes	

QC Review	QA/QC Lead Comment	Response
Spot check that water quality data in Swale #1-4 WQ tabs and Final Swale WQ tab was entered correctly from lab reports.	There were some errors I found in the times when the time was not recorded cumulatively in the Pea Gravel swale. I've highlighted the cells that I checked, but someone will need to look at rows 5 and 6 since I didn't check those. I also added a note to add an identifier to the gravel backfill swales to tie them to the field forms like you've done in the other swales. Per our discussion I didn't check the manning's calculations. I did check the velocity calculations and they are OK.	As discussed, verified that times were added correctly for rows 3-6 for the Pea Gravel swale. Also added an identifier to the gravel backfill swale tables to tie them to the field forms.
Spot check that velocity (time) data in Velocity&ManningsN tab was entered correctly from field data sheets.	I spot checked this data and didn't find any errors.	Noted
Spot check formulas to make sure percent removal, infiltration, velocity, and Manning's n are calculated correctly.	Spot checked formulas and didn't find any errors.	Noted
In the Final Swale WQ tab, the last 4 sections of the page use equations developed on the "Trendlines to estim % removal" tab to estimate what percent removal.	I checked the equations and they are consistent throughout.	Noted. As discussed, will add identifiers to graphs or discussion to Final Swale WQ tab or Trendlines to estim %removal tab to clarify which trendlines were used in the Final Swale WQ tab.
General	Suggestion to add a ReadMe page; descriptions where applicable to make spreadsheet and tabs easier to revisit or read if never seen before.	Will add a ReadMe page at the beginning to explain the purpose and contents of each sheet. Will add additional descriptions to tabs where applicable.

Appendix C.5 – Deviations from QAPP

This appendix contains a summary of deviations from the QAPP and how they were addressed to maintain data quality. Reasons for modifications included: revising procedures to provide a benefit to data quality or data collection; revision of steps following guidance provided by the analytical laboratories; and revision of steps following use of equipment in the field and experiencing field conditions. A review of the deviations is discussed in **Sections 3.1** and **3.2**.

Deviations From QAPP				
Revision #	**Section and Page**	**Original Instructions**	**Suggested Revision**	**Reason for Deviation**
1	Section 8.1.2, Step 1	Turn on the submersible pump intended to mix the SilCoSil in the 1,000-gallon tank. Add the amount of SilCoSil needed to achieve a concentration of 100 mg/L in 1,000 gallons (0.83lbs).	Turn on the submersible pump intended to mix the SilCoSil in the 1,000-gallon tank. Add the amount of SilCoSil needed to achieve a concentration of 100 mg/L in 1,000 gallons (1.67lbs).	At least 1000 gallons were filled, but sometimes up to 1500 gallons due to the series of mechanism used to turn off the water. Section 7.5 indicated sufficient SilCoSil would be added to achieve an influent concentration between 100-200mg/L. To achieve that concentration, 1.67lbs of SilCoSil was added to the approximate 1,000 gallons.
2	Section 8.1.1, Step 4	Inspect the piezometers and sample ports prior to each simulated storm event.	Delete step.	Time to reach each sample location was used instead of the piezometers following the first sample event, because water travelled too slowly through the swale to measure velocity as described in Section 7.4 of the QAPP.
3	Section 8.1.1, Step 7	Verify the influent flow meter reading (impliled prior to each simulated storm event).	Verify the influent flow meter reading at the start of each day, before simulated storm events are begun.	The flow meter reading was verified prior to every event for the first few events, but the frequency was lowered to once per day when drifting was not observed for the meter.
4	Section 8.1.1, Step 9	Verify the water level meter prior to each simulated storm event.	Delete step.	Time to reach each sample location was used instead of the piezometers following the first sample event, because water travelled too slowly through the swale to measure velocity as described in Section 7.4 of the QAPP. As such, the water level meter wasn't verified or used after the first sample event.
5	Section 8.1.2, Step 6	Take a total of three depth measurements at each piezometer in the swale during Phase 1 of the simulated storm event.	Delete step.	Time to reach each sample location was used instead of the piezometers following the first sample event, because water travelled too slowly through the swale to measure velocity as described in Section 7.4 of the QAPP. As such, the water level meter wasn't used after the first sample event.
6	Section 8.1.2 Steps 8-10	Empty the tank fully during Phase 1 and collect all automatic grab samplers after each Phase 1 of the simulated storm events.	Empty the tank to the lowest extent possible with the pump used during Phase 1 and collect all automatic grab samplers after each Phase 1 of the simulated storm events.	The pump used to deliver synthetic stormwater to the swale was able to draw down the tank to a depth that correlated to approximately 50 gallons of water left in the tank. This volume was not emptied from the tank, and was estimated to contain a maximum of 2.4 ounces (assuming a concentration of 200 mg/L) of SilCoSil. The tank was refilled with approximately 1000 gallons of water for the simulation of an annual load of TSS (Phase 2), which was supplemented with 14 pounds of SilCoSil. As a result, the 2.4 ounces was not anticipated to have a significant impact on the simulation of the annual load of TSS.
7	Section 8.1.3 Step 1	Place sample bottles in a fridge or cooler filled with ice prior to sampling to keep bottles cool.	Delete step.	Due to the high temperatures and lack of shade at the site, the bottles would warm up by the time sampling was complete, despite being cooled beforehand. The bottles were placed in a fridge immediately after sampling was complete.
8	Section 8.1.3 Step 4	Shake samples or swirl to homogenize the sample prior to transferring to sample bottles provided by the lab.	Delete step.	Did not need to transfer samples to another bottle. The bottles provided by the lab fit the grab sampler.
9	Section 8.1.3 Page 41	Keep samples in a cooler filled with loose ice or fridge to keep the samples below a temperature of 6 degrees Celsius.	Keep samples in a temperature-controlled fridge until they are ready for delivery to the lab. If samples are delivered on the same date as they are collected, they can be delivered in a cooler without ice. If they are delivered on a different date, the cooler must be filled with loose ice to keep samples below a temperature of 6 degrees Celsius.	The analytical laboratory communicated that samples did not need to be cooled if delivered the same day as the samples taken, but did need to be cooled to below 6 degrees Celsius if delivered on the following day or later.
10	Section 8.1.2 Page 39	SOP defines procedures for simulating a storm event at the site, and assumes TSS loading is performed after each simulated water quality design event.	While testing the final swale alternative, perform TSS loading after the second and fourth simulated water quality design storm (simulates three years).	Water quality results from testing of the four swale design alternatives indicated the gravel backfill for drywells would require maintenance to restore performance potentially by the second or third year. Using this information, TSS loading was performed after the second and fourth simulated water quality design storm events. This allowed the research team to collect more data during each simulated year, i.e., two events for the first year, two events for the second year, and two events for the 3 year.

Appendix D – Swale Alternatives Testing

The water quality results of the four swale design alternatives (herein referred to as alternatives) are described in this appendix. These results were used to support the selection of the final alternative (results of the final alternative are in **Section 4.2**). Specifically, the water quality results include TSS concentrations collected at the influent and eight effluent sample locations in the swale, percent TSS removal over the length of the test swale, and the ratio of effluent to influent concentrations at each location. A discussion of the results with images from field data collection accompany the water quality results. The raw data collected and analyzed for each of the four swale design alternatives can be found in **Appendix C** and **Appendix E**.

Also included in each section is a brief summary of the materials used in each swale alternative. Detailed descriptions of the swale alternatives can be found in Section 3.3.1 of the study QAPP; only changes since the QAPP was finalized are discussed in this document. All four swale design alternatives were installed over an impermeable liner to evaluate the treatment capacity of the rock without the influence of subsurface soils. Additionally, field tests related to rock movement during high flows and typical maintenance actions are discussed for each alternative. The testing procedures are discussed in detail in the QAPP but generally included exposing all swale alternatives to a 25-year flow and air flow from a leaf blower to observe whether rock moved. The goal was to select materials that would not move during this testing. The leaf blower's make and model was what is typically used for swale maintenance (as reported by the study TAC members).

The final paragraph in each of the following subsections for each alternative provides the reasoning why it was or was not considered for the final swale alternative. The conclusions are also summarized in **Section 4.1**.

9.1.6 Introduction to Tables and Figures

The water quality results for the four swale design alternatives are shown in **Table D 9-1**–**Table D 9-4** and **Figure D 9-1**, **Figure D 9-6**, **Figure D 9-10**, and **Figure D 9-12**. The tables contain the TSS concentrations at the influent and eight effluent locations, which are called out in relation to the test swale as shown in **Figure 4-1** and **Figure** 4-2, as well as the percent removal over the length of the test swale (influent to sample location 8). The effluent concentrations are highlighted in the table on a relative scale according to the range of values in the table: red is assigned to the highest concentrations, green indicates the lowest concentrations, and concentrations falling between those values are assigned shades between red and green. As mentioned in **Section 1.4**, the effluent concentrations in the tables are grab sample results that represent the first flush concentrations through the swale. As such, they are expected to be higher than an event mean concentration, which is typically used to evaluate the treatment performance of BMPs. The figures included in this section show the ratio of effluent concentration at each sample location to the influent concentration to illustrate the change in TSS concentrations as runoff flowed through the swale. The figures also show a target of 80% removal line in order to compare the performance of the swale to the targeted removal. The results in the figures and tables specific to each alternative are described in the following sections (Alternative 1, Alternative 2, Alternative 3, and Alternative 4).

9.1.7 Alternative 1

9.1.7.1 Alternative 1 Materials

Alternative 1, as described in the study QAPP, was comprised of a 7-inch depth of 1.25-inch gravel, which extended up the sides of the swale to protect the side slopes. The 1.25-inch gravel was not readily available, so HMA gravel was substituted. HMA gravel was chosen because of its availability statewide. Additionally, findings of the literature search described in Section 3.3 of the study QAPP indicated that potentially effective treatment rock layers include choke stone or riprap and the gradation of the HMA gravel fell between the gravel backfill for drywells (smaller than riprap) and pea gravel sizes (similar size to choke stone), so it was anticipated to effectively remove TSS.

9.1.7.2 Alternative 1 Water Quality Results and Field Observations

Table D 9-1 and **Figure D 9-1** show the results of testing Alternative 1 in the field. As shown by the concentrations in **Table D 9-1** and **Figure D 9-1**, Alternative 1 did not show a consistent pattern of removal throughout the swale nor was 80% reduction of TSS ever achieved. However, in comparing the TSS concentration at sample location 1 to sample location 8, an 80% reduction was observed, which suggests it is possible to achieve this reduction, but the field conditions described herein likely impacted the results. For example, during testing of Alternative 1 it was found that the impermeable liner was not taped securely to the sample ports, and sediment was possibly entering the swale from the opening in the liner around the sample port. This may have contributed to the variation in the TSS concentrations at the sample locations in the swale and removal throughout the swale. For example, during Event 2 at sample location 4 (swale length of 100 feet), there is a sharp decrease in TSS concentration, followed by an increase in concentration at sample location 5 that continues through the rest of the swale. Fines in the HMA gravel were also considered as a potential reason for the high concentrations in the swale; however, a background sample collected from the end of the swale before testing began indicated a background concentration 75 mg/L, which is much lower than the concentrations observed in the swale. As such, it was hypothesized that sediment entering the swale from gaps between the liner and sample ports were causing the high concentrations in the rock.

Additionally, observations during field testing suggested that the Sil-Co-Sil® and fines in the rock were travelling along the liner at the bottom of the swale as opposed to through the treatment rock layer. Water that reached the sample ports first appeared to be entering along the liner, and water was tinted a brown color, which matched the existing ground and the fines in the rock. The samples collected from two simulated storm events shown in **Figure D 9-2** show an example of the color of the water in sample bottles. Once testing was complete and the HMA gravel was removed from the liner, the same color sediment was observed along the bottom of the liner, as shown in **Figure D 9-3**. The tinted color of the samples and residual fines along the bottom of the liner suggests that the fines from the rock or the existing ground were short circuiting around the treatment rock layer, thereby receiving reduced treatment and potentially increasing water quality results in the swale.

9.1.7.3 Alternative 1 Rock Movement Testing

The HMA gravel was also tested for movement of rock during high-flow events and typical maintenance actions, specifically use of a leaf blower to remove debris. Some minor erosion of the HMA gravel was observed at the inlet during the 25-year flow (**Figure D 9-4**), but not in any other location in the swale. As such, energy dissipation would likely be required at the inlet for an installation of Alternative 1. More movement of the HMA gravel was observed during the leaf blower test, as shown in **Figure D 9-5**. When the leaf blower was applied to the HMA gravel, smaller pieces of gravel would fly up the side slopes of the swale. The TAC voiced a preference for rock that did not move or leave the swale during the use of a leaf blower, as the use of the leaf blower is a common maintenance practice and rock being displaced or leaving the swale creates extra work for the maintenance crew.

9.1.7.4 Alternative 1 Conclusion

HMA gravel was not selected for use in the final design alternative as it did not meet treatment performance goals and because of its mobility during the 25-year flow and leaf blower test. Additionally, it is expected that it would be difficult to find HMA gravel in a “clean” or washed form because its typical application is for roadways and a certain amount of fines is acceptable.

Table D 9-1: Alternative 1 (HMA gravel) water quality results

	Concentration mg/L [1]					
Years TSS Loading Simulated	**t=0**	**t=1yr**	**t=2yr**	**t=3yr**	**t=4yr**	**t=5yr**
Influent	**160**	**183**	**151**	**100**	**111**	**127**
Location in Swale	**Event #1**	**Event #2**	**Event #3**	**Event #4**	**Event #5**	**Event #6**
Sample Location 1 (25 feet)	349	3182	2004	3867	9719	1836
Sample Location 2 (50 feet)	1637	2940	1565	2917	2418	1202
75	1542	1859	1263	155	656	624
100	919	116	751	1085	358	860
125	704	890	674	761	285	727
150	457	783	448	483	177	518
175	338	631	296	370	100	382
200	107	437	130	121	84	155
% Removal from Influent to 200 feet	33.1%	-138.7%	13.7%	-20.0%	24.3%	-21.9%
% Removal from 25 feet to 200 feet	69.3% [46.3%][2]	86.3% [-119%][2]	93.5% [35.1%][2]	96.9% [39.7%][2]	99.1% [57.9%][2]	91.6% [22.7%][2]

[1] Background samples were taken at the end of each alternative during the initial 25-year flow test to understand what TSS was present in the rock. The background sample for HMA was 75.0 mg/L.

[2] Per TAPE, influent concentrations that are greater than the influent range must be set to the value at the upper end of the range (200 mg/L for TSS). The value in the table reflects the change in concentration between the first sample location (25 feet from the influent) to sample location 8 (200 feet), and it uses 200 mg/L as the concentration at sample location 1 (25 feet) because the measured concentration at that location was greater than 200 mg/L.

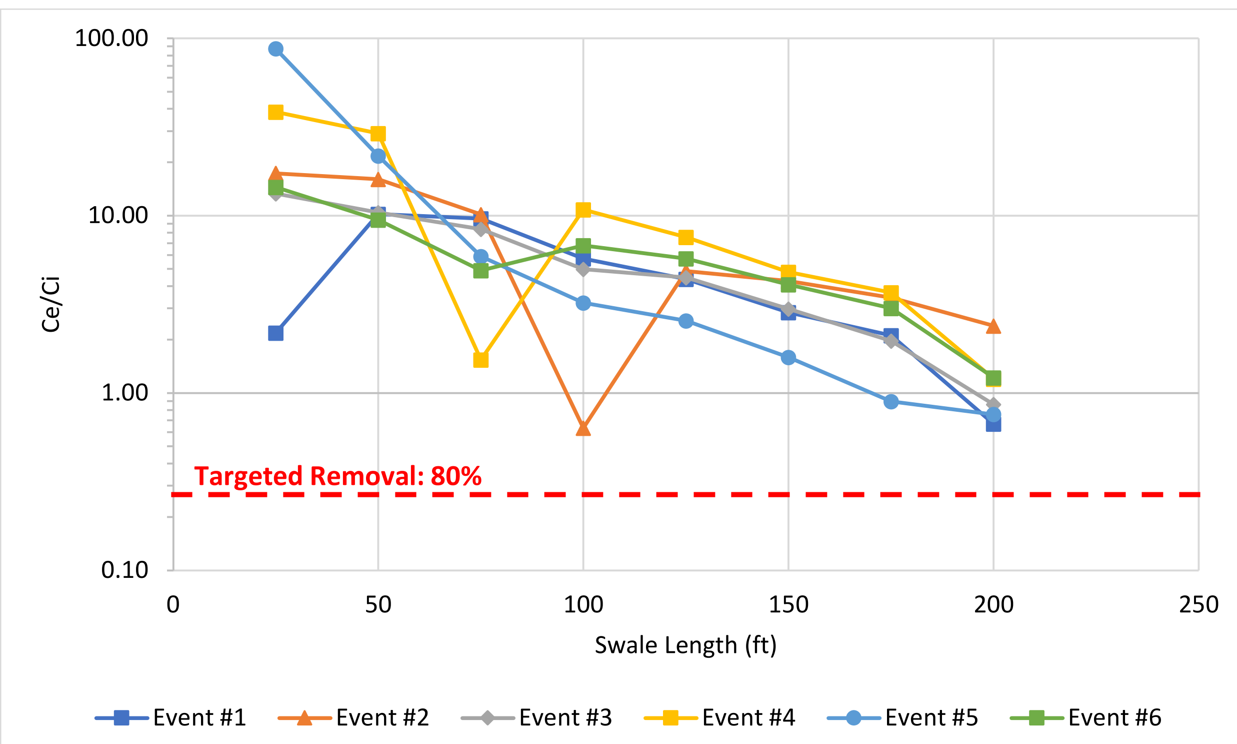

Figure D 9-1: HMA gravel effluent to influent ratio (Ce/Ci)

Figure D 9-2: Example of sample tint
(Photo credit: Evergreen StormH2O)

Figure D 9-3: Liner after removal of gravel and fines present below HMA gravel
(Photo credit: Drew Woodruff, City of West Richland)

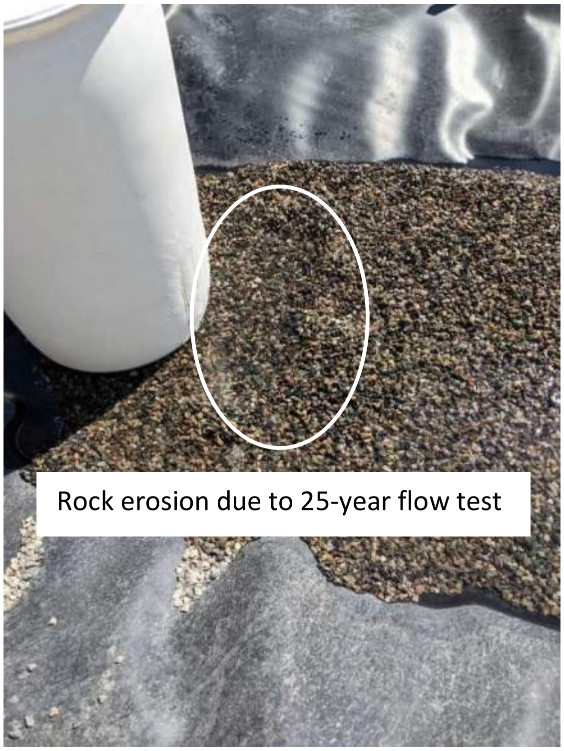

Figure D 9-4: HMA gravel erosion from 25-year flow test
(Photo credit: Evergreen StormH2O)

Figure D 9-5: HMA gravel movement during blower test
(Photo credit: Evergreen StormH2O)

9.1.8 Alternative 2

9.1.8.1 Alternative 2 Materials

Alternative 2, as described in the study QAPP, was comprised of a 7-inch depth of pea gravel. The alternative also included a 2.5-inch depth of 1.25-inch (for swales with longitudinal slopes of 1% to 2.5%) or 2.5-inch coarse gravel (for swales with longitudinal slopes of 2.5% to 5%). As described in Alternative 1, the 1.25-inch gravel was not readily available. A 2-inch crushed basalt was sourced for the test swale, as it was the only rock available where the full gradation was larger than 1.25-inch gravel. The 2-inch crushed basalt was only applied on the first 5–10 feet of the test swale to limit erosion at the inlet and limit the quantity of 2-inch crushed basalt needed.

9.1.8.2 Alternative 2 Water Quality Results and Field Observations

Table D 9-2 and **Figure D 9-6** show the results of testing Alternative 2 in the field. While an 80% removal was achieved between Location 1 and Location 8 (**Table D 9-2**), which suggests the rock is capable of achieving the targeted treatment, Alternative 2 did not achieve an 80% reduction of TSS when comparing the influent to sample location 8 (200 feet) for the potential reasons described herein. As shown by **Table D 9-2**, the concentrations in the swale remained high during testing and inconsistent percent removals were achieved. A background sample taken prior to testing indicated that TSS present in the rock was 594 mg/L. While the pea gravel was thoroughly washed during installation, it is possible that pockets of sediment remained within the pea gravel as testing began. This hypothesis would explain the high background TSS and the high concentrations at sample locations 1 (25 feet), 2 (50 feet), and 4 (100 feet) during Event 1. While the background was expected to be washed out as more water was sent through the test swale, the concentrations indicated that either the quantity of water was insufficient to fully wash out the background TSS, or that the annual loads delivered to the swale following each simulated storm event were sufficient to maintain high concentrations in the swale. These concentrations could have been exacerbated in the samples by the short-circuiting of flow around the liner, as described in Alternative 1.

Another reason that concentrations in the swale remained high may be related to the depth of flow in the swale during testing. During the simulated storm events and delivery of the annual load of TSS, which both routed water to the swale at the water quality design flow rate, flow was not contained within the pea gravel or treatment rock layer. **Figure D 9-7** shows an example of the depth of water in the swale at that flow rate, which was partly flowing on top of the rock instead of through it. It is possible that the porosity was too low or that the resistance provided by the pea gravel was high enough that the 7.5 inches of rock depth was insufficient to contain the depth of the water quality design flow rate. The flow over the top of the pea gravel likely allowed some TSS to bypass the rock, thereby treating less of the water quality design flow than a swale that was able to route the full depth of flow through the treatment rock layer. These findings suggest that if Alternative 2 were used, the swale size would likely need to be increased to route the full depth of the water quality design flow through the pea gravel.

9.1.8.3 Alternative 2 Rock Movement Testing

In addition to the water quality testing, Alternative 2 was tested for movement of rock during high-flow events and typical maintenance actions, specifically the use of a leaf blower to remove debris. As mentioned previously, the first 5–10 feet of the swale was protected with a layer of 2-inch crushed basalt. The basalt appeared to protect the pea gravel from movement during the 25-year flow test. Minor scouring of pea gravel at the end of the crushed basalt layer and where the pea gravel met the liner was observed and is shown in **Figure D 9-8**. It is thereby anticipated that installations of Alternative 2, especially ones with steeper slopes (>1%), would need a layer of 2-inch crushed basalt covering the full swale length.

The results of the blower test indicated that use of a leaf blower, applied to exposed pea gravel, would result in similar or worse displacement of rock to what was observed for Alternative 1. Additionally, a recurring observation of the pea gravel was that it was very easily moved if anyone stepped into the swale. During sampling, boards were used in the swale, similar to the one shown in **Figure D 9-8**, to reduce footprints or displacement of the pea gravel when samples were collected. In **Figure D 9-9**, you can clearly see the outline of footprints and the board used in the swale (the swale was frequently raked during testing to maintain an even layer of pea gravel). Moreover, it is anticipated that if a bike or motorized vehicle were to enter an installation of Alternative 2, a significant amount of pea gravel would be pushed around or out of the swale. As mentioned for Alternative 1, the TAC for the study voiced a preference for rock that did not move or leave the swale during the use of a leaf blower, and concerns were voiced during field testing of Alternative 2 that the ease with which the pea gravel could be moved by foot or other traffic would create a large amount of effort for maintenance staff. A layer of 2-inch crushed basalt over the swale length would potentially reduce the movement of the pea gravel from foot traffic, though over time the basalt may be pushed into the pea gravel layer.

9.1.8.4 Alternative 2 Conclusion

Alternative 2 was not selected for the final swale alternative because treatment performance goals were not met. Additionally, field testing indicated that a swale utilizing pea gravel for the treatment rock layer would need to be upsized to route the depth of the water quality design flow rate through the rock and not over the top of the swale. Lastly, the mobility of the rock during the 25-year flow and leaf blower test, as well as from any foot traffic in the swale, suggests that Alternative 2 would result in frequent maintenance or the need for an additional rock layer over the top of the pea gravel.

Table D 9-2: Alternative 2 (pea gravel) water quality results

	Concentration mg/L [1]					
	t=0	**t=1yr**	**t=2yr**	**t=3yr**	**t=4yr**	**t=5yr**
Influent	**127**	**211**	**123**	**118**	**109**	**127**
Location in Swale	**Event #1**	**Event #2**	**Event #3**	**Event #4**	**Event #5**	**Event #6**
25	848	2111	2181	3485	3805	5055
50	694	2242	2340	2415	2399	3297
75	132	1210	908	1440	1797	1202
100	1505	1586	1555	991	2120	774
125	149	935	1184	592	1224	296
150	151	391	548	349	810	352
175	65	116	293	166	356	107
200	112	109	115	33	216	47
% Removal from Influent to 200 feet	12.2%	48.5% [45.6%][2]	6.5%	71.7%	-97.4%	63.3%
% Removal from 25 feet to 200 feet	86.8% [44.2%][2]	94.8% [45.6%][2]	94.7% [42.7%][2]	99.0% [83.3%][2]	94.3% [-7.8%][2]	99.1% [76.7%][2]

[1] Background samples were taken at the end of each alternative during the initial 25-year flow test to understand what TSS was present in the rock. The background sample for the pea gravel was 594 mg/L.

[2] Per TAPE, influent concentrations that are greater than the influent range must be set to the value at the upper end of the range (200 mg/L for TSS). The value in the table reflects the change in concentration between the first sample location (25 feet from the influent) to sample location 8 (200 feet), and it uses 200 mg/L as the concentration at sample location 1 (25 feet) because the measured concentration at that location was greater than 200 mg/L.

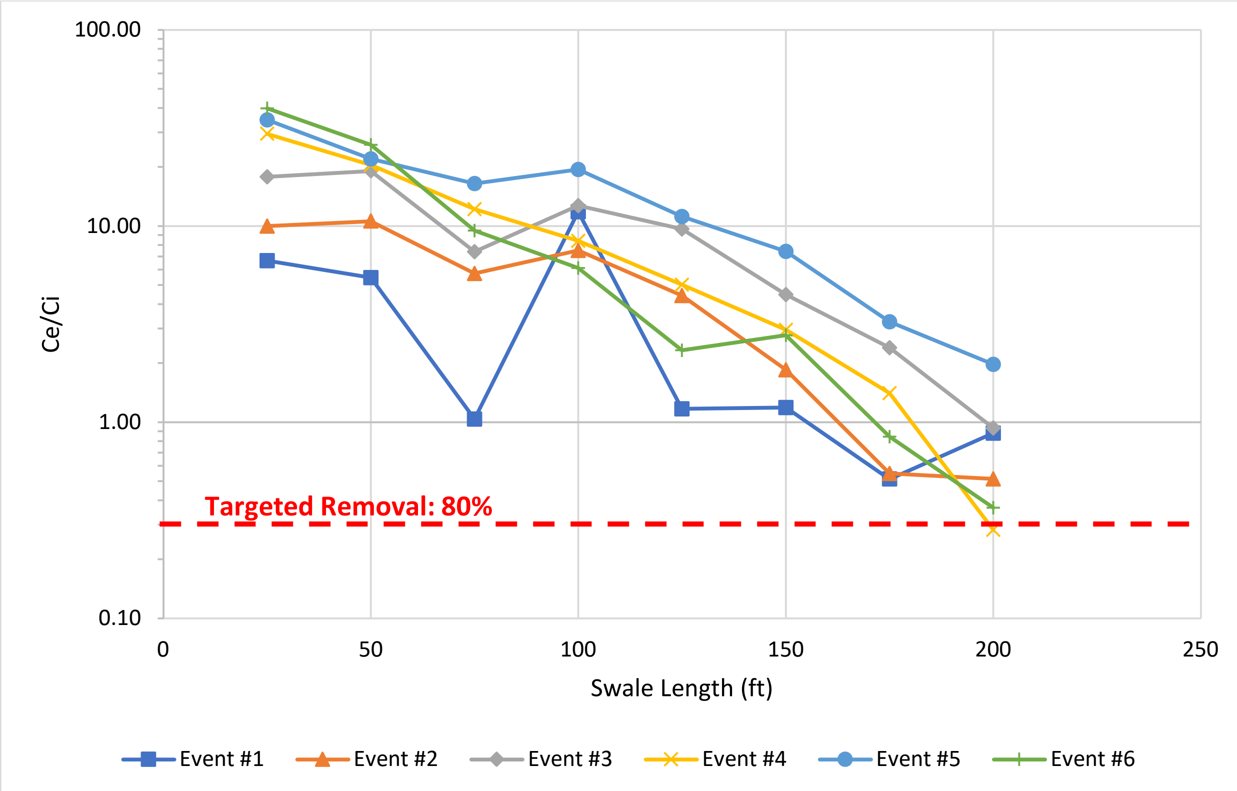

Figure D 9-6: Pea gravel effluent to influent ratio (Ce/Ci)

Figure D 9-7: Alternative 2 flow depth during annual load (delivered at water quality design flow rate)
(Photo credit: Evergreen StormH2O)

Figure D 9-8: Observations of eroded pea gravel following 25-year flow test
(Photo credit: Evergreen StormH2O)

Figure D 9-9: Example of footprints and board print in pea gravel
(Photo credit: Evergreen StormH2O)

9.1.9 Alternative 3

9.1.9.1 Alternative 3 Materials

Alternative 3, as described in the study QAPP, was comprised of a 7-inch depth of gravel backfill for drywells. The alternative also included the 2.5-inch depth of 1.25-inch (for swales with longitudinal slopes of 1% to 2.5%) or 2.5-inch coarse gravel (for swales with longitudinal slopes of 2.5% to 5%), as described in Alternative 2. The 2-5-inch stabilization layer was not installed on the test swale, as the gravel backfill for drywell gradation was similar to the 1.25-inch coarse gravel originally proposed for the alternative. The rock was also hypothesized to be unlikely to mobilize at the start of testing, which was supported by the 25-year flow test and maintenance test discussed later in this section.

9.1.9.2 Alternative 3 Water Quality Results and Field Observations

Table D 9-3 and **Figure D 9-10** show the results of testing Alternative 3 in the field. While 80% removal of TSS was not met between the influent and end of the swale, a consistent percent removal was achieved between the influent and end of the swale, as well as greater than 80% removal between location 1 (25 feet) and location 8 (200 feet). Concentrations appear to be consistently low near the end of the swale for the first two events and exceed the influent concentration by Event 3, suggesting that treatment would be maintained for approximately two to three years before maintenance would be required. Additionally, based on the Ce/Ci data in **Figure D 9-10**, Alternative 3 appeared to have the most consistent, predictable pattern (relative to the other alternatives), in that concentrations were reduced over the length of the swale, with the treatment reduction declining as more years of TSS loading were simulated. The consistency may have been due to one or a combination of the following:

- A lower background concentration (79.9 mg/L) was measured at the end of the swale before testing began, and likely was flushed out immediately based on the concentrations at the end of the swale for Events 1 and 2.
- During testing, no gaps were observed between the liner and sample ports, and as result no sediment intruded at the sample ports like what was described for Alternative 1.
- The full depth of the water quality event was routed within the depth of gravel backfill for drywells, allowing for treatment of all the water quality design flow.

While still not meeting the targeted 80% removal of TSS by the end of the swale, the gravel backfill for drywells appeared to be the most promising option due to the relative consistency of the data and the proximity of the Ce/Ci data for Event 1 to the targeted 80% removal. The percent removal from location 1 (percent removal calculated between 25 feet and 200 feet) shown in **Table D 9-3** is also consistent for Events 2–6. The consistent percent removal from location 1 indicates that even with TSS accumulating at the inlet of the swale, the gravel backfill for drywells will limit what leaves the end of the swale. Moreover, the short-circuiting of flow and TSS along the liner described for Alternative 1 was observed during testing of Alternative 3. It was anticipated that removal of the liner or replacement of the liner with a rougher or more permeable barrier would further improve the treatment performance of the gravel backfill for drywells.

9.1.9.3 Alternative 3 Rock Movement Testing

The gravel backfill for drywells was also tested for movement of rock during high flow events and application of a leaf blower, as described in Alternative 1. No erosion of rock was observed during the 25-year flow, as shown in **Figure D 9-11**. Little to no movement of rock was observed when the leaf blower was applied to the swale.

9.1.9.4 Alternative 3 Conclusion

While still not meeting the targeted 80% removal of TSS by the end of the swale, the gravel backfill for drywells appeared to be the most promising option due to the relative consistency of the data and the proximity of the Ce/Ci data for Event 1 to the targeted 80% removal. The alternative also appeared to contain the most stable of the gravels tested and little to no movement was observed during the 25-year flow or leaf blower test. A modified version of Alternative 3 was developed for the final swale alternative.

Table D 9-3: Alternative 3 (gravel backfill for drywells) water quality results

	Concentration mg/L [1]					
	t=1yr	**t=2yr**	**t=3 yr**	**t=4 yr**	**t=5 year**	**t=6yr**
Influent	**158**	**151**	**102**	**149**	**160**	**133**
Location in Swale	**Event #1**	**Event #2**	**Event #3**	**Event #4**	**Event #5**	**Event #6**
25	356	1612	5344	6370	8477	8403
50	219	696	2158	2009	1323	3294
75	224	354	1092	1047	811	1595
100	85	199	552	431	473	892
125	70	146	403	358	241	673
150	38	96	190	157	196	297
175	52	78	197	168	140	315
200	66	79	175	232	102	222
% Removal from Influent to 200 feet	58.3%	47.8%	-72.1%	-55.7%	36.2%	-67.1%
% Removal from 25 feet to 200 feet	81.5% [67.0%][2]	95.1% [60.7%][2]	96.7% [12.5%][2]	96.4% [-16.0%][2]	98.8% [48.9%][2]	97.4% [-11.2%][2]

[1] Background samples were taken at the end of each alternative during the initial 25-year flow test to understand what TSS was present in the rock. The background sample for the gravel backfill for drywells was 79.9 mg/L.

[2] Per TAPE, influent concentrations that are greater than the influent range must be set to the value at the upper end of the range (200 mg/L for TSS). The value in the table reflects the change in concentration between the first sample location (25 feet from the influent) to sample location 8 (200 feet), and it uses 200 mg/L as the concentration at sample location 1 (25 feet) because the measured concentration at that location was greater than 200 mg/L.

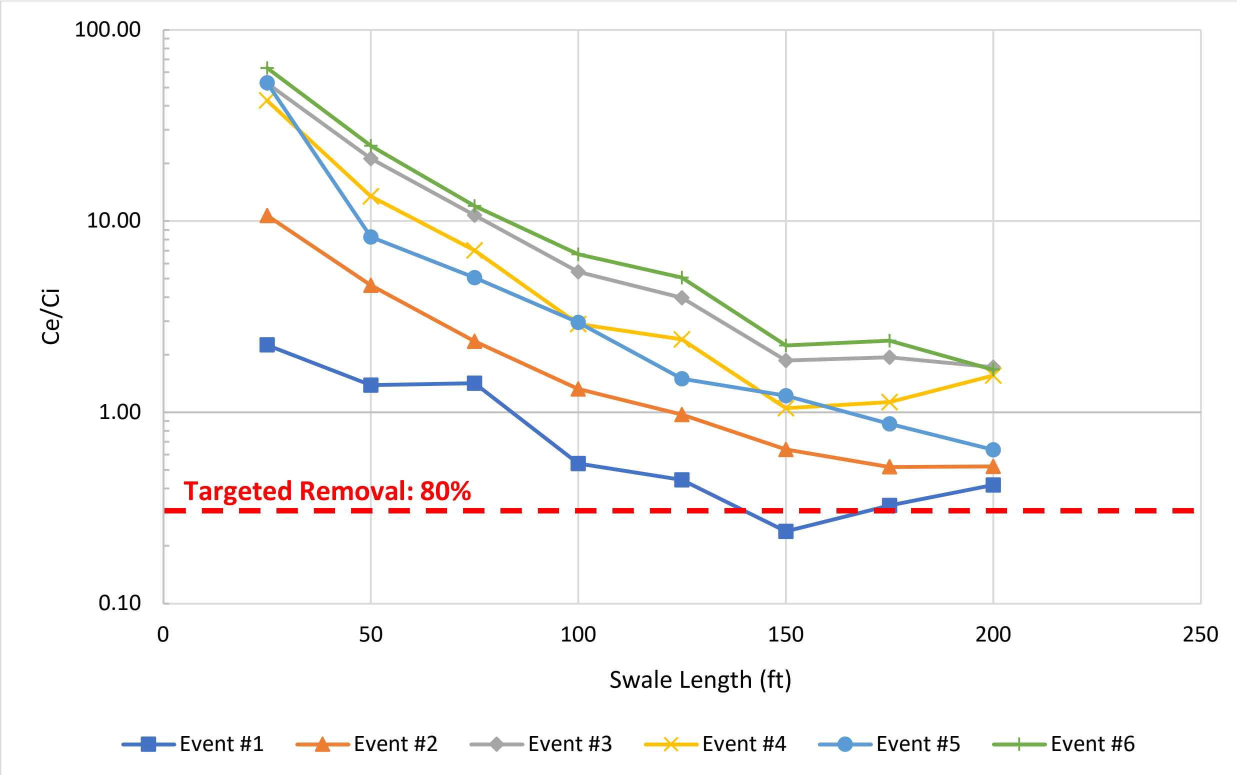

Figure D 9-10: Gravel backfill for drywells effluent to influent ratio (Ce/Ci)

Figure D 9-11: Alternative 3 (gravel backfill for drywells) 25-year flow test
(Photo credit: Drew Woodruff, City of West Richland)

9.1.10 Alternative 4

9.1.10.1 Alternative 4 Materials

Alternative 4, as described in the study QAPP, was comprised of 4.5 inches of sand media under 3 inches of pea gravel. The alternative also included the 2.5-inch depth of 1.25-inch (for swales with longitudinal slopes of 1% to 2.5%) or 2.5-inch coarse gravel (for swales with longitudinal slopes of 2.5% to 5%), as described in Alternative 2. A 2-inch crushed basalt was sourced for the test swale instead of the 1.25-inch coarse gravel and was only applied on the first 5–10 feet of the test swale for the reasons described for Alternative 2.

9.1.10.2 Alternative 4 Water Quality Results and Field Observations

Table D 9-4 and **Figure D 9-12** show the results of testing Alternative 4 in the field. As shown by the concentrations in **Table D 9-4** and **Figure D 9-12**, Alternative 4 did not achieve 80% reduction of TSS. However, in comparing the TSS concentration at sample location 1 to sample location 8, an 80% reduction was observed for Events 3–6, which suggests it is possible to achieve this reduction, but the conditions described herein likely impacted the results.

As shown **Table D 9-4**, concentrations are especially high in the swale for Event 1, considering no annual load had been applied yet, and given the average influent concentration of 109 mg/L. **Figure D 9-12** illustrates these high concentrations for Event 1 and shows that, after Event 1, the remaining events follow a consistent pattern, which also results in concentrations in the swale being above the average influent concentration starting at sample location 1 (25 feet). Also shown in **Table D 9-4** and **Figure D 9-12** are concentrations of samples taken approximately 5 feet after the last sample location in the swale (205 feet). The concentrations of TSS at 205 feet drop significantly compared to the samples taken at 200 feet. One hypothesis for why the high concentrations exist in the swale and not beyond the final sample location has to do with the construction of the sample ports for Alternative 4. In order to limit migration of the sand media into sample ports, pea gravel was placed around each sample port from the liner to the top of the swale. After the last sample location, a 7.5-inch-deep pea gravel layer was placed to limit sand media from leaving the swale. It is possible that the pea gravel layers around each sample port were not thick enough to limit migration of the sand media into the sample ports, and that the pea gravel buffer at the end of the swale was thick enough to act as a barrier for the sand media, including any moving along the liner as described in Alternative 1. As shown in **Figure D 9-13**, the sand media used in the swale was fine enough that it could feasibly pass through a thin pea gravel layer. As a result, it is anticipated that the sand media used in Alternative 4 may be too fine grained for this application.

Another hypothesis for the high concentrations in the swale and significantly lower concentrations after last sample port is that the water quality design flow partially travelled above the top of the pea gravel (see description for Alternative 2) until the last sample location, where it appeared to primarily flow out the bottom of the swale cross-section. **Figure D 9-14** shows the end of the swale during one of the simulated storm events as well as the ponded flow disappearing shortly after the last sample location. It is possible that the last several feet of pea gravel provided some additional treatment.

9.1.10.3 Alternative 4 Rock Movement Testing

Alternative 4 was also tested for movement of rock during high-flow events as described in Alternative 1, but was not subjected to the leaf blower test as the top layer was the same as what was used in Alternative 2. As such, the results of the leaf blower test for Alternative 4 were assumed to be the same as the results for Alternative 2. During the high-flow test, the same erosion at the end of the 2-inch crushed basalt pad and along the liner was observed as described for Alternative 2. Additionally, similar issues related to movement of the rock under foot traffic were experienced as those described for Alternative 2. A layer of 2-inch crushed basalt over the swale length would potentially reduce the movement of the pea gravel from high flows, leaf blowers, and foot or other traffic, though over time the basalt may be pushed into the pea gravel layer.

9.1.10.4 Alternative 4 Conclusion

Alternative 4 was not selected for the final swale alternative because it did not meet treatment performance goals and was not able to contain the depth of the water quality design flow rate within the treatment rock layer. The sand media in the alternative appeared to produce too much resistance for flow to occur through the media and be fully treated. Based on the water quality results for Alternative 4, it was also anticipated that the sand media would migrate through or out of the swale over time. Additionally, field testing suggested it would require a stabilization rock layer over the pea gravel to limit movement of the rock, and that the size of the swale would need to be increased to contain the depth of the water quality flow rate in the depth of the pea gravel and sand.

Table D 9-4: Sand plus pea gravel (swale design Alternative 4) water quality results

	Concentration mg/L [1]					
	t=0	**t=1yr**	**t=2yr**	**t=3yr**	**t=4yr**	**t=5yr**
Influent	**109**	**119**	**128**	**108**	**108**	**147**
Location in Swale	**Event #1**	**Event #2**	**Event #3**	**Event #4**	**Event #5**	**Event #6**
25	702	1003	916	1029	1000	1200
50	508	1261	1344	1277	1300	1100
75	870	366	325	379	380	390
100	624	962	1401	1270	1300	1300
125	588	408	432	243	240	340
150	523	230	235	228	270	220
175	421	214	173	135	180	140
200	321	296	165	156	160	93
% Removal from Influent to 200 feet	-193.2%	-148.4%	-28.4%	-44.7%	-48.6%	36.6%
% Removal from 25 feet to 200 feet	54.3% [-60.5%][2]	70.5% [-47.9%][2]	82.0% [17.6%][2]	84.8% [22.0%][2]	93.4% [19.2%][2]	93.1% [53.3%][2]

[1] Background samples were taken at the end of each alternative during the initial 25-year flow test to understand what TSS was present in the rock. The background sample for the sand media under pea gravel was 95.75 mg/L.
[2] Per TAPE, influent concentrations that are greater than the influent range must be set to the value at the upper end of the range (200 mg/L for TSS). The value in the table reflects the change in concentration between the first sample location (25 feet from the influent) to sample location 8 (200 feet), and it uses 200 mg/L as the concentration at sample location 1 (25 feet) because the measured concentration at that location was greater than 200 mg/L.

