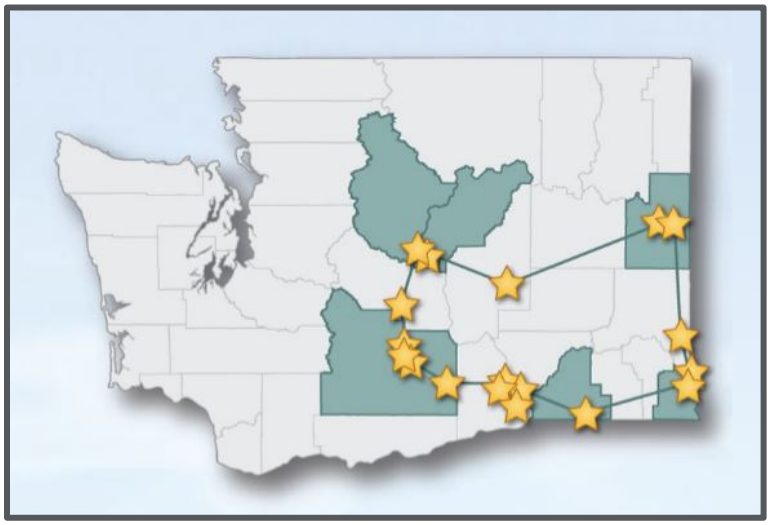
Eastern Washington

Stormwater Effectiveness Studies
Phase 2 & 3



Final Report

Prepared for:

City of Spokane Valley &
Eastern Washington Stormwater Group

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7 Appendices

1 Introduction, Background, and Goals

The City of Spokane Valley is an NPDES Phase II Municipal stormwater permittee along with 23 other cities and counties (permittees) in eastern Washington. *(Note: The permittees are often referred to as the Eastern Washington Stormwater Group (EWSG)).*Under the Phase II permit issued on August 1, 2014 (section S8.B) these agencies are required to select, propose, develop, and conduct 8 to 12 Ecology approved studies that will assess the effectiveness of their permit-required stormwater management program activities and BMP practices [1]. In support of this effort, the City of Spokane Valley received grant funding from Ecology to lead and collaborate with the other permittees in multiple phases as described below and summarized in Table 1. Phase 2 and 3 are the focus of this report.

Phase 1

During Phase 1, the EWSG identified over 40 study ideas. The list was narrowed down to 24 study ideas and a conceptual study design was developed for each study. The work complete during this Phase is summarized in a report titled '*Phase 1: Development of Effectiveness Study Questions for Eastern Washington Permittees*' [3] which was completed on June 30, 2015. The prime consultant that led this effort was Herrera Environmental Engineers and NB Stormwater Engineering served as a subconsultant.

Phase 2

During Phase 2, the permittees developed a ranked list of their top 14 study ideas which was submitted to Ecology on June 30, 2016. Two of the study ideas on this list were new or substantially modified after Phase 1. The consultant that led this effort was NB Stormwater Engineering.

Phase 3 & 3a

Initial work in Phase 3 began on July 1, 2016 and included developing Quality Assurance Project Plan (QAPP) Templates for Structural, Operational, and Education and Outreach BMPs. Version 0 of these documents were finalized on January 9, 2017. The prime consultant that led this effort was NB Stormwater Engineering and Drummond Carpenter, PLLC, and Cascade Water Resources, LLC served as a subconsultants.

The second part of Phase 3 (referred to as Phase 3a in this document) began in March of 2017. This phase focused on planning for and developing the detailed study design proposal (Proposal) for 8 and a half studies. Of the studies developed, 3 were selected by the permittees and submitted to Ecology on June 30, 2017. An additional 5 studies were submitted to Ecology which were either developed by the permittees or the permittees hired consultants to develop the proposals. The prime consultant that led this effort was HDR, Inc and Drummond Carpenter, PLLC, Cascade Water Resources, LLC, and D&H Technology Solutions, LLC served as a subconsultants.