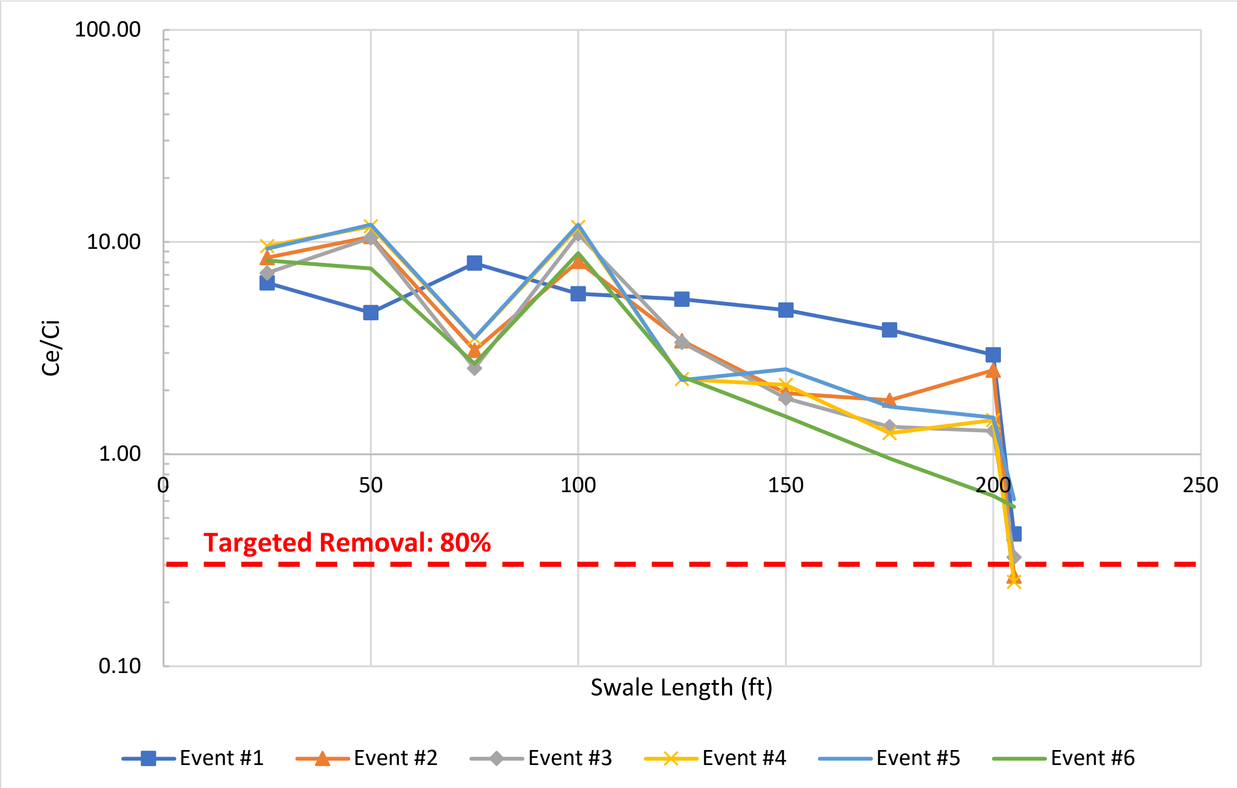

Figure D 9-12: Sand plus pea gravel effluent to influent ratio (Ce/Ci)

Figure D 9-13: Sample of sand media used in Alternative 4
(Photo credit: Drew Woodruff, City of West Richland)

Figure D 9-14: Flow leaving swale during simulated water quality event for Alternative 4
(Photo credit: Evergreen StormH2O)

Figure D 9-15: Test of 25-year flow for Alternative 4 (sand under pea gravel)
(Photo credit: Drew Woodruff, City of West Richland)

Appendix E – Data Analysis

TSS Concentrations in Four Swale Alternatives

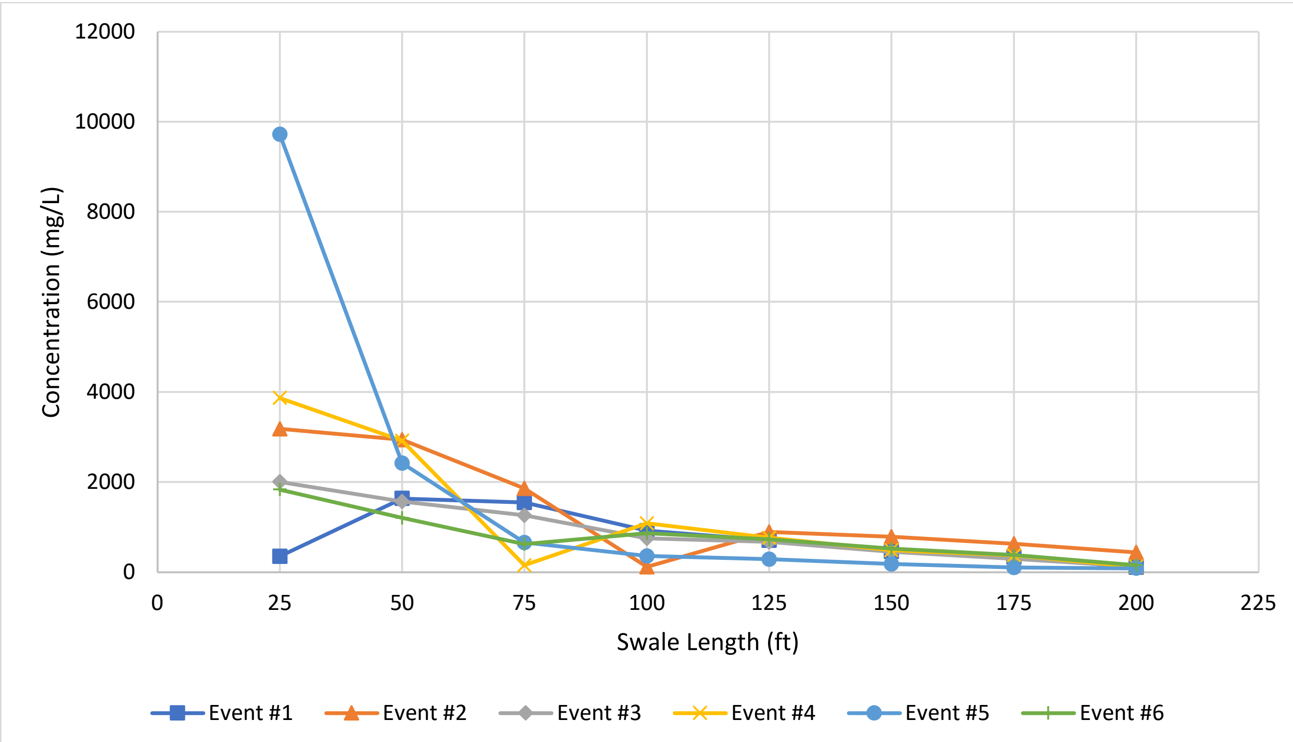

Figure E-1 Alternative 1 (HMA) Concentration

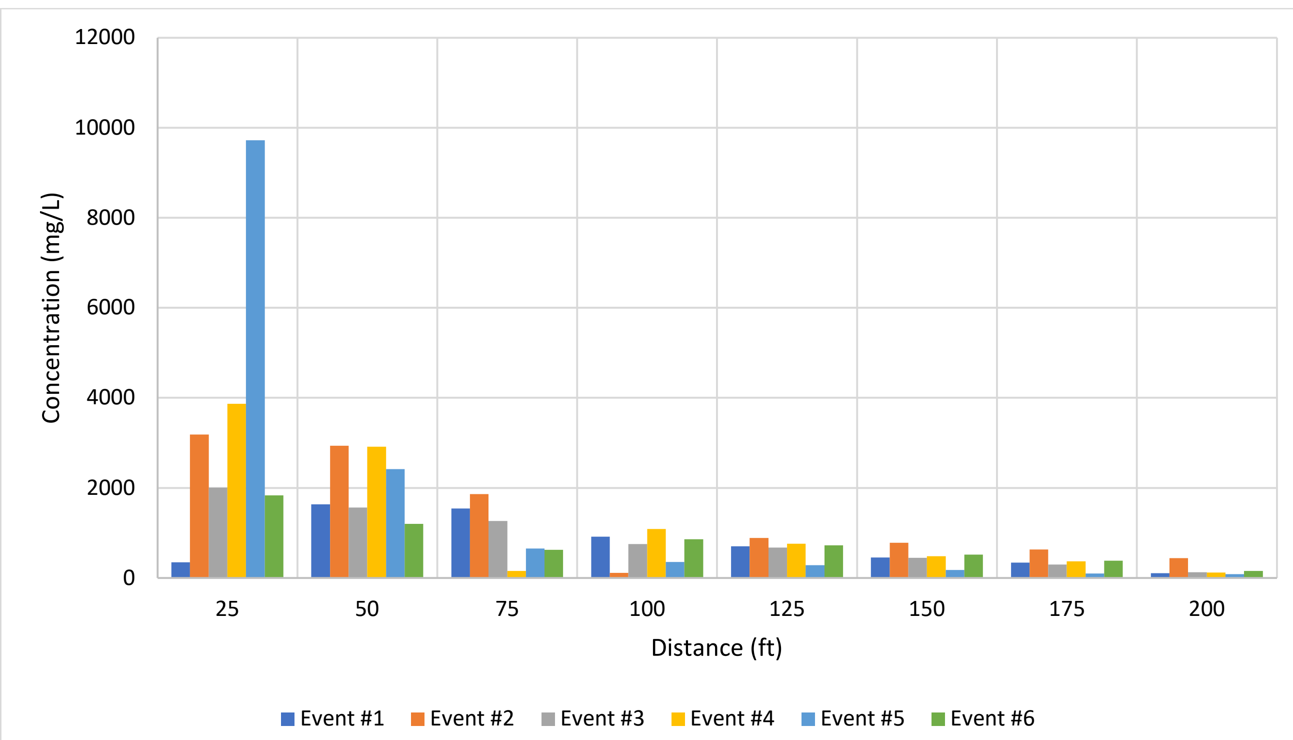

Figure E-2 Alternative 1 (HMA) Concentration

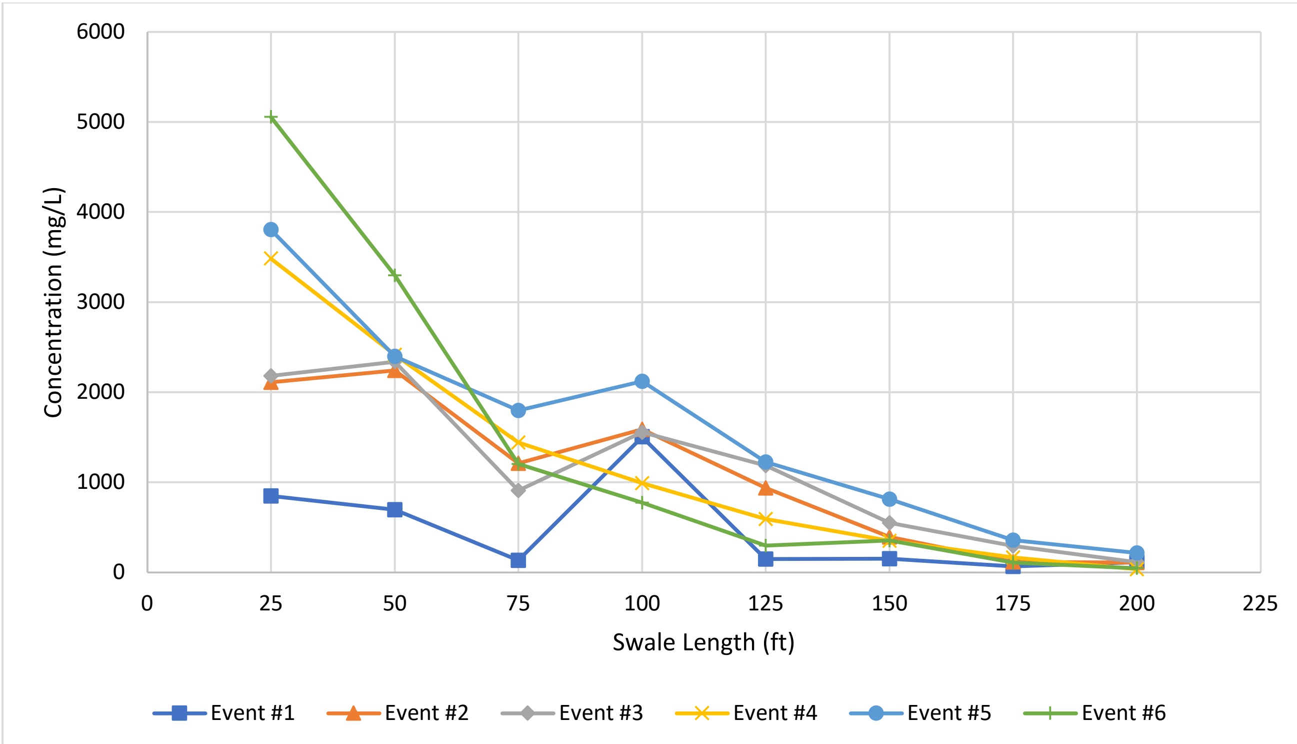

Figure E-3 Alternative 2 (Pea Gravel) Concentrations

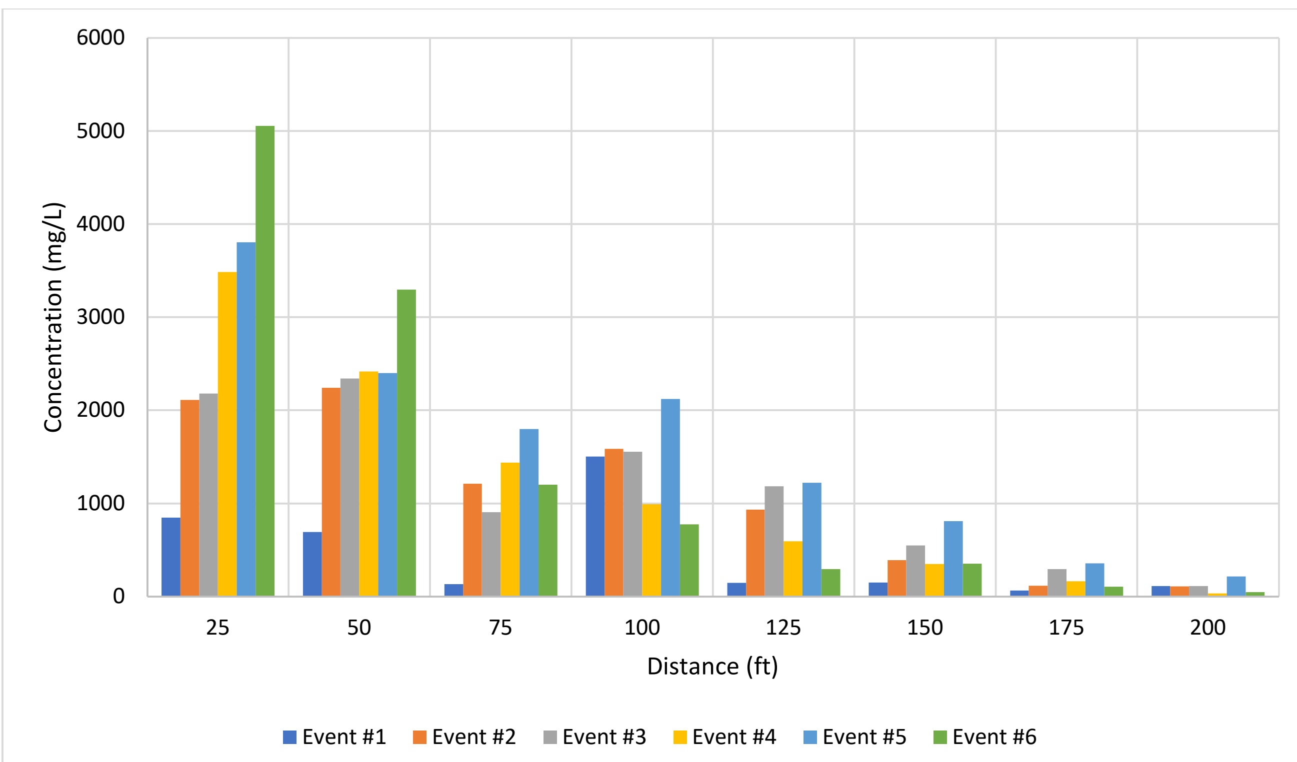

Figure E-4 Alternative 2 (Pea Gravel) Concentrations

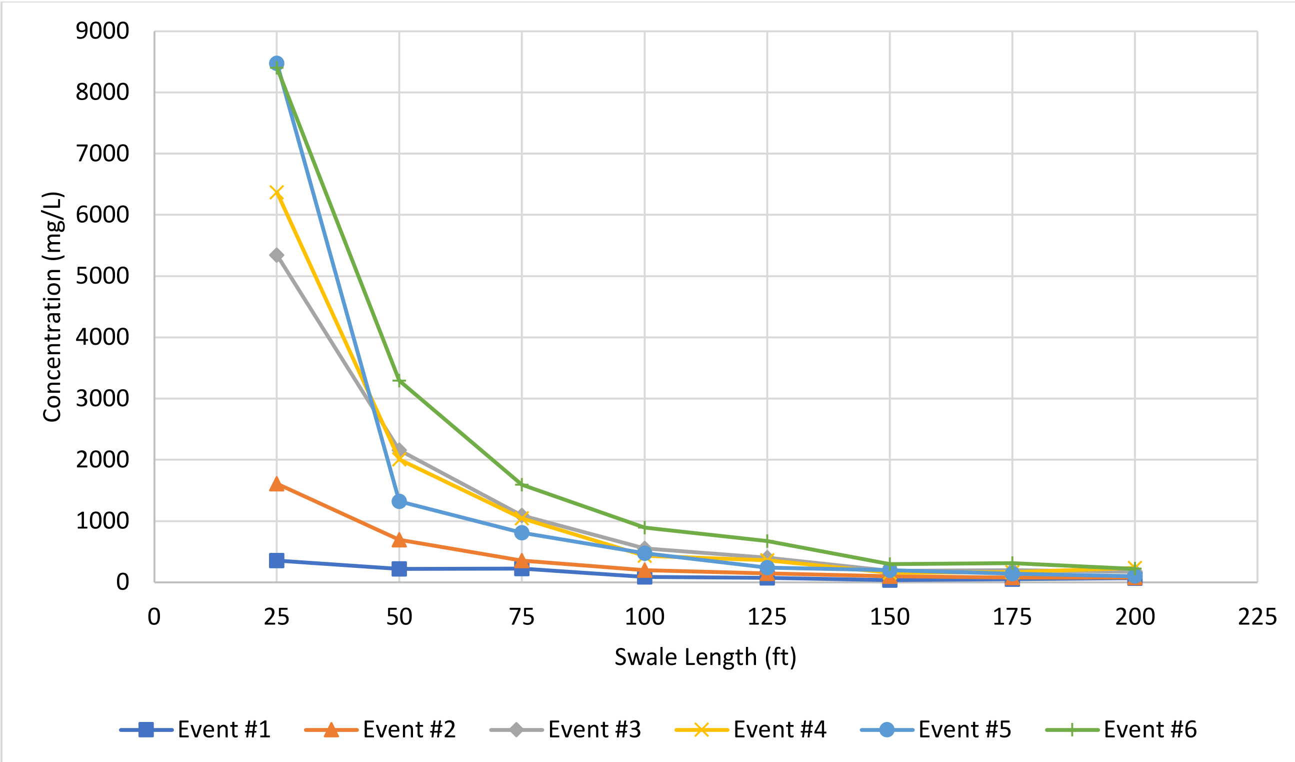

Figure E-5 Alternative 3 (Gravel Backfill for Drywell) Concentration

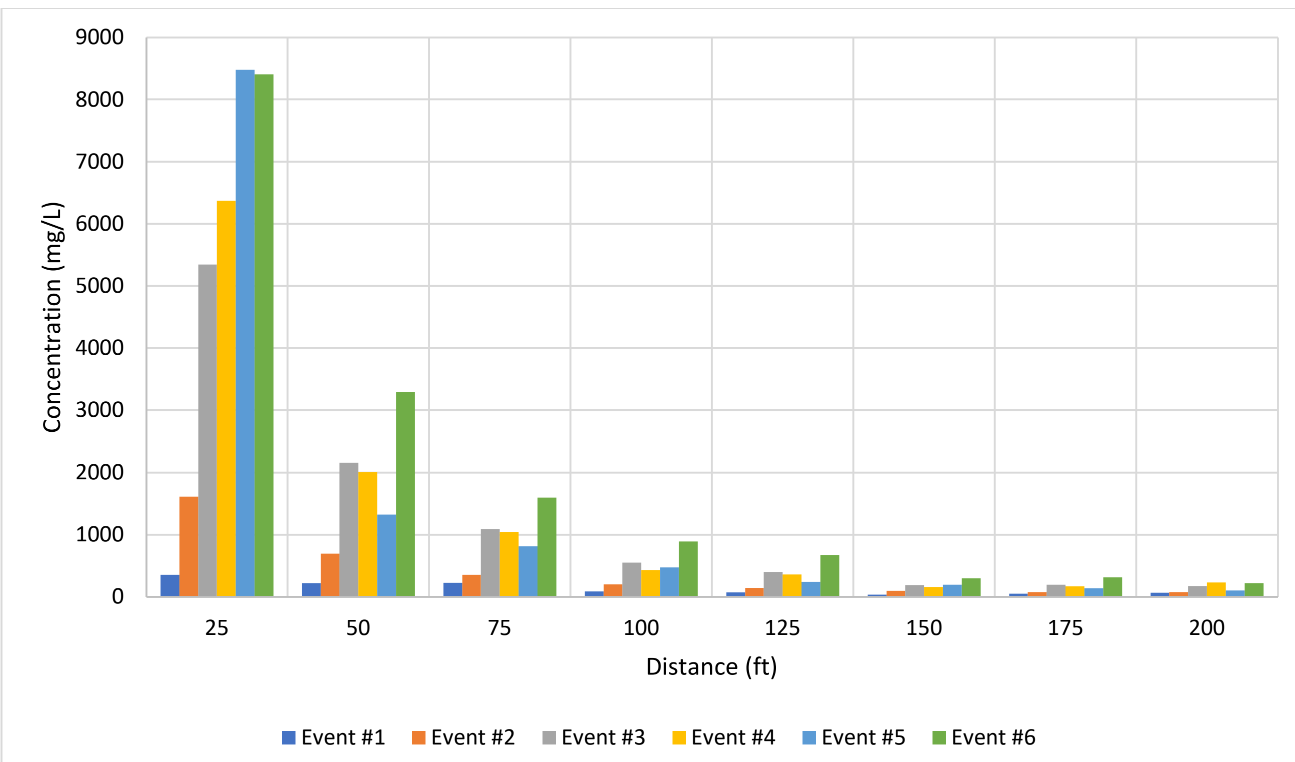

Figure E-6 Alternative 3 (Gravel Backfill for Drywell) Concentration

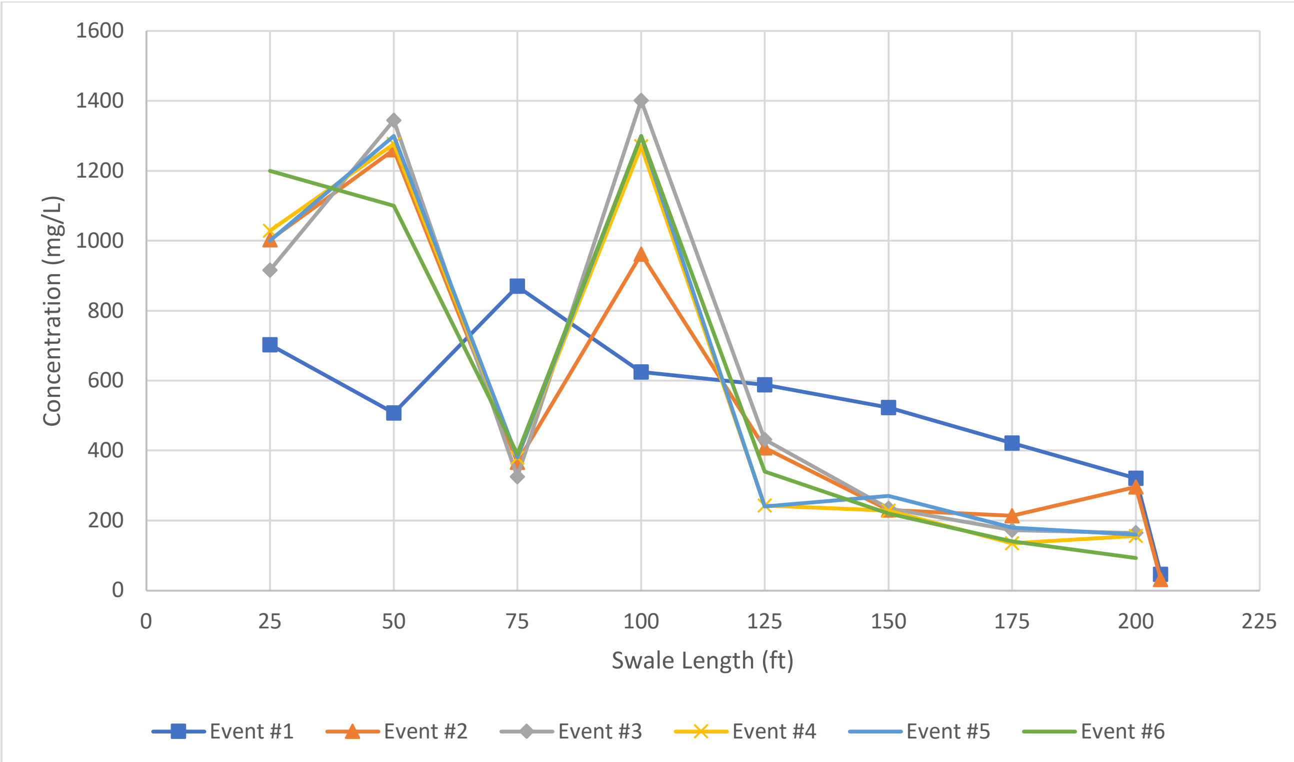

Figure E-7 Alternative 4 (Sand Pea Gravel) Concentrations

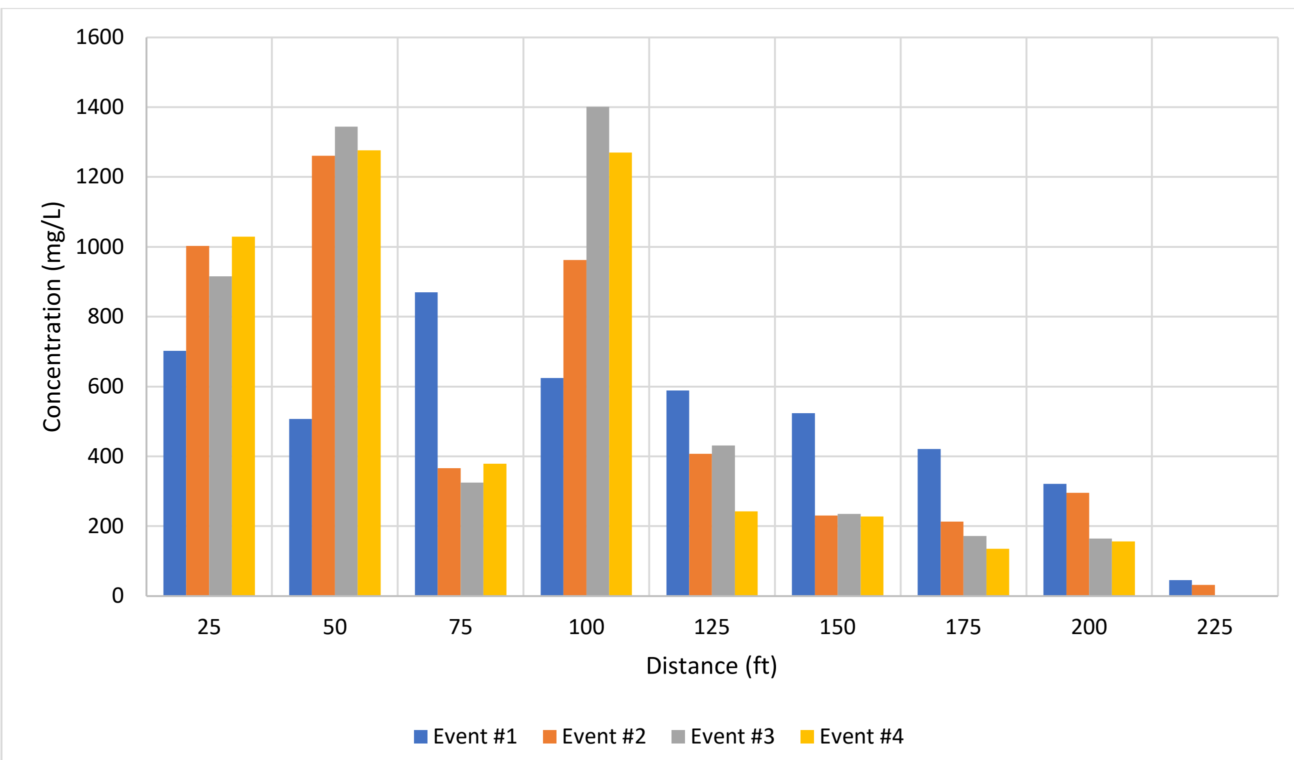

Figure E-8 Alternative 4 (Sand Pea Gravel) Concentrations

Removal Efficiency of Four Swale Alternatives

Table E-1 Alternative 1 (HMA) Percent Removal

Location	Percent Removal from influent						
	t=0	t=1yr	t=2yr	t=3yr	t=4yr	t=5yr	Average
	Event #1	Event #2	Event #3	Event #4	Event #5	Event #6	
Location 1	-118%	-1637%	-1231%	-3748%	-8640%	-1347%	-2787%
Location 2	-921%	-1505%	-940%	-2803%	-2074%	-847%	-1515%
Location 3	-862%	-915%	-739%	-54%	-490%	-391%	-575%
Location 4	-473%	36%	-399%	-980%	-222%	-577%	-436%
Location 5	-339%	-386%	-348%	-657%	-156%	-472%	-393%
Location 6	-185%	-327%	-197%	-381%	-59%	-308%	-243%
Location 7	-111%	-244%	-97%	-268%	10%	-201%	-152%
Location 8	33%	-139%	14%	-20%	24%	-22%	-18%

Table E-2 Alternative 2 (Pea Gravel) Percent Removal

Location	Percent Removal from influent						
	t=0	t=1yr	t=2yr	t=3yr	t=4yr	t=5yr	Average
	Event #1	Event #2	Event #3	Event #4	Event #5	Event #6	
Location 1	-567%	-899%	-1680%	-2857%	-3382%	-3884%	-2212%
Location 2	-446%	-960%	-1810%	-1949%	-2095%	-2498%	-1627%
Location 3	-4%	-472%	-641%	-1121%	-1545%	-847%	-772%
Location 4	-1084%	-650%	-1170%	-740%	-1840%	-510%	-999%
Location 5	-17%	-342%	-866%	-402%	-1020%	-133%	-463%
Location 6	-19%	-85%	-347%	-196%	-642%	-177%	-244%
Location 7	49%	45%	-139%	-41%	-225%	16%	-49%
Location 8	12%	48%	6%	72%	-97%	63%	17%
End of Swale	27%	42%	-99%	46%	28%	17%	10%

Table E-3 Alternative 3 (Gravel Backfill for Drywell) Percent Removal

Location	Percent Removal from influent						
	t=0	t=1yr	t=2yr	t=3yr	t=4yr	t=5yr	Average
	Event #1	Event #2	Event #3	Event #4	Event #5	Event #6	
Location 1	-125%	-970%	-5157%	-4176%	-5183%	-6217%	-3638%
Location 2	-38%	-362%	-2023%	-1249%	-725%	-2376%	-1129%
Location 3	-42%	-135%	-974%	-603%	-405%	-1099%	-543%
Location 4	46%	-32%	-443%	-189%	-195%	-570%	-231%
Location 5	56%	3%	-297%	-140%	-50%	-406%	-139%
Location 6	76%	36%	-87%	-5%	-22%	-124%	-21%
Location 7	67%	48%	-94%	-13%	13%	-137%	-19%
Location 8	58%	48%	-72%	-56%	36%	-67%	-9%

Table E-4 Alternative 4 (Sand Pea Gravel) Percent Removal

Location	Percent Removal from influent						
	t=0	t=1yr	t=2yr	t=3yr	t=4yr	t=5yr	Average
	Event #1	Event #2	Event #3	Event #4	Event #5	Event #6	
Location 1	-542%	-742%	-613%	-854%	-829%	-718%	-716%
Location 2	-364%	-959%	-947%	-1084%	-1107%	-650%	-852%
Location 3	-695%	-208%	-153%	-252%	-253%	-166%	-288%
Location 4	-470%	-708%	-991%	-1078%	-1107%	-786%	-857%
Location 5	-437%	-242%	-236%	-125%	-123%	-132%	-216%
Location 6	-378%	-93%	-83%	-112%	-151%	-50%	-144%
Location 7	-285%	-79%	-34%	-25%	-67%	5%	-81%
Location 8	-193%	-148%	-28%	-45%	-49%	37%	-71%
End of Swale	58%	73%	67%	75%	39%	43%	59%

Velocity of Flow through Four Swale Alternatives

Table E-5 Swale Alternative 1 (HMA) Time Measurements

Event	Time (hh:mm:ss) at Each Location								
	Start	25 FT	50 FT	75 FT	100 FT	125 FT	150 FT	175 FT	200 FT
1	0:00:00	-	0:08:00	0:13:00	0:19:00	0:24:00	0:31:00	0:40:00	0:49:00
2	0:00:00	0:02:38	0:07:10	0:12:28	0:18:15	0:24:15	0:30:30	0:37:53	0:46:15
3	0:00:00	0:03:02	0:07:40	0:13:05	0:19:05	0:24:56	0:31:28	0:39:26	0:48:41
4	0:00:00	0:02:56	0:07:26	0:12:49	0:18:40	0:24:36	0:31:26	0:38:40	0:46:55
5	0:00:00	0:02:38	0:06:52	0:11:54	0:17:28	0:22:47	0:28:49	0:35:25	0:43:13
6	0:00:00	-	0:08:08	0:12:28	0:19:28	0:25:05	0:31:23	0:38:58	0:47:40
Average	**0:00:00**	**0:02:49**	**0:07:33**	**0:12:37**	**0:18:39**	**0:24:16**	**0:30:46**	**0:38:24**	**0:46:57**

Table E-6 Swale Alternative 1 (HMA) Velocity

Event	Velocity (ft/s) at Each Sample Location								
	Start	25 FT	50 FT	75 FT	100 FT	125 FT	150 FT	175 FT	200 FT
1	0.00	-	0.05	0.08	0.07	0.08	0.06	0.05	0.05
2	0.00	0.16	0.09	0.08	0.07	0.07	0.07	0.06	0.05
3	0.00	0.14	0.09	0.08	0.07	0.07	0.06	0.05	0.05
4	0.00	0.14	0.09	0.08	0.07	0.07	0.06	0.06	0.05
5	0.00	0.16	0.10	0.08	0.07	0.08	0.07	0.06	0.05
6	0.00	-	0.05	0.10	0.06	0.07	0.07	0.05	0.05
Average	**0.00**	**0.15**	**0.08**	**0.08**	**0.07**	**0.07**	**0.06**	**0.06**	**0.05**

Table E-7 Swale Alternative 2 (Pea Gravel) Time Measurements

Event	Time (hh:mm:ss) at Each Location								
	Start	25 FT	50 FT	75 FT	100 FT	125 FT	150 FT	175 FT	200 FT
1	0:00:00	0:03:39	0:07:42	0:11:59	0:15:34	0:20:19	0:25:28	0:31:35	0:39:25
2	0:00:00	0:03:58	0:08:14	0:12:44	0:16:50	0:21:38	0:27:19	0:34:46	0:44:21
3	0:00:00	0:03:31	0:07:38	0:12:11	0:15:58	0:20:51	0:26:54	0:34:40	0:44:32
4	0:00:00	0:03:36	0:07:40	0:11:58	0:15:35	0:20:39	0:26:03	0:31:27	0:39:53
5	0:00:00	0:03:40	0:07:44	0:12:00	0:15:56	0:21:03	0:26:22	0:33:28	0:43:05
6	0:00:00	0:03:30	0:07:14	0:11:13	0:14:39	0:19:27	0:24:00	0:29:13	0:37:43
Average	**0:00:00**	**0:03:39**	**0:07:42**	**0:12:01**	**0:15:45**	**0:20:39**	**0:26:01**	**0:32:31**	**0:41:30**

Table E-8 Swale Alternative 2 (Pea Gravel) Velocity

Event	Velocity (ft/s) at Each Sample Location								
	Start	25 FT	50 FT	75 FT	100 FT	125 FT	150 FT	175 FT	200 FT
1	0.00	0.11	0.10	0.10	0.12	0.09	0.08	0.07	0.05
2	0.00	0.11	0.10	0.09	0.10	0.09	0.07	0.06	0.04
3	0.00	0.12	0.10	0.09	0.11	0.09	0.07	0.05	0.04
4	0.00	0.12	0.10	0.10	0.12	0.08	0.08	0.08	0.05
5	0.00	0.11	0.10	0.10	0.11	0.08	0.08	0.06	0.04
6	0.00	0.12	0.11	0.10	0.12	0.09	0.09	0.08	0.05
Average	**0.00**	**0.11**	**0.10**	**0.10**	**0.11**	**0.09**	**0.08**	**0.07**	**0.05**

Table E-9 Swale Alternative 3 (Gravel Backfill for Drywells) Time Measurements

Event	Time (hh:mm:ss) at Each Location								
	Start	25 FT	50 FT	75 FT	100 FT	125 FT	150 FT	175 FT	200 FT
1	0:00:00	-	-	-	-	-	-	-	0:34:00
2	0:00:00	0:02:00	0:06:00	0:10:00	0:14:00	0:18:00	0:23:00	0:28:00	0:32:00
3	0:00:00	0:02:11	0:05:48	0:10:15	0:14:15	0:18:57	0:23:58	0:28:40	0:33:25
4	0:00:00	0:02:31	0:06:14	0:10:47	0:15:01	0:19:46	0:25:03	0:29:58	0:35:12
5	0:00:00	0:02:07	0:05:35	0:09:38	0:13:45	0:18:24	0:23:06	0:27:44	0:32:09
6	0:00:00	0:02:09	0:05:46	0:10:08	0:14:10	0:18:44	0:23:36	0:28:11	0:32:57
Average	**-**	**0:02:12**	**0:05:53**	**0:10:10**	**0:14:14**	**0:18:46**	**0:23:45**	**0:28:31**	**0:33:17**

Table E-10 Swale Alternative 3 (Gravel Backfill for Drywells) Velocity

Event	Velocity (ft/s) at Each Sample Location								
	Start	25 FT	50 FT	75 FT	100 FT	125 FT	150 FT	175 FT	200 FT
1	0.00	-	-	-	-	-	-	-	0.10
2	0.00	0.21	0.10	0.10	0.10	0.10	0.08	0.08	0.10
3	0.00	0.19	0.12	0.09	0.10	0.09	0.08	0.09	0.09
4	0.00	0.17	0.11	0.09	0.10	0.09	0.08	0.08	0.08
5	0.00	0.20	0.12	0.10	0.10	0.09	0.09	0.09	0.09
6	0.00	0.19	0.12	0.10	0.10	0.09	0.09	0.09	0.09
Average	**-**	**0.19**	**0.11**	**0.10**	**0.10**	**0.09**	**0.08**	**0.09**	**0.09**

Table E-11 Swale Alternative 4 (Sand Pea Gravel) Time Measurements

Event	Time (hh:mm:ss) at Each Location								
	Start	25 FT	50 FT	75 FT	100 FT	125 FT	150 FT	175 FT	200 FT
1	0:00:00	0:02:47	0:05:52	0:08:30	0:11:27	0:14:43	0:17:10	0:20:35	0:23:14
2	0:00:00	0:02:41	0:05:41	0:08:07	0:11:08	0:14:14	0:16:41	0:19:56	0:22:33
3	0:00:00	0:02:32	0:05:32	0:07:51	0:10:44	0:13:42	0:16:02	0:19:09	0:21:37
4	0:00:00	0:02:40	0:05:47	0:08:11	0:11:14	0:14:20	0:16:50	0:20:02	0:22:35
5	0:00:00	0:02:30	0:05:24	0:07:45	0:10:35	0:13:37	0:15:57	0:19:06	0:21:38
6	0:00:00	0:02:16	0:05:17	0:07:36	0:10:29	0:13:27	0:15:47	0:18:57	0:21:25
Average	**0:00:00**	**0:02:34**	**0:05:36**	**0:08:00**	**0:10:56**	**0:14:00**	**0:16:24**	**0:19:38**	**0:22:10**

Table E-12 Swale Alternative 4 (Sand Pea Gravel) Velocity

Event	Velocity (ft/s) at Each Location								
	Start	25 FT	50 FT	75 FT	100 FT	125 FT	150 FT	175 FT	200 FT
1	0.00	0.15	0.14	0.16	0.14	0.13	0.17	0.12	0.16
2	0.00	0.16	0.14	0.17	0.14	0.13	0.17	0.13	0.16
3	0.00	0.16	0.14	0.18	0.14	0.14	0.18	0.13	0.17
4	0.00	0.16	0.13	0.17	0.14	0.13	0.17	0.13	0.16
5	0.00	0.17	0.14	0.18	0.15	0.14	0.18	0.13	0.16
Average	**0.00**	**0.16**	**0.14**	**0.17**	**0.14**	**0.13**	**0.17**	**0.13**	**0.16**

Table E-13 Final Swale Alternative Time Measurements

Event	Time (hh:mm:ss) at Each Location								
	Start	25 FT	50 FT	75 FT	100 FT	125 FT	150 FT	175 FT	200 FT
Rinse #1	0:00:00	0:03:39	0:08:40	0:14:10	0:20:01	0:26:48	0:34:33	0:43:25	-
Rinse #2	0:00:00	0:03:42	0:08:32	0:14:32	0:20:50	0:27:19	0:34:55	0:42:45	0:52:40
1	0:00:00	0:03:40	0:08:45	0:14:00	0:20:15	0:26:25	0:33:22	0:40:43	0:51:15
2	0:00:00	0:03:53	0:08:27	0:13:51	0:19:42	0:25:38	0:32:24	0:39:32	-
3	0:00:00	0:03:50	0:09:04	0:14:30	0:20:44	0:27:14	0:34:42	0:42:59	0:52:36
4	0:00:00	0:03:36	0:08:26	0:13:45	0:19:37	0:25:41	0:32:26	0:39:34	0:46:41
5	0:00:00	0:03:39	0:08:32	0:13:57	0:19:57	0:26:04	0:33:02	0:40:33	0:48:47
6	0:00:00	0:03:40	0:08:32	0:13:57	0:19:57	0:26:04	0:32:58	0:40:21	0:48:58
Average	**0:00:00**	**0:03:42**	**0:08:37**	**0:14:05**	**0:20:08**	**0:26:24**	**0:33:33**	**0:41:14**	**0:50:10**

Table E-14 Final Swale Alternative Velocity

Event	Velocity (ft/s) at Each Sample Location							
	25 ft	50 FT	75 FT	100 FT	125 FT	150 FT	175 FT	200 FT
1	0.11	0.08	0.08	0.07	0.07	0.06	0.06	0.04
2	0.11	0.09	0.08	0.07	0.07	0.06	0.06	-
3	0.11	0.08	0.08	0.07	0.06	0.06	0.05	0.04
4	0.12	0.09	0.08	0.07	0.07	0.06	0.06	0.06
5	0.11	0.09	0.08	0.07	0.07	0.06	0.06	0.05
6	0.11	0.09	0.08	0.07	0.07	0.06	0.06	0.05
Average	**0.11**	**0.08**	**0.08**	**0.07**	**0.07**	**0.06**	**0.05**	**0.05**

Manning’s n Verification

Table E-15 Porosity of Gravel Backfill for Drywell

Variable	Units	Value
Weight of container	lb	0.675
Weight of rock, container	lb	14
Weight of rock, water, container	lb	17.6
Water density	lb/ft3	62.4
Volume of Voids	mL	1634
Volume of Container	mL	4000
Porosity	%	0.40

Table E-16 Pea Gravel Layer Dimensions

Variable	Units	Value
porosity	%	0.4
b	ft	2
Z	unitless	3
y	ft	0.1
T	ft	2.6

Table E-17 GBD Layer Dimensions

Variable	Units	Value
porosity	%	0.41
b	ft	2.6
Z	unitless	3
y	ft	0.25
T	ft	4.1

Table E-18 Manning’s n no flow through Pea Gravel

Variable	Units	Value
R	ft	0.205
V	(ft/s)	0.066
y	ft	0.26
z	unitless	3
b	ft	2.6
Slope	(ft/ft)	0.01
Manning's n:	0.7743	

Single Ring Infiltrometer Tests

The single ring infiltrometer test was conducted at the test site to estimate average infiltration in the final swale. A PVC pipe was used to form the single ring infiltrometer. The single ring infiltrometer test was conducted according to procedures outlined in the 2019 SWMMEW, except a flow meter was not available, so the time for water in the pipe to fall 1" from a depth of 12" was measured and recorded. After each measurement, the depth of water was filled to 12" mark. The single ring infiltrometer test was ended when less than 5% change in time occurred between 3 consecutive measurements (time for water in pipe to fall 1"). The percent change for measurement #1 reflects the change between measurements #1 and #2; the percent change for measurement #2 reflects the change between measurements #2 and #3; and the percent change for measurement #3 reflects the change between measurements #1 and #3 to verify less than 5% change occurred over the duration of the test.

Table E-19 Single Ring Parameters

Internal Pipe Diameter	11.75	inches
Area	108.43	sq. in.
Area	0.75	sf
Depth to Fall	1	in.

Table E-20 Single Ring Infiltration Measurements

Measurement	Time	Time (min.)	% change	Time (hour)	I (in/hr)
#1	35:11.2	35.18	4.2%	0.59	1.71
#2	36:42.7	36.72	-0.5%	0.61	1.63
#3	36:31.5	36.53	3.8%	0.61	1.64
				Average	1.66

Statistical Analyses

Normality Tests

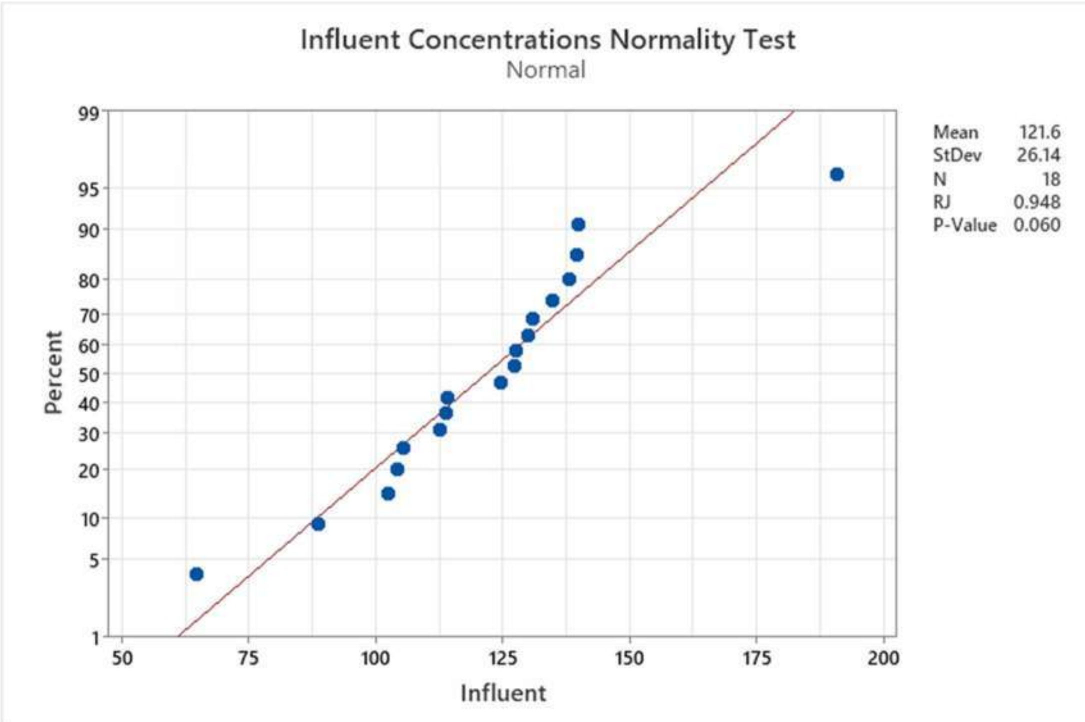

Figure E-9 Influent Concentrations Normality Test

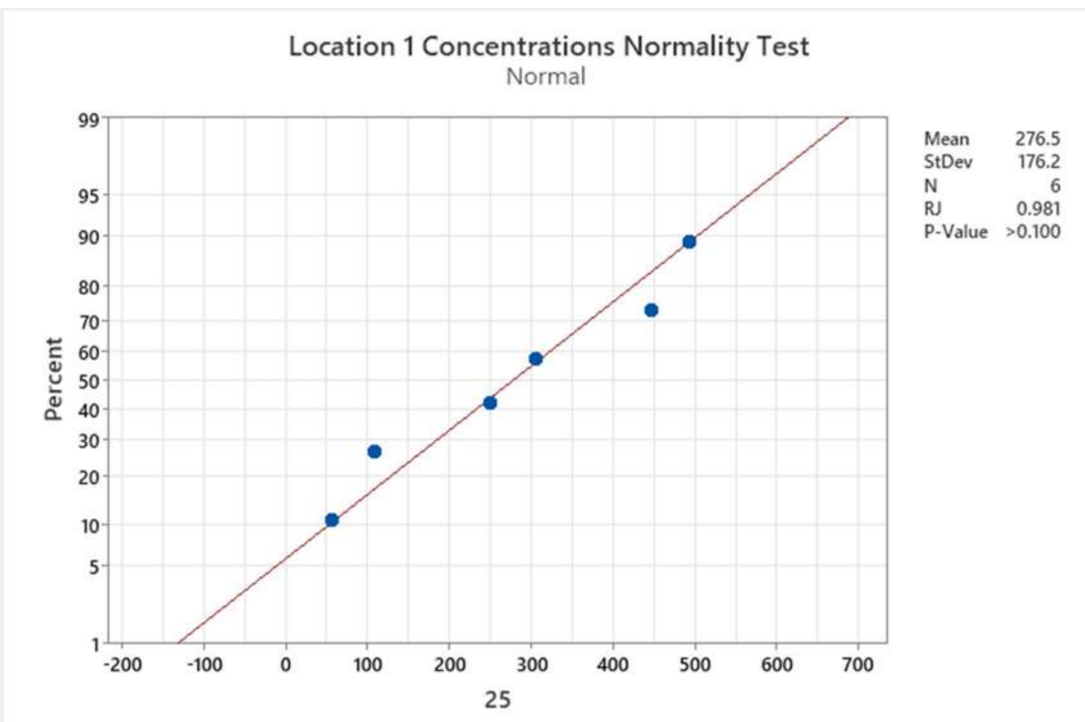

Figure E-10 Sample Location 1 (25 feet) Concentrations Normality Test

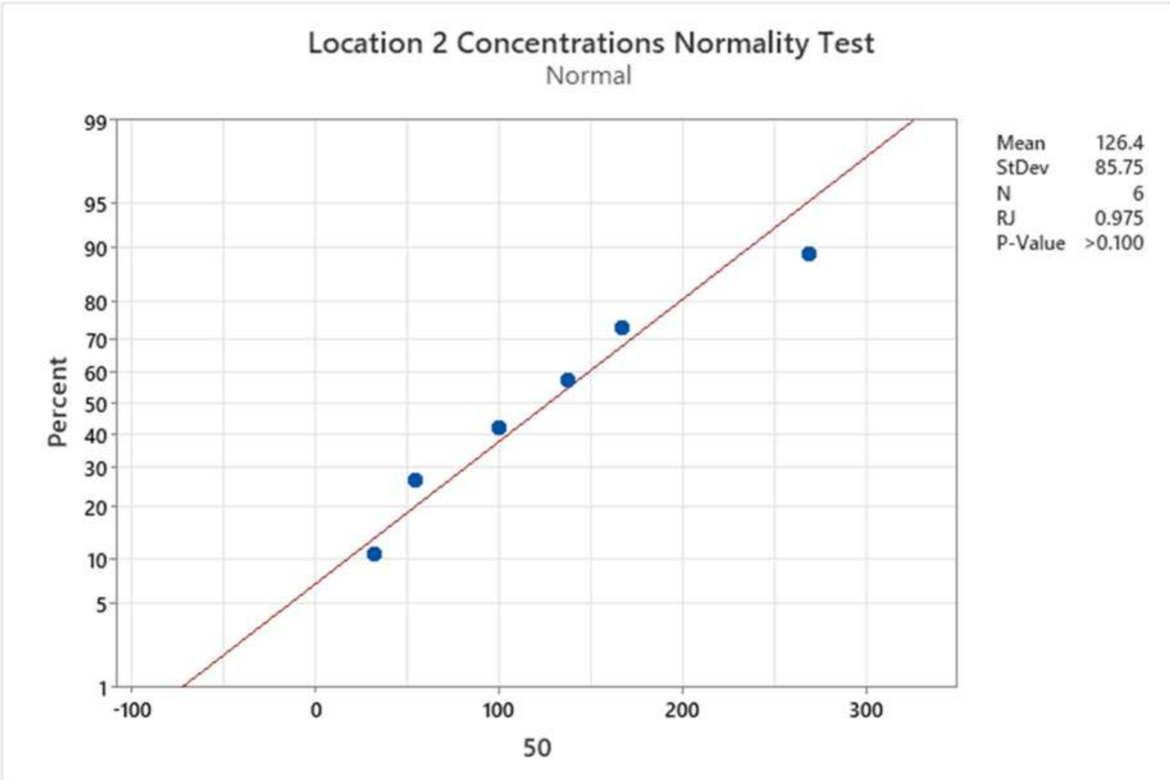

Figure E-11 Sample Location 2 (50 feet) Concentrations Normality Test

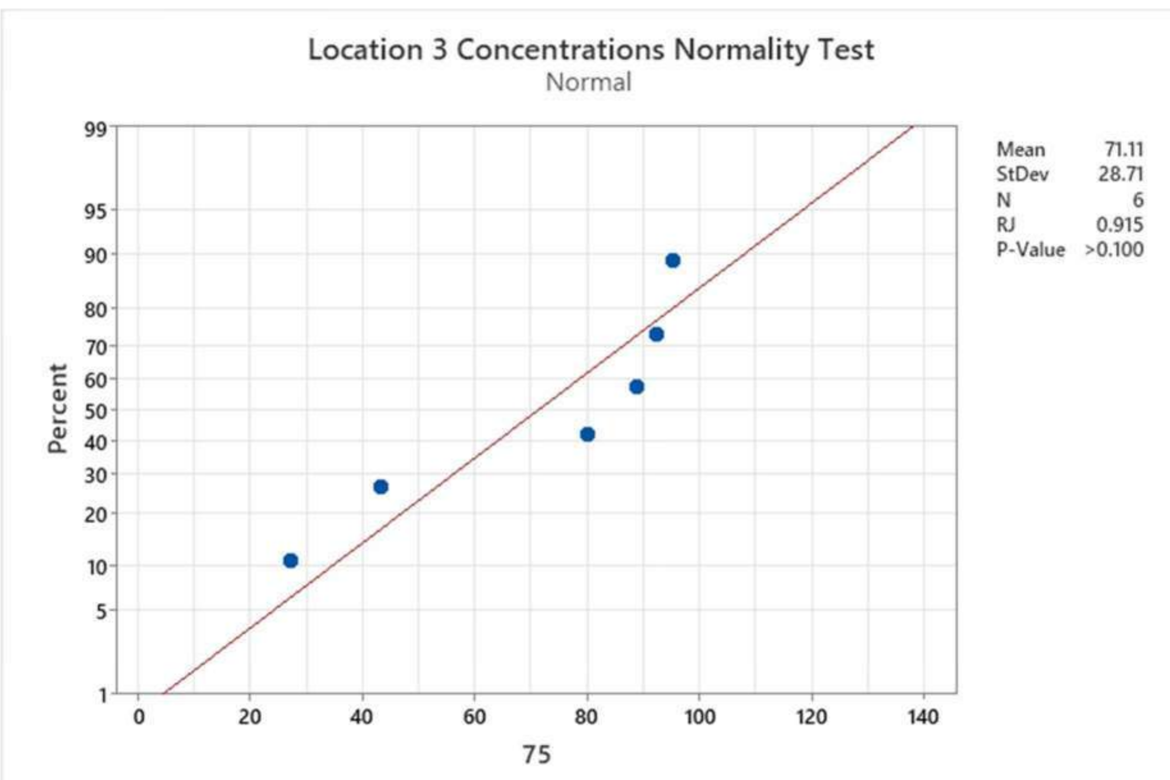

Figure E-12 Sample Location 3 (75 feet) Concentrations Normality Test

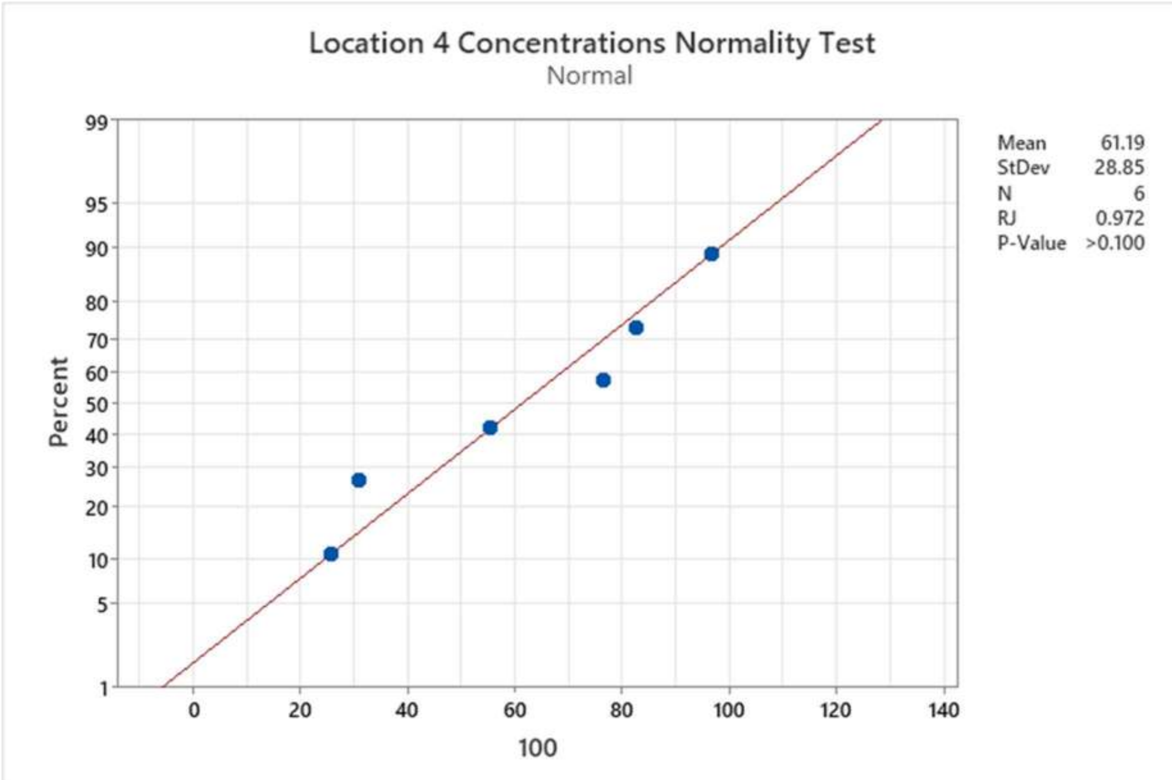

Figure E-13 Sample Location 4 (100 feet) Concentrations Normality Test

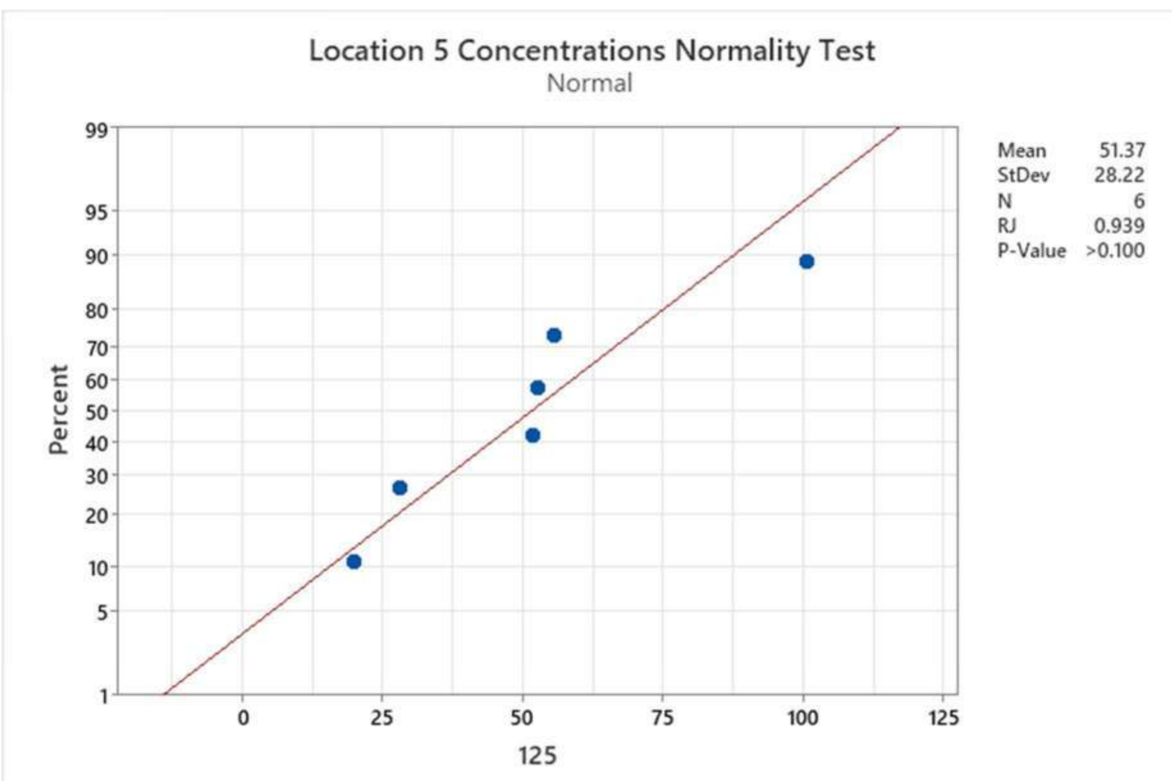

Figure E-14 Sample Location 5 (125 feet) Concentrations Normality Test

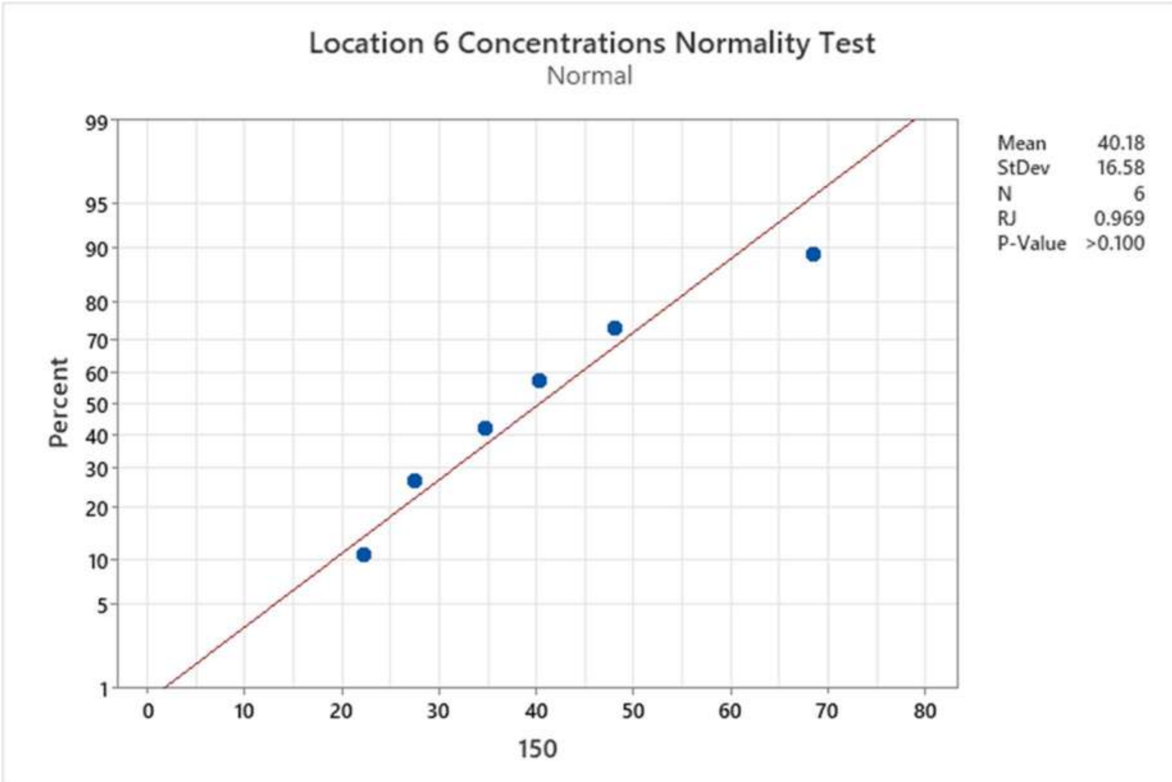

Figure E-15 Sample Location 6 (150 feet) Concentrations Normality Test

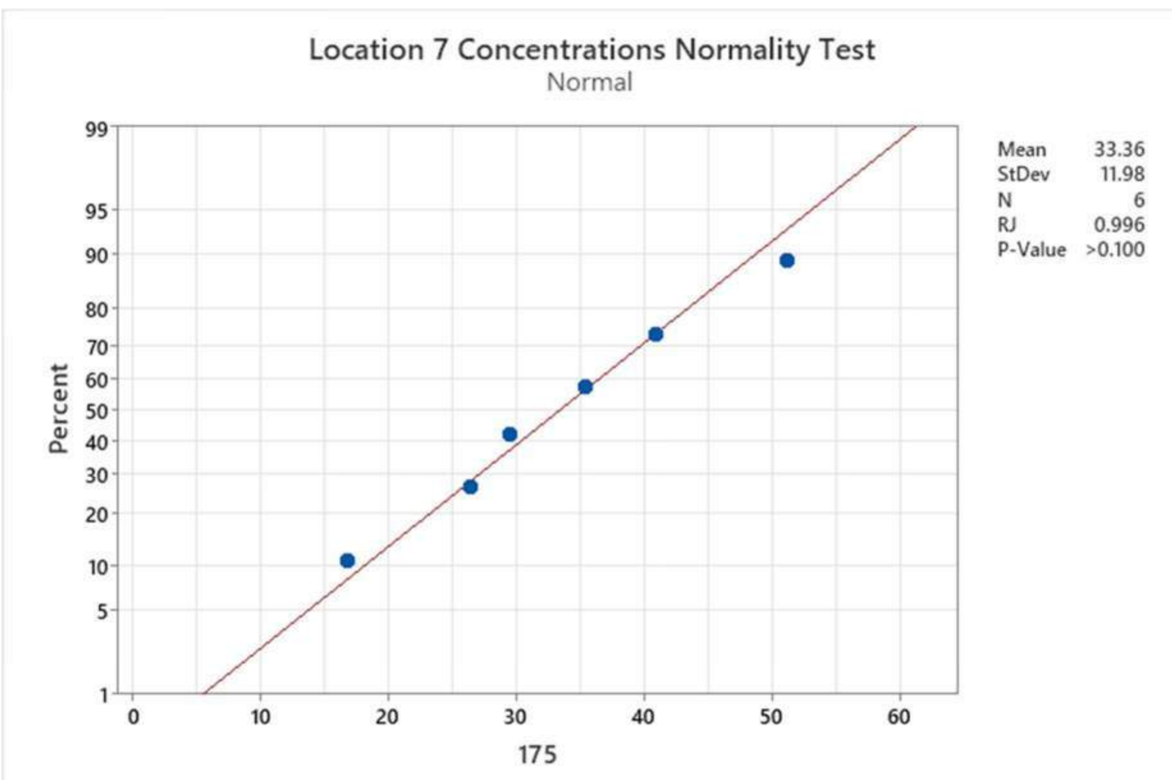

Figure E-16 Sample Location 7 (175 feet) Concentrations Normality Test

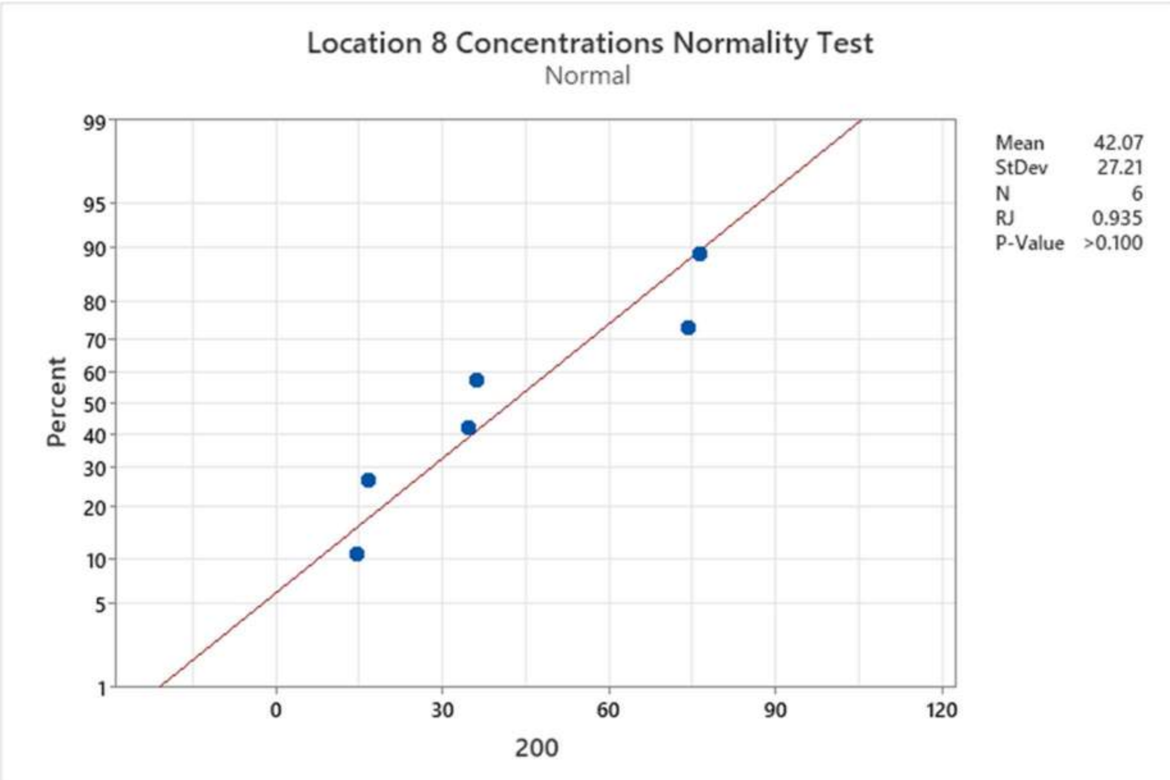

Figure E-17 Sample Location 8 (200 feet) Concentrations Normality Test

Two-Sample T-Test Results

Two-Sample T-Test and CI: Influent, Location 1 (25 feet)

Method

μ_1: population mean of Influent
μ_2: population mean of 25
Difference: $\mu_1 - \mu_2$

Equal variances are not assumed for this analysis.

Descriptive Statistics

Sample	N	Mean	StDev	SE Mean
Influent	18	121.6	26.1	6.2
25	6	277	176	72

Estimation for Difference

Difference	95% CI for Difference
-154.9	(-340.5, 30.6)

Test

Null hypothesis $H_0: \mu_1 - \mu_2 = 0$
Alternative hypothesis $H_1: \mu_1 - \mu_2 \neq 0$

T-Value	DF	P-Value
-2.15	5	0.085

Two-Sample T-Test and CI: Influent, Location 2 (50 feet)

Method

μ_1: population mean of Influent
μ_2: population mean of 50
Difference: $\mu_1 - \mu_2$

Equal variances are not assumed for this analysis.

Descriptive Statistics

Sample	N	Mean	StDev	SE Mean
Influent	18	121.6	26.1	6.2
50	6	126.4	85.7	35

Estimation for Difference

Difference	95% CI for Difference
-4.8	(-96.2, 86.5)

Test

Null hypothesis $H_0: \mu_1 - \mu_2 = 0$
Alternative hypothesis $H_1: \mu_1 - \mu_2 \neq 0$

T-Value	DF	P-Value
-0.14	5	0.897

Two-Sample T-Test and CI: Influent, Location 3 (75 feet)

Method

μ_1: population mean of Influent
μ_2: population mean of 75
Difference: $\mu_1 - \mu_2$

Equal variances are not assumed for this analysis.

Descriptive Statistics

Sample	N	Mean	StDev	SE Mean
Influent	18	121.6	26.1	6.2
75	6	71.1	28.7	12

Estimation for Difference

Difference	95% CI for Difference
50.5	(19.1, 81.8)

Test

Null hypothesis H_0: $\mu_1 - \mu_2 = 0$
Alternative hypothesis H_1: $\mu_1 - \mu_2 \neq 0$

T-Value	DF	P-Value
3.81	7	0.007

Two-Sample T-Test and CI: Influent, Location 4 (100 feet)

Method

μ_1: population mean of Influent
μ_2: population mean of 100
Difference: $\mu_1 - \mu_2$

Equal variances are not assumed for this analysis.

Descriptive Statistics

Sample	N	Mean	StDev	SE Mean
Influent	18	121.6	26.1	6.2
100	6	61.2	28.9	12

Estimation for Difference

Difference	95% CI for Difference
60.4	(28.9, 91.8)

Test

Null hypothesis H_0: $\mu_1 - \mu_2 = 0$
Alternative hypothesis H_1: $\mu_1 - \mu_2 \neq 0$

T-Value	DF	P-Value
4.54	7	0.003

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Two-Sample T-Test and CI: Influent, Location 5 (125 feet)

Method

μ_1: population mean of Influent
μ_2: population mean of 125
Difference: $\mu_1 - \mu_2$

Equal variances are not assumed for this analysis.

Descriptive Statistics

Sample	N	Mean	StDev	SE Mean
Influent	18	121.6	26.1	6.2
125	6	51.4	28.2	12

Estimation for Difference

Difference	95% CI for Difference
70.2	(40.1, 100.3)

Test

Null hypothesis	$H_0: \mu_1 - \mu_2 = 0$
Alternative hypothesis	$H_1: \mu_1 - \mu_2 \neq 0$

T-Value	DF	P-Value
5.37	8	0.001

Two-Sample T-Test and CI: Influent, Location 6 (150 feet)

Method

μ_1: population mean of Influent
μ_2: population mean of 150
Difference: $\mu_1 - \mu_2$

Equal variances are not assumed for this analysis.

Descriptive Statistics

Sample	N	Mean	StDev	SE Mean
Influent	18	121.6	26.1	6.2
150	6	40.2	16.6	6.8

Estimation for Difference

Difference	95% CI for Difference
81.39	(61.62, 101.16)

Test

Null hypothesis	$H_0: \mu_1 - \mu_2 = 0$
Alternative hypothesis	$H_1: \mu_1 - \mu_2 \neq 0$

T-Value	DF	P-Value
8.89	13	0.000

Two-Sample T-Test and CI: Influent, Location 7 (175 feet)

Method

μ_1: population mean of Influent
μ_2: population mean of 175
Difference: $\mu_1 - \mu_2$

Equal variances are not assumed for this analysis.

Descriptive Statistics

Sample	N	Mean	StDev	SE Mean
Influent	18	121.6	26.1	6.2
175	6	33.4	12.0	4.9

Estimation for Difference

Difference	95% CI for Difference
88.21	(71.75, 104.68)

Test

Null hypothesis	$H_0: \mu_1 - \mu_2 = 0$
Alternative hypothesis	$H_1: \mu_1 - \mu_2 \neq 0$

T-Value	DF	P-Value
11.21	19	0.000

Two-Sample T-Test and CI: Influent, Location 8 (200 feet)

Method

μ_1: population mean of Influent
μ_2: population mean of 200
Difference: $\mu_1 - \mu_2$

Equal variances are not assumed for this analysis.

Descriptive Statistics

Sample	N	Mean	StDev	SE Mean
Influent	18	121.6	26.1	6.2
200	6	42.1	27.2	11

Estimation for Difference

Difference	95% CI for Difference
79.5	(50.2, 108.8)

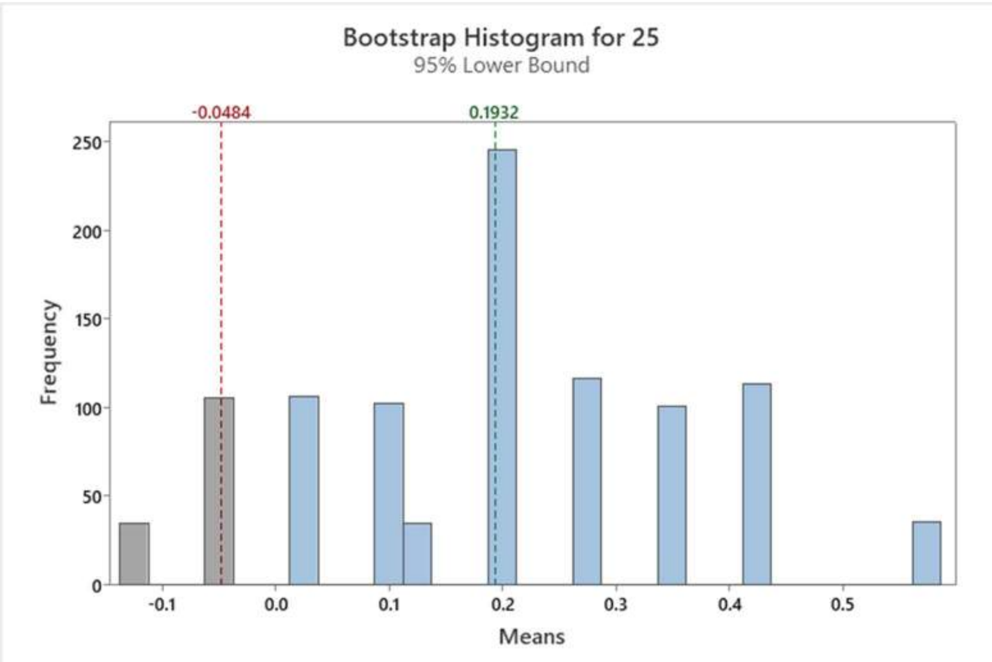
Test

Null hypothesis	H_0: $\mu_1 - \mu_2 = 0$
Alternative hypothesis	H_1: $\mu_1 - \mu_2 \neq 0$

T-Value	DF	P-Value
6.26	8	0.000

Bootstrapping Tests Results

Bootstrapping for 1-Sample Mean: Location 1 (25 feet)



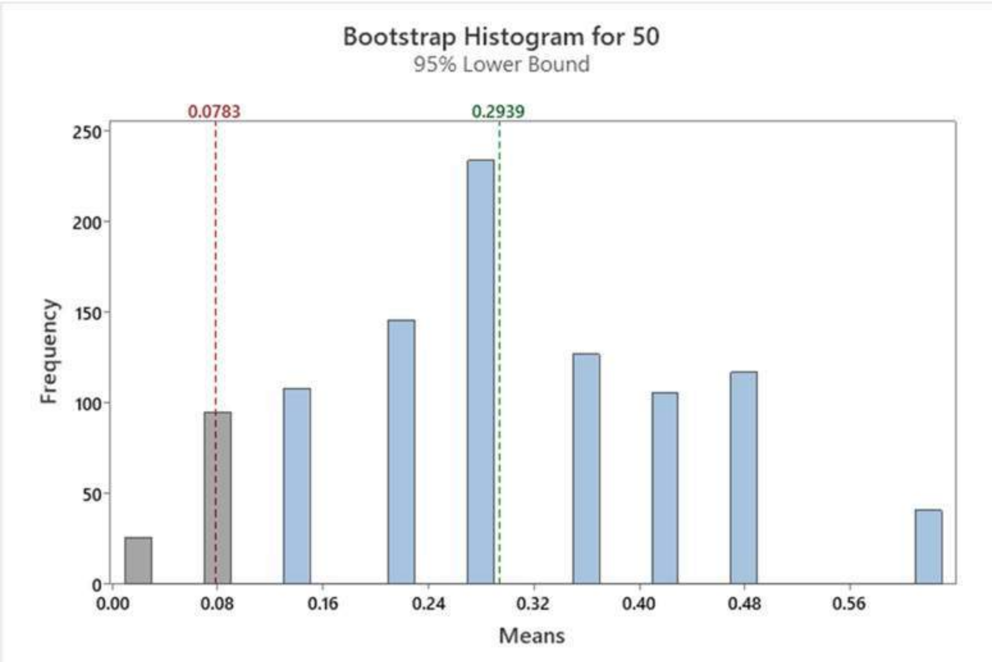
Observed Sample

Variable	N	Mean	StDev	Variance	Sum	Minimum	Median	Maximum
25	3	0.191	0.364	0.132	0.572	-0.132	0.119	0.585

Bootstrap Samples for Mean

Number of Resamples	Mean	StDev	95% Lower Bound for μ
1000	0.19321	0.16907	-0.04840

Bootstrapping for 1-Sample Mean: Location 2 (50 feet)



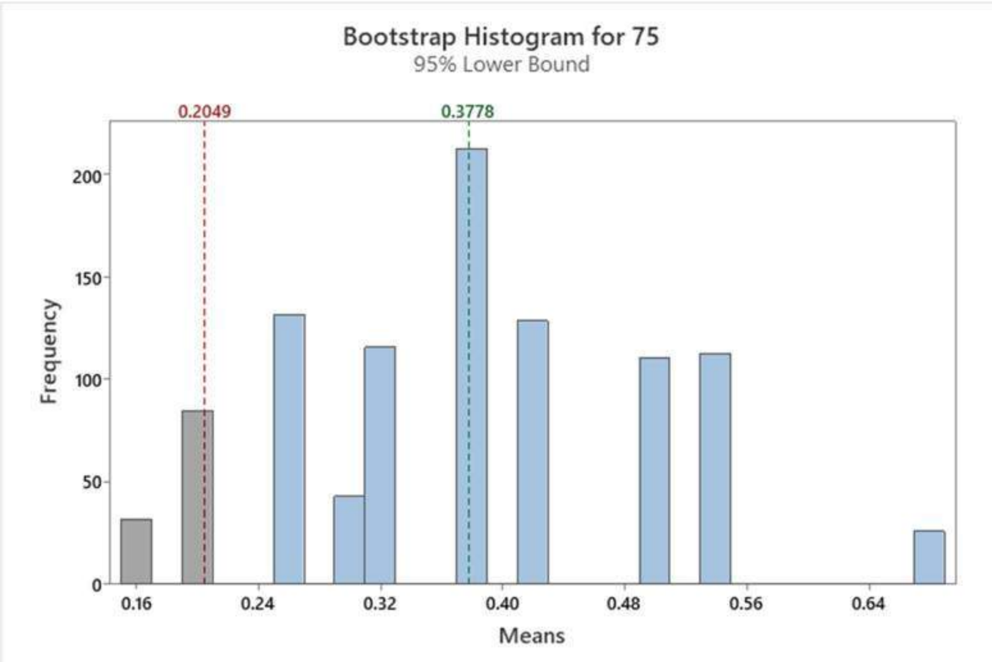
Observed Sample

Variable	N	Mean	StDev	Variance	Sum	Minimum	Median	Maximum
50	3	0.284	0.314	0.099	0.852	0.010	0.214	0.628

Bootstrap Samples for Mean

Number of Resamples	Mean	StDev	95% Lower Bound for µ
1000	0.29388	0.14497	0.07827

Bootstrapping for 1-Sample Mean: Location 3 (75 feet)



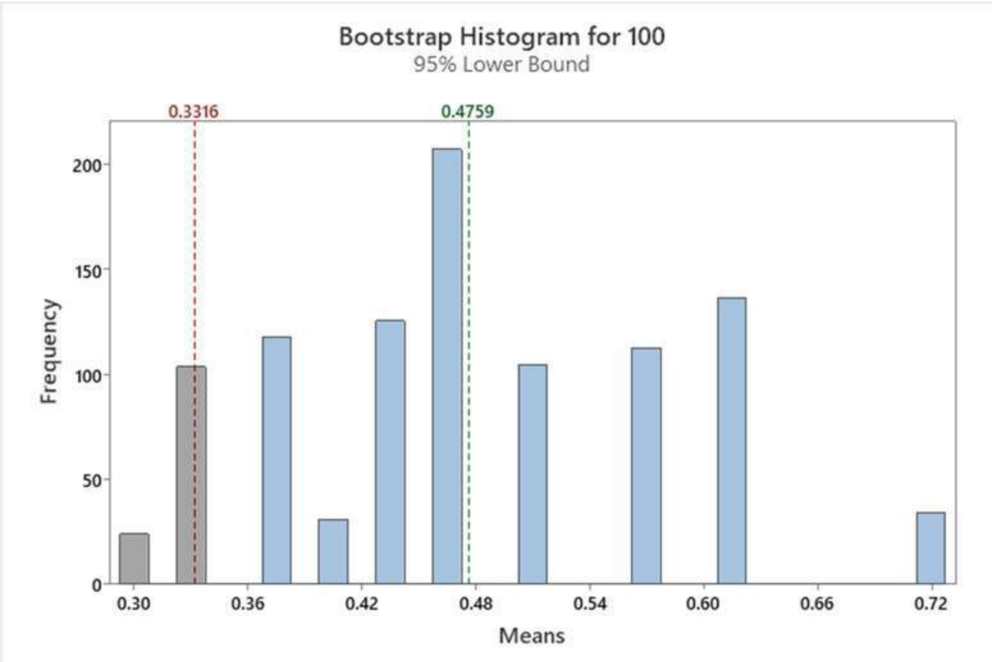
Observed Sample

Variable	N	Mean	StDev	Variance	Sum	Minimum	Median	Maximum
75	3	0.377	0.265	0.070	1.132	0.153	0.309	0.670

Bootstrap Samples for Mean

Number of Resamples	Mean	StDev	95% Lower Bound for μ
1000	0.37780	0.11884	0.20493

Bootstrapping for 1-Sample Mean: Location 4 (100 feet)



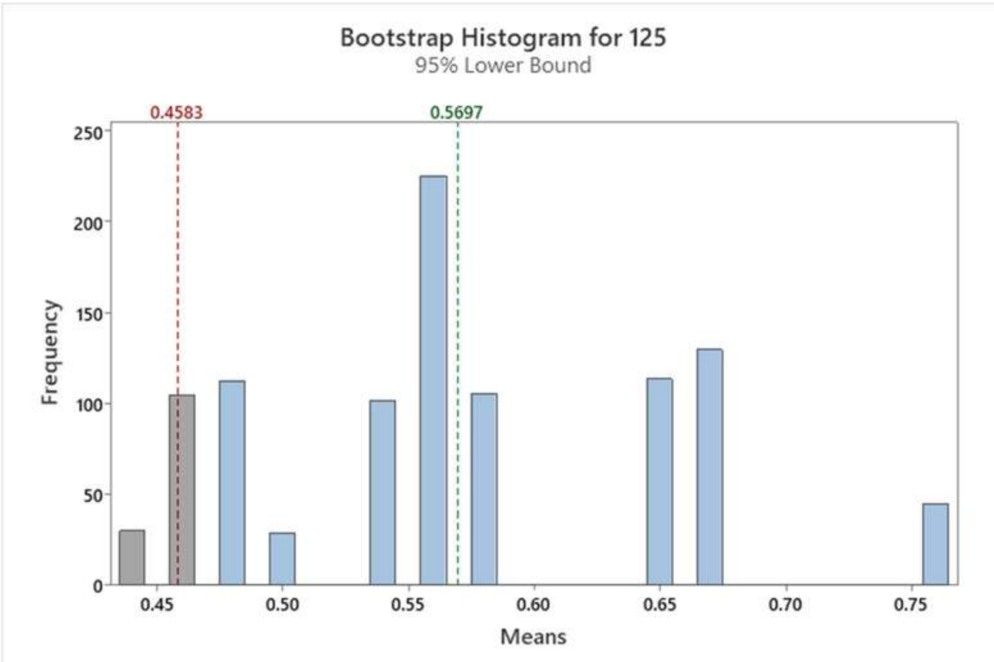
Observed Sample

Variable	N	Mean	StDev	Variance	Sum	Minimum	Median	Maximum
100	3	0.471	0.216	0.047	1.412	0.295	0.404	0.713

Bootstrap Samples for Mean

Number of Resamples	Mean	StDev	95% Lower Bound for μ
1000	0.47593	0.10127	0.33160

Bootstrapping for 1-Sample Mean: Location 5 (125 feet)



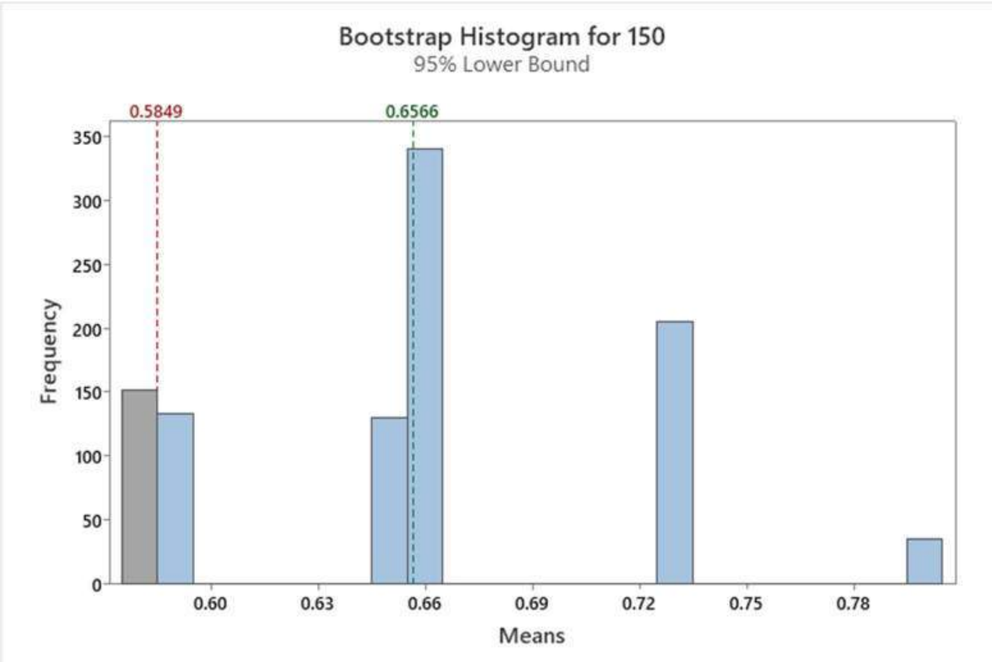
Observed Sample

Variable	N	Mean	StDev	Variance	Sum	Minimum	Median	Maximum
125	3	0.5640	0.1683	0.0283	1.6920	0.4379	0.4990	0.7551

Bootstrap Samples for Mean

Number of Resamples	Mean	StDev	95% Lower Bound for μ
1000	0.56974	0.08114	0.45827

Bootstrapping for 1-Sample Mean: Location 6 (150 feet)



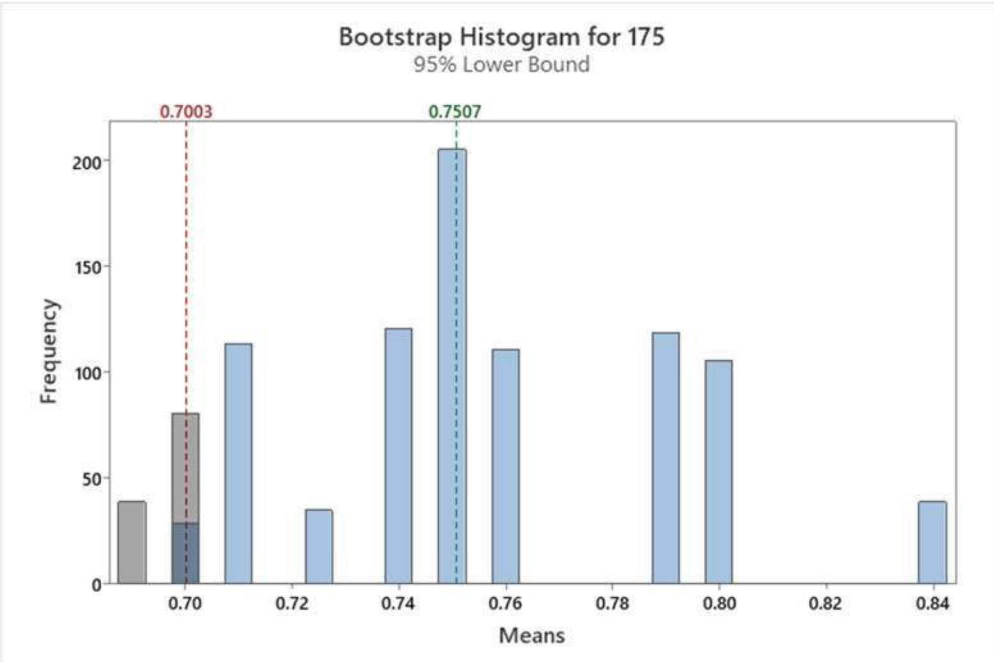
Observed Sample

Variable	N	Mean	StDev	Variance	Sum	Minimum	Median	Maximum
150	3	0.6573	0.1217	0.0148	1.9720	0.5804	0.5940	0.7976

Bootstrap Samples for Mean

Number of Resamples	Mean	StDev	95% Lower Bound for μ
1000	0.65662	0.05609	0.58493

Bootstrapping for 1-Sample Mean: Location 7 (175 feet)



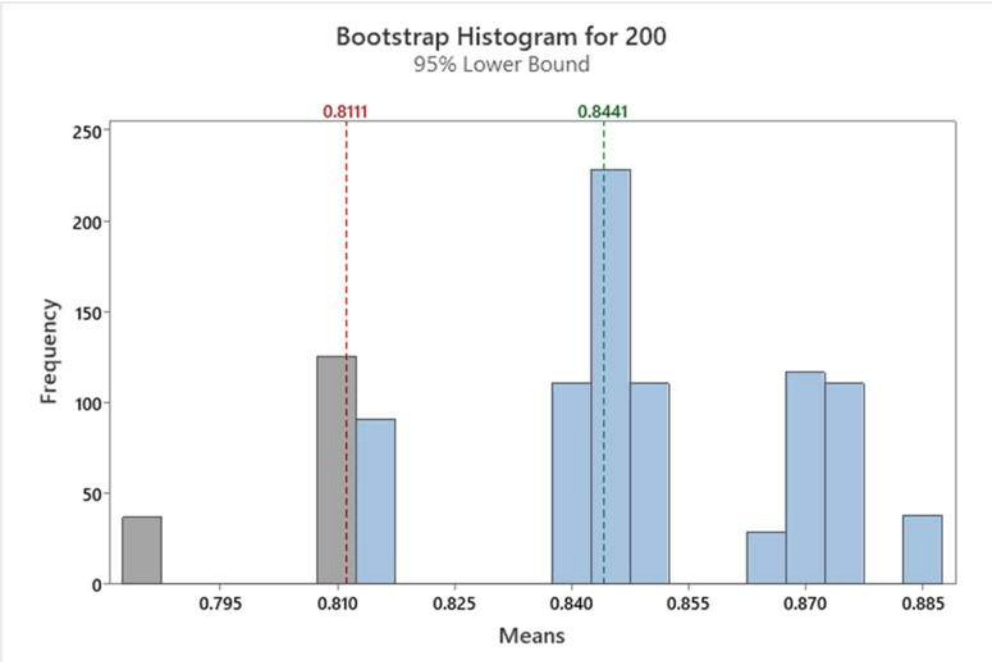
Observed Sample

Variable	N	Mean	StDev	Variance	Sum	Minimum	Median	Maximum
175	3	0.7507	0.0793	0.0063	2.2520	0.6890	0.7229	0.8401

Bootstrap Samples for Mean

Number of Resamples	Mean	StDev	95% Lower Bound for μ
1000	0.75066	0.03771	0.70030

Bootstrapping for 1-Sample Mean: Location 8 (200 feet)



Observed Sample

Variable	N	Mean	StDev	Variance	Sum	Minimum	Median	Maximum
200	3	0.8440	0.0527	0.0028	2.5320	0.7840	0.8654	0.8826

Bootstrap Samples for Mean

Number of Resamples	Mean	StDev	95% Lower Bound for μ
1000	0.844080	0.024903	0.811133

Appendix F – Laboratory Analytical Reports

Report of Analysis

For: **City of West Richland**
3801 Van Giesen
W Richland, WA 99353
Attn: Drew Woodruff

Cust Sample #: GBD - Storm 3 - Loc3 **Lab Sample ID:** 230191-06
Site: City of West Richland **Collection Date:** 8/26/2022 8:00 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	1100 mg/L	2	jhill	LB017	8/30/2022	13:00

Cust Sample #: GBD - Storm 3 - Loc4 **Lab Sample ID:** 230191-07
Site: City of West Richland **Collection Date:** 8/26/2022 8:00 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	550 mg/L	2	jhill	LB017	8/30/2022	13:00

Cust Sample #: GBD - Storm 3 - Loc5 **Lab Sample ID:** 230191-08
Site: City of West Richland **Collection Date:** 8/26/2022 8:00 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	400 mg/L	2	jhill	LB017	8/30/2022	13:00

Cust Sample #: GBD - Storm 3 - Loc6 **Lab Sample ID:** 230191-09
Site: City of West Richland **Collection Date:** 8/26/2022 8:00 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	190 mg/L	2	jhill	LB017	8/30/2022	13:00

Cust Sample #: GBD - Storm 3 - Loc7 **Lab Sample ID:** 230191-10
Site: City of West Richland **Collection Date:** 8/26/2022 8:00 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	200 mg/L	2	jhill	LB017	8/30/2022	13:00

Cust Sample #: GBD - Storm 3 - Loc8 **Lab Sample ID:** 230191-11
Site: City of West Richland **Collection Date:** 8/26/2022 8:00 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	170 mg/L	2	jhill	LB017	8/30/2022	13:00

Cust Sample #: HMA - Storm 2 - Inf1 **Lab Sample ID:** 230192-01
Site: City of West Richland **Collection Date:** 8/26/2022 9:00 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	200 mg/L	1	jhill	LB017	8/30/2022	13:00

Cust Sample #: HMA - Storm 2 - Inf2 **Lab Sample ID:** 230192-02
Site: City of West Richland **Collection Date:** 8/26/2022 9:05 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	170 mg/L	1	jhill	LB017	8/30/2022	13:00

Cust Sample #: HMA - Storm 2 - Inf3 **Lab Sample ID:** 230192-03
Site: City of West Richland **Collection Date:** 8/26/2022 9:10 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	180 mg/L	1	jhill	LB017	8/30/2022	13:00

Cust Sample #: HMA - Storm 2 - Loc1 **Lab Sample ID:** 230192-04
Site: City of West Richland **Collection Date:** 8/26/2022 10:00 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	3200 mg/L	5	jhill	LB017	8/30/2022	13:00

Cust Sample #: HMA - Storm 2 - Loc2 **Lab Sample ID:** 230192-05
Site: City of West Richland **Collection Date:** 8/26/2022 10:00 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	2900 mg/L	5	jhill	LB017	8/30/2022	13:00

Cust Sample #: HMA - Storm 2 - Loc3 **Lab Sample ID:** 230192-06
Site: City of West Richland **Collection Date:** 8/26/2022 10:00 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	1900 mg/L	5	jhill	LB017	8/30/2022	13:00

Cust Sample #: HMA - Storm 2 - Loc4 **Lab Sample ID:** 230192-07
Site: City of West Richland **Collection Date:** 8/26/2022 10:00 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	120 mg/L	5	jhill	LB017	8/30/2022	13:00

Cust Sample #: HMA - Storm 2 - Loc5 **Lab Sample ID:** 230192-08
Site: City of West Richland **Collection Date:** 8/26/2022 10:00 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	890 mg/L	5	jhill	LB017	8/30/2022	13:00

Cust Sample #: HMA - Storm 2 - Loc6 **Lab Sample ID:** 230192-09
Site: City of West Richland **Collection Date:** 8/26/2022 10:00 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	780 mg/L	5	jhill	LB017	8/30/2022	13:00

Cust Sample #: HMA - Storm 2 - Loc7 **Lab Sample ID:** 230192-10
Site: City of West Richland **Collection Date:** 8/26/2022 10:00 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	630 mg/L	5	jhill	LB017	8/30/2022	13:00

Cust Sample #: HMA - Storm 2 - Loc8 **Lab Sample ID:** 230192-11
Site: City of West Richland **Collection Date:** 8/26/2022 10:00 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	440 mg/L	5	jhill	LB017	8/30/2022	13:00

Cust Sample #: GBD - Storm 4 - Inf1 **Lab Sample ID:** 230193-01
Site: City of West Richland **Collection Date:** 8/29/2022 7:45 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	160 mg/L	1	jhill	LB017	8/30/2022	13:00

Cust Sample #: GBD - Storm 4 - Inf2 **Lab Sample ID:** 230193-02
Site: City of West Richland **Collection Date:** 8/29/2022 7:00 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	150 mg/L	1	jhill	LB017	8/30/2022	13:00

Cust Sample #: GBD - Storm 4 - Inf3 **Lab Sample ID:** 230193-03
Site: City of West Richland **Collection Date:** 8/29/2022 7:55 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	140 mg/L	1	jhill	LB017	8/30/2022	13:00

QC Results

QCBatch ID	QC ID	Parameter	% Recovery / RPD	Control Limits
LB017	230191-06: Replicate 1	Total suspended solids	1.9497	0 - 5
	230192-11: Replicate 2	Total suspended solids	0.0343	0 - 5
	LCS 1	Total suspended solids	96.9	77.1 - 110
	MB 1	Total suspended solids	-0.71	- 1

Qualifier: * Replicate RPD outside acceptable range of <5%. A sample and its replicate may vary due to sample matrix and concentration.
Other QC within acceptable range. Samples reported without qualification.