Table 1-1 Eastern Washington Effectiveness Study Phases and Timeline

Study Phases	Timeline
Phase 1 – Identify Study Ideas	
Identify 24 Study Ideas	**Completed by**: June 30, 2015
Phase 2 – Ranked Study Ideas (S8.B3)	
Rank top 14 study Ideas	**Completed by**: June 30, 2016
Phase 3 - Develop Experimental Design (S8.B4-6)	
QAPP Template Development	Completed: January 9, 2017
Phase 3a - Detailed Study Design Proposal Development (S8.B4-5)	**Completed by**: June 30, 2017
Ecology Review/Approval Period	No set time period
Phase 3b - QAPP Development (S8.B6)	Submit QAPP to Ecology 6 months (maximum) after Proposal Approval
Ecology QAPP Review/Approval Period	90 days (maximum) after receiving QAPP
Phase 4 – Conduct Study (S8.B7)	
Phase 4a: Implement Minimum 4 Studies	6 months (maximum) after QAPP approval
Phase 4b: Implement Remaining Studies	15 months (maximum) after QAPP approval
Phase 5 - Report Results (S8.B8-10)	
Annual Report	Annual Report Deadline
Environmental Information Management (EIM) Database	End of water year (September 30) or 6 months (maximum) after data is collected
Final Report	6 months (maximum) after completing Phase 4
Phase 5 - Modified & New Structural Treatment BMPs Only	
Technical Evaluation Report (TER)	30 months (maximum) after Ecology approves Phase 3a Proposal
TER Review Period	90 days (maximum) after receiving TER

2 Phase 2: Overview, Goals, and Deliverables

The goal of Phase 2 was to reduce the Phase 1 list of 24 study ideas down to 12-15 ranked study ideas. This work was completed by gathering input from the permittees during monthly meetings as well as input from the public during a Public Briefing. The study ranking was developed based on the results from a survey that was completed by the permittees. This section provides an overview of this work.

2.1 Meetings

Meetings were held with the EWSG in Moses Lake on January 28, 2016, April 28, 2016 and May 26, 2016. Attendees at these meetings included the permittees, Ecology, and the consultant. The purpose of the meetings was for the City of Spokane Valley and the Consultant to present ideas for prioritizing the studies and to collect comments/feedback from the permittees. The meeting agendas, reference documents, and minutes are located in Appendix 1.

2.2 Public Briefing

On June 16, 2016, a Public Briefing was held in Moses Lake for the purpose of collecting comments from the public on the study ideas. This meeting was advertised through Ecology's "Eastern Washington Stormwater Listserve", on the City's website, and through emails to stormwater professionals employed by government and consulting firms. During the meeting, each of the jurisdictions who had elected to be the lead for a study, presented a slide about their study. Each slide included a picture that represented their study along with a summary of the study goal, conceptual study approach, and the data to be collected. The public was invited to provide written comments as well as verbal comments to the study lead during their presentation. These comments were reviewed and where applicable, incorporated into the study idea list. A copy of the Public Briefing presentation and a summary of the public comments is located in the Appendix 2.

2.3 Deliverable

The studies were ranked based on the results of a survey which is summarized in Table 2-1. This survey was emailed to the EWSG and each permittee was asked to score the study idea using the following qualitative metrics: high, medium, or low. The qualitative metrics are defined in Table 2-1. Seventeen of the 24 permittees responded to the survey and their response were converted to a 3 point Likert Scale (high = 3; medium = 2; and low = 1). The ranked score was determined by calculating the average score for each study. A copy of the final ranked study list is located in the Appendix 3. This is the same list that was submitted to Ecology on June 30, 2016.

Table 2-1 Phase 2 Study Ranking Survey

Survey Instructions: Below is a list of the top study ideas that were identified by our group during the last meeting. Using the guidelines provided, please rank each study as high, medium, or low. The groups ranking from this survey will be combined with the rankings from the April 28th meeting to develop a final ranking for the studies and submitted as part of the June 30th permit requirements.

High

- The study appears to be applicable to the local conditions in my region
- The anticipated study outcome aligns with the future direction of my stormwater program
- The outcome of this study is anticipated to refine or improve a portion of my stormwater program which is currently a large percentage of my overall stormwater program budget
- The study addresses a water quality issue that is also an issue in my City/County or region

Low

- The study does not appear applicable to the local conditions in my region
- The anticipated study outcome does not aligns with the future direction of my stormwater program
- The outcome of study is unlikely to refine or improve a portion of my stormwater program that is currently a large percentage of my overall stormwater program budget
- The study does not appear to address a water quality issue in my City/County or region

Medium

- The study includes a balance of items that are both high and low priority to my stormwater program