Approved: [signature] 23-Sep-22

M Turner, Laboratory Manager

ENERGY NORTHWEST

Chain of Custody
Services Sales Order

Environmental Services
350 Hills Street Suite 107, Richland, WA 99354
Phone: 509-377-8058 Fax: 509-377-8464

Account Information

Company Name: City of West Richland Public Works

Customer Contact: Drew Woodruff

Mailing Address: 3100 Belmont Blvd West Richland, WA 99353

Billing Adress (if different):

Email: drew@westrichland.org Phone: 509-967-5434

Receive Invoice: ☐ Hard Copy ☒ Email Receive Report: ☐ Hard Copy ☒ Email

Project ID:

Order ID: 230191

Requested Tests: TSS SM2540D

Matrix
S - Soil
WW - Waste Water
DW - Drinking Water
O - Oil
N - NPDES
Ot - Other

Rush TAT
☐ Yes ☐ No
# of working days: ____
Date Requested: ____

Lab Use Only	Sample Identification (Location, Name, Code, etc)	Collection Date	Collection Time	Matrix	Number of Bottles	TSS SM2540D
01 ✓	GBD-Storm3-Inf1	8/26	7:00a	WW		X
02 ✓	GBD-Storm3-Inf2	8/26	7:05a	↓		X
03 ✓	GBD-Storm3-Inf3	↓	7:10a	↓		X
04 ✓	GBD-Storm3-Loc1	↓	8:00a	↓		X
05 ✓	GBD-Storm3-Loc2	↓	↓	↓		X
06 ✓	↓ -Loc3	↓	↓	↓		X
07 ✓	↓ -Loc4	↓	↓	↓		X
08 ✓	↓ -Loc5	↓	↓	↓		X
09 ✓	↓ -Loc6	↓	↓	↓		X
10 ✓	↓ -Loc7	↓	↓	↓		X
11 ✓	↓ -Loc8	↓	↓	↓		X

Comments
Please include QA/QC results w/report + forward results to taylor@evergreenstormh2o.com

Being duly authorized and empowered by Customer, by signing below, Customer agrees to having reviewed, understood, and is fully accepting of the terms on the reverse side of this form.

	Print / Signature	Date / Time	Print / Signature	Date / Time
Relinquished by:	Taylor Wilhelm Bublak	8/29/22 15:05	Received by:	
Relinquished by:			Received by:	
Accepted by lab:	[signature]	08/29/22 15:10		

Payment Type (circle) ☐ Paid
CC Check
Amount $

Please make all checks payable to Energy Northwest

Sample Condition at Receipt
Temperature (circle):
Ambient *Cold* *Frozen*
☐ Containers Intact/ Lids tight
☐ VOC Vials w/o Headspace
☐ Labels Match Custody

26334 R2

ENERGY NORTHWEST

environmental services

Sample Receipt Form

Company Name: City of West Richland Date/Time: 08/29/22 15:10

Customer Contact: Drew Woodruff

Turnaround time: Normal ☒ Rush ☐ _____ days

Samples Received via: Fedex ☐ UPS ☐ USPS ☐ Customer ☒ Other ☐: ____________

Number of coolers/boxes: 2 Type of Ice: Ice Cubes ☒ Ice Packs ☐ Dry Ice ☐ None ☐

Sample(s) Temp as Read (°C): — Corrected Temp (°C): — Thermometer ID: —

				Comments:
Chain of Custody Present?	Yes	No	N/A	
Samples Received Intact?	Yes	No	N/A	
Samples Received within hold time?	Yes	No	N/A	
40 mL Vials Free of Headspace?	Yes	No	N/A	
40 mL Vials Trip blank Present?	Yes	No	N/A	
Samples Properly Preserved?	Yes	No	N/A	
Bottle Labels and C.O.C/WSI Agree?	Yes	No	N/A	
Total Number of Bottles Received?	55			

Chain of Custody Fully Completed?	Yes	No	N/A	
Correct bottles/containers Received?	Yes	No	N/A	
ENW Bottles Used?	Yes	No	unkn	

Preservatives for bottles/containers:

NA

Comments:

Work orders 230191, 230192, 230193, 230194, 230195

Received by: [signature] Date/Time: 08/29/22 15:10

Environmental Services
350 Hills St. Suite 107, Richland, WA 99354
Phone: 509-377-8058 **Fax:** 509-377-8464

ENERGY NORTHWEST

Chain of Custody Services Sales Order

Environmental Services
350 Hills Street Suite 107, Richland, WA 99354
Phone: 509-377-8058 Fax: 509-377-8464

Account Information

Company Name: City of West Richland Public Works
Customer Contact: Drew Woodruff
Mailing Address: 3100 Belmont Blvd West Richland, WA 99353
Billing Adress (if different):
Email: drew@westrichland.org Phone: 509-967-5434
Receive Invoice: ☐ Hard Copy ☒ Email
Receive Report: ☐ Hard Copy ☒ Email

Project ID:
Order ID: 230192

Requested Tests: TSS SM2540D

Matrix
S - Soil
WW - Waste Water
DW - Drinking Water
O - Oil
N - NPDES
Ot - Other

Rush TAT
☐ Yes ☐ No
# of working days: ____
Date Requested: ____

Comments
Please include QA/QC results w/ report + forward results to taylor@evergreenstormh2o.com

Lab Use Only	Sample Identification (Location, Name, Code, etc)	Collection Date	Collection Time	Matrix	Number of Bottles	TSS SM2540D
01	HMA-Storm 2-Inf 1	8/26	9:00	WW	1	X
02	-Inf 2	↓	9:05a	↓	↓	X
03	-Inf 3	↓	9:10a	↓	↓	X
04	-Loc 1	↓	10:02a	↓	↓	X
05	-Loc 2	↓	↓	↓	↓	X
06	-Loc 3	↓	↓	↓	↓	X
07	-Loc 4	↓	↓	↓	↓	X
08	-Loc 5	↓	↓	↓	↓	X
09	-Loc 6	↓	↓	↓	↓	X
10	-Loc 7	↓	↓	↓	↓	X
11	-Loc 8	↓	↓	↓	↓	X

Being duly authorized and empowered by Customer, by signing below, Customer agrees to having reviewed, understood, and is fully accepting of the terms on the reverse side of this form.

Print / Signature	Date / Time	Print / Signature	Date / Time
Relinquished by: Taylor [signature]	8/29/22 15:05	Received by:	
Relinquished by:		Received by:	
Accepted by lab: [signature]	08/29/22 15:10		

Payment Type (circle) ☐ Paid
CC Check
Amount $

Please make all checks payable to Energy Northwest

Sample Condition at Receipt
Temperature (circle):
Ambient Cold Frozen
☐ Containers intact/ Lids tight
☐ VOC Vials w/o Headspace
☐ Labels Match Custody

26334 R2

ENERGY NORTHWEST

environmental services

Sample Receipt Form

Company Name: City of West Richland Date/Time: 08/29/22 15:10

Customer Contact: Drew Woodruff

Turnaround time: Normal ☒ Rush ☐ _____ days

Samples Received via: Fedex ☐ UPS ☐ USPS ☐ Customer ☒ Other ☐: __________

Number of coolers/boxes: 2 Type of Ice: Ice Cubes ☒ Ice Packs ☐ Dry Ice ☐ None ☐

Sample(s) Temp as Read (°C): — Corrected Temp (°C): — Thermometer ID: —

				Comments:
Chain of Custody Present?	Yes	No	N/A	
Samples Received Intact?	Yes	No	N/A	
Samples Received within hold time?	Yes	No	N/A	
40 mL Vials Free of Headspace?	Yes	No	N/A	
40 mL Vials Trip blank Present?	Yes	No	N/A	
Samples Properly Preserved?	Yes	No	N/A	
Bottle Labels and C.O.C/WSI Agree?	Yes	No	N/A	
Total Number of Bottles Received?	55			

Chain of Custody Fully Completed?	Yes	No	N/A	
Correct bottles/containers Received?	Yes	No	N/A	
ENW Bottles Used?	Yes	No	unkn	

Preservatives for bottles/containers:

NA

Comments:

Work orders 230191, 230192, 230193, 230194, 230195

Received by: [signature] Date/Time: 08/29/22 15:10

Environmental Services
350 Hills St. Suite 107, Richland, WA 99354
Phone: 509-377-8058 **Fax:** 509-377-8464

ENERGY NORTHWEST

Chain of Custody Services Sales Order

Environmental Services
350 Hills Street Suite 107, Richland, WA 99354
Phone: 509-377-8058 Fax: 509-377-8464

Account Information

Company Name: City of West Richland Public Works

Customer Contact: Drew Woodruff

Project ID:

Order ID: 230193

Mailing Address: 3100 Belmont Blvd West Richland, WA 99353

Billing Adress (*if different*):

Email: drew@westrichland.org Phone: 509-967-5434

Receive Invoice: ☐ Hard Copy ☒ Email Receive Report: ☐ Hard Copy ☒ Email

Requested Tests: TSS SM2540D

Lab Use Only	Sample Identification (*Location, Name, Code, etc*)	Collection Date	Collection Time	Matrix	Number of Bottles	TSS SM2540D
01	GBD-Storm4-Inf1	8/29	7:45	WW	1	X
02	-Inf2	↓	7:50	↓	↓	X
03	-Inf3	↓	7:55	↓	↓	X
04	-Loc1	↓	8:05	↓	↓	X
05	-Loc2	↓	↓	↓	↓	X
06	-Loc3	↓	↓	↓	↓	X
07	-Loc4	↓	↓	↓	↓	X
08	-Loc5	↓	↓	↓	↓	X
09	-Loc6	↓	↓	↓	↓	X
10	-Loc7	↓	↓	↓	↓	X
11	-Loc8	↓	↓	↓	↓	X

Matrix
S - Soil
WW - Waste Water
DW - Drinking Water
O - Oil
N - NPDES
Ot - Other

Rush TAT
☐ Yes ☐ No
# of working days: ____
Date Requested: ____

Comments
Please include QA/QC results w/ report + forward results to taylor@evergreenstormh2o.com

Being duly authorized and empowered by Customer, by signing below, Customer agrees to having reviewed, understood, and is fully accepting of the terms on the reverse side of this form.

	Print / Signature	Date / Time		Print / Signature	Date / Time
Relinquished by:	Taylor Wells	8/29/22 15:05	Received by:		
Relinquished by:			Received by:		
Accepted by lab:	[signature]	08/29/22 15:10			

Payment Type (*circle*) ☐ Paid CC Check Amount $

Please make all checks payable to Energy Northwest

Sample Condition at Receipt
Temperature (*circle*): *Ambient* *Cold* *Frozen*
☐ Containers intact/ Lids tight
☐ VOC Vials w/o Headspace
☐ Labels Match Custody

ENERGY NORTHWEST

environmental services

Sample Receipt Form

Company Name: City of West Richland Date/Time: 08/29/22 15:10

Customer Contact: Drew Woodruff

Turnaround time: Normal ☒ Rush ☐ ____ days

Samples Received via: Fedex ☐ UPS ☐ USPS ☐ Customer ☒ Other ☐: ________

Number of coolers/boxes: 2 Type of Ice: Ice Cubes ☒ Ice Packs ☐ Dry Ice ☐ None ☐

Sample(s) Temp as Read (°C): — Corrected Temp (°C): — Thermometer ID: —

				Comments:
Chain of Custody Present?	Yes	No	N/A	
Samples Received Intact?	Yes	No	N/A	
Samples Received within hold time?	Yes	No	N/A	
40 mL Vials Free of Headspace?	Yes	No	N/A	
40 mL Vials Trip blank Present?	Yes	No	N/A	
Samples Properly Preserved?	Yes	No	N/A	
Bottle Labels and C.O.C/WSI Agree?	Yes	No	N/A	
Total Number of Bottles Received?	55			

Chain of Custody Fully Completed?	Yes	No	N/A	
Correct bottles/containers Received?	Yes	No	N/A	
ENW Bottles Used?	Yes	No	unkn	

Preservatives for bottles/containers:

NA

Comments:

Work orders 230191, 230192, 230193, 230194, 230195

Received by: [signature] Date/Time: 08/29/22 15:10

Environmental Services
350 Hills St. Suite 107, Richland, WA 99354
Phone: 509-377-8058 **Fax:** 509-377-8464

Report of Analysis

For: **City of West Richland**
3801 Van Giesen
W Richland, WA 99353
Attn: Drew Woodruff

Cust Sample #: GBD - Storm 5 - Inf2 | **Lab Sample ID:** 230195-02
Site: City of West Richland | **Collection Date:** 8/29/2022 12:10 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed
Total suspended solids	SM 2540D	170 mg/L	1	tkroupa	LB019	8/31/2022 13:00

Cust Sample #: GBD - Storm 5 - Inf3 | **Lab Sample ID:** 230195-03
Site: City of West Richland | **Collection Date:** 8/29/2022 12:15 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed
Total suspended solids	SM 2540D	140 mg/L	1	tkroupa	LB019	8/31/2022 13:00

Cust Sample #: GBD - Storm 5 - Loc1 | **Lab Sample ID:** 230195-04
Site: City of West Richland | **Collection Date:** 8/29/2022 12:45 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed
Total suspended solids	SM 2540D	8500 mg/L	20	tkroupa	LB019	8/31/2022 13:00

QC Results

QCBatch ID	QC ID	Parameter	% Recovery / RPD	Control Limits
LB019	230195-04: Replicate 2	Total suspended solids	1.1984	0 - 5
	230207-07: Replicate 1	Total suspended solids	3.9123	0 - 5
	LCS 1	Total suspended solids	96.0	77.1 - 110
	MB 1	Total suspended solids	-0.57	- 1

Qualifier: * Replicate RPD outside acceptable range of <5%. A sample and its replicate may vary due to sample matrix and concentration. Other QC within acceptable range. Samples reported without qualification.

Approved: 23-Sep-22

M Turner, Laboratory Manager

ENERGY NORTHWEST

Services Sales Order / Chain of Custody

Environmental Services

350 Hills Street Suite 107, Richland, WA 99354
Phone: 509-377-8058 FAX: 509-377-8464

Customer contact: Drew Woodruff
Business name: City of West Richland Public Works
Address: 3100 Belmont Blvd
West Richland, WA 99353
Email: drew@westrichland.org
Phone/FAX: 509-967-5434

Project ID:

Rush TAT: Y ☐ N ☐ # of days:

Order ID: 230195

*Matrix: NPDES: ☐ Solid waste: ☐ Drinking water: ☐ Other: ☐ Waste Water: ☒

Requested Tests: TSS SM2540D

Lab Use Only	Customer Sample ID (Unique identifier or code)	Collection Date	Collection Time	*Matrix	Number of bottles	TSS SM2540D	Comments
01	GBD-storm5-Inf1	8/29	12:05p	WW	1		Please include QA/QC
02	-Inf2	↓	12:10p	↓	↓		results w/report +
03	-Inf3	↓	12:15p	↓	↓		forward results to
04	-Loc1	↓	12:45p	↓	↓		taylor@
05	-Loc2	↓	↓	↓	↓		evergreenstormh2o.com
06	-Loc3	↓	↓	↓	↓		
07	-Loc4	↓	↓	↓	↓		
08	-Loc5	↓	↓	↓	↓		
09	-Loc6	↓	↓	↓	↓		
10	-Loc7	↓	↓	↓	↓		
11	-Loc8	↓	↓	↓	↓		
~~12~~							

By signing below, Customer agrees to and accepts the terms on the reverse side of this form.

Customer Signature/Date	Name/Title/Telephone No.	

CUSTODY	Signature	Date/Time	Signature	Date/Time
Relinquished by:	Taylor Hollenbeck	8/29/2022 15:05	Received by:	
Relinquished by:			Received by:	
Accepted by Lab:	[signature]	08/29/22 15:10		

Sample Conditions at receipt:
Temperature (circle): *Ambient* *Cold* *Frozen*
Containers intact/Lids tight: ☐
VOC vials without headspace: ☐
Labels match custody: ☐

ENERGY NORTHWEST

environmental services

Sample Receipt Form

Company Name: City of West Richland Date/Time: 08/29/22 15:10

Customer Contact: Drew Woodruff

Turnaround time: Normal ☒ Rush ☐ _____ days

Samples Received via: Fedex ☐ UPS ☐ USPS ☐ Customer ☒ Other ☐: __________

Number of coolers/boxes: 2 Type of Ice: Ice Cubes ☒ Ice Packs ☐ Dry Ice ☐ None ☐

Sample(s) Temp as Read (°C): — Corrected Temp (°C): — Thermometer ID: —

Question	Answer	Comments
Chain of Custody Present?	Yes No N/A — Yes	
Samples Received Intact?	Yes No N/A — Yes	
Samples Received within hold time?	Yes No N/A — Yes	
40 mL Vials Free of Headspace?	Yes No N/A — N/A	
40 mL Vials Trip blank Present?	Yes No N/A — N/A	
Samples Properly Preserved?	Yes No N/A — N/A	
Bottle Labels and C.O.C/WSI Agree?	Yes No N/A — Yes	
Total Number of Bottles Received?	55	

Question	Answer	Comments
Chain of Custody Fully Completed?	Yes No N/A — Yes	
Correct bottles/containers Received?	Yes No N/A — Yes	
ENW Bottles Used?	Yes No unkn — Yes	

Preservatives for bottles/containers:

NA

Comments:

Work orders 230191, 230192, 230193, 230194, 230195

Received by: [signature] Date/Time: 08/29/22 15:10

Environmental Services
350 Hills St. Suite 107, Richland, WA 99354
Phone: 509-377-8058 **Fax:** 509-377-8464

Report of Analysis

For: **City of West Richland**
3801 Van Giesen
W Richland, WA 99353
Attn: Drew Woodruff

Cust Sample #: GBD - Storm 5 - Loc2 **Lab Sample ID:** 230195-05
Site: City of West Richland **Collection Date:** 8/29/2022 12:45 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	1300 mg/L	5	jhill	LB020	9/1/2022	8:00

Cust Sample #: GBD - Storm 5 - Loc3 **Lab Sample ID:** 230195-06
Site: City of West Richland **Collection Date:** 8/29/2022 12:45 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	810 mg/L	5	jhill	LB020	9/1/2022	8:00

Cust Sample #: GBD - Storm 5 - Loc4 **Lab Sample ID:** 230195-07
Site: City of West Richland **Collection Date:** 8/29/2022 12:45 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	470 mg/L	5	jhill	LB020	9/1/2022	8:00

Cust Sample #: GBD - Storm 5 - Loc5 **Lab Sample ID:** 230195-08
Site: City of West Richland **Collection Date:** 8/29/2022 12:45 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	240 mg/L	5	jhill	LB020	9/1/2022	8:00

Cust Sample #: GBD - Storm 5 - Loc6 **Lab Sample ID:** 230195-09
Site: City of West Richland **Collection Date:** 8/29/2022 12:45 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	200 mg/L	2	jhill	LB020	9/1/2022	8:00

Cust Sample #: GBD - Storm 5 - Loc7 **Lab Sample ID:** 230195-10
Site: City of West Richland **Collection Date:** 8/29/2022 12:45 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	140 mg/L	5	jhill	LB020	9/1/2022	8:00

Cust Sample #: GBD - Storm 5 - Loc8 **Lab Sample ID:** 230195-11
Site: City of West Richland **Collection Date:** 8/29/2022 12:45 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	100 mg/L	5	jhill	LB020	9/1/2022	8:00

Cust Sample #: HMA - Storm 4 - Inf1 **Lab Sample ID:** 230201-01
Site: City of West Richland **Collection Date:** 8/30/2022 8:20 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	110 mg/L	1	jhill	LB020	9/1/2022	8:00

Cust Sample #: HMA - Storm 4 - Inf2 **Lab Sample ID:** 230201-02
Site: City of West Richland **Collection Date:** 8/30/2022 8:25 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	110 mg/L	1	jhill	LB020	9/1/2022	8:00

Cust Sample #: HMA - Storm 4 - Inf3 **Lab Sample ID:** 230201-03
Site: City of West Richland **Collection Date:** 8/30/2022 8:30 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	90 mg/L	1	jhill	LB020	9/1/2022	8:00

Cust Sample #: HMA - Storm 4 - Loc1 **Lab Sample ID:** 230201-04
Site: City of West Richland **Collection Date:** 8/30/2022 9:05 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	3900 mg/L	10	jhill	LB020	9/1/2022	8:00

Cust Sample #: HMA - Storm 4 - Loc2 **Lab Sample ID:** 230201-05
Site: City of West Richland **Collection Date:** 8/30/2022 9:05 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	2900 mg/L	10	jhill	LB020	9/1/2022	8:00

Cust Sample #: HMA - Storm 4 - Loc3 **Lab Sample ID:** 230201-06
Site: City of West Richland **Collection Date:** 8/30/2022 9:05 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	150 mg/L	5	jhill	LB020	9/1/2022	8:00

Cust Sample #: HMA - Storm 4 - Loc4 **Lab Sample ID:** 230201-07
Site: City of West Richland **Collection Date:** 8/30/2022 9:05 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	1100 mg/L	10	jhill	LB020	9/1/2022	8:00

Cust Sample #: HMA - Storm 4 - Loc5 **Lab Sample ID:** 230201-08
Site: City of West Richland **Collection Date:** 8/30/2022 9:05 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	760 mg/L	10	jhill	LB020	9/1/2022	8:00

Cust Sample #: HMA - Storm 4 - Loc6 **Lab Sample ID:** 230201-09
Site: City of West Richland **Collection Date:** 8/30/2022 9:05 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	480 mg/L	10	jhill	LB020	9/1/2022	8:00

Cust Sample #: HMA - Storm 4 - Loc7 **Lab Sample ID:** 230201-10
Site: City of West Richland **Collection Date:** 8/30/2022 9:05 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	370 mg/L	10	jhill	LB020	9/1/2022	8:00

Cust Sample #: HMA - Storm 4 - Loc8 **Lab Sample ID:** 230201-11
Site: City of West Richland **Collection Date:** 8/30/2022 9:05 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	120 mg/L	5	jhill	LB020	9/1/2022	8:00

Cust Sample #: HMA - Storm 5 - Inf1 **Lab Sample ID:** 230202-01
Site: City of West Richland **Collection Date:** 8/30/2022 12:30 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	140 mg/L	1	jhill	LB020	9/1/2022	8:00

Cust Sample #: HMA - Storm 5 - Inf2 **Lab Sample ID:** 230202-02
Site: City of West Richland **Collection Date:** 8/30/2022 12:35 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	98 mg/L	1	jhill	LB020	9/1/2022	8:00

QC Results

QCBatch ID	QC ID	Parameter	% Recovery / RPD	Control Limits
LB020	230195-10: Replicate 1	Total suspended solids	1.103	0 - 5
	230201-05: Replicate 2	Total suspended solids	3.9582	0 - 5
	LCS 1	Total suspended solids	88.45	77.1 - 110
	MB 1	Total suspended solids	-0.42	- 1

Qualifier: * Replicate RPD outside acceptable range of <5%. A sample and its replicate may vary due to sample matrix and concentration.
Other QC within acceptable range. Samples reported without qualification.

Approved: 28-Sep-22

M Turner, Laboratory Manager

ENERGY NORTHWEST

Services Sales Order / Chain of Custody

Environmental Services

350 Hills Street Suite 107, Richland, WA 99354

Phone: 509-377-8058 **FAX:** 509-377-8464

Customer contact: Drew Woodruff

Business name: City of West Richland Public Works

Address: 3100 Belmont Blvd
West Richland, WA 99353

Email: drew@westrichland.org **Phone/FAX:** 509-967-5434

Project ID

Rush TAT Y ☐ N ☐ # of days

Order ID: 230195

*Matrix: NPDES: ☐ Solid waste: ☐ Drinking water: ☐ Other: ☐ Waste Water: ☒

Requested Tests: TSS SM2540D

Lab Use Only	Customer Sample ID (Unique identifier or code)	Collection Date	Collection Time	*Matrix	Number of bottles	TSS SM2540D	Comments
01	GBD-StormS-Inf1	8/29	12:05 p	WW	1		Please include QA/QC
02	-Inf2	↓	12:10 p	↓	↓		results w/ report +
03	-Inf3	↓	12:15 p	↓	↓		forward results to
04	-Loc1	↓	12:45 p	↓	↓		taylor@
05	-Loc2	↓	↓	↓	↓		evergreenstormh2o.com
06	-Loc3	↓	↓	↓	↓		
07	-Loc4	↓	↓	↓	↓		
08	-Loc5	↓	↓	↓	↓		
09	-Loc6	↓	↓	↓	↓		
10	-Loc7	↓	↓	↓	↓		
11	-Loc8	↓	↓	↓	↓		
~~12~~							

By signing below, Customer agrees to and accepts the terms on the reverse side of this form.

Customer Signature/Date	Name/Title/Telephone No.

CUSTODY Signature	Date/Time	Signature	Date/Time
Relinquished by: Taylor Hollenbeck [signature]	8/29/2022 15:05	Received by:	
Relinquished by:		Received by:	
Accepted by Lab: [signature]	08/29/22 15:10		

Sample Conditions at receipt:
Temperature (circle): *Ambient* *Cold* *Frozen*
Containers intact/Lids tight: ☐
VOC vials without headspace: ☐
Labels match custody: ☐

ENERGY NORTHWEST

environmental services

Sample Receipt Form

Company Name: City of West Richland Date/Time: 08/29/22 15:10

Customer Contact: Drew Woodruff

Turnaround time: Normal ☒ Rush ☐ ____ days

Samples Received via: Fedex ☐ UPS ☐ USPS ☐ Customer ☒ Other ☐: ________

Number of coolers/boxes: 2 Type of Ice: Ice Cubes ☒ Ice Packs ☐ Dry Ice ☐ None ☐

Sample(s) Temp as Read (°C): — Corrected Temp (°C): — Thermometer ID: —

				Comments:
Chain of Custody Present?	Yes	No	N/A	
Samples Received Intact?	Yes	No	N/A	
Samples Received within hold time?	Yes	No	N/A	
40 mL Vials Free of Headspace?	Yes	No	N/A	
40 mL Vials Trip blank Present?	Yes	No	N/A	
Samples Properly Preserved?	Yes	No	N/A	
Bottle Labels and C.O.C/WSI Agree?	Yes	No	N/A	
Total Number of Bottles Received?	55			

Chain of Custody Fully Completed?	Yes	No	N/A	
Correct bottles/containers Received?	Yes	No	N/A	
ENW Bottles Used?	Yes	No	unkn	

Preservatives for bottles/containers:

NA

Comments:

Work orders 230191, 230192, 230193, 230194, 230195

Received by: [signature] Date/Time: 08/29/22 15:10

Environmental Services
350 Hills St. Suite 107, Richland, WA 99354
Phone: 509-377-8058 **Fax:** 509-377-8464

ENERGY NORTHWEST

Services Sales Order / Chain of Custody

Environmental Services

350 Hills Street Suite 107, Richland, WA 99354

Phone: 509-377-8058 FAX: 509-377-8464

Customer contact: Drew Woodruff

Business name: City of West Richland Public Works

Address: 3100 Belmont Blvd West Richland, WA 99353

Email: drew@westrichland.org

Phone/FAX: 509-967-5434

Project ID:

Rush TAT: Y ☐ N ☐ # of days

Order ID: 23D201

*Matrix: NPDES: ☐ Solid waste: ☐ Drinking water: ☐ Other: ☐ Waste Water: ☒

Requested Tests: TSS SM2540D

Lab Use Only	Customer Sample ID (Unique identifier or code)	Collection Date	Collection Time	*Matrix	Number of bottles	TSS SM2540D	Comments
01	HMA-Storm4-Inf1	8/30/22	8:20a	WW	1	X	Please include QA/QC
02	-Inf2	↓	8:25a	↓	↓	X	results w/report +
03	-Inf3	↓	8:30a	↓	↓	X	forward results to
04	-Loc1	↓	9:05a	↓	↓	X	taylor@
05	-Loc2	↓	↓	↓	↓	X	evergreenstormh2o.com
06	-Loc3	↓	↓	↓	↓	X	
07	-Loc4	↓	↓	↓	↓	X	
08	-Loc5	↓	↓	↓	↓	X	
09	-Loc6	↓	↓	↓	↓	X	
10	-Loc7	↓	↓	↓	↓	X	
11	-Loc8	↓	↓	↓	↓	X	

By signing below, Customer agrees to and accepts the terms on the reverse side of this form.

Customer Signature/Date	Name/Title/Telephone No.	

CUSTODY	Signature	Date/Time		Signature	Date/Time
Relinquished by:	Taylor [signature]	8/30/22 15:15	Received by:		
Relinquished by:			Received by:		
Accepted by Lab:	[signature]	08/30/22 1515			

Sample Conditions at receipt:
Temperature (circle): Ambient Cold Frozen
Containers intact/Lids tight: ☐
VOC vials without headspace: ☐
Labels match custody: ☐

26334 R1

ENERGY NORTHWEST

environmental services

Sample Receipt Form

Company Name: City of West Richland

Date/Time: 08/30/22 ~~16:05~~ 15:15 DMS 08/30/22

Customer Contact: Drew Woodruff

Turnaround time: Normal ☒ Rush ☐ ____ days

Samples Received via: Fedex ☐ UPS ☐ USPS ☐ Customer ☒ Other ☐: ____

Number of coolers/boxes: 1 Type of Ice: Ice Cubes ☐ Ice Packs ☐ Dry Ice ☐ None ☒

Sample(s) Temp as Read (°C): – Corrected Temp (°C): – Thermometer ID: ____

				Comments:
Chain of Custody Present?	Yes	No	N/A	
Samples Received Intact?	Yes	No	N/A	
Samples Received within hold time?	Yes	No	N/A	
40 mL Vials Free of Headspace?	Yes	~~No~~	N/A	
40 mL Vials Trip blank Present?	Yes	~~No~~	N/A	
Samples Properly Preserved?	Yes	No	N/A	
Bottle Labels and C.O.C/WSI Agree?	Yes	No	N/A	
Total Number of Bottles Received?	35			

Chain of Custody Fully Completed?	Yes	No	N/A	
Correct bottles/containers Received?	Yes	No	N/A	
ENW Bottles Used?	Yes	No	unkn	

Preservatives for bottles/containers:

N/A

Comments:

Work orders 230201, 230202, 230203

Received by: [signature]

Date/Time: 08/30/22 15:15

Environmental Services
350 Hills St. Suite 107, Richland, WA 99354
Phone: 509-377-8058 **Fax:** 509-377-8464

ENERGY NORTHWEST

Services Sales Order / Chain of Custody

Environmental Services

350 Hills Street Suite 107, Richland, WA 99354
Phone: 509-377-8058 FAX: 509-377-8464

Customer contact:	Drew Woodruff
Business name:	City of West Richland Public Works
Address:	3100 Belmont Blvd West Richland, WA 99353
Email:	drew@westrichland.org
Phone/FAX:	509-967-5434
Project ID	
Rush TAT	Y ☐ N ☐ # of days
Order ID:	230202

*Matrix: NPDES: ☐ Solid waste: ☐ Drinking water: ☐ Other: ☐ Waste Water: ☒

Requested Tests: TSS SM 2540D

Lab Use Only	Customer Sample ID (Unique identifier or code)	Collection Date	Collection Time	*Matrix	Number of bottles	TSS SM 2540D	Comments
01	HMA-Storm5-Inf1	8/30/22	12:30	WW	1	X	Please include QA/QC
02	-Inf2	↓	12:35	↓	↓	X	results w/ report +
03	-Inf3	↓	12:40	↓	↓	X	forward results to
04	-Loc1	↓	1:15	↓	↓	X	taylor@
05	-Loc2	↓	↓	↓	↓	X	evergreenstormh2o.com
06	-Loc3	↓	↓	↓	↓	X	
07	-Loc4	↓	↓	↓	↓	X	
08	-Loc5	↓	↓	↓	↓	X	
09	-Loc6	↓	↓	↓	↓	X	
10	-Loc7	↓	↓	↓	↓	X	
11	-Loc8	↓	↓	↓	↓	X	
12	-end	↓	↓	↓	↓	X	

By signing below, Customer agrees to and accepts the terms on the reverse side of this form.

Customer Signature/Date	Name/Title/Telephone No.	

CUSTODY	Signature	Date/Time		Signature	Date/Time
Relinquished by:	Taylor [illegible]	8/30/22 15:15	Received by:		
Relinquished by:			Received by:		
Accepted by Lab:	[illegible]	08/30/22 15:15			

Sample Conditions at receipt:
Temperature (circle): *Ambient* *Cold* *Frozen*
Containers intact/Lids tight: ☐
VOC vials without headspace: ☐
Labels match custody: ☐

ENERGY NORTHWEST

environmental services

Sample Receipt Form

Company Name: City of West Richland

Date/Time: 08/30/22 ~~16:05~~ 15:15 DMS 08/30/22

Customer Contact: Drew Woodruff

Turnaround time: Normal ☒ Rush ☐ _____ days

Samples Received via: Fedex ☐ UPS ☐ USPS ☐ Customer ☒ Other ☐: ________

Number of coolers/boxes: 1 Type of Ice: Ice Cubes ☐ Ice Packs ☐ Dry Ice ☐ None ☒

Sample(s) Temp as Read (°C): — Corrected Temp (°C): — Thermometer ID: ________

				Comments:
Chain of Custody Present?	Yes	No	N/A	
Samples Received Intact?	Yes	No	N/A	
Samples Received within hold time?	Yes	No	N/A	
40 mL Vials Free of Headspace?	Yes	~~No~~	N/A	
40 mL Vials Trip blank Present?	Yes	~~No~~	N/A	
Samples Properly Preserved?	Yes	No	N/A	
Bottle Labels and C.O.C/WSI Agree?	Yes	No	N/A	
Total Number of Bottles Received?	35			

Chain of Custody Fully Completed?	Yes	No	N/A	
Correct bottles/containers Received?	Yes	No	N/A	
ENW Bottles Used?	Yes	No	unkn	

Preservatives for bottles/containers:

N/A

Comments:

Work orders 230201, 230202, 230203

Received by: [signature] Date/Time: 08/30/22 1515

Environmental Services
350 Hills St. Suite 107, Richland, WA 99354
Phone: 509-377-8058 **Fax:** 509-377-8464

Report of Analysis

For: **City of West Richland**
3801 Van Giesen
W Richland, WA 99353
Attn: Drew Woodruff

Cust Sample #: GBD - Storm 6 - Loc8 **Lab Sample ID:** 230204-11
Site: City of West Richland **Collection Date:** 8/30/2022 11:00 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	220 mg/L	5	jhill	LB022	9/6/2022	8:00

Cust Sample #: GBD - Storm 6 - end **Lab Sample ID:** 230204-12
Site: City of West Richland **Collection Date:** 8/30/2022 11:00 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	130 mg/L	5	jhill	LB022	9/6/2022	8:00

Cust Sample #: HMA - Storm 6 - Inf1 **Lab Sample ID:** 230208-01
Site: City of West Richland **Collection Date:** 8/31/2022 7:05 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	160 mg/L	1	jhill	LB022	9/6/2022	8:00

Cust Sample #: HMA - Storm 6 - Inf2 **Lab Sample ID:** 230208-02
Site: City of West Richland **Collection Date:** 8/31/2022 7:10 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	130 mg/L	1	jhill	LB022	9/6/2022	8:00

Cust Sample #: HMA - Storm 6 - Inf3 **Lab Sample ID:** 230208-03
Site: City of West Richland **Collection Date:** 8/31/2022 7:15 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	94 mg/L	1	jhill	LB022	9/6/2022	8:00

Cust Sample #: HMA - Storm 6 - Loc1 **Lab Sample ID:** 230208-04
Site: City of West Richland **Collection Date:** 8/31/2022 7:45 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	1800 mg/L	10	jhill	LB022	9/6/2022	8:00

Cust Sample #: HMA - Storm 6 - Loc2 **Lab Sample ID:** 230208-05
Site: City of West Richland **Collection Date:** 8/31/2022 7:45 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	1200 mg/L	10	jhill	LB022	9/6/2022	8:00

Cust Sample #: HMA - Storm 6 - Loc3 **Lab Sample ID:** 230208-06
Site: City of West Richland **Collection Date:** 8/31/2022 7:45 AM

Analyte	Method	Sample Result		RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	620 mg/L		10	jhill	LB022	9/6/2022	8:00

Cust Sample #: HMA - Storm 6 - Loc4 **Lab Sample ID:** 230208-07
Site: City of West Richland **Collection Date:** 8/31/2022 7:45 AM

Analyte	Method	Sample Result		RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	860 mg/L		10	jhill	LB022	9/6/2022	8:00

Cust Sample #: HMA - Storm 6 - Loc5 **Lab Sample ID:** 230208-08
Site: City of West Richland **Collection Date:** 8/31/2022 7:45 AM

Analyte	Method	Sample Result		RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	730 mg/L		20	jhill	LB022	9/6/2022	8:00

Cust Sample #: HMA - Storm 6 - Loc6 **Lab Sample ID:** 230208-09
Site: City of West Richland **Collection Date:** 8/31/2022 7:45 AM

Analyte	Method	Sample Result		RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	520 mg/L	*	20	jhill	LB022	9/6/2022	8:00

Cust Sample #: HMA - Storm 6 - Loc7 **Lab Sample ID:** 230208-10
Site: City of West Richland **Collection Date:** 8/31/2022 7:45 AM

Analyte	Method	Sample Result		RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	380 mg/L		20	jhill	LB022	9/6/2022	8:00

Cust Sample #: HMA - Storm 6 - Loc8 **Lab Sample ID:** 230208-11
Site: City of West Richland **Collection Date:** 8/31/2022 7:45 AM

Analyte	Method	Sample Result		RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	150 mg/L		10	jhill	LB022	9/6/2022	8:00

Cust Sample #: HMA - Storm 6 - end **Lab Sample ID:** 230208-12
Site: City of West Richland **Collection Date:** 8/31/2022 7:45 AM

Analyte	Method	Sample Result		RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	120 mg/L		10	jhill	LB022	9/6/2022	8:00

QC Results

QCBatch ID	QC ID	Parameter	% Recovery / RPD	Control Limits
LB022	230204-12: Replicate 1	Total suspended solids	1.0118	0 - 5
	230208-09: Replicate 2	Total suspended solids	15.91	0 - 5
	LCS 1	Total suspended solids	107.15	77.1 - 110
	MB 1	Total suspended solids	-0.36	- 1

Qualifier: * Replicate RPD outside acceptable range of <5%. A sample and its replicate may vary due to sample matrix and concentration. Other QC within acceptable range. Samples reported without qualification.

Approved: 23-Sep-22

M Turner, Laboratory Manager

ENERGY NORTHWEST

Services Sales Order / Chain of Custody

Environmental Services

350 Hills Street Suite 107, Richland, WA 99354

Phone: 509-377-8058 **FAX:** 509-377-8464

Customer contact: Drew Woodruff

Business name: City of West Richland Public Works

Address: 3100 Belmont ~~Blvd~~ Blvd West Richland, WA 99353

Email: drew@westrichland.org

Phone/FAX: 509-967-5434

Project ID

Rush TAT Y ☐ N ☐ # of days

Order ID: 230204

*Matrix: NPDES: ☐ Solid waste: ☐ Drinking water: ☐ Other: ☐ Waste Water: ☒

Requested Tests: TSS SM2540D

Lab Use Only	Customer Sample ID (Unique identifier or code)	Collection Date	Collection Time	*Matrix	Number of bottles	TSS SM2540D	Comments
01	GBD-Storm6-Inf1	8/30/22	10:20	WW	1	X	Please include QA/QC
02	-Inf2	↓	10:25	↓	1	X	results w/report +
03	-Inf3		10:30			X	forward results to
04	-Loc1		11:00			X	taylor@
05	-Loc2		↓			X	evergreenstormh2o.com
06	-Loc3					X	
07	-Loc4					X	
08	-Loc5					X	
09	-Loc6					X	
10	-Loc7					X	
11	-Loc8					X	
12	-End	↓	↓	↓	↓	X	

By signing below, Customer agrees to and accepts the terms on the reverse side of this form.

Customer Signature/Date	Name/Title/Telephone No.

CUSTODY	Signature	Date/Time	Signature	Date/Time
Relinquished by:	Taylor W-B	8/30/22 15:15	Received by:	
Relinquished by:			Received by:	
Accepted by Lab:	[signature]	08/30/22 1515		

Sample Conditions at receipt:
Temperature (circle): *Ambient* *Cold* *Frozen*
Containers intact/Lids tight: ☐
VOC vials without headspace: ☐
Labels match custody: ☐

26334 R1

ENERGY NORTHWEST

environmental services

Sample Receipt Form

Company Name: City of West Richland

Date/Time: 08/30/22 ~~16:05~~ 15:15 (initials) 08/30/22

Customer Contact: Drew Woodruff

Turnaround time: Normal ☒ Rush ☐ _____ days

Samples Received via: Fedex ☐ UPS ☐ USPS ☐ Customer ☒ Other ☐: ____________

Number of coolers/boxes: 1 Type of Ice: Ice Cubes ☐ Ice Packs ☐ Dry Ice ☐ None ☒

Sample(s) Temp as Read (°C): – Corrected Temp (°C): – Thermometer ID: ________

	Response	Comments:
Chain of Custody Present?	Yes	
Samples Received Intact?	Yes	
Samples Received within hold time?	Yes	
40 mL Vials Free of Headspace?	~~No~~ N/A	
40 mL Vials Trip blank Present?	~~No~~ N/A	
Samples Properly Preserved?	N/A	
Bottle Labels and C.O.C/WSI Agree?	Yes	
Total Number of Bottles Received?	35	

	Response	Comments
Chain of Custody Fully Completed?	Yes	
Correct bottles/containers Received?	Yes	
ENW Bottles Used?	Yes	

Preservatives for bottles/containers:

N/A

Comments:

Work orders 230201, 230202, 230203

Received by: (signature)

Date/Time: 08/30/22 1515

Environmental Services
350 Hills St. Suite 107, Richland, WA 99354
Phone: 509-377-8058 **Fax:** 509-377-8464

ENERGY NORTHWEST

Chain of Custody Services Sales Order

Environmental Services
350 Hills Street Suite 107, Richland, WA 99354
Phone: 509-377-8058 Fax: 509-377-8464

Account Information

Company Name: City of West Richland Public Works

Customer Contact: Drew Woodruff

Project ID:

Order ID: 230208

Mailing Address: 3100 Belmont Blvd West Richland, WA 99353

Billing Adress (if different):

Email: drew@westrichland.org Phone: 609-967-5434

Receive Invoice: ☐ Hard Copy ☒ Email Receive Report: ☐ Hard Copy ☒ Email

Requested Tests: TSS SM2540D

Lab Use Only	Sample identification (Location, Name, Code, etc)	Collection Date	Collection Time	Matrix	Number of Bottles	TSS SM2540D
-01	HMA-Storm6-Inf1	8/31	7:05	WW	1	X
-02	-Inf2	8/31	7:10			X
-03	-Inf3	8/31	7:15			X
-04	-Loc1	8/31	7:45			X
-05	-Loc2	8/31				X
-06	-Loc3	8/31				X
-07	-Loc4	8/31				X
-08	-Loc5	8/31				X
-09	-Loc6	8/31				X
-10	-Loc7	8/31				X
-11	-Loc8	8/31				X
-12	-end	8/31				X

Matrix
S - Soil
WW - Waste Water
DW - Drinking Water
O - Oil
N - NPDES
Ot - Other

Rush TAT
☐ Yes ☐ No
\# of working days: ____
Date Requested: ________

Comments
Please include QA/QC results w/report + forward results to taylor@evergreenstormh2o.com

Being duly authorized and empowered by Customer, by signing below, Customer agrees to having reviewed, understood, and is fully accepting of the terms on the reverse side of this form.

	Print / Signature	Date / Time		Print / Signature	Date / Time
Relinquished by:	Taylor Hallman [signature]	8/31/22 9:43	Received by:		
Relinquished by:			Received by:		
Accepted by lab:	[signature]	08/31/22 9:43			

Payment Type (circle) ☐ Paid
CC Check
Amount $

Please make all checks payable to Energy Northwest

Sample Condition at Receipt
Temperature (circle): *Ambient* *Cold* *Frozen*
☐ Containers intact/ Lids tight
☐ VOC Vials w/o Headspace
☐ Labels Match Custody

26334 R2

ENERGY NORTHWEST

environmental services

Sample Receipt Form

Company Name: City of West Richland   Date/Time: 08/31/22 09:43

Customer Contact: Drew Woodruff

Turnaround time: Normal ☑ Rush ☐ _____ days

Samples Received via: Fedex ☐ UPS ☐ USPS ☐ Customer ☑ Other ☐: ________

Number of coolers/boxes: ______ Type of Ice: Ice Cubes ☐ Ice Packs ☐ Dry Ice ☐ None ☑

Sample(s) Temp as Read (°C): — Corrected Temp (°C): — Thermometer ID: ________

Question	Yes	No	N/A	Comments
Chain of Custody Present?	Yes	No	N/A	
Samples Received Intact?	Yes	No	N/A	
Samples Received within hold time?	Yes	No	N/A	
40 mL Vials Free of Headspace?	Yes	No	N/A	
40 mL Vials Trip blank Present?	Yes	No	N/A	
Samples Properly Preserved?	Yes	No	N/A	
Bottle Labels and C.O.C/WSI Agree?	Yes	No	N/A	
Total Number of Bottles Received?	12			

Question	Yes	No	N/A	Comments
Chain of Custody Fully Completed?	Yes	No	N/A	
Correct bottles/containers Received?	Yes	No	N/A	
ENW Bottles Used?	Yes	No	unkn	

Preservatives for bottles/containers:

Comments:

Received by: [signature]   Date/Time: 08/31/22 10:12

Environmental Services
350 Hills St. Suite 107, Richland, WA 99354
Phone: 509-377-8058 **Fax:** 509-377-8464

Report of Analysis

For: **City of West Richland**
3801 Van Giesen
W Richland, WA 99353
Attn: Drew Woodruff

Cust Sample #: HMA - Storm 5 - Inf3 **Lab Sample ID:** 230202-03
Site: City of West Richland **Collection Date:** 8/30/2022 12:40 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	92 mg/L	1	tkroupa	LB021	9/2/2022	8:00

Cust Sample #: HMA - Storm 5 - Loc1 **Lab Sample ID:** 230202-04
Site: City of West Richland **Collection Date:** 8/30/2022 1:15 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	9700 mg/L	20	tkroupa	LB021	9/2/2022	8:00

Cust Sample #: HMA - Storm 5 - Loc2 **Lab Sample ID:** 230202-05
Site: City of West Richland **Collection Date:** 8/30/2022 1:15 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	2400 mg/L	10	tkroupa	LB021	9/2/2022	8:00

Cust Sample #: HMA - Storm 5 - Loc3 **Lab Sample ID:** 230202-06
Site: City of West Richland **Collection Date:** 8/30/2022 1:15 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	660 mg/L	5	tkroupa	LB021	9/2/2022	8:00

Cust Sample #: HMA - Storm 5 - Loc4 **Lab Sample ID:** 230202-07
Site: City of West Richland **Collection Date:** 8/30/2022 1:15 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	360 mg/L	5	tkroupa	LB021	9/2/2022	8:00

Cust Sample #: HMA - Storm 5 - Loc5 **Lab Sample ID:** 230202-08
Site: City of West Richland **Collection Date:** 8/30/2022 1:15 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	280 mg/L	5	tkroupa	LB021	9/2/2022	8:00

Cust Sample #: HMA - Storm 5 - Loc6 **Lab Sample ID:** 230202-09
Site: City of West Richland **Collection Date:** 8/30/2022 1:15 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	180 mg/L	2	tkroupa	LB021	9/2/2022	8:00

Cust Sample #: HMA - Storm 5 - Loc7 **Lab Sample ID:** 230202-10
Site: City of West Richland **Collection Date:** 8/30/2022 1:15 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	100 mg/L	2	tkroupa	LB021	9/2/2022	8:00

Cust Sample #: HMA - Storm 5 - Loc8 **Lab Sample ID:** 230202-11
Site: City of West Richland **Collection Date:** 8/30/2022 1:15 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	84 mg/L	1	tkroupa	LB021	9/2/2022	8:00

Cust Sample #: HMA - Storm 5 - end **Lab Sample ID:** 230202-12
Site: City of West Richland **Collection Date:** 8/30/2022 1:15 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	96 mg/L	1	tkroupa	LB021	9/2/2022	8:00

Cust Sample #: GBD - Storm 6 - Inf1 **Lab Sample ID:** 230204-01
Site: City of West Richland **Collection Date:** 8/30/2022 10:20 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	170 mg/L	1	tkroupa	LB021	9/2/2022	8:00

Cust Sample #: GBD - Storm 6 - Inf2 **Lab Sample ID:** 230204-02
Site: City of West Richland **Collection Date:** 8/30/2022 10:25 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	130 mg/L	1	tkroupa	LB021	9/2/2022	8:00

Cust Sample #: GBD - Storm 6 - Inf3 **Lab Sample ID:** 230204-03
Site: City of West Richland **Collection Date:** 8/30/2022 10:30 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	100 mg/L	1	tkroupa	LB021	9/2/2022	8:00

Cust Sample #: GBD - Storm 6 - Loc1 **Lab Sample ID:** 230204-04
Site: City of West Richland **Collection Date:** 8/30/2022 11:00 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	8400 mg/L	20	tkroupa	LB021	9/2/2022	8:00

Cust Sample #: GBD - Storm 6 - Loc2 **Lab Sample ID:** 230204-05
Site: City of West Richland **Collection Date:** 8/30/2022 11:00 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	3300 mg/L	10	tkroupa	LB021	9/2/2022	8:00

Cust Sample #:	GBD - Storm 6 - Loc3	**Lab Sample ID:**	230204-06	
Site:	City of West Richland	**Collection Date:**	8/30/2022	11:00 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed
Total suspended solids	SM 2540D	1600 mg/L	10	tkroupa	LB021	9/2/2022 8:00

Cust Sample #:	GBD - Storm 6 - Loc4	**Lab Sample ID:**	230204-07	
Site:	City of West Richland	**Collection Date:**	8/30/2022	11:00 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed
Total suspended solids	SM 2540D	890 mg/L	10	tkroupa	LB021	9/2/2022 8:00

Cust Sample #:	GBD - Storm 6 - Loc5	**Lab Sample ID:**	230204-08	
Site:	City of West Richland	**Collection Date:**	8/30/2022	11:00 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed
Total suspended solids	SM 2540D	670 mg/L	5	tkroupa	LB021	9/2/2022 8:00

Cust Sample #:	GBD - Storm 6 - Loc6	**Lab Sample ID:**	230204-09	
Site:	City of West Richland	**Collection Date:**	8/30/2022	11:00 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed
Total suspended solids	SM 2540D	300 mg/L	5	tkroupa	LB021	9/2/2022 8:00

Cust Sample #:	GBD - Storm 6 - Loc7	**Lab Sample ID:**	230204-10	
Site:	City of West Richland	**Collection Date:**	8/30/2022	11:00 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed
Total suspended solids	SM 2540D	320 mg/L	3	tkroupa	LB021	9/2/2022 8:00

QC Results

QCBatch ID	QC ID	Parameter	% Recovery / RPD	Control Limits
LB021	230202-07: Replicate 1	Total suspended solids	0.406	0 - 5
	230204-06: Replicate 2	Total suspended solids	0.0314	0 - 5
	LCS 1	Total suspended solids	84.0	77.1 - 110
	MB 1	Total suspended solids	0.15	- 1

Qualifier: * Replicate RPD outside acceptable range of <5%. A sample and its replicate may vary due to sample matrix and concentration.
Other QC within acceptable range. Samples reported without qualification.

Approved: 23-Sep-22

M Turner, Laboratory Manager

ENERGY NORTHWEST

Services Sales Order / Chain of Custody

Environmental Services

350 Hills Street Suite 107, Richland, WA 99354

Phone: 509-377-8058 FAX: 509-377-8464

Customer contact: Drew Woodruff

Business name: City of West Richland Public Works

Address: 3100 Belmont Blvd West Richland, WA 99353

Email: drew@westrichland.org

Phone/FAX: 509-967-5434

Project ID

Rush TAT Y ☐ N ☐ # of days

Order ID: 230202

*Matrix: NPDES: ☐ Solid waste: ☐ Drinking water: ☐ Other: ☐ Waste Water: ☒

Requested Tests: TSS SM 2540D

Lab Use Only	Customer Sample ID (Unique identifier or code)	Collection Date	Collection Time	*Matrix	Number of bottles	TSS SM 2540D	Comments
01	HMA-Storm5-Inf1	8/30/22	12:30	WW	1	X	Please include QA/QC
02	-Inf2	↓	12:35	↓	1	X	results w/ report +
03	-Inf3		12:40			X	forward results to
04	-Loc1		1:15			X	taylor@
05	-Loc2		↓			X	evergreenstormh2o.com
06	-Loc3					X	
07	-Loc4					X	
08	-Loc5					X	
09	-Loc6					X	
10	-Loc7					X	
11	-Loc8					X	
12	-end	↓	↓	↓	↓	X	

By signing below, Customer agrees to and accepts the terms on the reverse side of this form.

Customer Signature/Date	Name/Title/Telephone No.	

CUSTODY	Signature	Date/Time	Signature	Date/Time
Relinquished by:	Taylor [signature]	8/30/22 15:15	Received by:	
Relinquished by:			Received by:	
Accepted by Lab:	[signature] KESH	08/30/22 15:15		

Sample Conditions at receipt:
Temperature (circle): *Ambient* *Cold* *Frozen*
Containers intact/Lids tight: ☐
VOC vials without headspace: ☐
Labels match custody: ☐

26334 R1

ENERGY NORTHWEST

environmental services

Sample Receipt Form

Company Name: City of West Richland Date/Time: 08/30/22 ~~16:05~~ 15:15 DMS 08/30/22

Customer Contact: Drew Woodruff

Turnaround time: Normal ☒ Rush ☐ _____ days

Samples Received via: Fedex ☐ UPS ☐ USPS ☐ Customer ☒ Other ☐: ________

Number of coolers/boxes: 1 Type of Ice: Ice Cubes ☐ Ice Packs ☐ Dry Ice ☐ None ☒

Sample(s) Temp as Read (°C): — Corrected Temp (°C): — Thermometer ID: ________

				Comments:
Chain of Custody Present?	Yes	No	N/A	
Samples Received Intact?	Yes	No	N/A	
Samples Received within hold time?	Yes	No	N/A	
40 mL Vials Free of Headspace?	Yes	~~No~~	N/A	
40 mL Vials Trip blank Present?	Yes	~~No~~	N/A	
Samples Properly Preserved?	Yes	No	N/A	
Bottle Labels and C.O.C/WSI Agree?	Yes	No	N/A	
Total Number of Bottles Received?	35			

Chain of Custody Fully Completed?	Yes	No	N/A	
Correct bottles/containers Received?	Yes	No	N/A	
ENW Bottles Used?	Yes	No	unkn	

Preservatives for bottles/containers:

N/A

Comments:

Work orders 230201, 230202, 230203

Received by: [signature] Date/Time: 08/30/22 1515

Environmental Services
350 Hills St. Suite 107, Richland, WA 99354
Phone: 509-377-8058 **Fax:** 509-377-8464

ENERGY NORTHWEST

Services Sales Order / Chain of Custody

Environmental Services

350 Hills Street Suite 107, Richland, WA 99354
Phone: 509-377-8058 FAX: 509-377-8464

Customer contact: Drew Woodruff
Business name: City of West Richland Public Works
Address: 3100 Belmont ~~Blvd~~ Blvd
West Richland, WA 99353
Email: drew@westrichland.org
Phone/FAX: 509-967-5434

Project ID:
Rush TAT: Y ☐ N ☐ # of days

Order ID: 230204

*Matrix: NPDES: ☐ Solid waste: ☐ Drinking water: ☐ Other: ☐ Waste Water: ☒

Requested Tests: TSS SM2540D

Lab Use Only	Customer Sample ID (Unique identifier or code)	Collection Date	Collection Time	*Matrix	Number of bottles	TSS SM2540D										Comments
01	GBD-Storm6-Inf1	8/30/22	10:20	WW	1	X										Please include QA/QC
02	-Inf2	↓	10:25	↓	1	X										results w/report +
03	-Inf3		10:30			X										forward results to
04	-Loc1		11:00			X										taylor@
05	-Loc2		↓			X										evergreenstormh2o.com
06	-Loc3					X										
07	-Loc4					X										
08	-Loc5					X										
09	-Loc6					X										
10	-Loc7					X										
11	-Loc8					X										
12	↓ -End	↓	↓	↓	↓	X										

By signing below, Customer agrees to and accepts the terms on the reverse side of this form.

Customer Signature/Date	Name/Title/Telephone No.	

CUSTODY	Signature	Date/Time	Signature	Date/Time
Relinquished by:	Taylor W-B	8/30/22 15:15	Received by:	
Relinquished by:			Received by:	
Accepted by Lab:	A-SH	08/30/22 1515		

Sample Conditions at receipt:
Temperature (circle): *Ambient* *Cold* *Frozen*
Containers intact/Lids tight: ☐
VOC vials without headspace: ☐
Labels match custody: ☐

26334 R1

ENERGY NORTHWEST

environmental services

Sample Receipt Form

Company Name: City of West Richland

Date/Time: 08/30/22 ~~16:05~~ 15:15 RMS 08/30/22

Customer Contact: Drew Woodruff

Turnaround time: Normal ☒ Rush ☐ ____ days

Samples Received via: Fedex ☐ UPS ☐ USPS ☐ Customer ☒ Other ☐: ____

Number of coolers/boxes: 1 Type of Ice: Ice Cubes ☐ Ice Packs ☐ Dry Ice ☐ None ☒

Sample(s) Temp as Read (°C): – Corrected Temp (°C): – Thermometer ID: ____

				Comments:
Chain of Custody Present?	Yes (circled)	No	N/A	
Samples Received Intact?	Yes (circled)	No	N/A	
Samples Received within hold time?	Yes (circled)	No	N/A	
40 mL Vials Free of Headspace?	Yes	~~No~~	N/A (circled)	
40 mL Vials Trip blank Present?	Yes	~~No~~	N/A (circled)	
Samples Properly Preserved?	Yes	No	N/A (circled)	
Bottle Labels and C.O.C/WSI Agree?	Yes (circled)	No	N/A	
Total Number of Bottles Received?	35			

Chain of Custody Fully Completed?	Yes (circled)	No	N/A	
Correct bottles/containers Received?	Yes (circled)	No	N/A	
ENW Bottles Used?	Yes (circled)	No	unkn	

Preservatives for bottles/containers:

N/A

Comments:

Work orders 230201, 230202, 230203

Received by: [signature]

Date/Time: 08/30/22 1515

Environmental Services
350 Hills St. Suite 107, Richland, WA 99354
Phone: 509-377-8058 **Fax:** 509-377-8464

Report of Analysis

ENERGY NORTHWEST PRECISION LABS

For: City of West Richland
3801 Van Giesen
W Richland, WA 99353
Attn: Drew Woodruff

Cust Sample #: PG- Background **Lab Sample ID:** 230252-01
Site: City of West Richland **Collection Date:** 9/12/2022 8:30 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	590 mg/L	10	jhill	LB024	9/13/2022	8:00

Cust Sample #: SPG - Background **Lab Sample ID:** 230252-02
Site: City of West Richland **Collection Date:** 9/12/2022 9:30 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	96 mg/L	5	jhill	LB024	9/13/2022	8:00

Cust Sample #: PG - Storm 1- Inf 1 **Lab Sample ID:** 230252-03
Site: City of West Richland **Collection Date:** 9/12/2022 12:36 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	140 mg/L	1	jhill	LB024	9/13/2022	8:00

Cust Sample #: PG - Storm 1 - Inf 2 **Lab Sample ID:** 230252-04
Site: City of West Richland **Collection Date:** 9/12/2022 12:40 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	130 mg/L	1	jhill	LB024	9/13/2022	8:00

Cust Sample #: PG - Storm 1 - Inf 3 **Lab Sample ID:** 230252-05
Site: City of West Richland **Collection Date:** 9/12/2022 12:45 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	110 mg/L	1	jhill	LB024	9/13/2022	8:00

Cust Sample #: PG - Storm 1 - Loc 1 **Lab Sample ID:** 230252-06
Site: City of West Richland **Collection Date:** 9/12/2022 1:15 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	850 mg/L	10	jhill	LB024	9/13/2022	8:00

Cust Sample #: PG - Storm 1 - Loc 2 **Lab Sample ID:** 230252-07
Site: City of West Richland **Collection Date:** 9/12/2022 1:15 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	690 mg/L	10	jhill	LB024	9/13/2022	8:00

Cust Sample #: PG - Storm 1 - Loc 3 **Lab Sample ID:** 230252-08
Site: City of West Richland **Collection Date:** 9/12/2022 1:15 PM

Analyte	Method	Sample Result		RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	130 mg/L		5	jhill	LB024	9/13/2022	8:00

Cust Sample #: PG - Storm 1 - Loc 4 **Lab Sample ID:** 230252-09
Site: City of West Richland **Collection Date:** 9/12/2022 1:15 PM

Analyte	Method	Sample Result		RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	1500 mg/L		10	jhill	LB024	9/13/2022	8:00

Cust Sample #: PG - Storm 1 - Loc 5 **Lab Sample ID:** 230252-10
Site: City of West Richland **Collection Date:** 9/12/2022 1:15 PM

Analyte	Method	Sample Result		RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	150 mg/L	*	5	jhill	LB024	9/13/2022	8:00

Cust Sample #: PG - Storm 1 - Loc 6 **Lab Sample ID:** 230252-11
Site: City of West Richland **Collection Date:** 9/12/2022 1:15 PM

Analyte	Method	Sample Result		RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	150 mg/L		5	jhill	LB024	9/13/2022	8:00

Cust Sample #: PG - Storm 1 - Loc 7 **Lab Sample ID:** 230252-12
Site: City of West Richland **Collection Date:** 9/12/2022 1:15 PM

Analyte	Method	Sample Result		RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	65 mg/L		5	jhill	LB024	9/13/2022	8:00

Cust Sample #: PG - Storm 1 - Loc 8 **Lab Sample ID:** 230252-13
Site: City of West Richland **Collection Date:** 9/12/2022 1:15 PM

Analyte	Method	Sample Result		RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	110 mg/L		5	jhill	LB024	9/13/2022	8:00

Cust Sample #: PG - Storm 1 - end **Lab Sample ID:** 230252-14
Site: City of West Richland **Collection Date:** 9/12/2022 1:15 PM

Analyte	Method	Sample Result		RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	92 mg/L		5	jhill	LB024	9/13/2022	8:00

QC Results

QCBatch ID	QC ID	Parameter	% Recovery / RPD	Control Limits
LB024	230252-01: Replicate 1	Total suspended solids	1.6032	
	230252-10: Replicate 2	Total suspended solids	9.6609	
	LCS 1	Total suspended solids	83.05	
	MB 1	Total suspended solids	-0.3	

Qualifier: * Replicate RPD outside acceptable range of <5%. A sample and its replicate may vary due to sample matrix and concentration. Other QC within acceptable range. Samples reported without qualification.

Approved: 23-Sep-22

M Turner, Laboratory Manager

ENERGY NORTHWEST

Chain of Custody Services Sales Order

Environmental Services
350 Hills Street Suite 107, Richland, WA 99354
Phone: 509-377-8058 Fax: 509-377-8464

Account Information
Company Name: City of West Richland Public Works
Customer Contact: Drew Woodruff
Mailing Address: 3100 Belmont Blvd West Richland, WA 99353
Billing Adress (if different):
Email: drew@westrichland.org Phone: 509-967-5434
Receive Invoice: ☐ Hard Copy ☒ Email Receive Report: ☐ Hard Copy ☒ Email

Project ID

Order ID: 230252

Requested Tests: TSS SM2540D

Matrix
S - Soil
WW - Waste Water
DW - Drinking Water
O - Oil
N - NPDES
Ot - Other

Rush TAT
☐ Yes ☐ No
# of working days: ____
Date Requested: ____

Comments: Please include QA/QC results w/report + forward results to taylor@evergreenstormh2o.com

Lab Use Only	Sample Identification (Location, Name, Code, etc)	Collection Date	Collection Time	Matrix	Number of Bottles	TSS SM2540D
01	PG - Background	9/12	8:30a	WW	1	X
02	SPG - Background	↓	9:30a	↓	↓	X
03	PG - Storm 1 - Inf1	↓	12:35p	↓	↓	X
04	- Inf2	↓	12:40	↓	↓	X
05	- Inf3	↓	12:45	↓	↓	X
06	- Loc 1	↓	1:15p	↓	↓	X
07	- Loc 2	↓	1:15	↓	↓	X
08	- Loc 3	↓	1:15	↓	↓	X
09	- Loc 4	↓	↓	↓	↓	X
10	- Loc 5	↓	↓	↓	↓	X
11	- Loc 6	↓	↓	↓	↓	X
12	- Loc 7	↓	↓	↓	↓	X
13	- Loc 8	↓	↓	↓	↓	X
14	- End	↓	↓	↓	↓	X

	Print / Signature	Date / Time		Print / Signature	Date / Time
Relinquished by:	Taylor Wellman Bellard	9/12/22 3:42p	Received by:	[signature]	09/12/22 1542
Relinquished by:			Received by:		
Accepted by lab:	[signature]	09/12/22 1542			

Payment Type (circle): ☐ Paid CC Check
Amount $

Please make all checks payable to Energy Northwest

Sample Condition at Receipt
Temperature (circle): *Ambient* *Cold* *Frozen*
☐ Containers intact/ Lids tight
☐ VOC Vials w/o Headspace
☐ Labels Match Custody

ENERGY NORTHWEST

environmental services

Sample Receipt Form

Company Name: City of West Richland   Date/Time: 09/12/22 1542

Customer Contact: Drew Woodruff

Turnaround time: Normal ☒ Rush ☐ _____ days

Samples Received via: Fedex ☐ UPS ☐ USPS ☐ Customer ☒ Other ☐: ________

Number of coolers/boxes: 1   Type of Ice: Ice Cubes ☐ Ice Packs ☐ Dry Ice ☐ None ☒

Sample(s) Temp as Read (°C): NA   Corrected Temp (°C): _____   Thermometer ID: ________

				Comments:
Chain of Custody Present?	Yes	No	N/A	
Samples Received Intact?	Yes	No	N/A	
Samples Received within hold time?	Yes	No	N/A	
40 mL Vials Free of Headspace?	Yes	No	N/A	
40 mL Vials Trip blank Present?	Yes	No	N/A	
Samples Properly Preserved?	Yes	No	N/A	
Bottle Labels and C.O.C/WSI Agree?	Yes	No	N/A	
Total Number of Bottles Received?	14			

Chain of Custody Fully Completed?	Yes	No	N/A	
Correct bottles/containers Received?	Yes	No	N/A	
ENW Bottles Used?	Yes	No	unkn	

Preservatives for bottles/containers:

Comments:

WO 230252

Received by: [signature]   Date/Time: 09/12/22 1542

Environmental Services
350 Hills St. Suite 107, Richland, WA 99354
Phone: 509-377-8058 **Fax:** 509-377-8464

Report of Analysis

ENERGY NORTHWEST PRECISION LABS

For: **City of West Richland**
3801 Van Giesen
W Richland, WA 99353
Attn: Drew Woodruff

Cust Sample #: PG - Storm 2- Inf 1 **Lab Sample ID:** 230257-01
Site: City of West Richland **Collection Date:** 9/13/2022 7:55 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	270 mg/L	1	jhill	LB025	9/14/2022	8:00

Cust Sample #: PG - Storm 2- Inf 2 **Lab Sample ID:** 230257-02
Site: City of West Richland **Collection Date:** 9/13/2022 8:00 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	170 mg/L	1	jhill	LB025	9/14/2022	8:00

Cust Sample #: PG - Storm 2- Inf 3 **Lab Sample ID:** 230257-03
Site: City of West Richland **Collection Date:** 9/13/2022 8:05 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	190 mg/L	1	jhill	LB025	9/14/2022	8:00

Cust Sample #: PG - Storm 2- Loc 1 **Lab Sample ID:** 230257-04
Site: City of West Richland **Collection Date:** 9/13/2022 8:35 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	2100 mg/L	5	jhill	LB025	9/14/2022	8:00

Cust Sample #: PG - Storm 2- Loc 2 **Lab Sample ID:** 230257-05
Site: City of West Richland **Collection Date:** 9/13/2022 8:35 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	2200 mg/L	10	jhill	LB025	9/14/2022	8:00

Cust Sample #: PG - Storm 2- Loc 3 **Lab Sample ID:** 230257-06
Site: City of West Richland **Collection Date:** 9/13/2022 8:35 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	1200 mg/L	10	jhill	LB025	9/14/2022	8:00

Cust Sample #: PG - Storm 2- Loc 4 **Lab Sample ID:** 230257-07
Site: City of West Richland **Collection Date:** 9/13/2022 8:35 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	1600 mg/L	10	jhill	LB025	9/14/2022	8:00

Cust Sample #: PG - Storm 2- Loc 5 **Lab Sample ID:** 230257-08
Site: City of West Richland **Collection Date:** 9/13/2022 8:35 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	930 mg/L	10	jhill	LB025	9/14/2022	8:00

Cust Sample #: PG - Storm 2- Loc 6 **Lab Sample ID:** 230257-09
Site: City of West Richland **Collection Date:** 9/13/2022 8:35 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	390 mg/L	10	jhill	LB025	9/14/2022	8:00

Cust Sample #: PG - Storm 2- Loc 7 **Lab Sample ID:** 230257-10
Site: City of West Richland **Collection Date:** 9/13/2022 8:35 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	120 mg/L	10	jhill	LB025	9/14/2022	8:00

Cust Sample #: PG - Storm21- Loc 8 **Lab Sample ID:** 230257-11
Site: City of West Richland **Collection Date:** 9/13/2022 8:35 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	110 mg/L	5	jhill	LB025	9/14/2022	8:00

Cust Sample #: PG - Storm 2- end **Lab Sample ID:** 230257-12
Site: City of West Richland **Collection Date:** 9/13/2022 8:35 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	120 mg/L	5	jhill	LB025	9/14/2022	8:00

Cust Sample #: SPG-Storm 1-Inf 1 **Lab Sample ID:** 230258-01
Site: City of West Richland **Collection Date:** 9/13/2022 10:55 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	150 mg/L	1	jhill	LB025	9/14/2022	8:00

Cust Sample #: SPG-Storm 1-Inf 2 **Lab Sample ID:** 230258-02
Site: City of West Richland **Collection Date:** 9/13/2022 11:00 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	94 mg/L	1	jhill	LB025	9/14/2022	8:00

Cust Sample #: SPG-Storm 1-Inf 3 **Lab Sample ID:** 230258-03
Site: City of West Richland **Collection Date:** 9/13/2022 11:05 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	88 mg/L	1	jhill	LB025	9/14/2022	8:00

Cust Sample #: SPG-Storm 1-Loc 1 **Lab Sample ID:** 230258-04
Site: City of West Richland **Collection Date:** 9/13/2022 11:20 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	700 mg/L	10	jhill	LB025	9/14/2022	8:00

Cust Sample #: SPG-Storm 1-Loc 2 **Lab Sample ID:** 230258-05
Site: City of West Richland **Collection Date:** 9/13/2022 11:20 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	510 mg/L	10	jhill	LB025	9/14/2022	8:00

Cust Sample #: SPG-Storm 1-Loc 3 **Lab Sample ID:** 230258-06
Site: City of West Richland **Collection Date:** 9/13/2022 11:20 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	870 mg/L	10	jhill	LB025	9/14/2022	8:00

Cust Sample #: SPG-Storm 1-Loc 4 **Lab Sample ID:** 230258-07
Site: City of West Richland **Collection Date:** 9/13/2022 11:20 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	620 mg/L	10	jhill	LB025	9/14/2022	8:00

Cust Sample #: SPG-Storm 1-Loc 5 **Lab Sample ID:** 230258-08
Site: City of West Richland **Collection Date:** 9/13/2022 11:20 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	590 mg/L	10	jhill	LB025	9/14/2022	8:00

QC Results

QCBatch ID	QC ID	Parameter	% Recovery / RPD	Control Limits
LB025	230257-06: Replicate 1	Total suspended solids	2.899	0 - 5
	230258-04: Replicate 2	Total suspended solids	1.3153	0 - 5
	LCS 1	Total suspended solids	78.1	77.1 - 110
	MB 1	Total suspended solids	-0.65	- 1

Qualifier: * Replicate RPD outside acceptable range of <5%. A sample and its replicate may vary due to sample matrix and concentration. Other QC within acceptable range. Samples reported without qualification.

Approved: 23-Sep-22

M Turner, Laboratory Manager

ENERGY NORTHWEST

Chain of Custody Services Sales Order

Environmental Services
350 Hills Street Suite 107, Richland, WA 99354
Phone: 509-377-8058 Fax: 509-377-8464

Account Information	Project ID	Order ID
Company Name: City of West Richland Public Works		230257
Customer Contact: Drew Woodruff		

Mailing Address: 3100 Belmont Blvd
West Richland, WA 99353

Billing Adress (if different):

Email: drew@westrichland.org Phone: 509-967-5434

Receive Invoice: ☐ Hard Copy ☒ Email Receive Report: ☐ Hard Copy ☒ Email

Requested Tests: TSS SM2540D

Lab Use Only	Sample Identification (Location, Name, Code, etc)	Collection Date	Collection Time	Matrix	Number of Bottles	TSS SM2540D
01	PG-Storm2-Inf1	9/13	7:55	WW	1	X
02	-Inf2		8:00			X
03	-Inf3		8:05			X
04	-~~[illegible]~~ Loc1		8:35			X
05	-Loc2					X
06	-Loc3					X
07	-Loc4					X
08	-Loc5					X
09	-Loc6					X
10	-Loc7					X
11	-Loc8					X
12	-end					X

Matrix: **S** - Soil, **WW** - Waste Water, **DW** - Drinking Water, **O** - Oil, **N** - NPDES, **Ot** - Other

Rush TAT: ☐ Yes ☐ No
# of working days: ____
Date Requested: ____

Comments: Please include QA/QC results w/ report + forward results to taylor@evergreenstormh2o.com

Being duly authorized and empowered by Customer, by signing below, Customer agrees to having reviewed, understood, and is fully accepting of the terms on the reverse side of this form.

	Print / Signature	Date / Time		Print / Signature	Date / Time
Relinquished by:	Taylor Holloman-Bellis	9/13 1443	Received by:		
Relinquished by:			Received by:		
Accepted by lab:	[signature]	09/13/2022 1443			

Payment Type (circle): ☐ Paid CC Check
Amount $

Please make all checks payable to Energy Northwest

Sample Condition at Receipt
Temperature (circle): *Ambient Cold Frozen*
☐ Containers Intact/ Lids tight
☐ VOC Vials w/o Headspace
☐ Labels Match Custody

26334 R2

ENERGY NORTHWEST

environmental services

Sample Receipt Form

Company Name: City of West Richland

Date/Time: 09/13/22 14:43

Customer Contact: Drew Woodruff

Turnaround time: Normal ☒ Rush ☐ ____ days

Samples Received via: Fedex ☐ UPS ☐ USPS ☐ Customer ☒ Other ☐: ____

Number of coolers/boxes: 1 Type of Ice: Ice Cubes ☐ Ice Packs ☐ Dry Ice ☐ None ☒

Sample(s) Temp as Read (°C): NA Corrected Temp (°C): ____ Thermometer ID: ____

				Comments:
Chain of Custody Present?	Yes	No	N/A	
Samples Received Intact?	Yes	No	N/A	
Samples Received within hold time?	Yes	No	N/A	
40 mL Vials Free of Headspace?	Yes	No	N/A	
40 mL Vials Trip blank Present?	Yes	No	N/A	
Samples Properly Preserved?	Yes	No	N/A	
Bottle Labels and C.O.C/WSI Agree?	Yes	No	N/A	
Total Number of Bottles Received?	24			

Chain of Custody Fully Completed?	Yes	No	N/A	
Correct bottles/containers Received?	Yes	No	N/A	
ENW Bottles Used?	Yes	No	unkn	

Preservatives for bottles/containers:

Comments:

WO 230257-230258

Received by: [signature]

Date/Time: 09/13/22 14:43

Environmental Services
350 Hills St. Suite 107, Richland, WA 99354
Phone: 509-377-8058 **Fax:** 509-377-8464

ENERGY NORTHWEST

Chain of Custody Services Sales Order

Environmental Services
350 Hills Street Suite 107, Richland, WA 99354
Phone: 509-377-8058 **Fax:** 509-377-8464

Account Information	Project ID	Order ID
Company Name: City of West Richland Public Works		230258
Customer Contact: Drew Woodruff		

Mailing Address: 3100 Belmont Blvd
West Richland, WA 99353

Billing Adress (*if different*):

Email: drew@westrichland.org Phone: 509-967-5434

Receive Invoice: ☐ Hard Copy ☒ Email Receive Report: ☐ Hard Copy ☒ Email

Requested Tests: TSS SM 2540D

Lab Use Only	Sample Identification (*Location, Name, Code, etc*)	Collection Date	Collection Time	Matrix	Number of Bottles	TSS SM 2540D
01	SPG-Storm 1-Inf1	9/13	10:55	WW	1	X
02	-Inf2	↓	11:00	↓	↓	X
03	-Inf3		11:05			X
04	-Loc1		11:20			X
05	-Loc2		↓			X
06	-Loc3					X
07	-Loc4					X
08	-Loc5					X
09	-Loc6					X
10	-Loc7					X
11	-Loc8					X
12	-end	↓	↓	↓	↓	X

Matrix
S - Soil
WW - Waste Water
DW - Drinking Water
O - Oil
N - NPDES
Ot - Other

Rush TAT
☐ Yes ☐ No
# of working days: ____
Date Requested: ________

Comments
Please include QA/QC results w/report + forward results to taylor@evergreenstormh2o.com

Being duly authorized and empowered by Customer, by signing below, Customer agrees to having reviewed, understood, and is fully accepting of the terms on the reverse side of this form.

	Print / Signature	Date / Time		Print / Signature	Date / Time
Relinquished by:	Taylor Hollman Ballard	9/13 14:43	Received by:		
Relinquished by:			Received by:		
Accepted by lab:	[signature]	09/13/22 1443			

Payment Type (circle): ☐ Paid CC Check Amount $

Please make all checks payable to Energy Northwest

Sample Condition at Receipt
Temperature (*circle*): *Ambient* *Cold* *Frozen*
☐ Containers intact/ Lids tight
☐ VOC Vials w/o Headspace
☐ Labels Match Custody

26334 R2

ENERGY NORTHWEST

environmental services

Sample Receipt Form

Company Name: City of West Richland Date/Time: 09/13/22 14:43

Customer Contact: Drew Woodruff

Turnaround time: Normal ☒ Rush ☐ _____ days

Samples Received via: Fedex ☐ UPS ☐ USPS ☐ Customer ☒ Other ☐: ________

Number of coolers/boxes: 1 Type of Ice: Ice Cubes ☐ Ice Packs ☐ Dry Ice ☐ None ☒

Sample(s) Temp as Read (°C): NA Corrected Temp (°C): _____ Thermometer ID: ________

		Comments:
Chain of Custody Present?	Yes No N/A (Yes circled)	
Samples Received Intact?	Yes No N/A (Yes circled)	
Samples Received within hold time?	Yes No N/A (Yes circled)	
40 mL Vials Free of Headspace?	Yes No N/A (N/A circled)	
40 mL Vials Trip blank Present?	Yes No N/A (N/A circled)	
Samples Properly Preserved?	Yes No N/A (Yes circled)	
Bottle Labels and C.O.C/WSI Agree?	Yes No N/A (Yes circled)	
Total Number of Bottles Received?	24	

Chain of Custody Fully Completed?	Yes No N/A (Yes circled)	
Correct bottles/containers Received?	Yes No N/A (Yes circled)	
ENW Bottles Used?	Yes No unkn (Yes circled)	

Preservatives for bottles/containers:

Comments:

WD 230257 - 230258

Received by: [signature] Date/Time: 09/13/22 14:43

Environmental Services
350 Hills St. Suite 107, Richland, WA 99354
Phone: 509-377-8058 **Fax:** 509-377-8464

Report of Analysis

ENERGY NORTHWEST PRECISION LABS

For: **City of West Richland**
3801 Van Giesen
W Richland, WA 99353
Attn: Drew Woodruff

Cust Sample #: SPG-Storm 1-Loc 6 **Lab Sample ID:** 230258-09
Site: City of West Richland **Collection Date:** 9/13/2022 11:20 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed
Total suspended solids	SM 2540D	520 mg/L	10	jhill	LB023	9/14/2022 12:00

Cust Sample #: SPG-Storm 1-Loc 7 **Lab Sample ID:** 230258-10
Site: City of West Richland **Collection Date:** 9/13/2022 11:20 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed
Total suspended solids	SM 2540D	420 mg/L	10	jhill	LB023	9/14/2022 12:00

Cust Sample #: SPG-Storm 1-Loc 8 **Lab Sample ID:** 230258-11
Site: City of West Richland **Collection Date:** 9/13/2022 11:20 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed
Total suspended solids	SM 2540D	320 mg/L	10	jhill	LB023	9/14/2022 12:00

Cust Sample #: SPG-Storm 1-end **Lab Sample ID:** 230258-12
Site: City of West Richland **Collection Date:** 9/13/2022 11:20 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed
Total suspended solids	SM 2540D	46 mg/L	2	jhill	LB023	9/14/2022 12:00

QC Results

QCBatch ID	QC ID	Parameter	% Recovery / RPD	Control Limits
LB023	230258-09: Replicate 2	Total suspended solids	2.8129	0 - 5
	230263-03: Replicate 1	Total suspended solids	19.0476	0 - 5
	LCS 1	Total suspended solids	81.7	77.1 - 110
	MB 1	Total suspended solids	0.01	- 1

Qualifier: * Replicate RPD outside acceptable range of <5%. A sample and its replicate may vary due to sample matrix and concentration. Other QC within acceptable range. Samples reported without qualification.

Approved: 23-Sep-22

M Turner, Laboratory Manager

ENERGY NORTHWEST

Chain of Custody Services Sales Order

Environmental Services
350 Hills Street Suite 107, Richland, WA 99354
Phone: 509-377-8058 Fax: 509-377-8464

Account Information

Company Name: City of West Richland Public Works
Customer Contact: Drew Woodruff
Mailing Address: 3100 Belmont Blvd West Richland, WA 99353
Billing Adress (if different):
Email: drew@westrichland.org Phone: 509-967-5434
Receive Invoice: ☐ Hard Copy ☒ Email Receive Report: ☐ Hard Copy ☒ Email

Project ID:
Order ID: 230258

Requested Tests: TSS SM 2540D

Matrix: S - Soil, WW - Waste Water, DW - Drinking Water, O - Oil, N - NPDES, Ot - Other

Rush TAT: ☐ Yes ☐ No
# of working days: ____
Date Requested: ____

Lab Use Only	Sample Identification (Location, Name, Code, etc)	Collection Date	Collection Time	Matrix	Number of Bottles	TSS SM 2540D
01	SPG-Storm1-Inf1	9/13	10:55	WW	1	X
02	-Inf2	↓	11:00	↓	↓	X
03	-Inf3	↓	11:05	↓	↓	X
04	-Loc1	↓	11:20	↓	↓	X
05	-Loc2	↓	↓	↓	↓	X
06	-Loc3	↓	↓	↓	↓	X
07	-Loc4	↓	↓	↓	↓	X
08	-Loc5	↓	↓	↓	↓	X
09	-Loc6	↓	↓	↓	↓	X
10	-Loc7	↓	↓	↓	↓	X
11	-Loc8	↓	↓	↓	↓	X
12	-end	↓	↓	↓	↓	X

Comments: Please include QA/QC results w/report + forward results to taylor@evergreenstormh2o.com

Being duly authorized and empowered by Customer, by signing below, Customer agrees to having reviewed, understood, and is fully accepting of the terms on the reverse side of this form.

	Print / Signature	Date / Time		Print / Signature	Date / Time
Relinquished by:	Taylor Hollman-Ballard	9/13 14:43	Received by:		
Relinquished by:			Received by:		
Accepted by lab:	[signature]	09/13/22 1443			

Payment Type (circle): ☐ Paid CC Check
Amount $

Please make all checks payable to Energy Northwest

Sample Condition at Receipt
Temperature (circle): *Ambient* *Cold* *Frozen*
☐ Containers intact/ Lids tight
☐ VOC Vials w/o Headspace
☐ Labels Match Custody

26334 R2

ENERGY NORTHWEST

environmental services

Sample Receipt Form

Company Name: City of West Richland

Date/Time: 09/13/22 14:43

Customer Contact: Drew Woodruff

Turnaround time: Normal ☒ Rush ☐ _____ days

Samples Received via: Fedex ☐ UPS ☐ USPS ☐ Customer ☒ Other ☐: ____________

Number of coolers/boxes: 1 Type of Ice: Ice Cubes ☐ Ice Packs ☐ Dry Ice ☐ None ☒

Sample(s) Temp as Read (°C): NA Corrected Temp (°C): _____ Thermometer ID: ________

				Comments:
Chain of Custody Present?	Yes	No	N/A	
Samples Received Intact?	Yes	No	N/A	
Samples Received within hold time?	Yes	No	N/A	
40 mL Vials Free of Headspace?	Yes	No	N/A	
40 mL Vials Trip blank Present?	Yes	No	N/A	
Samples Properly Preserved?	Yes	No	N/A	
Bottle Labels and C.O.C/WSI Agree?	Yes	No	N/A	
Total Number of Bottles Received?	24			

Chain of Custody Fully Completed?	Yes	No	N/A	
Correct bottles/containers Received?	Yes	No	N/A	
ENW Bottles Used?	Yes	No	unkn	

Preservatives for bottles/containers:

Comments:

WD 230257 - 230258

Received by: [signature]

Date/Time: 09/13/22 14:43

Environmental Services
350 Hills St. Suite 107, Richland, WA 99354
Phone: 509-377-8058 **Fax:** 509-377-8464

Report of Analysis

For: **City of West Richland**
3801 Van Giesen
W Richland, WA 99353
Attn: Drew Woodruff

Cust Sample #: PG - Storm 3- Inf 1 **Lab Sample ID:** 230267-01
Site: City of West Richland **Collection Date:** 9/14/2022 7:45 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	160 mg/L	2	jhill	LB026	9/15/2022	8:00

Cust Sample #: PG - Storm 3- Inf 2 **Lab Sample ID:** 230267-02
Site: City of West Richland **Collection Date:** 9/14/2022 7:50 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	120 mg/L	2	jhill	LB026	9/15/2022	8:00

Cust Sample #: PG - Storm 3- Inf 3 **Lab Sample ID:** 230267-03
Site: City of West Richland **Collection Date:** 9/14/2022 7:55 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	96 mg/L	2	jhill	LB026	9/15/2022	8:00

Cust Sample #: PG - Storm 3- Loc 1 **Lab Sample ID:** 230267-04
Site: City of West Richland **Collection Date:** 9/14/2022 8:15 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	2200 mg/L	10	jhill	LB026	9/15/2022	8:00

Cust Sample #: PG - Storm 3- Loc 2 **Lab Sample ID:** 230267-05
Site: City of West Richland **Collection Date:** 9/14/2022 8:15 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	2300 mg/L	10	jhill	LB026	9/15/2022	8:00

Cust Sample #: PG - Storm 3- Loc 3 **Lab Sample ID:** 230267-06
Site: City of West Richland **Collection Date:** 9/14/2022 8:15 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	910 mg/L	10	jhill	LB026	9/15/2022	8:00

Cust Sample #: PG - Storm 3- Loc 4 **Lab Sample ID:** 230267-07
Site: City of West Richland **Collection Date:** 9/14/2022 8:15 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	1600 mg/L	10	jhill	LB026	9/15/2022	8:00

Cust Sample #: PG - Storm 3- Loc 5 **Lab Sample ID:** 230267-08
Site: City of West Richland **Collection Date:** 9/14/2022 8:15 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	1200 mg/L	10	jhill	LB026	9/15/2022	8:00

Cust Sample #: PG - Storm 3- Loc 6 **Lab Sample ID:** 230267-09
Site: City of West Richland **Collection Date:** 9/14/2022 8:15 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	550 mg/L	10	jhill	LB026	9/15/2022	8:00

Cust Sample #: PG - Storm 3- Loc 7 **Lab Sample ID:** 230267-10
Site: City of West Richland **Collection Date:** 9/14/2022 8:15 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	290 mg/L	10	jhill	LB026	9/15/2022	8:00

Cust Sample #: PG - Storm 3- Loc 8 **Lab Sample ID:** 230267-11
Site: City of West Richland **Collection Date:** 9/14/2022 8:15 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	110 mg/L	10	jhill	LB026	9/15/2022	8:00

Cust Sample #: PG - Storm 3- end **Lab Sample ID:** 230267-12
Site: City of West Richland **Collection Date:** 9/14/2022 8:15 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	240 mg/L	5	jhill	LB026	9/15/2022	8:00

Cust Sample #: PG - Storm 4- Inf 1 **Lab Sample ID:** 230268-01
Site: City of West Richland **Collection Date:** 9/14/2022 1:00 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	150 mg/L	2	jhill	LB026	9/15/2022	8:00

Cust Sample #: PG - Storm 4- Inf 2 **Lab Sample ID:** 230268-02
Site: City of West Richland **Collection Date:** 9/14/2022 1:05 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	110 mg/L	2	jhill	LB026	9/15/2022	8:00

Cust Sample #: PG - Storm 4- Inf 3 **Lab Sample ID:** 230268-03
Site: City of West Richland **Collection Date:** 9/14/2022 1:10 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	94 mg/L	2	jhill	LB026	9/15/2022	8:00

Cust Sample #: PG - Storm 4- Loc 1 **Lab Sample ID:** 230268-04
Site: City of West Richland **Collection Date:** 9/14/2022 1:45 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	3500 mg/L	10	jhill	LB026	9/15/2022	8:00

Cust Sample #: PG - Storm 4- Loc 2 **Lab Sample ID:** 230268-05
Site: City of West Richland **Collection Date:** 9/14/2022 1:45 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	2400 mg/L	10	jhill	LB026	9/15/2022	8:00

Cust Sample #: PG - Storm 4- Loc 3 **Lab Sample ID:** 230268-06
Site: City of West Richland **Collection Date:** 9/14/2022 1:45 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	1400 mg/L	10	jhill	LB026	9/15/2022	8:00

Cust Sample #: PG - Storm 4- Loc 4 **Lab Sample ID:** 230268-07
Site: City of West Richland **Collection Date:** 9/14/2022 1:45 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	990 mg/L	10	jhill	LB026	9/15/2022	8:00

Cust Sample #: PG - Storm 4- Loc 5 **Lab Sample ID:** 230268-08
Site: City of West Richland **Collection Date:** 9/14/2022 1:45 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	590 mg/L	10	jhill	LB026	9/15/2022	8:00

QC Results

QCBatch ID	QC ID	Parameter	% Recovery / RPD	Control Limits
LB026	230267-04: Replicate 1	Total suspended solids	1.9297	0 - 5
	230268-08: Replicate 2	Total suspended solids	2.6329	0 - 5
	LCS 1	Total suspended solids	93.4	77.1 - 110
	MB 1	Total suspended solids	-0.14	- 1

Qualifier: * Replicate RPD outside acceptable range of <5%. A sample and its replicate may vary due to sample matrix and concentration.
Other QC within acceptable range. Samples reported without qualification.

Approved: 23-Sep-22

M Turner, Laboratory Manager

ENERGY NORTHWEST

Chain of Custody Services Sales Order

Environmental Services
350 Hills Street Suite 107, Richland, WA 99354
Phone: 509-377-8058 Fax: 509-377-8464

Account Information	Project ID	Order ID
Company Name: City of West Richland Public Works		230267
Customer Contact: Drew Woodruff		
Mailing Address: 3100 Belmont Blvd West Richland, WA 99353		
Billing Adress (if different):		
Email: drew@westrichland.org Phone: 509-967-5434		
Receive Invoice: ☐ Hard Copy ☒ Email Receive Report: ☐ Hard Copy ☒ Email		

Matrix: S - Soil, WW - Waste Water, DW - Drinking Water, O - Oil, N - NPDES, Ot - Other

Rush TAT: ☐ Yes ☐ No
# of working days: ___
Date Requested: ___

Requested Tests: TSS SM2540D

Lab Use Only	Sample Identification (Location, Name, Code, etc)	Collection Date	Collection Time	Matrix	Number of Bottles	TSS SM2540D
01	PG-Storm 3-Inf 1	9/14	7:45a	WW	1	X
02	-Inf 2		7:50			X
03	-Inf 3		7:55			X
04	-~~Eff~~ Loc 1		8:15			X
05	-Loc 2					X
06	-Loc 3					X
07	-Loc 4					X
08	-Loc 5					X
09	-Loc 6					X
10	-Loc 7					X
11	-Loc 8					X
12	-End					X

Comments: Please include QA/QC results w/report + forward results to taylor@evergreenstormh2o.com

Being duly authorized and empowered by Customer, by signing below, Customer agrees to having reviewed, understood, and is fully accepting of the terms on the reverse side of this form.

	Print / Signature	Date / Time		Print / Signature	Date / Time
Relinquished by:	Taylor Hallman Ballard	9/14 1542	Received by:		
Relinquished by:			Received by:		
Accepted by lab:	[signature]	09/14/22 1542			

Payment Type (circle): ☐ Paid CC Check Amount $

Please make all checks payable to Energy Northwest

Sample Condition at Receipt
Temperature (circle): Ambient Cold Frozen
☐ Containers intact/ Lids tight
☐ VOC Vials w/o Headspace
☐ Labels Match Custody

26334 R2

ENERGY NORTHWEST

environmental services

Sample Receipt Form

Company Name: City of West Richland Date/Time: 09/14/22 1542

Customer Contact: Drew Woodruff

Turnaround time: Normal X Rush ☐ ____ days

Samples Received via: Fedex ☐ UPS ☐ USPS ☐ Customer X Other ☐: ________

Number of coolers/boxes: 1 Type of Ice: Ice Cubes ☐ Ice Packs ☐ Dry Ice ☐ None X

Sample(s) Temp as Read (°C): NA Corrected Temp (°C): ____ Thermometer ID: ____

				Comments:
Chain of Custody Present?	Yes	No	N/A	
Samples Received Intact?	Yes	No	N/A	
Samples Received within hold time?	Yes	No	N/A	
40 mL Vials Free of Headspace?	Yes	No	N/A	
40 mL Vials Trip blank Present?	Yes	No	N/A	
Samples Properly Preserved?	Yes	No	N/A	
Bottle Labels and C.O.C/WSI Agree?	Yes	No	N/A	
Total Number of Bottles Received?	36			

Chain of Custody Fully Completed?	Yes	No	N/A	
Correct bottles/containers Received?	Yes	No	N/A	
ENW Bottles Used?	Yes	No	unkn	

Preservatives for bottles/containers:

Comments:

WO: 230267-230269

Received by: [signature] Date/Time: 09/14/22 16:10

Environmental Services
350 Hills St. Suite 107, Richland, WA 99354
Phone: 509-377-8058 **Fax:** 509-377-8464

ENERGY NORTHWEST

Chain of Custody
Services Sales Order

Environmental Services
350 Hills Street Suite 107, Richland, WA 99354
Phone: 509-377-8058 Fax: 509-377-8464

Account Information

Company Name: City of West Richland Public Works

Customer Contact: Drew Woodruff

Project ID:

Order ID: 230268·01

Mailing Address: 3100 Belmont Blvd, West Richland, WA 99353

Billing Adress (if different):

Email: drew@westrichland.org Phone: 509-967-5434

Receive Invoice: ☐ Hard Copy ☒ Email

Receive Report: ☐ Hard Copy ☒ Email

Matrix
S - Soil
WW - Waste Water
DW - Drinking Water
O - Oil
N - NPDES
Ot - Other

Rush TAT
☐ Yes ☐ No
# of working days: ____
Date Requested: ____

Lab Use Only	Sample Identification (Location, Name, Code, etc)	Collection Date	Collection Time	Matrix	Number of Bottles	TSS SM2540D
01	PG-Storm 4-Inf1	9/14	1:00	H2O	1	X
02	-Inf2	↓	1:05	↓	↓	X
03	-Inf3	↓	1:10	↓	↓	X
04	-Loc1	↓	1:45	↓	↓	X
05	-Loc2	↓	↓	↓	↓	X
06	-Loc3	↓	↓	↓	↓	X
07	-Loc4	↓	↓	↓	↓	X
08	-Loc5	↓	↓	↓	↓	X
09	-Loc6	↓	↓	↓	↓	X
10	-Loc7	↓	↓	↓	↓	X
11	-Loc8	↓	↓	↓	↓	X
12	-end	↓	↓	↓	↓	X

Comments
Please include QA/QC results w/report + forward results to taylor@evergreenstormh2o.com

Being duly authorized and empowered by Customer, by signing below, Customer agrees to having reviewed, understood, and is fully accepting of the terms on the reverse side of this form.

	Print / Signature	Date / Time		Print / Signature	Date / Time
Relinquished by:	Taylor Holloman Ballard	9/14 1542	Received by:		
Relinquished by:			Received by:		
Accepted by lab:	[signature]	09/14/22 1542			

Payment Type (circle) ☐ Paid CC Check

Amount $

Please make all checks payable to Energy Northwest

Sample Condition at Receipt
Temperature (circle):
Ambient *Cold* *Frozen*
☐ Containers Intact/ Lids tight
☐ VOC Vials w/o Headspace
☐ Labels Match Custody

ENERGY NORTHWEST

environmental services

Sample Receipt Form

Company Name: City of West Richland   Date/Time: 09/14/22 1542

Customer Contact: Drew Woodruff

Turnaround time: Normal ☒ Rush ☐ ____ days

Samples Received via: Fedex ☐ UPS ☐ USPS ☐ Customer ☒ Other ☐: ________

Number of coolers/boxes: 1   Type of Ice: Ice Cubes ☐ Ice Packs ☐ Dry Ice ☐ None ☒

Sample(s) Temp as Read (°C): NA Corrected Temp (°C): ____ Thermometer ID: ________

				Comments:
Chain of Custody Present?	Yes	No	N/A	
Samples Received Intact?	Yes	No	N/A	
Samples Received within hold time?	Yes	No	N/A	
40 mL Vials Free of Headspace?	Yes	No	N/A	
40 mL Vials Trip blank Present?	Yes	No	N/A	
Samples Properly Preserved?	Yes	No	N/A	
Bottle Labels and C.O.C/WSI Agree?	Yes	No	N/A	
Total Number of Bottles Received?	36			

Chain of Custody Fully Completed?	Yes	No	N/A	
Correct bottles/containers Received?	Yes	No	N/A	
ENW Bottles Used?	Yes	No	unkn	

Preservatives for bottles/containers:

Comments:

WO: 230267-230269

Received by: [signature]   Date/Time: 09/14/22 16:10

Environmental Services
350 Hills St. Suite 107, Richland, WA 99354
Phone: 509-377-8058 **Fax:** 509-377-8464

Report of Analysis

For: **City of West Richland**
3801 Van Giesen
W Richland, WA 99353
Attn: Drew Woodruff

Cust Sample #: PG - Storm 4- Loc 6 **Lab Sample ID:** 230268-09
Site: City of West Richland **Collection Date:** 9/14/2022 1:45 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed
Total suspended solids	SM 2540D	350 mg/L	10	jhill	LB027	9/15/2022 13:00

Cust Sample #: PG - Storm 4- Loc 7 **Lab Sample ID:** 230268-10
Site: City of West Richland **Collection Date:** 9/14/2022 1:45 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed
Total suspended solids	SM 2540D	170 mg/L	10	jhill	LB027	9/15/2022 13:00

Cust Sample #: PG - Storm 4- Loc 8 **Lab Sample ID:** 230268-11
Site: City of West Richland **Collection Date:** 9/14/2022 1:45 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed
Total suspended solids	SM 2540D	33 mg/L	2	jhill	LB027	9/15/2022 13:00

Cust Sample #: PG - Storm 4- end **Lab Sample ID:** 230268-12
Site: City of West Richland **Collection Date:** 9/14/2022 1:45 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed
Total suspended solids	SM 2540D	63 mg/L	2	jhill	LB027	9/15/2022 13:00

Cust Sample #: SPG-Storm 2-Inf 1 **Lab Sample ID:** 230269-01
Site: City of West Richland **Collection Date:** 9/14/2022 9:30 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed
Total suspended solids	SM 2540D	160 mg/L	2	jhill	LB027	9/15/2022 13:00

Cust Sample #: SPG-Storm 2-Inf 2 **Lab Sample ID:** 230269-02
Site: City of West Richland **Collection Date:** 9/14/2022 9:35 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed
Total suspended solids	SM 2540D	110 mg/L	2	jhill	LB027	9/15/2022 13:00

Cust Sample #: SPG-Storm 2-Inf 3 **Lab Sample ID:** 230269-03
Site: City of West Richland **Collection Date:** 9/14/2022 9:40 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed
Total suspended solids	SM 2540D	96 mg/L	2	jhill	LB027	9/15/2022 13:00

Cust Sample #: SPG-Storm 2-Loc 1 **Lab Sample ID:** 230269-04
Site: City of West Richland **Collection Date:** 9/14/2022 9:50 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	1000 mg/L	10	jhill	LB027	9/15/2022	13:00

Cust Sample #: SPG-Storm 2-Loc 2 **Lab Sample ID:** 230269-05
Site: City of West Richland **Collection Date:** 9/14/2022 9:50 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	1300 mg/L	10	jhill	LB027	9/15/2022	13:00

Cust Sample #: SPG-Storm 2-Loc 3 **Lab Sample ID:** 230269-06
Site: City of West Richland **Collection Date:** 9/14/2022 9:50 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	370 mg/L	10	jhill	LB027	9/15/2022	13:00

Cust Sample #: SPG-Storm 2-Loc 4 **Lab Sample ID:** 230269-07
Site: City of West Richland **Collection Date:** 9/14/2022 9:50 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	960 mg/L	10	jhill	LB027	9/15/2022	13:00

Cust Sample #: SPG-Storm 2-Loc 5 **Lab Sample ID:** 230269-08
Site: City of West Richland **Collection Date:** 9/14/2022 9:50 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	410 mg/L	10	jhill	LB027	9/15/2022	13:00

Cust Sample #: SPG-Storm 2-Loc 6 **Lab Sample ID:** 230269-09
Site: City of West Richland **Collection Date:** 9/14/2022 9:50 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	230 mg/L	10	jhill	LB027	9/15/2022	13:00

Cust Sample #: SPG-Storm 2-Loc 7 **Lab Sample ID:** 230269-10
Site: City of West Richland **Collection Date:** 9/14/2022 9:50 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	210 mg/L	10	jhill	LB027	9/15/2022	13:00

Cust Sample #: SPG-Storm 2-Loc 8 **Lab Sample ID:** 230269-11
Site: City of West Richland **Collection Date:** 9/14/2022 9:50 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	300 mg/L	10	jhill	LB027	9/15/2022	13:00

Cust Sample #:	SPG-Storm 2-end	**Lab Sample ID:**	230269-12
Site:	City of West Richland	**Collection Date:**	9/14/2022 9:50 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed
Total suspended solids	SM 2540D	32 mg/L	5	jhill	LB027	9/15/2022 13:00

QC Results

QCBatch ID	QC ID	Parameter	% Recovery / RPD	Control Limits
LB027	230268-09: Replicate 1	Total suspended solids	2.3516	0 - 5
	230269-04: Replicate 2	Total suspended solids	4.7223	0 - 5
	LCS 1	Total suspended solids	89.2	77.1 - 110
	MB 1	Total suspended solids	-0.29	- 1

Qualifier: * Replicate RPD outside acceptable range of <5%. A sample and its replicate may vary due to sample matrix and concentration. Other QC within acceptable range. Samples reported without qualification.

Approved: 23-Sep-22

M Turner, Laboratory Manager

ENERGY NORTHWEST

Chain of Custody
Services Sales Order

Environmental Services
350 Hills Street Suite 107, Richland, WA 99354
Phone: 509-377-8058 **Fax:** 509-377-8464

Account Information

Company Name: City of West Richland Public Works
Customer Contact: Drew Woodruff
Mailing Address: 3100 Belmont Blvd, West Richland, WA 99353
Billing Adress (if different):
Email: drew@westrichland.org Phone: 509-967-5434
Receive Invoice: ☐ Hard Copy ☒ Email Receive Report: ☐ Hard Copy ☒ Email

Project ID:

Order ID: 230268.01

Requested Tests: TSS SM2540D

Matrix: S - Soil, WW - Waste Water, DW - Drinking Water, O - Oil, N - NPDES, Ot - Other

Rush TAT: ☐ Yes ☐ No
# of working days: ____
Date Requested: ____

Lab Use Only	Sample Identification (Location, Name, Code, etc)	Collection Date	Collection Time	Matrix	Number of Bottles	TSS SM2540D
01	PG-Storm 4-Inf1	9/14	1:00	WW	1	X
02	-Inf2	↓	1:05	↓	↓	X
03	-Inf3	↓	1:10	↓	↓	X
04	-Loc1	↓	1:45	↓	↓	X
05	-Loc2	↓	↓	↓	↓	X
06	-Loc3	↓	↓	↓	↓	X
07	-Loc4	↓	↓	↓	↓	X
08	-Loc5	↓	↓	↓	↓	X
09	-Loc6	↓	↓	↓	↓	X
10	-Loc7	↓	↓	↓	↓	X
11	-Loc8	↓	↓	↓	↓	X
12	-end	↓	↓	↓	↓	X

Comments: Please include QA/QC results w/report + forward results to taylor@evergreenstormh2o.com

Being duly authorized and empowered by Customer, by signing below, Customer agrees to having reviewed, understood, and is fully accepting of the terms on the reverse side of this form.

	Print / Signature	Date / Time		Print / Signature	Date / Time
Relinquished by:	Taylor Holloman Ballard	9/14 1542	Received by:		
Relinquished by:			Received by:		
Accepted by lab:	[signature]	09/14/22 1542			

Payment Type (circle): ☐ Paid CC Check
Amount $

Please make all checks payable to Energy Northwest

Sample Condition at Receipt
Temperature (circle): *Ambient Cold Frozen*
☐ Containers Intact/ Lids tight
☐ VOC Vials w/o Headspace
☐ Labels Match Custody

ENERGY NORTHWEST

environmental services

Sample Receipt Form

Company Name: City of West Richland Date/Time: 09|14|22 1542

Customer Contact: Drew Woodruff

Turnaround time: Normal ☒ Rush ☐ _____ days

Samples Received via: Fedex ☐ UPS ☐ USPS ☐ Customer ☒ Other ☐: ________

Number of coolers/boxes: 1 Type of Ice: Ice Cubes ☐ Ice Packs ☐ Dry Ice ☐ None ☒

Sample(s) Temp as Read (°C): NA Corrected Temp (°C):_____ Thermometer ID:________

				Comments:
Chain of Custody Present?	Yes	No	N/A	
Samples Received Intact?	Yes	No	N/A	
Samples Received within hold time?	Yes	No	N/A	
40 mL Vials Free of Headspace?	Yes	No	N/A	
40 mL Vials Trip blank Present?	Yes	No	N/A	
Samples Properly Preserved?	Yes	No	N/A	
Bottle Labels and C.O.C/WSI Agree?	Yes	No	N/A	
Total Number of Bottles Received?	36			

Chain of Custody Fully Completed?	Yes	No	N/A	
Correct bottles/containers Received?	Yes	No	N/A	
ENW Bottles Used?	Yes	No	unkn	

Preservatives for bottles/containers:

Comments:

WO: 230267-230269

Received by: [signature] Date/Time: 09|14|22 16:10

Environmental Services
350 Hills St. Suite 107, Richland, WA 99354
Phone: 509-377-8058 **Fax:** 509-377-8464

ENERGY NORTHWEST

Chain of Custody
Services Sales Order

Environmental Services
350 Hills Street Suite 107, Richland, WA 99354
Phone: 509-377-8058 **Fax:** 509-377-8464

Account Information

Company Name: City of West Richland Public Works

Customer Contact: Drew Woodruff

Project ID:

Order ID: 230269

Mailing Address: 3100 Belmont Blvd, West Richland, WA 99353

Billing Adress (*if different*):

Email: drew@westrichland.org Phone: 509-967-5434

Receive Invoice: ☐ Hard Copy ☒ Email   Receive Report: ☐ Hard Copy ☒ Email

Requested Tests: TSS SM2540D

Lab Use Only	Sample Identification (Location, Name, Code, etc)	Collection Date	Collection Time	Matrix	Number of Bottles	TSS SM2540D
01	SPG - Storm 2 - Infl	9/14	9:30	WW	1	X
02	- Inf2	↓	9:35	↓	↓	X
03	- Inf3	↓	9:40	↓	↓	X
04	- Loc1	↓	9:50	↓	↓	X
05	- Loc2	↓	↓	↓	↓	X
06	- Loc3	↓	↓	↓	↓	X
07	- Loc4	↓	↓	↓	↓	X
08	- Loc5	↓	↓	↓	↓	X
09	- Loc6	↓	↓	↓	↓	X
10	- Loc7	↓	↓	↓	↓	X
11	- Loc8	↓	↓	↓	↓	X
12	- End	↓	↓	↓	↓	X

Matrix
S - Soil
WW - Waste Water
DW - Drinking Water
O - Oil
N - NPDES
Ot - Other

Rush TAT
☐ Yes ☐ No
# of working days: ____
Date Requested: ________

Comments
Please include QA/QC results w/ report + forward results to taylor@evergreenstormh2o.com

Being duly authorized and empowered by Customer, by signing below, Customer agrees to having reviewed, understood, and is fully accepting of the terms on the reverse side of this form.

Print / Signature	Date / Time	Print / Signature	Date / Time
Relinquished by: Taylor Wollman Bella	9/14 1542	Received by:	
Relinquished by:		Received by:	
Accepted by lab: [signature]	09/14/22 1542		

Payment Type (*circle*) ☐ Paid   CC   Check   Amount $

Please make all checks payable to Energy Northwest

Sample Condition at Receipt
Temperature (*circle*): *Ambient* *Cold* *Frozen*
☐ Containers intact/ Lids tight
☐ VOC Vials w/o Headspace
☐ Labels Match Custody

ENERGY NORTHWEST

environmental services

Sample Receipt Form

Company Name: City of West Richland Date/Time: 09/14/22 1542

Customer Contact: Drew Woodruff

Turnaround time: Normal ☒ Rush ☐ ____ days

Samples Received via: Fedex ☐ UPS ☐ USPS ☐ Customer ☒ Other ☐: ________

Number of coolers/boxes: 1 Type of Ice: Ice Cubes ☐ Ice Packs ☐ Dry Ice ☐ None ☒

Sample(s) Temp as Read (°C): NA Corrected Temp (°C): ____ Thermometer ID: ________

				Comments:
Chain of Custody Present?	Yes	No	N/A	
Samples Received Intact?	Yes	No	N/A	
Samples Received within hold time?	Yes	No	N/A	
40 mL Vials Free of Headspace?	Yes	No	N/A	
40 mL Vials Trip blank Present?	Yes	No	N/A	
Samples Properly Preserved?	Yes	No	N/A	
Bottle Labels and C.O.C/WSI Agree?	Yes	No	N/A	
Total Number of Bottles Received?	36			

Chain of Custody Fully Completed?	Yes	No	N/A	
Correct bottles/containers Received?	Yes	No	N/A	
ENW Bottles Used?	Yes	No	unkn	

Preservatives for bottles/containers:

Comments:

WO: 230267-230269

Received by: [signature] Date/Time: 09/14/22 16:10

Environmental Services
350 Hills St. Suite 107, Richland, WA 99354
Phone: 509-377-8058 **Fax:** 509-377-8464

Report of Analysis

For: **City of West Richland**
3801 Van Giesen
W Richland, WA 99353
Attn: Drew Woodruff

Cust Sample #: PG - Storm 5- Inf 1 **Lab Sample ID:** 230274-01
Site: City of West Richland **Collection Date:** 9/15/2022 7:50 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	130 mg/L	2	jhill	LB029	9/19/2022	9:00

Cust Sample #: PG - Storm 5- Inf 2 **Lab Sample ID:** 230274-02
Site: City of West Richland **Collection Date:** 9/15/2022 7:55 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	110 mg/L	2	jhill	LB029	9/19/2022	9:00

Cust Sample #: PG - Storm 5- Inf 3 **Lab Sample ID:** 230274-03
Site: City of West Richland **Collection Date:** 9/15/2022 8:00 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	88 mg/L	2	jhill	LB029	9/19/2022	9:00

Cust Sample #: PG - Storm 5- Loc 1 **Lab Sample ID:** 230274-04
Site: City of West Richland **Collection Date:** 9/15/2022 8:30 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	3800 mg/L	10	jhill	LB029	9/19/2022	9:00

Cust Sample #: PG - Storm 5- Loc 2 **Lab Sample ID:** 230274-05
Site: City of West Richland **Collection Date:** 9/15/2022 8:30 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	2400 mg/L	10	jhill	LB029	9/19/2022	9:00

Cust Sample #: PG - Storm 5- Loc 3 **Lab Sample ID:** 230274-06
Site: City of West Richland **Collection Date:** 9/15/2022 8:30 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	1800 mg/L	10	jhill	LB029	9/19/2022	9:00

Cust Sample #: PG - Storm 5- Loc 4 **Lab Sample ID:** 230274-07
Site: City of West Richland **Collection Date:** 9/15/2022 8:30 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	2100 mg/L	10	jhill	LB029	9/19/2022	9:00

Cust Sample #: PG - Storm 5- Loc 5 **Lab Sample ID:** 230274-08
Site: City of West Richland **Collection Date:** 9/15/2022 8:30 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	1200 mg/L	10	jhill	LB029	9/19/2022	9:00

Cust Sample #: PG - Storm 5- Loc 6 **Lab Sample ID:** 230274-09
Site: City of West Richland **Collection Date:** 9/15/2022 8:30 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	810 mg/L	10	jhill	LB029	9/19/2022	9:00

Cust Sample #: PG - Storm 5- Loc 7 **Lab Sample ID:** 230274-10
Site: City of West Richland **Collection Date:** 9/15/2022 8:30 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	360 mg/L	10	jhill	LB029	9/19/2022	9:00

Cust Sample #: PG - Storm 5- Loc 8 **Lab Sample ID:** 230274-11
Site: City of West Richland **Collection Date:** 9/15/2022 8:30 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	220 mg/L	10	jhill	LB029	9/19/2022	9:00

Cust Sample #: PG - Storm 5- end **Lab Sample ID:** 230274-12
Site: City of West Richland **Collection Date:** 9/15/2022 8:30 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	79 mg/L	10	jhill	LB029	9/19/2022	9:00

Cust Sample #: SPG-Storm 3-Inf 1 **Lab Sample ID:** 230275-01
Site: City of West Richland **Collection Date:** 9/15/2022 10:05 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	160 mg/L	2	jhill	LB029	9/19/2022	9:00

Cust Sample #: SPG-Storm 3-Inf 2 **Lab Sample ID:** 230275-02
Site: City of West Richland **Collection Date:** 9/15/2022 10:10 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	120 mg/L	2	jhill	LB029	9/19/2022	9:00

Cust Sample #: SPG-Storm 3-Inf 3 **Lab Sample ID:** 230275-03
Site: City of West Richland **Collection Date:** 9/15/2022 10:15 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	100 mg/L	2	jhill	LB029	9/19/2022	9:00

Cust Sample #:	SPG-Storm 3-Loc 1	**Lab Sample ID:**	230275-04
Site:	City of West Richland	**Collection Date:**	9/15/2022 10:25 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed
Total suspended solids	SM 2540D	920 mg/L	10	jhill	LB029	9/19/2022 9:00

Cust Sample #:	SPG-Storm 3-Loc 2	**Lab Sample ID:**	230275-05
Site:	City of West Richland	**Collection Date:**	9/15/2022 10:25 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed
Total suspended solids	SM 2540D	1300 mg/L	10	jhill	LB029	9/19/2022 9:00

Cust Sample #:	SPG-Storm 3-Loc 3	**Lab Sample ID:**	230275-06
Site:	City of West Richland	**Collection Date:**	9/15/2022 10:25 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed
Total suspended solids	SM 2540D	330 mg/L	10	jhill	LB029	9/19/2022 9:00

Cust Sample #:	SPG-Storm 3-Loc 4	**Lab Sample ID:**	230275-07
Site:	City of West Richland	**Collection Date:**	9/15/2022 10:25 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed
Total suspended solids	SM 2540D	1400 mg/L	10	jhill	LB029	9/19/2022 9:00

Cust Sample #:	SPG-Storm 3-Loc 5	**Lab Sample ID:**	230275-08
Site:	City of West Richland	**Collection Date:**	9/15/2022 10:25 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed
Total suspended solids	SM 2540D	430 mg/L	5	jhill	LB029	9/19/2022 9:00

QC Results

QCBatch ID	QC ID	Parameter	% Recovery / RPD	Control Limits
LB029	230274-04: Replicate 1	Total suspended solids	3.4636	0 - 5
	230274-11: Replicate 2	Total suspended solids	4.8433	0 - 5
	LCS 1	Total suspended solids	87.65	77.1 - 110
	MB 1	Total suspended solids	0.07	- 1

Qualifier: * Replicate RPD outside acceptable range of <5%. A sample and its replicate may vary due to sample matrix and concentration. Other QC within acceptable range. Samples reported without qualification.

Approved: 23-Sep-22

M Turner, Laboratory Manager

ENERGY NORTHWEST

Chain of Custody Services Sales Order

Environmental Services
350 Hills Street Suite 107, Richland, WA 99354
Phone: 509-377-8058 **Fax:** 509-377-8464

Account Information

Company Name: City of West Richland Public Works

Customer Contact: Drew Woodruff

Project ID:

Order ID: 230274

Mailing Address: 3100 Belmont Blvd
West Richland, WA 99353

Billing Adress (*if different*):

Email: drew@westrichland.org Phone: 509-967-5434

Receive Invoice: ☐ Hard Copy ☒ Email Receive Report: ☐ Hard Copy ☒ Email

Requested Tests: TSS SM2540D

Lab Use Only	Sample Identification (Location, Name, Code, etc)	Collection Date	Collection Time	Matrix	Number of Bottles	TSS SM2540D
01	PG-Storm5-[illegible] Inf1	9/15	7:50a	WW	1	X
02	-Inf2	↓	7:55	↓	↓	X
03	-Inf3	↓	8:00	↓	↓	X
04	-Loc1	↓	8:30	↓	↓	X
05	-Loc2	↓	↓	↓	↓	X
06	-Loc3	↓	↓	↓	↓	X
07	-Loc4	↓	↓	↓	↓	X
08	-Loc5	↓	↓	↓	↓	X
09	-Loc6	↓	↓	↓	↓	X
10	-Loc7	↓	↓	↓	↓	X
11	-Loc8	↓	↓	↓	↓	X
12	-end	↓	↓	↓	↓	X

Matrix
S - Soil
WW - Waste Water
DW - Drinking Water
O - Oil
N - NPDES
Ot - Other

Rush TAT
☐ Yes ☐ No
# of working days: ____
Date Requested: ________

Comments
Please include QA/QC results w/ report + forward results to taylor@evergreenstormh2o.com

Being duly authorized and empowered by Customer, by signing below, Customer agrees to having reviewed, understood, and is fully accepting of the terms on the reverse side of this form.

	Print / Signature	Date / Time		Print / Signature	Date / Time
Relinquished by:	Taylor Wells Rubb	9/15 1451	Received by:		
Relinquished by:			Received by:		
Accepted by lab:	DSM	09/15/22 1451			

Payment Type (*circle*) ☐ Paid
CC Check
Amount $

Please make all checks payable to Energy Northwest

Sample Condition at Receipt
Temperature (*circle*):
Ambient *Cold* *Frozen*
☐ Containers intact/ Lids tight
☐ VOC Vials w/o Headspace
☐ Labels Match Custody

26334 R2

ENERGY NORTHWEST

environmental services

Sample Receipt Form

Company Name: City of West Richland Date/Time: 09/15/22 1451

Customer Contact: Drew Woodruff

Turnaround time: Normal ☒ Rush ☐ ____ days

Samples Received via: Fedex ☐ UPS ☐ USPS ☐ Customer ☒ Other ☐: ________

Number of coolers/boxes: 1 Type of Ice: Ice Cubes ☐ Ice Packs ☐ Dry Ice ☐ None ☒

Sample(s) Temp as Read (°C): NA Corrected Temp (°C): ____ Thermometer ID: ________

				Comments:
Chain of Custody Present?	Yes	No	N/A	
Samples Received Intact?	Yes	No	N/A	
Samples Received within hold time?	Yes	No	N/A	
40 mL Vials Free of Headspace?	Yes	No	N/A	
40 mL Vials Trip blank Present?	Yes	No	N/A	
Samples Properly Preserved?	Yes	No	N/A	
Bottle Labels and C.O.C/WSI Agree?	Yes	No	N/A	
Total Number of Bottles Received?	36			

Chain of Custody Fully Completed?	Yes	No	N/A	
Correct bottles/containers Received?	Yes	No	N/A	
ENW Bottles Used?	Yes	No	unkn	

Preservatives for bottles/containers:

Comments:

WO: 230274 - 230276

Received by: [signature] Date/Time: 09/15/22 15:08

Environmental Services
350 Hills St. Suite 107, Richland, WA 99354
Phone: 509-377-8058 **Fax:** 509-377-8464

ENERGY NORTHWEST

Chain of Custody
Services Sales Order

Environmental Services
350 Hills Street Suite 107, Richland, WA 99354
Phone: 509-377-8058 Fax: 509-377-8464

Account Information

Company Name: City of West Richland Public Works
Customer Contact: Drew Woodruff
Mailing Address: 3100 Belmont Blvd West Richland, WA 99353
Billing Adress (*if different*):
Email: drew@westrichland.org Phone: 509-967-5434
Receive Invoice: ☐ Hard Copy ☒ Email
Receive Report: ☐ Hard Copy ☒ Email

Project ID:
Order ID: 230275

Requested Tests: TSS SM 2540D

Matrix
S - Soil
WW - Waste Water
DW - Drinking Water
O - Oil
N - NPDES
Ot - Other

Rush TAT
☐ Yes ☐ No
# of working days: ____
Date Requested: ________

Lab Use Only	Sample Identification (Location, Name, Code, etc)	Collection Date	Collection Time	Matrix	Number of Bottles	TSS SM 2540D
01	SPG-Storm3-Infl	9/15	10:05	WW	1	X
02	SPG-Storm3-Inf2	↓	10:10	↓	↓	X
03	-Inf3	↓	10:15	↓	↓	X
04	-Loc1	↓	10:25	↓	↓	X
05	-Loc2	↓	↓	↓	↓	X
06	-Loc3	↓	↓	↓	↓	X
07	-Loc4	↓	↓	↓	↓	X
08	-Loc5	↓	↓	↓	↓	X
09	-Loc6	↓	↓	↓	↓	X
10	-Loc7	↓	↓	↓	↓	X
11	-Loc8	↓	↓	↓	↓	X
12	-end	↓	↓	↓	↓	X

Comments
Please include QA/QC results w/ report + forward results to taylor@evergreenstormh2o.com

Being duly authorized and empowered by Customer, by signing below, Customer agrees to having reviewed, understood, and is fully accepting of the terms on the reverse side of this form.

Print / Signature	Date / Time	Print / Signature	Date / Time
Relinquished by: Taylor Hollman Bullock	9/15 1451	Received by:	
Relinquished by:		Received by:	
Accepted by lab: [signature]	09/15/22 1451		

Payment Type (*circle*) ☐ Paid
CC Check
Amount
$

Please make all checks payable to Energy Northwest

Sample Condition at Receipt
Temperature (*circle*):
Ambient *Cold* *Frozen*
☐ Containers intact/ Lids tight
☐ VOC Vials w/o Headspace
☐ Labels Match Custody

26334 R2

ENERGY NORTHWEST

environmental services

Sample Receipt Form

Company Name: City of West Richland   Date/Time: 09/15/22 1451

Customer Contact: Drew Woodruff

Turnaround time: Normal ☒ Rush ☐ _____ days

Samples Received via: Fedex ☐ UPS ☐ USPS ☐ Customer ☒ Other ☐: __________

Number of coolers/boxes: 1   Type of Ice: Ice Cubes ☐ Ice Packs ☐ Dry Ice ☐ None ☒

Sample(s) Temp as Read (°C): NA   Corrected Temp (°C): ____   Thermometer ID: ______

Question	Answer	Comments:
Chain of Custody Present?	Yes	
Samples Received Intact?	Yes	
Samples Received within hold time?	Yes	
40 mL Vials Free of Headspace?	N/A	
40 mL Vials Trip blank Present?	N/A	
Samples Properly Preserved?	N/A	
Bottle Labels and C.O.C/WSI Agree?	Yes	
Total Number of Bottles Received?	36	

Question	Answer	Comments
Chain of Custody Fully Completed?	Yes	
Correct bottles/containers Received?	Yes	
ENW Bottles Used?	Yes	

Preservatives for bottles/containers:

Comments:

WO: 230274 - 230276

Received by: [signature]   Date/Time: 09/15/22 15:08

Environmental Services
350 Hills St. Suite 107, Richland, WA 99354
Phone: 509-377-8058 **Fax:** 509-377-8464

Report of Analysis

For: **City of West Richland**
3801 Van Giesen
W Richland, WA 99353
Attn: Drew Woodruff

Cust Sample #: SPG-Storm 3-Loc 6 **Lab Sample ID:** 230275-09
Site: City of West Richland **Collection Date:** 9/15/2022 10:25 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	240 mg/L	10	jhill	LB030	9/19/2022	13:00

Cust Sample #: SPG-Storm 3-Loc 7 **Lab Sample ID:** 230275-10
Site: City of West Richland **Collection Date:** 9/15/2022 10:25 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	170 mg/L	10	jhill	LB030	9/19/2022	13:00

Cust Sample #: SPG-Storm 3-Loc 8 **Lab Sample ID:** 230275-11
Site: City of West Richland **Collection Date:** 9/15/2022 10:25 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	160 mg/L	10	jhill	LB030	9/19/2022	13:00

Cust Sample #: SPG-Storm 3-end **Lab Sample ID:** 230275-12
Site: City of West Richland **Collection Date:** 9/15/2022 10:25 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	42 mg/L	5	jhill	LB030	9/19/2022	13:00

Cust Sample #: PG - Storm 6- Inf 1 **Lab Sample ID:** 230276-01
Site: City of West Richland **Collection Date:** 9/15/2022 12:50 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	160 mg/L	2	jhill	LB030	9/19/2022	13:00

Cust Sample #: PG - Storm 6- Inf 2 **Lab Sample ID:** 230276-02
Site: City of West Richland **Collection Date:** 9/15/2022 12:55 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	120 mg/L	2	jhill	LB030	9/19/2022	13:00

Cust Sample #: PG - Storm 6- Inf 3 **Lab Sample ID:** 230276-03
Site: City of West Richland **Collection Date:** 9/15/2022 1:00 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	93 mg/L	2	jhill	LB030	9/19/2022	13:00

Cust Sample #: PG - Storm 6- Loc 1 **Lab Sample ID:** 230276-04
Site: City of West Richland **Collection Date:** 9/15/2022 1:25 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	5100 mg/L	10	jhill	LB030	9/19/2022	13:00

Cust Sample #: PG - Storm 6- Loc 2 **Lab Sample ID:** 230276-05
Site: City of West Richland **Collection Date:** 9/15/2022 1:25 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	3300 mg/L	10	jhill	LB030	9/19/2022	13:00

Cust Sample #: PG - Storm 6- Loc 3 **Lab Sample ID:** 230276-06
Site: City of West Richland **Collection Date:** 9/15/2022 1:25 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	1200 mg/L	10	jhill	LB030	9/19/2022	13:00

Cust Sample #: PG - Storm 6- Loc 4 **Lab Sample ID:** 230276-07
Site: City of West Richland **Collection Date:** 9/15/2022 1:25 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	770 mg/L	10	jhill	LB030	9/19/2022	13:00

Cust Sample #: PG - Storm 6- Loc 5 **Lab Sample ID:** 230276-08
Site: City of West Richland **Collection Date:** 9/15/2022 1:25 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	300 mg/L	10	jhill	LB030	9/19/2022	13:00

Cust Sample #: PG - Storm 6- Loc 6 **Lab Sample ID:** 230276-09
Site: City of West Richland **Collection Date:** 9/15/2022 1:25 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	350 mg/L	10	jhill	LB030	9/19/2022	13:00

Cust Sample #: PG - Storm 6- Loc 7 **Lab Sample ID:** 230276-10
Site: City of West Richland **Collection Date:** 9/15/2022 1:25 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	110 mg/L	10	jhill	LB030	9/19/2022	13:00

Cust Sample #: PG - Storm 6- Loc 8 **Lab Sample ID:** 230276-11
Site: City of West Richland **Collection Date:** 9/15/2022 1:25 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	47 mg/L	5	jhill	LB030	9/19/2022	13:00

Cust Sample #:	PG - Storm 6- end	**Lab Sample ID:**	230276-12	
Site:	City of West Richland	**Collection Date:**	9/15/2022	1:25 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	110 mg/L	5	jhill	LB030	9/19/2022	13:00

QC Results

QCBatch ID	QC ID	Parameter	% Recovery / RPD	Control Limits
LB030	230275-11: Replicate 1	Total suspended solids	0.5473	0 - 5
	230276-07: Replicate 2	Total suspended solids	2.234	0 - 5
	LCS 1	Total suspended solids	96.2	77.1 - 110
	MB 1	Total suspended solids	-0.14	- 1

Qualifier: * Replicate RPD outside acceptable range of <5%. A sample and its replicate may vary due to sample matrix and concentration.
Other QC within acceptable range. Samples reported without qualification.

Approved: 23-Sep-22

M Turner, Laboratory Manager

ENERGY NORTHWEST

Chain of Custody
Services Sales Order

Environmental Services
350 Hills Street Suite 107, Richland, WA 99354
Phone: 509-377-8058 Fax: 509-377-8464

Account Information	Project ID	Order ID
Company Name: City of West Richland Public Works Customer Contact: Drew Woodruff		230275

Mailing Address: 3100 Belmont Blvd
West Richland, WA 99353

Billing Adress (*if different*) :

Email: drew@westrichland.org Phone: 509-967-5434

Receive Invoice: ☐ Hard Copy ☒ Email Receive Report: ☐ Hard Copy ☒ Email

Requested Tests: TSS SM 2540D

Lab Use Only	Sample Identification (Location, Name, Code, etc)	Collection Date	Collection Time	Matrix	Number of Bottles	TSS SM 2540D
01	SPG-Storm3-Infl	9/15	10:05	WW	1	X
02	SPG-Storm3-Inf2		10:10			X
03	-Inf3		10:15			X
04	-Loc1		10:25			X
05	-Loc2					X
06	-Loc 3					X
07	-Loc4					X
08	-Loc5					X
09	-Loc6					X
10	-Loc7					X
11	-Loc8					X
12	-end					X

Matrix
S - Soil
WW - Waste Water
DW - Drinking Water
O - Oil
N - NPDES
Ot - Other

Rush TAT
☐ Yes ☐ No
# of working days: ____
Date Requested: ________

Comments
Please include QA/QC results w/ report + forward results to taylor@evergreenstormh2o.com

Being duly authorized and empowered by Customer, by signing below, Customer agrees to having reviewed, understood, and is fully accepting of the terms on the reverse side of this form.

Print / Signature	Date / Time	Print / Signature	Date / Time
Relinquished by: Taylor Holloman Bullock	9/15 1451	Received by:	
Relinquished by:		Received by:	
Accepted by lab: [signature]	09/15/22 1451		

Payment Type (*circle*) ☐ Paid CC Check Amount $

Please make all checks payable to Energy Northwest

Sample Condition at Receipt
Temperature (*circle*): *Ambient Cold Frozen*
☐ Containers intact/ Lids tight
☐ VOC Vials w/o Headspace
☐ Labels Match Custody

26334 R2

ENERGY NORTHWEST

environmental services

Sample Receipt Form

Company Name: City of West Richland Date/Time: 09/15/22 1451

Customer Contact: Drew Woodruff

Turnaround time: Normal ☒ Rush ☐ ____ days

Samples Received via: Fedex ☐ UPS ☐ USPS ☐ Customer ☒ Other ☐: ________

Number of coolers/boxes: 1 Type of Ice: Ice Cubes ☐ Ice Packs ☐ Dry Ice ☐ None ☒

Sample(s) Temp as Read (°C): NA Corrected Temp (°C): ____ Thermometer ID: ____

	Yes	No	N/A	Comments:
Chain of Custody Present?	Yes	No	N/A	
Samples Received Intact?	Yes	No	N/A	
Samples Received within hold time?	Yes	No	N/A	
40 mL Vials Free of Headspace?	Yes	No	N/A	
40 mL Vials Trip blank Present?	Yes	No	N/A	
Samples Properly Preserved?	Yes	No	N/A	
Bottle Labels and C.O.C/WSI Agree?	Yes	No	N/A	
Total Number of Bottles Received?	36			

Chain of Custody Fully Completed?	Yes	No	N/A	
Correct bottles/containers Received?	Yes	No	N/A	
ENW Bottles Used?	Yes	No	unkn	

Preservatives for bottles/containers:

Comments:

WO: 230274 - 230276

Received by: [signature] Date/Time: 09/15/22 15:08

Environmental Services
350 Hills St. Suite 107, Richland, WA 99354
Phone: 509-377-8058 **Fax:** 509-377-8464

ENERGY NORTHWEST

Chain of Custody Services Sales Order

Environmental Services
350 Hills Street Suite 107, Richland, WA 99354
Phone: 509-377-8058 Fax: 509-377-8464

Account Information

Company Name: City of West Richland Public Works
Customer Contact: Drew Woodruff
Mailing Address: 3100 Belmont Blvd West Richland, WA 99353
Billing Adress (if different):
Email: drew@westrichland.org Phone: 509-967-5434
Receive Invoice: ☐ Hard Copy ☒ Email Receive Report: ☐ Hard Copy ☒ Email

Project ID:
Order ID: 230276

Requested Tests: TSS SM2540D

Matrix
S - Soil
WW - Waste Water
DW - Drinking Water
O - Oil
N - NPDES
Ot - Other

Rush TAT
☐ Yes ☐ No
# of working days: ____
Date Requested: ____

Lab Use Only	Sample Identification (Location, Name, Code, etc)	Collection Date	Collection Time	Matrix	Number of Bottles	TSS SM2540D	Comments
01	PG-Storm6-Inf1	9/15	12:50p	WW	1	X	Please include
02	-Inf2	↓	12:55	↓	↓	X	QA/QC results
03	-Inf3		1:00			X	w/report +
04	-Loc1		1:25			X	forward results
05	-Loc2		↓			X	to taylor@
06	-Loc3					X	evergreenstorm
07	-Loc4					X	h2o.com
08	-Loc5					X	
09	-Loc6					X	
10	-Loc7					X	
11	-Loc8					X	
12	-end	↓	↓	↓	↓	X	

Being duly authorized and empowered by Customer, by signing below, Customer agrees to having reviewed, understood, and is fully accepting of the terms on the reverse side of this form.

	Print / Signature	Date / Time		Print / Signature	Date / Time
Relinquished by:	Taylor Hallman Ballard	9/15 1451	Received by:		
Relinquished by:			Received by:		
Accepted by lab:	DSA	09/15/22 1451			

Payment Type (circle) ☐ Paid Amount
CC Check $

Please make all checks payable to Energy Northwest

Sample Condition at Receipt
Temperature (circle):
Ambient *Cold* *Frozen*
☐ Containers intact/ Lids tight
☐ VOC Vials w/o Headspace
☐ Labels Match Custody

ENERGY NORTHWEST

environmental services

Sample Receipt Form

Company Name: City of West Richland   Date/Time: 09/15/22 1451

Customer Contact: Drew Woodruff

Turnaround time: Normal ☒ Rush ☐ ____ days

Samples Received via: Fedex ☐ UPS ☐ USPS ☐ Customer ☒ Other ☐: ____

Number of coolers/boxes: 1   Type of Ice: Ice Cubes ☐ Ice Packs ☐ Dry Ice ☐ None ☒

Sample(s) Temp as Read (°C): NA Corrected Temp (°C): ____ Thermometer ID: ____

				Comments:
Chain of Custody Present?	Yes	No	N/A	
Samples Received Intact?	Yes	No	N/A	
Samples Received within hold time?	Yes	No	N/A	
40 mL Vials Free of Headspace?	Yes	No	N/A	
40 mL Vials Trip blank Present?	Yes	No	N/A	
Samples Properly Preserved?	Yes	No	N/A	
Bottle Labels and C.O.C/WSI Agree?	Yes	No	N/A	
Total Number of Bottles Received?	36			

Chain of Custody Fully Completed?	Yes	No	N/A	
Correct bottles/containers Received?	Yes	No	N/A	
ENW Bottles Used?	Yes	No	unkn	

Preservatives for bottles/containers:

Comments:

WO: 230274 - 230276

Received by: [signature]   Date/Time: 09/15/22 15:08

Environmental Services
350 Hills St. Suite 107, Richland, WA 99354
Phone: 509-377-8058 **Fax:** 509-377-8464

Report of Analysis

For: **City of West Richland**
3801 Van Giesen
W Richland, WA 99353
Attn: Drew Woodruff

Cust Sample #: SPG-Storm 4-Inf 1 **Lab Sample ID:** 230286-01
Site: City of West Richland **Collection Date:** 9/16/2022 7:45 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	150 mg/L	2	jhill	LB028	9/19/2022	9:00

Cust Sample #: SPG-Storm 4-Inf 2 **Lab Sample ID:** 230286-02
Site: City of West Richland **Collection Date:** 9/16/2022 7:50 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	110 mg/L	2	jhill	LB028	9/19/2022	9:00

Cust Sample #: SPG-Storm 4-Inf 3 **Lab Sample ID:** 230286-03
Site: City of West Richland **Collection Date:** 9/16/2022 7:55 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	63 mg/L	1	jhill	LB028	9/19/2022	9:00

Cust Sample #: SPG-Storm 4-Loc 1 **Lab Sample ID:** 230286-04
Site: City of West Richland **Collection Date:** 9/16/2022 8:05 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	1000 mg/L	5	jhill	LB028	9/19/2022	9:00

Cust Sample #: SPG-Storm 4-Loc 2 **Lab Sample ID:** 230286-05
Site: City of West Richland **Collection Date:** 9/16/2022 8:05 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	1300 mg/L	10	jhill	LB028	9/19/2022	9:00

Cust Sample #: SPG-Storm 4-Loc 3 **Lab Sample ID:** 230286-06
Site: City of West Richland **Collection Date:** 9/16/2022 8:05 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	380 mg/L	5	jhill	LB028	9/19/2022	9:00

Cust Sample #: SPG-Storm 4-Loc 4 **Lab Sample ID:** 230286-07
Site: City of West Richland **Collection Date:** 9/16/2022 8:05 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	1300 mg/L	10	jhill	LB028	9/19/2022	9:00

Cust Sample #: SPG-Storm 4-Loc 5 **Lab Sample ID:** 230286-08
Site: City of West Richland **Collection Date:** 9/16/2022 8:05 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	240 mg/L	10	jhill	LB028	9/19/2022	9:00

Cust Sample #: SPG-Storm 4-Loc 6 **Lab Sample ID:** 230286-09
Site: City of West Richland **Collection Date:** 9/16/2022 8:05 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	230 mg/L	10	jhill	LB028	9/19/2022	9:00

Cust Sample #: SPG-Storm 4-Loc 7 **Lab Sample ID:** 230286-10
Site: City of West Richland **Collection Date:** 9/16/2022 8:05 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	140 mg/L	10	jhill	LB028	9/19/2022	9:00

Cust Sample #: SPG-Storm 4-Loc 8 **Lab Sample ID:** 230286-11
Site: City of West Richland **Collection Date:** 9/16/2022 8:05 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	160 mg/L	5	jhill	LB028	9/19/2022	9:00

Cust Sample #: SPG-Storm 4-end **Lab Sample ID:** 230286-12
Site: City of West Richland **Collection Date:** 9/16/2022 8:05 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	27 mg/L	2	jhill	LB028	9/19/2022	9:00

Cust Sample #: SPG-Storm 5-Inf 1 **Lab Sample ID:** 230287-01
Site: City of West Richland **Collection Date:** 9/19/2022 9:45 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	120 mg/L	2	jhill	LB028	9/19/2022	9:00

Cust Sample #: SPG-Storm 5-Inf 2 **Lab Sample ID:** 230287-02
Site: City of West Richland **Collection Date:** 9/19/2022 9:50 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	120 mg/L	2	jhill	LB028	9/19/2022	9:00

Cust Sample #: SPG-Storm 5-Inf 3 **Lab Sample ID:** 230287-03
Site: City of West Richland **Collection Date:** 9/19/2022 9:55 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	480 mg/L	10	jhill	LB028	9/19/2022	9:00

Cust Sample #: SPG-Storm 5-Loc 1 **Lab Sample ID:** 230287-04
Site: City of West Richland **Collection Date:** 9/19/2022 10:05 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	1300 mg/L	10	jhill	LB028	9/19/2022	9:00

Cust Sample #: SPG-Storm 5-Loc 2 **Lab Sample ID:** 230287-05
Site: City of West Richland **Collection Date:** 9/19/2022 10:05 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	1700 mg/L	10	jhill	LB028	9/19/2022	9:00

Cust Sample #: SPG-Storm 5-Loc 3 **Lab Sample ID:** 230287-06
Site: City of West Richland **Collection Date:** 9/19/2022 10:05 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	400 mg/L	10	jhill	LB028	9/19/2022	9:00

Cust Sample #: SPG-Storm 5-Loc 4 **Lab Sample ID:** 230287-07
Site: City of West Richland **Collection Date:** 9/19/2022 10:05 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	1200 mg/L	10	jhill	LB028	9/19/2022	9:00

Cust Sample #: SPG-Storm 5-Loc 5 **Lab Sample ID:** 230287-08
Site: City of West Richland **Collection Date:** 9/19/2022 10:05 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	320 mg/L	10	jhill	LB028	9/19/2022	9:00

QC Results

QCBatch ID	QC ID	Parameter	% Recovery / RPD	Control Limits
LB028	230286-05: Replicate 1	Total suspended solids	4.8295	0 - 5
	230287-05: Replicate 2	Total suspended solids	0.4935	0 - 5
	LCS 1	Total suspended solids	95.35	77.1 - 110
	MB 1	Total suspended solids	-0.33	- 1

Qualifier: * Replicate RPD outside acceptable range of <5%. A sample and its replicate may vary due to sample matrix and concentration.
Other QC within acceptable range. Samples reported without qualification.

Approved: 23-Sep-22

M Turner, Laboratory Manager

ENERGY NORTHWEST

Chain of Custody Services Sales Order

Environmental Services
350 Hills Street Suite 107, Richland, WA 99354
Phone: 509-377-8058 Fax: 509-377-8464

Account Information

Company Name: City of West Richland Public Works
Customer Contact: Drew Woodruff
Project ID:
Order ID: 230286
Mailing Address: 3100 Belmont Blvd West Richland, WA 99353
Billing Adress (if different):
Email: drew@westrichland.org Phone: 509-967-5434
Receive Invoice: ☐ Hard Copy ☒ Email Receive Report: ☐ Hard Copy ☒ Email

Matrix: S - Soil, WW - Waste Water, DW - Drinking Water, O - Oil, N - NPDES, Ot - Other

Rush TAT: ☐ Yes ☐ No
# of working days: ____
Date Requested: ____

Comments: Please include QA/QC results w/ report + forward results to taylor@evergreenstormh2o.com

Lab Use Only	Sample Identification (Location, Name, Code, etc)	Collection Date	Collection Time	Matrix	Number of Bottles	TSS SM2540D
	SPG-Storm4-Inf 1	9/16	7:45	WW	1	X
	-Inf 2	↓	7:50	↓	↓	X
	-Inf 3	↓	7:55	↓	↓	X
	-Loc 1	↓	8:05	↓	↓	X
	-Loc 2	↓	↓	↓	↓	X
	-Loc 3	↓	↓	↓	↓	X
	-Loc 4	↓	↓	↓	↓	X
	-Loc 5	↓	↓	↓	↓	X
	-Loc 6	↓	↓	↓	↓	X
	-Loc 7	↓	↓	↓	↓	X
	-Loc 8	↓	↓	↓	↓	X
	-end	↓	↓	↓	↓	X

Being duly authorized and empowered by Customer, by signing below, Customer agrees to having reviewed, understood, and is fully accepting of the terms on the reverse side of this form.

Print / Signature	Date / Time	Print / Signature	Date / Time
Relinquished by: Taylor Allen Bell [signature]	9/19 12:25	Received by:	
Relinquished by:		Received by:	
Accepted by lab: [signature]	09/19 12:25		

Payment Type (circle): ☐ Paid CC Check
Amount $

Please make all checks payable to Energy Northwest

Sample Condition at Receipt
Temperature (circle): *Ambient Cold Frozen*
☐ Containers intact/ Lids tight
☐ VOC Vials w/o Headspace
☐ Labels Match Custody

26334 R2

ENERGY NORTHWEST

environmental services

Sample Receipt Form

Company Name: City of West Richland

Date/Time: 09/19/22 12:25

Customer Contact: Drew Woodruff

Turnaround time: Normal ☒ Rush ☐ ____ days

Samples Received via: Fedex ☐ UPS ☐ USPS ☐ Customer ☒ Other ☐: ______

Number of coolers/boxes: 1 Type of Ice: Ice Cubes ☒ Ice Packs ☐ Dry Ice ☐ None ☐

Sample(s) Temp as Read (°C): NA Corrected Temp (°C): ____ Thermometer ID: ______

				Comments:
Chain of Custody Present?	Yes	No	N/A	
Samples Received Intact?	Yes	No	N/A	
Samples Received within hold time?	Yes	No	N/A	
40 mL Vials Free of Headspace?	Yes	No	N/A	
40 mL Vials Trip blank Present?	Yes	No	N/A	
Samples Properly Preserved?	Yes	No	N/A	
Bottle Labels and C.O.C/WSI Agree?	Yes	No	N/A	
Total Number of Bottles Received?	24			

Chain of Custody Fully Completed?	Yes	No	N/A	
Correct bottles/containers Received?	Yes	No	N/A	
ENW Bottles Used?	Yes	No	unkn	

Preservatives for bottles/containers:

NA

Comments:

Received by: [signature] Date/Time: 09/19/22

Environmental Services
350 Hills St. Suite 107, Richland, WA 99354
Phone: 509-377-8058 **Fax:** 509-377-8464

ENERGY NORTHWEST

Chain of Custody Services Sales Order

Environmental Services
350 Hills Street Suite 107, Richland, WA 99354
Phone: 509-377-8058 Fax: 509-377-8464

Account Information

Company Name: City of West Richland Public Works
Customer Contact: Drew Woodruff
Mailing Address: 3100 Belmont Blvd
West Richland, WA 99353
Billing Adress (*if different*):
Email: drew@westrichland.org Phone: 509-967-5434
Receive Invoice: ☐ Hard Copy ☒ Email Receive Report: ☐ Hard Copy ☒ Email

Project ID:

Order ID: 23287

Requested Tests: TSS SM2540D

Matrix
S - Soil
WW - Waste Water
DW - Drinking Water
O - Oil
N - NPDES
Ot - Other

Rush TAT
☐ Yes ☐ No
# of working days: ____
Date Requested: ______

Lab Use Only	Sample Identification (*Location, Name, Code, etc*)	Collection Date	Collection Time	Matrix	Number of Bottles	TSS SM2540D
	SPG-Storm 5-Inf1	9/19	9:48	WW	1	X
	-Inf2		9:50			X
	-Inf3		9:55			X
	-Loc1		10:05			X
	-Loc2					X
	-Loc3					X
	-Loc4					X
	-Loc5					X
	-Loc6					X
	-Loc7					X
	-Loc8					X
	-end					X

Comments: Please include QA/QC results w/ report + forward results to taylor@evergreenstormh2o.com

Being duly authorized and empowered by Customer, by signing below, Customer agrees to having reviewed, understood, and is fully accepting of the terms on the reverse side of this form.

	Print / Signature	Date / Time		Print / Signature	Date / Time
Relinquished by:	Taylor Heller Bell	9/19 12:25p	Received by:		
Relinquished by:			Received by:		
Accepted by lab:	[signature]	09/19/22 12:25			

Payment Type (circle) ☐ Paid CC Check
Amount $

Please make all checks payable to Energy Northwest

Sample Condition at Receipt
Temperature (*circle*): *Ambient* *Cold* *Frozen*
☐ Containers Intact/ Lids tight
☐ VOC Vials w/o Headspace
☐ Labels Match Custody

26334 R2

ENERGY NORTHWEST

environmental services

Sample Receipt Form

Company Name: City of West Richland

Date/Time: 09/19/22 12:25

Customer Contact: Drew Woodruff

Turnaround time: Normal ☒ Rush ☐ _____ days

Samples Received via: Fedex ☐ UPS ☐ USPS ☐ Customer ☒ Other ☐: ________

Number of coolers/boxes: 1 Type of Ice: Ice Cubes ☒ Ice Packs ☐ Dry Ice ☐ None ☐

Sample(s) Temp as Read (°C): NA Corrected Temp (°C): _____ Thermometer ID: ________

Question	Yes	No	N/A	Comments
Chain of Custody Present?	Yes (circled)	No	N/A	
Samples Received Intact?	Yes (circled)	No	N/A	
Samples Received within hold time?	Yes (circled)	No	N/A	
40 mL Vials Free of Headspace?	Yes	No	N/A (circled)	
40 mL Vials Trip blank Present?	Yes	No	N/A (circled)	
Samples Properly Preserved?	Yes	No	N/A (circled)	
Bottle Labels and C.O.C/WSI Agree?	Yes (circled)	No	N/A	
Total Number of Bottles Received?	24			

Question	Yes	No	N/A	Comments
Chain of Custody Fully Completed?	Yes (circled)	No	N/A	
Correct bottles/containers Received?	Yes (circled)	No	N/A	
ENW Bottles Used?	Yes (circled)	No	unkn	

Preservatives for bottles/containers:

NA

Comments:

Received by: [signature]

Date/Time: 09/19/22

Environmental Services
350 Hills St. Suite 107, Richland, WA 99354
Phone: 509-377-8058 **Fax:** 509-377-8464

Report of Analysis

ENERGY NORTHWEST
PRECISION LABS

For: **City of West Richland**
3801 Van Giesen
W Richland, WA 99353
Attn: Drew Woodruff

Cust Sample #: SPG-Storm 6 - Inf 1 **Lab Sample ID:** 230291-01
Site: City of West Richland **Collection Date:** 9/20/2022 7:49 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	180 mg/L	2	jhill	LB031	9/21/2022	9:00

Cust Sample #: SPG-Storm 6 - Inf 2 **Lab Sample ID:** 230291-02
Site: City of West Richland **Collection Date:** 9/20/2022 7:49 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	160 mg/L	2	jhill	LB031	9/21/2022	9:00

Cust Sample #: SPG-Storm 6 - Inf 3 **Lab Sample ID:** 230291-03
Site: City of West Richland **Collection Date:** 9/20/2022 7:49 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	100 mg/L	2	jhill	LB031	9/21/2022	9:00

Cust Sample #: SPG-Storm 6 - Loc 1 **Lab Sample ID:** 230291-04
Site: City of West Richland **Collection Date:** 9/20/2022 7:49 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	1200 mg/L	10	jhill	LB031	9/21/2022	9:00

Cust Sample #: SPG-Storm 6 - Loc 2 **Lab Sample ID:** 230291-05
Site: City of West Richland **Collection Date:** 9/20/2022 7:49 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	1100 mg/L	10	jhill	LB032	9/27/2022	7:00

Cust Sample #: SPG-Storm 6 - Loc 3 **Lab Sample ID:** 230291-06
Site: City of West Richland **Collection Date:** 9/20/2022 7:49 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	390 mg/L	10	jhill	LB032	9/27/2022	7:00

Cust Sample #: SPG-Storm 6 - Loc 4 **Lab Sample ID:** 230291-07
Site: City of West Richland **Collection Date:** 9/20/2022 7:49 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	1300 mg/L	10	jhill	LB032	9/27/2022	7:00

Cust Sample #:	SPG-Storm 6 - Loc 5	**Lab Sample ID:**	230291-08
Site:	City of West Richland	**Collection Date:**	9/20/2022 7:49 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed
Total suspended solids	SM 2540D	340 mg/L	10	jhill	LB032	9/27/2022 7:00

Cust Sample #:	SPG-Storm 6 - Loc 6	**Lab Sample ID:**	230291-09
Site:	City of West Richland	**Collection Date:**	9/20/2022 7:49 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed
Total suspended solids	SM 2540D	220 mg/L	5	jhill	LB032	9/27/2022 7:00

Cust Sample #:	SPG-Storm 6 - Loc 7	**Lab Sample ID:**	230291-10
Site:	City of West Richland	**Collection Date:**	9/20/2022 7:49 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed
Total suspended solids	SM 2540D	140 mg/L	5	jhill	LB032	9/27/2022 7:00

Cust Sample #:	SPG-Storm 6 - Loc 8	**Lab Sample ID:**	230291-11
Site:	City of West Richland	**Collection Date:**	9/20/2022 7:49 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed
Total suspended solids	SM 2540D	93 mg/L	5	jhill	LB032	9/27/2022 7:00

Cust Sample #:	SPG-Storm 6 - end	**Lab Sample ID:**	230291-12
Site:	City of West Richland	**Collection Date:**	9/20/2022 7:49 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed
Total suspended solids	SM 2540D	83 mg/L	2	jhill	LB032	9/27/2022 7:00

QC Results

QCBatch ID	QC ID	Parameter	% Recovery / RPD	Control Limits
LB031	230291-04: Replicate 1	Total suspended solids	1.2068	0 - 5
	230296-05: Replicate 2	Total suspended solids	3.7001	0 - 5
	LCS 1	Total suspended solids	79.25	77.1 - 110
	MB 1	Total suspended solids	-0.3	- 1
LB032	230291-05: Replicate 1	Total suspended solids	1.9327	0 - 5
	LCS 1	Total suspended solids	88.45	77.1 - 110
	MB 1	Total suspended solids	0.0	- 1

Qualifier: * Replicate RPD outside acceptable range of <5%. A sample and its replicate may vary due to sample matrix and concentration. Other QC within acceptable range. Samples reported without qualification.

Approved: 30-Sep-22

M Turner, Laboratory Manager

ENERGY NORTHWEST

Chain of Custody
Services Sales Order

Environmental Services
350 Hills Street Suite 107, Richland, WA 99354
Phone: 509-377-8058 **Fax:** 509-377-8464

Account Information

Company Name: City of West Richland Public Works
Customer Contact: Drew Woodruff
Project ID:
Order ID: 230291
Mailing Address: 3100 Belmont Blvd West Richland, WA 99353
Billing Adress (*if different*):
Email: drew@westrichland.org Phone: 509-967-5434
Receive Invoice: ☐ Hard Copy ☒ Email Receive Report: ☐ Hard Copy ☒ Email

Requested Tests: TSS SM2540D

Lab Use Only	Sample Identification (*Location, Name, Code, etc*)	Collection Date	Collection Time	Matrix	Number of Bottles	TSS SM2540D	Comments
01	SP6-Storm6-Inf1	9/20/22	8:49	WW	1	X	Please include
02	-Inf2	9/20/22	8:49			X	QA/QC results
03	-Inf3	9/20/22	8:49			X	w/ report +
04	-Loc1	9/20/22	8:49			X	forward results
05	-Loc2	9/20/22	8:49			X	to taylor@
06	-Loc3	9/20/22	8:49			X	evergreenstorm
07	-Loc4	9/20/22	8:49			X	h2o.com
08	-Loc5	9/20/22	8:49			X	
09	-Loc6	9/20/22	8:49			X	
10	-Loc7	9/20/22	8:49			X	
11	-Loc8	9/20/22	8:49			X	
12	-end	9/20/22	8:49			X	
							Cooler Temp: 11°C ~~on receipt~~ TN 9/20/22

Matrix: S - Soil; WW - Waste Water; DW - Drinking Water; O - Oil; N - NPDES; Ot - Other

Rush TAT: ☐ Yes ☐ No
# of working days: ____
Date Requested: ________

Being duly authorized and empowered by Customer, by signing below, Customer agrees to having reviewed, understood, and is fully accepting of the terms on the reverse side of this form.

	Print / Signature	Date / Time		Print / Signature	Date / Time
Relinquished by:	Andrew Woodruff	9/20/22 12:24	Received by:		
Relinquished by:			Received by:		
Accepted by lab:	Travis Nolan	9/20/22 @1224			

Payment Type (*circle*) ☐ Paid
CC Check
Amount $

Please make all checks payable to Energy Northwest

Sample Condition at Receipt
Temperature (*circle*): *Ambient* *Cold* *Frozen*
☐ Containers intact/ Lids tight
☐ VOC Vials w/o Headspace
☐ Labels Match Custody

2633

ENERGY NORTHWEST

environmental services

Sample Receipt Form

Company Name: City of West Richland Date/Time: 9/20/22 @ 1224

Customer Contact: Drew Woodruff

Turnaround time: Normal ☒ Rush ☐ _____ days

Samples Received via: Fedex ☐ UPS ☐ USPS ☐ Customer ☒ Other ☐: ____________

Number of coolers/boxes: 1 Type of Ice: Ice Cubes ☐ Ice Packs ☐ Dry Ice ☐ None ☒

Sample(s) Temp as Read (°C): 11 Corrected Temp (°C): 10.4 Thermometer ID: 0068740

				Comments:
Chain of Custody Present?	Yes	No	N/A	
Samples Received Intact?	Yes	No	N/A	
Samples Received within hold time?	Yes	No	N/A	
40 mL Vials Free of Headspace?	Yes	No	N/A	
40 mL Vials Trip blank Present?	Yes	No	N/A	
Samples Properly Preserved?	Yes	No	~~N/A~~	
Bottle Labels and C.O.~~C/WSI Agree?~~	Yes	No	N/A	
Total Number of Bottles Received?	12			12

Chain of Custody Fully Completed?	Yes	No	N/A	Client Added times to bottles
Correct bottles/containers Received?	Yes	No	N/A	
ENW Bottles Used?	Yes	No	unkn	

Preservatives for bottles/containers:

N/A

Comments:

Received by: Traci Nolan Date/Time: 9/20/22 @ 1224

Environmental Services
350 Hills St. Suite 107, Richland, WA 99354
Phone: 509-377-8058 **Fax:** 509-377-8464

Report of Analysis

For: **City of West Richland**
3801 Van Giesen
W Richland, WA 99353
Attn: Drew Woodruff

Cust Sample #: Influent Background | **Lab Sample ID:** 230401-01
Site: City of West Richland | **Collection Date:** 10/17/2022 12:00 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	9.4 mg/L	2	jhill	LB035	10/19/202	8:00

Cust Sample #: #1 | **Lab Sample ID:** 230401-02
Site: City of West Richland | **Collection Date:** 10/17/2022 12:00 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	58 mg/L	5	jhill	LB035	10/19/202	8:00

Cust Sample #: #2 | **Lab Sample ID:** 230401-03
Site: City of West Richland | **Collection Date:** 10/17/2022 12:00 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	22 mg/L	5	jhill	LB035	10/19/202	8:00

Cust Sample #: #3 | **Lab Sample ID:** 230401-04
Site: City of West Richland | **Collection Date:** 10/17/2022 12:00 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	33 mg/L	5	jhill	LB035	10/19/202	8:00

Cust Sample #: #4 | **Lab Sample ID:** 230401-05
Site: City of West Richland | **Collection Date:** 10/17/2022 12:00 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	29 mg/L	5	jhill	LB035	10/19/202	8:00

Cust Sample #: #5 | **Lab Sample ID:** 230401-06
Site: City of West Richland | **Collection Date:** 10/17/2022 12:00 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	20 mg/L	5	jhill	LB035	10/19/202	8:00

Cust Sample #: #6 | **Lab Sample ID:** 230401-07
Site: City of West Richland | **Collection Date:** 10/17/2022 12:00 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	31 mg/L	5	jhill	LB035	10/19/202	8:00

Cust Sample #:	#7	**Lab Sample ID:**	230401-08
Site:	City of West Richland	**Collection Date:**	10/17/2022 12:00 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	31 mg/L	5	jhill	LB035	10/19/202	8:00

Cust Sample #:	#7	**Lab Sample ID:**	230401-09
Site:	City of West Richland	**Collection Date:**	10/17/2022 12:00 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	37 mg/L	5	jhill	LB035	10/19/202	8:00

QC Results

QCBatch ID	QC ID	Parameter	% Recovery / RPD	Control Limits
LB035	230400-11: Replicate 1	Total suspended solids	8.9767	0 - 5
	230401-09: Replicate 2	Total suspended solids	2.5083	0 - 5
	LCS 1	Total suspended solids	109.2	77.1 - 110
	MB 1	Total suspended solids	-0.63	- 1

Qualifier: * Replicate RPD outside acceptable range of <5%. A sample and its replicate may vary due to sample matrix and concentration. Other QC within acceptable range. Samples reported without qualification.

Approved: 28-Oct-22

M Turner, Laboratory Manager

ENERGY NORTHWEST

Chain of Custody Services Sales Order

Environmental Services
350 Hills Street Suite 107, Richland, WA 99354
Phone: 509-377-8058 **Fax:** 509-377-8464

Account Information

Company Name: City of West Richland Public Works

Customer Contact: Drew Woodruff

Mailing Address: 3100 Belmont Blvd West Richland, WA 99353

Billing Adress (if different):

Email: drew@westrichland.org Phone: 509-967-5434

Receive Invoice: ☐ Hard Copy ☒ Email Receive Report: ☐ Hard Copy ☒ Email

Project ID:

Order ID: 230401

Requested Tests: SM 2540D TSS

Matrix: S - Soil, WW - Waste Water, DW - Drinking Water, O - Oil, N - NPDES, Ot - Other

Rush TAT: ☐ Yes ☐ No

# of working days: ____

Date Requested: ________

Lab Use Only	Sample Identification (Location, Name, Code, etc)	Collection Date	Collection Time	Matrix	Number of Bottles	SM 2540D TSS
01	Influent Bkgd	10/17	12:00p	WW	1	X
02	#1	↓	↓	↓	↓	X
03	#2	↓	↓	↓	↓	X
04	#3	↓	↓	↓	↓	X
05	#4	↓	↓	↓	↓	X
06	#5	↓	↓	↓	↓	X
07	#6	↓	↓	↓	↓	X
08	#7	↓	↓	↓	↓	X
09	#8	↓	↓	↓	↓	X

Comments: Please include QA/QC results w/ report + forward results to taylor@evergreenstorm h2o.com

Being duly authorized and empowered by Customer, by signing below, Customer agrees to having reviewed, understood, and is fully accepting of the terms on the reverse side of this form.

	Print / Signature	Date / Time		Print / Signature	Date / Time
Relinquished by:	Taylor Hallman Ballard	10/18/22 1550	Received by:		
Relinquished by:			Received by:		
Accepted by lab:	DSA	10/18/22 1550			

Payment Type (circle): ☐ Paid CC Check Amount $

Please make all checks payable to Energy Northwest

Sample Condition at Receipt
Temperature (circle): *Ambient Cold Frozen*
☐ Containers Intact/ Lids tight
☐ VOC Vials w/o Headspace
☐ Labels Match Custody

26334 R2

ENERGY NORTHWEST

environmental services

Sample Receipt Form

Company Name: City of West Richland

Date/Time: 10/18/22 1553

Customer Contact: Drew WoodRuff

Turnaround time: Normal ☐ Rush ☐ ____ days

Samples Received via: Fedex ☐ UPS ☐ USPS ☐ Customer ☒ Other ☐: ____________

Number of coolers/boxes: 2 Type of Ice: Ice Cubes ☒ Ice Packs ☐ Dry Ice ☐ None ☐

Sample(s) Temp as Read (°C): _____ Corrected Temp (°C): _____ Thermometer ID: __________

Question	Response	Comments
Chain of Custody Present?	Yes No N/A — Yes	
Samples Received Intact?	Yes No N/A — Yes	
Samples Received within hold time?	Yes No N/A — Yes	
40 mL Vials Free of Headspace?	Yes No N/A — N/A	
40 mL Vials Trip blank Present?	Yes No N/A — N/A	
Samples Properly Preserved?	Yes No N/A — N/A	
Bottle Labels and C.O.C/WSI Agree?	Yes No N/A — Yes	
Total Number of Bottles Received?	______	

Question	Response	Comments
Chain of Custody Fully Completed?	Yes No N/A — Yes	
Correct bottles/containers Received?	Yes No N/A — Yes	
ENW Bottles Used?	Yes No unkn — Yes	

Preservatives for bottles/containers:

Comments:

WO's 230399, 400, 401, 402, 403

Received by: [signature]

Date/Time: 10/18/22 1553

Environmental Services
350 Hills St. Suite 107, Richland, WA 99354
Phone: 509-377-8058 **Fax:** 509-377-8464

Report of Analysis

For: **City of West Richland**
3801 Van Giesen
W Richland, WA 99353
Attn: Drew Woodruff

Cust Sample #: GBD2-Storm 1- Inf 1 **Lab Sample ID:** 230399-01
Site: City of West Richland **Collection Date:** 10/17/2022 2:05 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	130 mg/L	2	jhill	LB034	10/20/202	13:00

Cust Sample #: GBD2-Storm 1- Inf 2 **Lab Sample ID:** 230399-02
Site: City of West Richland **Collection Date:** 10/17/2022 2:10 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	100 mg/L	2	jhill	LB034	10/20/202	13:00

Cust Sample #: GBD2-Storm 1- Inf 3 **Lab Sample ID:** 230399-03
Site: City of West Richland **Collection Date:** 10/17/2022 2:15 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	89 mg/L	2	jhill	LB034	10/20/202	13:00

Cust Sample #: GBD2-Storm 1 - Loc 1 **Lab Sample ID:** 230399-04
Site: City of West Richland **Collection Date:** 10/17/2022 2:55 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	55 mg/L	5	jhill	LB034	10/20/202	13:00

Cust Sample #: GBD2-Storm 1 - Loc 2 **Lab Sample ID:** 230399-05
Site: City of West Richland **Collection Date:** 10/17/2022 2:55 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	32 mg/L	5	jhill	LB034	10/20/202	13:00

Cust Sample #: GBD2-Storm 1 - Loc 3 **Lab Sample ID:** 230399-06
Site: City of West Richland **Collection Date:** 10/17/2022 2:55 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	27 mg/L	5	jhill	LB034	10/20/202	13:00

Cust Sample #: GBD2-Storm 1 - Loc 4 **Lab Sample ID:** 230399-07
Site: City of West Richland **Collection Date:** 10/17/2022 2:55 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	26 mg/L	5	jhill	LB034	10/20/202	13:00

Cust Sample #:	GBD2-Storm 1 - Loc 5	**Lab Sample ID:**	230399-08
Site:	City of West Richland	**Collection Date:**	10/17/2022 2:55 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed
Total suspended solids	SM 2540D	20 mg/L	5	jhill	LB034	10/20/202 13:00

Cust Sample #:	GBD2-Storm 1 - Loc 6	**Lab Sample ID:**	230399-09
Site:	City of West Richland	**Collection Date:**	10/17/2022 2:55 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed
Total suspended solids	SM 2540D	27 mg/L	5	jhill	LB034	10/20/202 13:00

Cust Sample #:	GBD2-Storm 1 - Loc 7	**Lab Sample ID:**	230399-10
Site:	City of West Richland	**Collection Date:**	10/17/2022 2:55 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed
Total suspended solids	SM 2540D	26 mg/L	5	jhill	LB034	10/20/202 13:00

Cust Sample #:	GBD2-Storm 1 - Loc 8	**Lab Sample ID:**	230399-11
Site:	City of West Richland	**Collection Date:**	10/17/2022 2:55 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed
Total suspended solids	SM 2540D	17 mg/L	5	jhill	LB034	10/20/202 13:00

QC Results

QCBatch ID	QC ID	Parameter	% Recovery / RPD	Control Limits
LB034	230399-03: Replicate 1	Total suspended solids	11.3604	0 - 5
	230400-07: Replicate 2	Total suspended solids	11.5119	0 - 5
	LCS 1	Total suspended solids	109.6	77.1 - 110
	MB 1	Total suspended solids	0.1	- 1

Qualifier: * Replicate RPD outside acceptable range of <5%. A sample and its replicate may vary due to sample matrix and concentration.
Other QC within acceptable range. Samples reported without qualification.

Approved: 28-Oct-22

M Turner, Laboratory Manager

ENERGY NORTHWEST

Chain of Custody Services Sales Order

Environmental Services
350 Hills Street Suite 107, Richland, WA 99354
Phone: 509-377-8058 **Fax:** 509-377-8464

Account Information

Company Name: City of West Richland Public Works

Customer Contact: Drew Woodruff

Mailing Address: 3100 Belmont Blvd, West Richland, WA 99353

Billing Adress (*if different*):

Email: drew@westrichland.org Phone: 509-967-5434

Receive Invoice: ☐ Hard Copy ☒ Email Receive Report: ☐ Hard Copy ☒ Email

Project ID:

Order ID: 230399

Requested Tests: TSS SM2540D

Lab Use Only	Sample Identification (*Location, Name, Code, etc*)	Collection Date	Collection Time	Matrix	Number of Bottles	TSS SM2540D
01	GBD2-Storm1-Inf1	10/17	2:05p	WW	1	X
02	-Inf2	↓	2:10	↓	↓	X
03	-Inf3	↓	2:15	↓	↓	X
04	-Loc1	↓	2:55	↓	↓	X
05	-Loc2	↓	↓	↓	↓	X
06	-Loc3	↓	↓	↓	↓	X
07	-Loc4	↓	↓	↓	↓	X
08	-Loc5	↓	↓	↓	↓	X
09	-Loc6	↓	↓	↓	↓	X
10	-Loc7	↓	↓	↓	↓	X
11	-Loc8	↓	↓	↓	↓	X

Matrix
S - Soil
WW - Waste Water
DW - Drinking Water
O - Oil
N - NPDES
Ot - Other

Rush TAT
☐ Yes ☐ No
# of working days: ____
Date Requested: ____

Comments
Please include QA/QC results w/ report & forward results to taylor@evergreenstormh2o.com

Being duly authorized and empowered by Customer, by signing below, Customer agrees to having reviewed, understood, and is fully accepting of the terms on the reverse side of this form.

Print / Signature	Date / Time	Print / Signature	Date / Time
Relinquished by: Taylor Ballard	10/18/22 15:50	Received by:	
Relinquished by:		Received by:	
Accepted by lab: [signature]	10/18/22 15:50		

Payment Type (circle) ☐ Paid
CC Check
Amount $

Please make all checks payable to Energy Northwest

Sample Condition at Receipt
Temperature (*circle*): *Ambient* *Cold* *Frozen*
☐ Containers Intact/ Lids tight
☐ VOC Vials w/o Headspace
☐ Labels Match Custody

26334 R2

ENERGY NORTHWEST

environmental services

Sample Receipt Form

Company Name: City of West Richland　　Date/Time: 10/18/22 1553

Customer Contact: Drew WoodRuff

Turnaround time:　Normal ☐　Rush ☐ _____ days

Samples Received via:　Fedex ☐　UPS ☐　USPS ☐　Customer ☒　Other ☐: __________

Number of coolers/boxes: 2　Type of Ice: Ice Cubes ☒　Ice Packs ☐　Dry Ice ☐　None ☐

Sample(s) Temp as Read (°C):_____　Corrected Temp (°C):_____　Thermometer ID:_________

				Comments:
Chain of Custody Present?	Yes	No	N/A	
Samples Received Intact?	Yes	No	N/A	
Samples Received within hold time?	Yes	No	N/A	
40 mL Vials Free of Headspace?	Yes	No	N/A	
40 mL Vials Trip blank Present?	Yes	No	N/A	
Samples Properly Preserved?	Yes	No	N/A	
Bottle Labels and C.O.C/WSI Agree?	Yes	No	N/A	
Total Number of Bottles Received?	_____			

Chain of Custody Fully Completed?	Yes	No	N/A	
Correct bottles/containers Received?	Yes	No	N/A	
ENW Bottles Used?	Yes	No	unkn	

Preservatives for bottles/containers:

Comments:

WO's 230399, 400, 401, 402, 403

Received by: [signature]　　Date/Time: 10/18/22 1553

Environmental Services
350 Hills St. Suite 107, Richland, WA 99354
Phone: 509-377-8058　**Fax:** 509-377-8464

Report of Analysis

For: **City of West Richland**
3801 Van Giesen
W Richland, WA 99353
Attn: Drew Woodruff

Cust Sample #: GBD2-Storm 2- Inf 1 **Lab Sample ID:** 230400-01
Site: City of West Richland **Collection Date:** 10/17/2022 3:40 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	120 mg/L	2	jhill	LB034	10/20/202	13:00

Cust Sample #: GBD2-Storm 2- Inf 2 **Lab Sample ID:** 230400-02
Site: City of West Richland **Collection Date:** 10/17/2022 3:45 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	130 mg/L	2	jhill	LB034	10/20/202	13:00

Cust Sample #: GBD2-Storm 2- Inf 3 **Lab Sample ID:** 230400-03
Site: City of West Richland **Collection Date:** 10/17/2022 3:50 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	110 mg/L	2	jhill	LB034	10/20/202	13:00

Cust Sample #: GBD2-Storm 2 - Loc 1 **Lab Sample ID:** 230400-04
Site: City of West Richland **Collection Date:** 10/17/2022 4:35 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	110 mg/L	5	jhill	LB034	10/20/202	13:00

Cust Sample #: GBD2-Storm 2 - Loc 2 **Lab Sample ID:** 230400-05
Site: City of West Richland **Collection Date:** 10/17/2022 4:35 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	54 mg/L	5	jhill	LB034	10/20/202	13:00

Cust Sample #: GBD2-Storm 2 - Loc 3 **Lab Sample ID:** 230400-06
Site: City of West Richland **Collection Date:** 10/17/2022 4:35 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	43 mg/L	5	jhill	LB034	10/20/202	13:00

Cust Sample #: GBD2-Storm 2 - Loc 4 **Lab Sample ID:** 230400-07
Site: City of West Richland **Collection Date:** 10/17/2022 4:35 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	31 mg/L	5	jhill	LB034	10/20/202	13:00

Cust Sample #: GBD2-Storm 2 - Loc 5 **Lab Sample ID:** 230400-08
Site: City of West Richland **Collection Date:** 10/17/2022 4:35 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	28 mg/L	5	jhill	LB034	10/20/202	13:00

Cust Sample #: GBD2-Storm 2 - Loc 6 **Lab Sample ID:** 230400-09
Site: City of West Richland **Collection Date:** 10/17/2022 4:35 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	22 mg/L	5	jhill	LB034	10/20/202	13:00

Cust Sample #: GBD2-Storm 2 - Loc 7 **Lab Sample ID:** 230400-10
Site: City of West Richland **Collection Date:** 10/17/2022 4:35 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	17 mg/L	5	jhill	LB035	10/19/202	8:00

Cust Sample #: GBD2-Storm 2 - Loc 8 **Lab Sample ID:** 230400-11
Site: City of West Richland **Collection Date:** 10/17/2022 4:35 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	15 mg/L	5	jhill	LB035	10/19/202	8:00

QC Results

QCBatch ID	QC ID	Parameter	% Recovery / RPD	Control Limits
LB034	230399-03: Replicate 1	Total suspended solids	11.3604	0 - 5
	230400-07: Replicate 2	Total suspended solids	11.5119	0 - 5
	LCS 1	Total suspended solids	109.6	77.1 - 110
	MB 1	Total suspended solids	0.1	- 1
LB035	230400-11: Replicate 1	Total suspended solids	8.9767	0 - 5
	230401-09: Replicate 2	Total suspended solids	2.5083	0 - 5
	LCS 1	Total suspended solids	109.2	77.1 - 110
	MB 1	Total suspended solids	-0.63	- 1

Qualifier: * Replicate RPD outside acceptable range of <5%. A sample and its replicate may vary due to sample matrix and concentration. Other QC within acceptable range. Samples reported without qualification.

Approved: 28-Oct-22

M Turner, Laboratory Manager

ENERGY NORTHWEST

Chain of Custody Services Sales Order

Environmental Services
350 Hills Street Suite 107, Richland, WA 99354
Phone: 509-377-8058 **Fax:** 509-377-8464

Account Information

Company Name: City of West Richland Public Works
Customer Contact: Drew Woodruff
Mailing Address: 3100 Belmont Blvd West Richland, WA 99353
Billing Adress (*if different*):
Email: drew@westrichland.org Phone: 509-967-5434
Receive Invoice: ☐ Hard Copy ☒ Email Receive Report: ☐ Hard Copy ☒ Email

Project ID:
Order ID: 230400

Requested Tests: TSS SM2540D

Matrix
S - Soil
WW - Waste Water
DW - Drinking Water
O - Oil
N - NPDES
Ot - Other

Rush TAT
☐ Yes ☐ No
# of working days:
Date Requested:

Lab Use Only	Sample Identification (*Location, Name, Code, etc*)	Collection Date	Collection Time	Matrix	Number of Bottles	TSS SM2540D
01	GBD2-Storm2-~~[illegible]~~ Inf1	~~10/17~~ 10/18	3:40p	WW	1	X
02	-Inf2	↓	3:45	↓	↓	X
03	-Inf3	↓	3:50	↓	↓	X
04	-Loc1	↓	4:35p	↓	↓	X
05	-Loc2	↓	↓	↓	↓	X
06	-Loc3	↓	↓	↓	↓	X
07	-Loc4	↓	↓	↓	↓	X
08	-Loc5	↓	↓	↓	↓	X
09	-Loc6	↓	↓	↓	↓	X
10	-Loc7	↓	↓	↓	↓	X
11	-Loc8	↓	↓	↓	↓	X

Comments
Please include QA/QC ~~[illegible]~~ results w/ report + forward report to taylor@evergreenstormh2o.com

Changed Collection date to match bottles. Bms 10/18/22

Being duly authorized and empowered by Customer, by signing below, Customer agrees to having reviewed, understood, and is fully accepting of the terms on the reverse side of this form.

Print / Signature	Date / Time	Print / Signature	Date / Time
Relinquished by: Taylor [signature]	10/18/22 3:50p	Received by:	
Relinquished by:		Received by:	
Accepted by lab: [signature]	10/18/22 15:50p		

Payment Type (circle) ☐ Paid CC Check Amount $

Please make all checks payable to Energy Northwest

Sample Condition at Receipt
Temperature (*circle*): *Ambient* *Cold* *Frozen*
☐ Containers Intact/ Lids tight
☐ VOC Vials w/o Headspace
☐ Labels Match Custody

26334 R2

ENERGY NORTHWEST

environmental services

Sample Receipt Form

Company Name: City of West Richland Date/Time: 10/18/22 1553

Customer Contact: Drew WoodRuff

Turnaround time: Normal ☐ Rush ☐ _____ days

Samples Received via: Fedex ☐ UPS ☐ USPS ☐ Customer ☒ Other ☐: __________

Number of coolers/boxes: 2 Type of Ice: Ice Cubes ☒ Ice Packs ☐ Dry Ice ☐ None ☐

Sample(s) Temp as Read (°C): _____ Corrected Temp (°C): _____ Thermometer ID: _____

				Comments:
Chain of Custody Present?	Yes	No	N/A	
Samples Received Intact?	Yes	No	N/A	
Samples Received within hold time?	Yes	No	N/A	
40 mL Vials Free of Headspace?	Yes	No	N/A	
40 mL Vials Trip blank Present?	Yes	No	N/A	
Samples Properly Preserved?	Yes	No	N/A	
Bottle Labels and C.O.C/WSI Agree?	Yes	No	N/A	
Total Number of Bottles Received?				

Chain of Custody Fully Completed?	Yes	No	N/A	
Correct bottles/containers Received?	Yes	No	N/A	
ENW Bottles Used?	Yes	No	unkn	

Preservatives for bottles/containers:

Comments:

WD's 230399, 400, 401, 402, 403

Received by: [signature] Date/Time: 10/18/22 1553

Environmental Services
350 Hills St. Suite 107, Richland, WA 99354
Phone: 509-377-8058 **Fax:** 509-377-8464

Report of Analysis

For: **City of West Richland**
3801 Van Giesen
W Richland, WA 99353
Attn: Drew Woodruff

Cust Sample #: GBD2-Storm 3- Inf 1 **Lab Sample ID:** 230402-01
Site: City of West Richland **Collection Date:** 10/18/2022 12:15 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	140 mg/L	5	jhill	LB037	10/20/202	13:00

Cust Sample #: GBD2-Storm 3- Inf 2 **Lab Sample ID:** 230402-02
Site: City of West Richland **Collection Date:** 10/18/2022 12:20 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	110 mg/L	5	jhill	LB037	10/20/202	13:00

Cust Sample #: GBD2-Storm 3- Inf 3 **Lab Sample ID:** 230402-03
Site: City of West Richland **Collection Date:** 10/18/2022 12:25 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	65 mg/L	5	jhill	LB037	10/20/202	13:00

Cust Sample #: GBD2-Storm 3 - Loc 1 **Lab Sample ID:** 230402-04
Site: City of West Richland **Collection Date:** 10/18/2022 1:05 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	250 mg/L	5	jhill	LB037	10/20/202	13:00

Cust Sample #: GBD2-Storm 3 - Loc 2 **Lab Sample ID:** 230402-05
Site: City of West Richland **Collection Date:** 10/18/2022 1:05 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	100 mg/L	5	jhill	LB037	10/20/202	13:00

Cust Sample #: GBD2-Storm 3 - Loc 3 **Lab Sample ID:** 230402-06
Site: City of West Richland **Collection Date:** 10/18/2022 1:05 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	80 mg/L	5	jhill	LB037	10/20/202	13:00

Cust Sample #: GBD2-Storm 3 - Loc 4 **Lab Sample ID:** 230402-07
Site: City of West Richland **Collection Date:** 10/18/2022 1:05 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	55 mg/L	5	jhill	LB037	10/20/202	13:00

Cust Sample #:	GBD2-Storm 3 - Loc 5	**Lab Sample ID:**	230402-08
Site:	City of West Richland	**Collection Date:**	10/18/2022 1:05 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed
Total suspended solids	SM 2540D	52 mg/L	5	jhill	LB037	10/20/202 13:00

Cust Sample #:	GBD2-Storm 3 - Loc 6	**Lab Sample ID:**	230402-09
Site:	City of West Richland	**Collection Date:**	10/18/2022 1:05 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed
Total suspended solids	SM 2540D	35 mg/L	5	jhill	LB037	10/20/202 13:00

Cust Sample #:	GBD2-Storm 3 - Loc 7	**Lab Sample ID:**	230402-10
Site:	City of West Richland	**Collection Date:**	10/18/2022 1:05 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed
Total suspended solids	SM 2540D	41 mg/L	5	jhill	LB037	10/20/202 13:00

Cust Sample #:	GBD2-Storm 3 - Loc 8	**Lab Sample ID:**	230402-11
Site:	City of West Richland	**Collection Date:**	10/18/2022 1:05 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed
Total suspended solids	SM 2540D	76 mg/L	5	jhill	LB037	10/20/202 13:00

QC Results

QCBatch ID	QC ID	Parameter	% Recovery / RPD	Control Limits
LB037	230402-05: Replicate 1	Total suspended solids	3.4082	0 - 5
	230413-09: Replicate 2	Total suspended solids	2.5126	0 - 5
	LCS 1	Total suspended solids	92.55	77.1 - 110
	MB 1	Total suspended solids	0.23	- 1

Qualifier: * Replicate RPD outside acceptable range of <5%. A sample and its replicate may vary due to sample matrix and concentration.
Other QC within acceptable range. Samples reported without qualification.

Approved: 28-Oct-22

M Turner, Laboratory Manager

ENERGY NORTHWEST

Chain of Custody Services Sales Order

Environmental Services
350 Hills Street Suite 107, Richland, WA 99354
Phone: 509-377-8058 **Fax:** 509-377-8464

Account Information

Company Name: City of West Richland Public Works

Customer Contact: Drew Woodruff

Mailing Address: 3100 Belmont Blvd West Richland, WA 99353

Billing Adress (*if different*):

Email: drew@westrichland.org Phone: 509-967-5434

Receive Invoice: ☐ Hard Copy ☒ Email Receive Report: ☐ Hard Copy ☒ Email

Project ID:

Order ID: 230402

Requested Tests: TSS SM2540D

Matrix: S - Soil, WW - Waste Water, DW - Drinking Water, O - Oil, N - NPDES, Ot - Other

Rush TAT: ☐ Yes ☐ No

\# of working days: ....

Date Requested: ....

Lab Use Only	Sample Identification (*Location, Name, Code, etc*)	Collection Date	Collection Time	Matrix	Number of Bottles	TSS SM2540D
01	GBD2-Storm3-Inf1	10/18	12:15	ww	1	X
02	-Inf2		12:20			X
03	-Inf3		12:25			X
04	-loc1		1:05			X
05	-loc2					X
06	-loc3					X
07	-loc4					X
08	-loc5					X
09	-loc6					X
10	-loc7					X
11	-loc8					X

Comments: Please include QA/QC results w/ report + forward results to taylor@evergreenstormh2o.com

Being duly authorized and empowered by Customer, by signing below, Customer agrees to having reviewed, understood, and is fully accepting of the terms on the reverse side of this form.

Print / Signature	Date / Time	Print / Signature	Date / Time
Relinquished by: Taylor Adlum Bell [signature]	10/18/22 15:53	Received by:	
Relinquished by:		Received by:	
Accepted by lab: [signature]	10/18/22 3:53		

Payment Type (circle) ☐ Paid CC Check

Amount $

Please make all checks payable to Energy Northwest

Sample Condition at Receipt
Temperature (*circle*): *Ambient* *Cold* *Frozen*
☐ Containers intact/ Lids tight
☐ VOC Vials w/o Headspace
☐ Labels Match Custody

26334 R2

ENERGY NORTHWEST

environmental services

Sample Receipt Form

Company Name: City of West Richland

Date/Time: 10/18/22 1553

Customer Contact: Drew WoodRuff

Turnaround time: Normal ☐ Rush ☐ _____ days

Samples Received via: Fedex ☐ UPS ☐ USPS ☐ Customer ☒ Other ☐: ____________

Number of coolers/boxes: 2 Type of Ice: Ice Cubes ☒ Ice Packs ☐ Dry Ice ☐ None ☐

Sample(s) Temp as Read (°C):_____ Corrected Temp (°C):_____ Thermometer ID:_________

				Comments:
Chain of Custody Present?	Yes	No	N/A	
Samples Received Intact?	Yes	No	N/A	
Samples Received within hold time?	Yes	No	N/A	
40 mL Vials Free of Headspace?	Yes	No	N/A	
40 mL Vials Trip blank Present?	Yes	No	N/A	
Samples Properly Preserved?	Yes	No	N/A	
Bottle Labels and C.O.C/WSI Agree?	Yes	No	N/A	
Total Number of Bottles Received?				

Chain of Custody Fully Completed?	Yes	No	N/A	
Correct bottles/containers Received?	Yes	No	N/A	
ENW Bottles Used?	Yes	No	unkn	

Preservatives for bottles/containers:

Comments:

WO's 230399, 400, 401, 402, 403

Received by: [signature]

Date/Time: 10/18/22 1553

Environmental Services
350 Hills St. Suite 107, Richland, WA 99354
Phone: 509-377-8058 **Fax:** 509-377-8464

Report of Analysis

For: **City of West Richland**
3801 Van Giesen
W Richland, WA 99353
Attn: Drew Woodruff

Cust Sample #: GBD2-Storm 4- Inf 1 **Lab Sample ID:** 230403-01
Site: City of West Richland **Collection Date:** 10/18/2022 2:05 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	140 mg/L	5	jhill	LB038	10/24/202	13:00

Cust Sample #: GBD2-Storm 4- Inf 2 **Lab Sample ID:** 230403-02
Site: City of West Richland **Collection Date:** 10/18/2022 2:10 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	130 mg/L	5	jhill	LB038	10/24/202	13:00

Cust Sample #: GBD2-Storm 4- Inf 3 **Lab Sample ID:** 230403-03
Site: City of West Richland **Collection Date:** 10/18/2022 2:15 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	100 mg/L	5	jhill	LB038	10/24/202	13:00

Cust Sample #: GBD2-Storm 4 - Loc 1 **Lab Sample ID:** 230403-04
Site: City of West Richland **Collection Date:** 10/18/2022 2:50 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	450 mg/L	5	jhill	LB038	10/24/202	13:00

Cust Sample #: GBD2-Storm 4 - Loc 2 **Lab Sample ID:** 230403-05
Site: City of West Richland **Collection Date:** 10/18/2022 2:50 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	140 mg/L	5	jhill	LB038	10/24/202	13:00

Cust Sample #: GBD2-Storm 4 - Loc 3 **Lab Sample ID:** 230403-06
Site: City of West Richland **Collection Date:** 10/18/2022 2:50 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	89 mg/L	5	jhill	LB038	10/24/202	13:00

Cust Sample #: GBD2-Storm 4 - Loc 4 **Lab Sample ID:** 230403-07
Site: City of West Richland **Collection Date:** 10/18/2022 2:50 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	97 mg/L	5	jhill	LB038	10/24/202	13:00

Cust Sample #: GBD2-Storm 4 - Loc 5 **Lab Sample ID:** 230403-08
Site: City of West Richland **Collection Date:** 10/18/2022 2:50 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	52 mg/L	5	jhill	LB038	10/24/202	13:00

Cust Sample #: GBD2-Storm 4 - Loc 6 **Lab Sample ID:** 230403-09
Site: City of West Richland **Collection Date:** 10/18/2022 2:50 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	48 mg/L	5	jhill	LB038	10/24/202	13:00

Cust Sample #: GBD2-Storm 4 - Loc 7 **Lab Sample ID:** 230403-10
Site: City of West Richland **Collection Date:** 10/18/2022 2:50 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	30 mg/L	5	jhill	LB038	10/24/202	13:00

Cust Sample #: GBD2-Storm 4 - Loc 8 **Lab Sample ID:** 230403-11
Site: City of West Richland **Collection Date:** 10/18/2022 2:50 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	36 mg/L	5	jhill	LB038	10/24/202	13:00

QC Results

QCBatch ID	QC ID	Parameter	% Recovery / RPD	Control Limits
LB038	230403-04: Replicate 1	Total suspended solids	0.6617	0 - 5
	230403-10: Replicate 2	Total suspended solids	13.9388	0 - 5
	LCS 1	Total suspended solids	91.55	77.1 - 110
	MB 1	Total suspended solids	0.05	- 1

Qualifier: * Replicate RPD outside acceptable range of <5%. A sample and its replicate may vary due to sample matrix and concentration. Other QC within acceptable range. Samples reported without qualification.

Approved: [signature] 28-Oct-22

M Turner, Laboratory Manager

ENERGY NORTHWEST

Chain of Custody Services Sales Order

Environmental Services
350 Hills Street Suite 107, Richland, WA 99354
Phone: 509-377-8058 Fax: 509-377-8464

Account Information

Company Name: City of West Richland Public Works
Customer Contact: Drew Woodruff
Mailing Address: 3100 Belmont Blvd West Richland, WA 99353
Billing Adress (if different):
Email: drew@westrichland.org Phone: 509-967-5434
Receive Invoice: ☐ Hard Copy ☒ Email Receive Report: ☐ Hard Copy ☒ Email

Project ID:
Order ID: 230403

Requested Tests: TSS SM2540D

Matrix
S - Soil
WW - Waste Water
DW - Drinking Water
O - Oil
N - NPDES
Ot - Other

Rush TAT
☐ Yes ☐ No
# of working days: ____
Date Requested: ________

Comments
Please include QA/QC results w/ report + forward results to taylor@ evergreenstorm @h2o.com

Lab Use Only	Sample Identification (Location, Name, Code, etc)	Collection Date	Collection Time	Matrix	Number of Bottles	TSS SM2540D
01	GBD 2 - Storm 4 - Inf 1	10/18	2:05	WW	1	X
02	-Inf 2		2:10			X
03	-Inf 3		2:15			X
04	-Loc 1		2:50			X
05	-Loc 2					X
06	-Loc 3					X
07	-Loc 4					X
08	-Loc 5					X
09	-Loc 6					X
10	-Loc 7					X
11	-Loc 8					X

Being duly authorized and empowered by Customer, by signing below, Customer agrees to having reviewed, understood, and is fully accepting of the terms on the reverse side of this form.

	Print / Signature	Date / Time		Print / Signature	Date / Time
Relinquished by:	Taylor Holborn-Bell	10/18/22 15:53	Received by:		
Relinquished by:			Received by:		
Accepted by lab:	[signature]	10/18/22 3:53			

Payment Type (circle) ☐ Paid CC Check
Amount $

Please make all checks payable to Energy Northwest

Sample Condition at Receipt
Temperature (circle): Ambient Cold Frozen
☐ Containers intact/ Lids tight
☐ VOC Vials w/o Headspace
☐ Labels Match Custody

26334 R2

ENERGY NORTHWEST

environmental services

Sample Receipt Form

Company Name: City of West Richland

Date/Time: 10/18/22 1553

Customer Contact: Drew WoodRuff

Turnaround time: Normal ☐ Rush ☐ ____ days

Samples Received via: Fedex ☐ UPS ☐ USPS ☐ Customer ☒ Other ☐: ____

Number of coolers/boxes: 2 Type of Ice: Ice Cubes ☒ Ice Packs ☐ Dry Ice ☐ None ☐

Sample(s) Temp as Read (°C): ____ Corrected Temp (°C): ____ Thermometer ID: ____

Question	Answer	Comments
Chain of Custody Present?	**Yes** No N/A	
Samples Received Intact?	**Yes** No N/A	
Samples Received within hold time?	**Yes** No N/A	
40 mL Vials Free of Headspace?	Yes No **N/A**	
40 mL Vials Trip blank Present?	Yes No **N/A**	
Samples Properly Preserved?	Yes No **N/A**	
Bottle Labels and C.O.C/WSI Agree?	**Yes** No N/A	
Total Number of Bottles Received?	____	

Question	Answer	Comments
Chain of Custody Fully Completed?	**Yes** No N/A	
Correct bottles/containers Received?	**Yes** No N/A	
ENW Bottles Used?	**Yes** No unkn	

Preservatives for bottles/containers:

Comments:

WO's 230399, 400, 401, 402, 403

Received by: [signature]

Date/Time: 10/18/22 1553

Environmental Services
350 Hills St. Suite 107, Richland, WA 99354
Phone: 509-377-8058 **Fax:** 509-377-8464

Report of Analysis

For: **City of West Richland**
3801 Van Giesen
W Richland, WA 99353
Attn: Drew Woodruff

Cust Sample #: GBD2-Storm 5- Inf 1 **Lab Sample ID:** 230412-01
Site: City of West Richland **Collection Date:** 10/19/2022 9:35 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	190 mg/L	5	jhill	LB036	10/20/202	8:00

Cust Sample #: GBD2-Storm 5- Inf 2 **Lab Sample ID:** 230412-02
Site: City of West Richland **Collection Date:** 10/19/2022 9:40 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	140 mg/L	5	jhill	LB036	10/20/202	8:00

Cust Sample #: GBD2-Storm 5- Inf 3 **Lab Sample ID:** 230412-03
Site: City of West Richland **Collection Date:** 10/19/2022 9:45 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	110 mg/L	5	jhill	LB036	10/20/202	8:00

Cust Sample #: GBD2-Storm 5 - Loc 1 **Lab Sample ID:** 230412-04
Site: City of West Richland **Collection Date:** 10/19/2022 10:20 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	490 mg/L	5	jhill	LB036	10/20/202	8:00

Cust Sample #: GBD2-Storm 5 - Loc 2 **Lab Sample ID:** 230412-05
Site: City of West Richland **Collection Date:** 10/19/2022 10:20 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	270 mg/L	5	jhill	LB036	10/20/202	8:00

Cust Sample #: GBD2-Storm 5 - Loc 3 **Lab Sample ID:** 230412-06
Site: City of West Richland **Collection Date:** 10/19/2022 10:20 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	92 mg/L	5	jhill	LB036	10/20/202	8:00

Cust Sample #: GBD2-Storm 5 - Loc 4 **Lab Sample ID:** 230412-07
Site: City of West Richland **Collection Date:** 10/19/2022 10:20 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	82 mg/L	5	jhill	LB036	10/20/202	8:00

Cust Sample #: GBD2-Storm 5 - Loc 5 **Lab Sample ID:** 230412-08
Site: City of West Richland **Collection Date:** 10/19/2022 10:20 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	100 mg/L	5	jhill	LB036	10/20/202	8:00

Cust Sample #: GBD2-Storm 5 - Loc 6 **Lab Sample ID:** 230412-09
Site: City of West Richland **Collection Date:** 10/19/2022 10:20 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	68 mg/L	5	jhill	LB036	10/20/202	8:00

Cust Sample #: GBD2-Storm 5 - Loc 7 **Lab Sample ID:** 230412-10
Site: City of West Richland **Collection Date:** 10/19/2022 10:20 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	51 mg/L	5	jhill	LB036	10/20/202	8:00

Cust Sample #: GBD2-Storm 5 - Loc 8 **Lab Sample ID:** 230412-11
Site: City of West Richland **Collection Date:** 10/19/2022 10:20 AM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	74 mg/L	5	jhill	LB036	10/20/202	8:00

QC Results

QCBatch ID	QC ID	Parameter	% Recovery / RPD	Control Limits
LB036	230412-05: Replicate 1	Total suspended solids	0.3532	0 - 5
	230413-06: Replicate 2	Total suspended solids	4.8465	0 - 5
	LCS 1	Total suspended solids	90.85	77.1 - 110
	MB 1	Total suspended solids	-0.2	- 1

Qualifier: * Replicate RPD outside acceptable range of <5%. A sample and its replicate may vary due to sample matrix and concentration. Other QC within acceptable range. Samples reported without qualification.

Approved: 28-Oct-22

M Turner, Laboratory Manager

350 Hills Street suite 107
Richland, WA 99354
509-377-8058

ENERGY NORTHWEST

Chain of Custody Services Sales Order

Environmental Services
350 Hills Street Suite 107, Richland, WA 99354
Phone: 509-377-8058 **Fax:** 509-377-8464

Account Information

Company Name: City of West Richland Public Works
Customer Contact: Drew Woodruff
Mailing Address: 3100 Belmont Blvd West Richland, WA 99353
Billing Adress (if different):
Email: drew@westrichland.org Phone: 509-967-5434
Receive Invoice: ☐ Hard Copy ☒ Email Receive Report: ☐ Hard Copy ☒ Email

Project ID:

Order ID: 4B230412

Requested Tests: TSS SSC Samples

Matrix
S - Soil
WW - Waste Water
DW - Drinking Water
O - Oil
N - NPDES
Ot - Other

Rush TAT
☐ Yes ☐ No
# of working days: ____
Date Requested: ________

Comments
Please include QA/QC results w/ report + forward results to taylor@evergreenstormh2o.com

Lab Use Only	Sample Identification (Location, Name, Code, etc)	Collection Date	Collection Time	Matrix	Number of Bottles	TSS SSC Samples
01	GBD2-Storm5-Infl	10/19	9:35	WW	1	X
02	-Inf2	↓	9:40	↓	↓	X
03	-Inf3	↓	9:45	↓	↓	X
04	-Loc1	↓	10:20	↓	↓	X
05	-Loc2	↓	↓	↓	↓	X
06	-Loc3	↓	↓	↓	↓	X
07	-Loc4	↓	↓	↓	↓	X
08	-Loc5	↓	↓	↓	↓	X
09	-Loc6	↓	↓	↓	↓	X
10	-Loc7	↓	↓	↓	↓	X
11	-Loc8	↓	↓	↓	↓	X

Being duly authorized and empowered by Customer, by signing below, Customer agrees to having reviewed, understood, and is fully accepting of the terms on the reverse side of this form.

	Print / Signature	Date / Time		Print / Signature	Date / Time
Relinquished by:	Taylor Hallman-Bolleck	10/19/22 1:40p	Received by:		
Relinquished by:			Received by:		
Accepted by lab:	Traci Nolan	10/19/22 @ 1341			

Payment Type (circle): ☐ Paid CC Check Amount $

Please make all checks payable to Energy Northwest

Sample Condition at Receipt
Temperature (circle): *Ambient* *Cold* *Frozen*
☐ Containers intact/ Lids tight
☐ VOC Vials w/o Headspace
☐ Labels Match Custody

26334 R2

ENERGY NORTHWEST

environmental services

Sample Receipt Form

Company Name: City of West Richland Date/Time: 10/19/2022

Customer Contact: Taylor Ballard / Drew Woodruff

Turnaround time: Normal ☒ Rush ☐ ____ days

Samples Received via: Fedex ☐ UPS ☐ USPS ☐ Customer ☒ Other ☐: ________

Number of coolers/boxes: NA Type of Ice: Ice Cubes ☐ Ice Packs ☐ Dry Ice ☐ None ☒

Sample(s) Temp as Read (°C): NA Corrected Temp (°C): ____ Thermometer ID: ________

				Comments:
Chain of Custody Present?	Yes	No	N/A	
Samples Received Intact?	Yes	No	N/A	
Samples Received within hold time?	Yes	No	N/A	
40 mL Vials Free of Headspace?	Yes	No	N/A	
40 mL Vials Trip blank Present?	Yes	No	N/A	
Samples Properly Preserved?	Yes	No	N/A	
Bottle Labels and C.O.C/WSI Agree?	Yes	No	N/A	
Total Number of Bottles Received?	22			

Chain of Custody Fully Completed?	Yes	No	N/A	
Correct bottles/containers Received?	Yes	No	N/A	
ENW Bottles Used?	Yes	No	unkn	

Preservatives for bottles/containers:

Comments:

WO 230412, 230413

Received by: Traci Nolan Date/Time: 10/19/2022 @ 1341

Environmental Services
350 Hills St. Suite 107, Richland, WA 99354
Phone: 509-377-8058 **Fax:** 509-377-8464

Report of Analysis

For: **City of West Richland**
3801 Van Giesen
W Richland, WA 99353
Attn: Drew Woodruff

Cust Sample #: GBD2-Storm 6- Inf 1 **Lab Sample ID:** 230413-01
Site: City of West Richland **Collection Date:** 10/19/2022 12:05 PM

Analyte	Method	Sample Result		RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	130	mg/L	5	jhill	LB036	10/20/202	8:00

Cust Sample #: GBD2-Storm 6- Inf 2 **Lab Sample ID:** 230413-02
Site: City of West Richland **Collection Date:** 10/19/2022 12:10 PM

Analyte	Method	Sample Result		RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	130	mg/L	5	jhill	LB036	10/20/202	8:00

Cust Sample #: GBD2-Storm 6- Inf 3 **Lab Sample ID:** 230413-03
Site: City of West Richland **Collection Date:** 10/19/2022 12:15 PM

Analyte	Method	Sample Result		RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	110	mg/L	5	jhill	LB036	10/20/202	8:00

Cust Sample #: GBD2-Storm 6 - Loc 1 **Lab Sample ID:** 230413-04
Site: City of West Richland **Collection Date:** 10/19/2022 12:48 PM

Analyte	Method	Sample Result		RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	310	mg/L	5	jhill	LB036	10/20/202	8:00

Cust Sample #: GBD2-Storm 6 - Loc 2 **Lab Sample ID:** 230413-05
Site: City of West Richland **Collection Date:** 10/19/2022 12:48 PM

Analyte	Method	Sample Result		RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	170	mg/L	5	jhill	LB036	10/20/202	8:00

Cust Sample #: GBD2-Storm 6 - Loc 3 **Lab Sample ID:** 230413-06
Site: City of West Richland **Collection Date:** 10/19/2022 12:48 PM

Analyte	Method	Sample Result		RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	95	mg/L	5	jhill	LB036	10/20/202	8:00

Cust Sample #: GBD2-Storm 6 - Loc 4 **Lab Sample ID:** 230413-07
Site: City of West Richland **Collection Date:** 10/19/2022 12:48 PM

Analyte	Method	Sample Result		RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	76	mg/L	5	jhill	LB036	10/20/202	8:00

Cust Sample #: GBD2-Storm 6 - Loc 5 **Lab Sample ID:** 230413-08
Site: City of West Richland **Collection Date:** 10/19/2022 12:48 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	56 mg/L	5	jhill	LB036	10/20/202	8:00

Cust Sample #: GBD2-Storm 6 - Loc 6 **Lab Sample ID:** 230413-09
Site: City of West Richland **Collection Date:** 10/19/2022 12:48 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	40 mg/L	5	jhill	LB037	10/20/202	13:00

Cust Sample #: GBD2-Storm 6 - Loc 7 **Lab Sample ID:** 230413-10
Site: City of West Richland **Collection Date:** 10/19/2022 12:48 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	35 mg/L	5	jhill	LB037	10/20/202	13:00

Cust Sample #: GBD2-Storm 6 - Loc 8 **Lab Sample ID:** 230413-11
Site: City of West Richland **Collection Date:** 10/19/2022 12:48 PM

Analyte	Method	Sample Result	RL	Analyst	QC Batch	Analyzed	
Total suspended solids	SM 2540D	34 mg/L	5	jhill	LB037	10/20/202	13:00

QC Results

QCBatch ID	QC ID	Parameter	% Recovery / RPD	Control Limits
LB036	230412-05: Replicate 1	Total suspended solids	0.3532	0 - 5
	230413-06: Replicate 2	Total suspended solids	4.8465	0 - 5
	LCS 1	Total suspended solids	90.85	77.1 - 110
	MB 1	Total suspended solids	-0.2	- 1
LB037	230402-05: Replicate 1	Total suspended solids	3.4082	0 - 5
	230413-09: Replicate 2	Total suspended solids	2.5126	0 - 5
	LCS 1	Total suspended solids	92.55	77.1 - 110
	MB 1	Total suspended solids	0.23	- 1

Qualifier: * Replicate RPD outside acceptable range of <5%. A sample and its replicate may vary due to sample matrix and concentration. Other QC within acceptable range. Samples reported without qualification.

Approved: 28-Oct-22

M Turner, Laboratory Manager

350 Hills Street suite 107
Richland, WA 99354
509-377-8058

ENERGY NORTHWEST

Chain of Custody Services Sales Order

Environmental Services
350 Hills Street Suite 107, Richland, WA 99354
Phone: 509-377-8058 Fax: 509-377-8464

Account Information

Company Name: City of West Richland Public Works
Customer Contact: Drew Woodruff
Mailing Address: 3100 Belmont Blvd, West Richland, WA 99353
Billing Adress (if different):
Email: drew@westrichland.org Phone: 509-967-5434
Receive Invoice: ☐ Hard Copy ☒ Email Receive Report: ☐ Hard Copy ☒ Email

Project ID:
Order ID: 230413

Requested Tests: TSS SM2540D

Matrix
S - Soil
WW - Waste Water
DW - Drinking Water
O - Oil
N - NPDES
Ot - Other

Rush TAT
☐ Yes ☐ No
# of working days: ....
Date Requested: ....

Comments
Please include QA/QC results w/ report + forward results to taylor@evergreenstormh2o.com

Lab Use Only	Sample Identification (Location, Name, Code, etc)	Collection Date	Collection Time	Matrix	Number of Bottles	TSS SM2540D
01	GBD2-Storm6 - Inf1	10/19	12:05	WW	1	X
02	-Inf2		12:10			X
03	-Inf3		12:15			X
04	-Loc1		12:48			X
05	-Loc2					X
06	-Loc3					X
07	-Loc4					X
08	-Loc5					X
09	-Loc6					X
10	-Loc7					X
11	-Loc8					X

Being duly authorized and empowered by Customer, by signing below, Customer agrees to having reviewed, understood, and is fully accepting of the terms on the reverse side of this form.

	Print / Signature	Date / Time		Print / Signature	Date / Time
Relinquished by:	Taylor Wollum Bullard	10/19/22 140p	Received by:		
Relinquished by:			Received by:		
Accepted by lab:	Tran Nolan	10/19/22 1342			

Payment Type (circle) ☐ Paid CC Check Amount $

Please make all checks payable to Energy Northwest

Sample Condition at Receipt
Temperature (circle): *Ambient* *Cold* *Frozen*
☐ Containers intact/ Lids tight
☐ VOC Vials w/o Headspace
☐ Labels Match Custody

26334 R2

ENERGY NORTHWEST

environmental services

Sample Receipt Form

Company Name: City of West Richland Date/Time: 10/19/2022

Customer Contact: Taylor Ballard / Drew Woodruff

Turnaround time: Normal ☒ Rush ☐ _____ days

Samples Received via: Fedex ☐ UPS ☐ USPS ☐ Customer ☒ Other ☐: __________

Number of coolers/boxes: NA Type of Ice: Ice Cubes ☐ Ice Packs ☐ Dry Ice ☐ None ☒

Sample(s) Temp as Read (°C): NA Corrected Temp (°C): _____ Thermometer ID: _________

				Comments:
Chain of Custody Present?	Yes	No	N/A	
Samples Received Intact?	Yes	No	N/A	
Samples Received within hold time?	Yes	No	N/A	
40 mL Vials Free of Headspace?	Yes	No	N/A	
40 mL Vials Trip blank Present?	Yes	No	N/A	
Samples Properly Preserved?	Yes	No	N/A	
Bottle Labels and C.O.C/WSI Agree?	Yes	No	N/A	
Total Number of Bottles Received?	22			

Chain of Custody Fully Completed?	Yes	No	N/A	
Correct bottles/containers Received?	Yes	No	N/A	
ENW Bottles Used?	Yes	No	unkn	

Preservatives for bottles/containers:

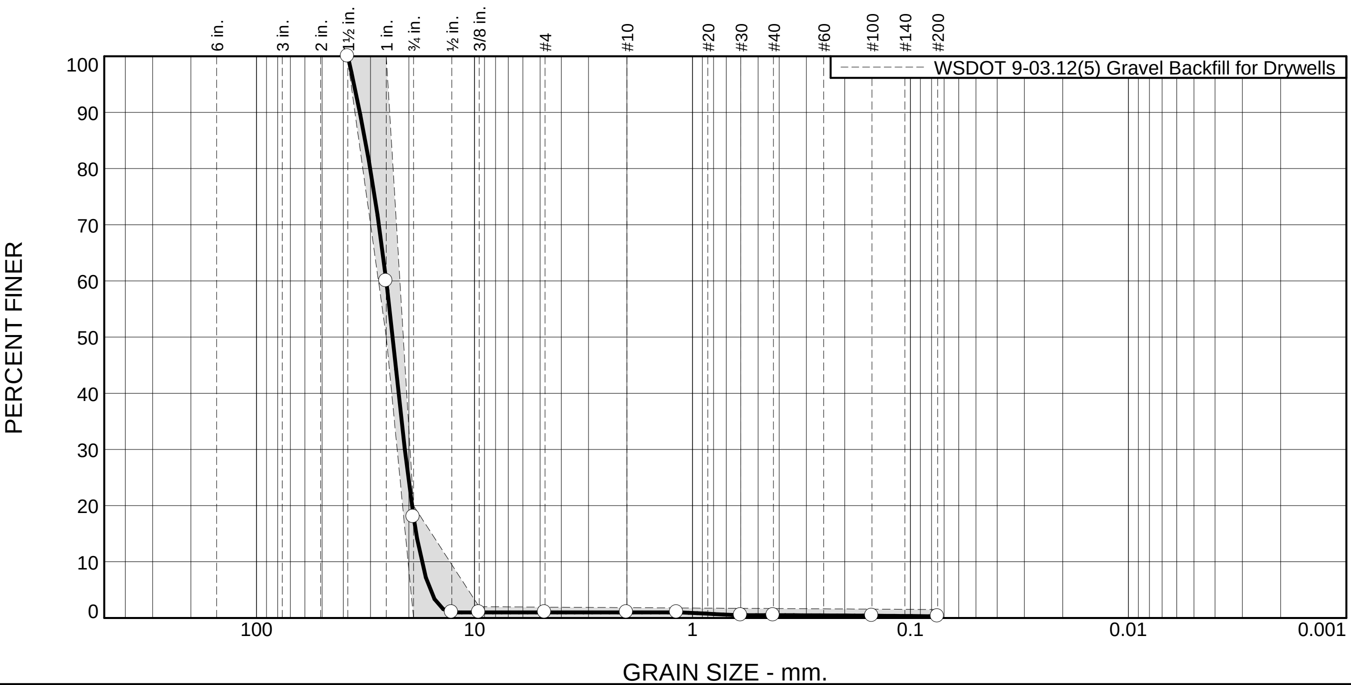
Comments:

WO 230412, 230413

Received by: Traci Nolan Date/Time: 10/19/2022 @ 1341

Environmental Services
350 Hills St. Suite 107, Richland, WA 99354
Phone: 509-377-8058 **Fax:** 509-377-8464

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	82.0	17.0	0.0	0.5	0.2	0.3	

Test Results (AASHTO T 27 & AASHTO T 11)

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1.5"	100.0	99.0 - 100.0	
1"	60.0	50.0 - 100.0	
3/4"	18.0	0.0 - 20.0	
1/2"	1.0		
3/8"	1.0	0.0 - 2.0	
#4	1.0		
#10	1.0		
#16	1.0		
#30	0.5		
#40	0.5		
#100	0.4		
#200	0.3	0.0 - 1.5	

* WSDOT 9-03.12(5) Gravel Backfill for Drywells

Material Description

Gravel Backfill for Drywells

Atterberg Limits (ASTM D 4318)

PL= **LL=** **PI=**

Classification

USCS (D 2487)= GP **AASHTO (M 145)=**

Coefficients

D_{90}= 33.6091 D_{85}= 31.7302 D_{60}= 25.4000
D_{50}= 23.7487 D_{30}= 20.8695 D_{15}= 18.5157
D_{10}= 17.4634 C_u= 1.45 C_c= 0.98

Remarks

Sampled By: Client

Date Received: 10/10/22 **Date Tested:** 10/17/22
Tested By: PH
Checked By: SW
Title: CSM

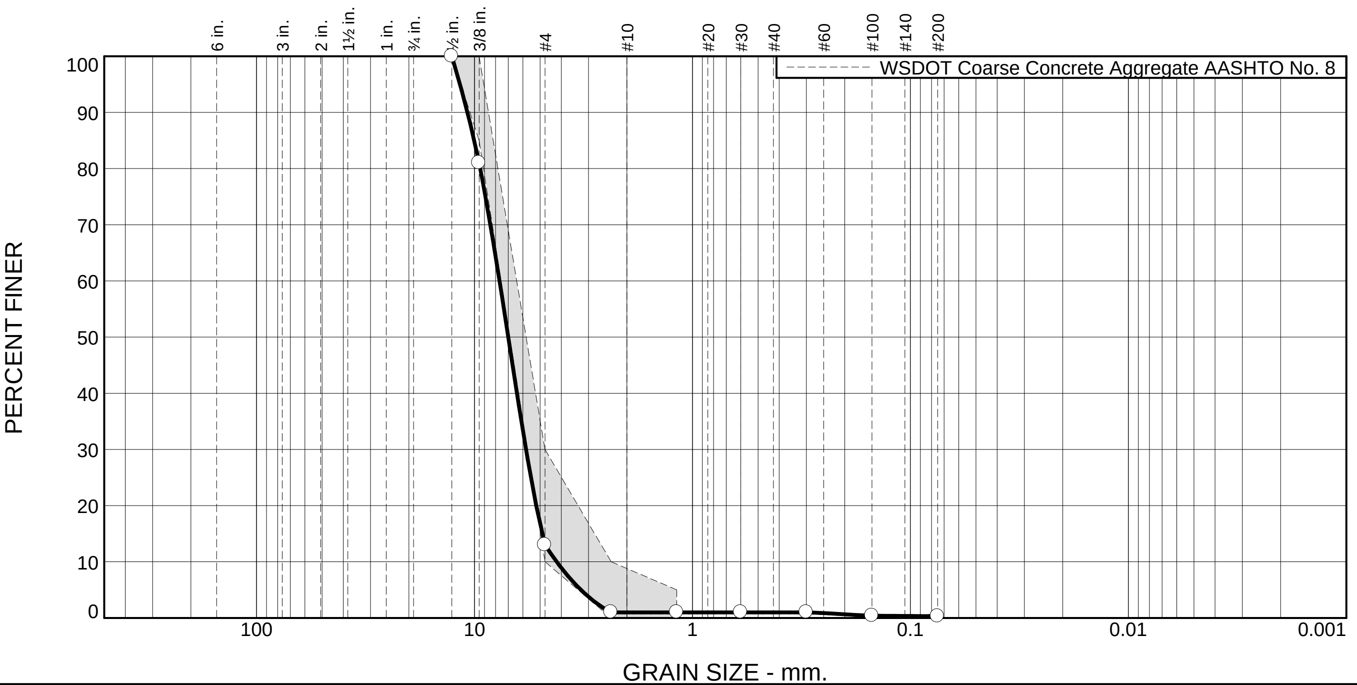
Source of Sample: R140 CWA Kiona Pit **Date Sampled:**
Sample Number: 70913

Intermountain Materials Testing & Geotechnical

Client: City of West Richland
Project: Stormwater Grant

Project No: L22273 **Figure**

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	87.0	12.0	0.0	0.7	0.3	

Test Results (AASHTO T 27 & AASHTO T 11)			
Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
1/2"	100.0	100.0	
3/8"	81.0	85.0 - 100.0	X
#4	13.0	10.0 - 30.0	
#8	1.0	0.0 - 10.0	
#16	1.0	0.0 - 5.0	
#30	1.0		
#50	1.0		
#100	0.4		
#200	0.3		

* WSDOT Coarse Concrete Aggregate AASHTO No. 8

Material Description

#8 Coarse Concrete Aggregate

Atterberg Limits (ASTM D 4318)

PL= **LL=** **PI=**

Classification

USCS (D 2487)= GP **AASHTO (M 145)=**

Coefficients

D_{90}= 10.7629 D_{85}= 10.0219 D_{60}= 7.6762
D_{50}= 7.0030 D_{30}= 5.8021 D_{15}= 4.8883
D_{10}= 4.1972 C_u= 1.83 C_c= 1.04

Remarks

Sampled By: Client

Date Received: 10-10 **Date Tested:** 10/17/22

Tested By: PH

Checked By: SW

Title: CSM

Source of Sample: R140 CWA Kiona Pit **Date Sampled:**

Sample Number: 70912

Intermountain Materials Testing & Geotechnical

Client: City of West Richland

Project: Stormwater Grant

Project No: L22273 **Figure**

Appendix G – Non-Vegetated Filtration Swale and Biofiltration Swale Lifecycle Costs

Table G 9-1 below provides a brief comparison between costs for a biofiltration swale and non-vegetated filtration swale. The biofiltration swale and the non-vegetated filtration swale were sized for the same basin and water quality flow event. The biofiltration swale has a 2-foot bottom width and is 133 feet long; the non-vegetated filtration swale has a 2-foot bottom width and is 200 feet long. The unit costs for each line item were obtained from the WSDOT standard unit bid analysis tool.

Table G 9-1: Construction cost comparison for biofiltration and non-vegetated filtration swales

Biofiltration Swale				
Cost to Construct BMP (use Unit Bid Analysis)[1]				
	Quantity	Units	$/Unit	Total Cost
Mobilization[2]				$ 2,425.38
Excavation	232.8	CY	$ 65.00	$ 15,128.75
Turf grass[3]	125	SY	$ 48.00	$ 6,000.00
Irrigation System[4]	1	LS	$ 7,500.00	$ 7,500.00
			Total Cost of Construction	**$ 31,491.63**
Non-Vegetated Filtration Swale				
Cost to Construct BMP (use Unit Bid Analysis)[1]				
	Quantity	Units	$/Unit	Total Cost
Mobilization[2]				$ 2,485.21
Excavation	350	CY	$ 65.00	$ 22,750.00
Gravel Backfill for drywells	24.9	CY	$ 81.76	$ 2,035.82
Pea Gravel	5.1	CY	$ 52.76	$ 269.08
			Total Cost of Construction	**$ 27,560.39**

[1] If a catch basin is needed, the cost per unit was estimated to be $1,783.33.

[2] Mobilization costs were assumed to be equal to 10% of the total cost of the other items.

[3] The cost in the table reflects the use of sod to establish grass. Seeding and mulching estimates from the WSDOT Unit Bid Analysis tool for this size swale resulted in a higher cost than sod. As such, it was assumed the cheaper material would be used to stabilize the swale.

[4] If irrigation is required, additional costs related to installation of a water meter, 1-inch service line, and connection fees are estimated to be a minimum of $8,459. This cost would increase if a water main is not immediately adjacent to the site, if roadway surface repair is needed, or if power is not readily available for irrigation controllers.

The annual cost to maintain the biofiltration swale is anticipated to be equivalent to 5–8% of the capital cost of the BMP (Barrett, 2005; Houle et al, 2013). This cost is expected to include the items shown in **Table G 9-2** and **Table G 9-3**. The non-vegetated filtration swale is not expected to need mowing or maintenance related to the irrigation system. However, the maintenance actions needed to restore treatment performance of the swale are unknown and, as such, the costs are unknown. Because a comparison of maintenance costs was not able to be developed, **Table G 9-2** is included, which provides a comparison of the primary maintenance needs for both swales. **Table G 9-3** provides a detailed side-by-side comparison of the maintenance needs for both types of swales with the biofiltration items from SWMMEW Table 5.43.

Table G 9-2: Maintenance actions comparison for biofiltration and non-vegetated filtration swales

Maintenance Action	Biofiltration Swale	Non-Vegetated Filtration Swale
Maintain adequate grass growth and eliminate bare spots	X	
Mow grass (as needed)	X	
Remove deposited sediment at inlet and outlet	X	X
Remove leaves, litter, and other debris in swale	X	X
Restore treatment performance every 2–3 years		X
Irrigation system maintenance[1]	X	
Double check valve annual inspection	X	

[1] It is important to note that there is an annual cost associated with water usage when an irrigation system is running. From discussions with the TAC, irrigation systems may run 3–4 times during the growing season, for about 20 minutes each time.

Table G 9-3: Detailed comparison of maintenance actions for biofiltration and non-vegetated filtration swales

Defect or Problem	Biofiltration Swales		Non-Vegetated Filtration Swale	
	Condition When Maintenance is Needed	Recommended Maintenance to Correct Problem	Condition When Maintenance is Needed	Recommended Maintenance to Correct Problem
Sediment Accumulation on Grass	Sediment depth > 2 inches.	• Remove sediment deposits on grass treatment area of the biofiltration swale. When finished, swale should be level from side to side and drain freely toward outlet. • There should be no areas of standing water once inflow has ceased.	Indicators of sediment accumulation include: • Flow above the surface of the rock during the water quality or smaller storm event • Vegetation growing in the swale Pay special attention to the first 25 feet and last 25 feet of the swale.	• Remove the sediment and treatment rock layer around the indicator or throughout the swale as applicable. • Replace with clean rock to match original rock gradations and depth.
Standing Water	When water stands in the swale between storms and does not drain freely.	Any of the following may apply: • Check for overwatering or soil saturation in swale • Check the outlet and remove sediment or trash blockages • Verify the swale bottom is infiltrating • Improve grade from head to foot of swale • Remove clogged check dams • Add underdrains or convert to a wet biofiltration swale	When water stands in the swale between storms and does not drain freely.	• Check the outlet of the swale for any debris or blockage. • Verify the swale bottom is infiltrating. • Improve grade from head to foot of swale.
Poor Coverage	When grass is sparse or bare or eroded patches occur in > 10% of the swale bottom.	• Determine why grass growth is poor and correct that condition. • Replant with plugs of grass from the upper slope: plant in the swale bottom at 8-inch intervals or reseed into loosened, fertile soil.	When rock-eroded channels occur in >10% of the swale bottom.	• Assess why channel eroded and correct that condition. • Add new rock to fix the eroded channel.
Vegetation	When the grass becomes excessively tall (> 10 inches); when nuisance weeds and other vegetation start to take over.	• Mow vegetation or remove nuisance vegetation so that flow is not impeded. • Grass should be mowed to a height of 3 to 4 inches. Remove grass clippings.	When grass or weeds become visually present in the swale.	• Remove grass or weeds so that flow is not impeded. • Check the treatment rock layer for sediment buildup below the surface by removing rock down to the pea gravel and/or down to the subsoil. If sediment is found in the rock, remove affected rock and replace with new clean rock to match original rock gradations and depth.
Inlet/Outlet	Inlet/outlet areas clogged with sediment and/or debris.	Remove material so that there is no clogging or blockage in the inlet and outlet area.	Inlet/outlet areas clogged with sediment and/or debris.	Remove material so that there is no clogging or blockage in the inlet and outlet area.
Trash and Debris Accumulation	Trash and debris accumulated in the biofiltration swale.	Remove trash and debris from biofiltration swale.	Trash and debris accumulated in the swale.	Remove trash and debris from swale.
Erosion/Scouring	Eroded or scoured swale bottom due to flow channelization or higher flows.	• For ruts or bare areas < 12 inches wide, repair the damaged area by filling with crushed gravel. • If bare areas are large, generally > 12 inches wide, the swale should be regraded and reseeded. • For smaller bare areas, overseed when bare spots are evident, or take plugs of grass from the upper slope and plant in the swale bottom at 8-inch intervals.	Eroded or scoured swale bottom due to flow channelization, or higher flows.	• For ruts < 12 inches wide, repair the damaged area by replacing with the applicable rock gradations. If ruts are large, generally > 12 inches wide, the swale should be regraded in the area. • Consider increasing the size of/adding a layer of 2.5" coarse cobbles at a depth of 2.5 inches on top of the existing rock if erosion or scouring occurred during flow 25-year or small event.
Restore Treatment Performance	Assuming the maintenance actions in this table are performed, restoration of treatment performance is not expected to be needed until the end of the lifecycle for the BMP.	See actions listed above.	Treatment performance does not meet TAPE treatment performance goals. No visual indicators were observed during field testing; additional testing is needed and/or maintenance will likely need to occur on a schedule.	The maintenance actions needed to restore treatment performance of the swale are unknown; potential actions include flushing the swale with water or removal of treatment rock layer near the inflow location.