Phase 1 Ranking	Study Title	High	Medium	Low
1	Modernizing Education and Outreach Strategies			
2	Mobile Contractor Illicit Discharge Education			
7	Stormwater BMP Owner Awareness			
9	BMP Inspection and Maintenance Responsibilities			
12	Long-term Permeable Pavement Sidewalk Infiltration Performance			
14	Sharp Avenue Porous Pavement Study			
15	Street Sweeping and Catch Basin Cleaning Comparison			
16	Seasonal Differences in Street Sweeping Material Removal			
18	Catch Basin Retrofit Device Placement			
20	Use of Non-vegetative Swale with Native Soils			
21	27b Media Component Study			
24	Biochar Media Stormwater Treatment Study			
27	27a Media Thickness Study			
28	Sand Filter Vault BMP			
29	Determining Pollutant Contributions from Municipal Stormwater in Eastern WA using GIS			

3 Phase 3: Overview, Goals, and Deliverables

The goal of phase 3 was to develop detailed study design proposals for 8 to 12 studies. To achieve this goal, the Phase 3 work was conducted in two parts. Part 1 (referred to as Phase 3 in this report) consisted of developing quality assurance project plan (QAPP) templates. Part 2 (referred to as Phase 3a in this report) consisted of developing the detailed study design proposals. This section provides background information regarding the need for the QAPP templates along with an overview of work complete, the deliverables, and the process followed to develop the deliverables.

3.1 QAPP Template Background

The 14 EWA effectiveness study ideas which were submitted to Ecology on June 30, 2016, include the following three classifications of BMPs:

1. Structural BMPs – are constructed facilities that provide runoff treatment and/or flow control [4]. Studies in this classification focus on evaluating the runoff treatment and/or flow control performance of a constructed facility. Examples of structural BMPs include swales, permeable pavement, sand filters, etc.
2. Operational BMPs – are also referred to as non-structural BMPs and generally described as a preventative action that involves maintenance practices and/or source controls for the purpose preventing or reducing pollutant runoff from municipal operations [4]. Studies in this classification focus on evaluating the effectiveness of operational procedures. Examples of operational BMPs include catch basin cleaning, street sweeping, etc.
3. Education & Outreach (E&O) BMPs – are also considered non-structural BMP and generally described as a preventive action used to protect receiving water quality by educating the public about the impacts of stormwater discharges to water bodies and the steps they can take to reduce pollutants in stormwater [4]. Studies in this classification focus on evaluating the effectiveness of an existing stormwater E&O program and/or collecting and analyzing data for the purpose of developing a new E&O program.

Among the 14 studies, there are four study goals which are common to the EWA Effectiveness studies with respect to identifying specific study requirements, particularly for structural treatment BMPs. Understanding these requirements is essential to developing an appropriate experimental design. As illustrated in Figure 3-1 and described in this section, all studies include the goal of evaluating the effectiveness of at least one BMP (Practice). Some studies also include different combinations of the common goals. A summary of the 14 Phase 2 study ideas along with the applicable classification and common goals is provided in Table 3-1. Note: This is not intended to be an inclusive list of all the *goals for all 14 of the EWA Effectiveness Studies, each study is unique and may include additional goals.*

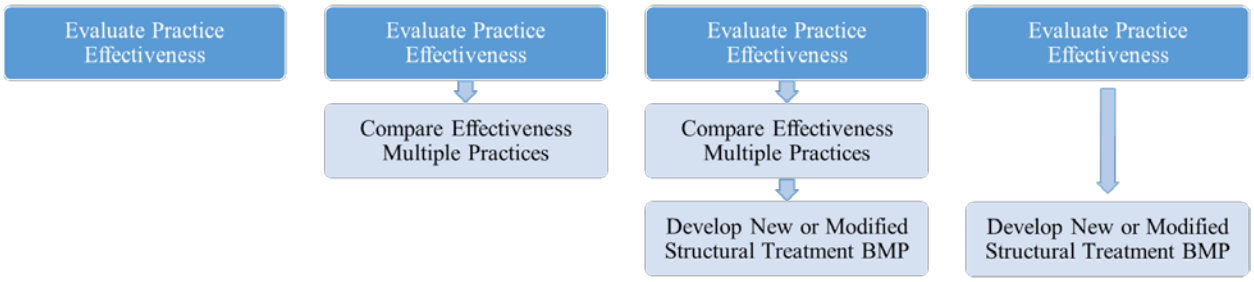

Figure 3-1 Overview of EWA Effectiveness Study Common Goals

1. Evaluate Practice Effectiveness: the study goal includes evaluating the effectiveness of at least one practice. Where Effectiveness is defined as the degree to which a BMP is successful in achieving the specific study goal(s). All effectiveness studies have this goal.
2. Compare Effectiveness of Multiple Practices: the study goal includes comparing the effectiveness of more than one practice typically for the purpose of determining which practice is better.
3. Develop Modified Structural Treatment BMP: A modified BMP is a previously approved structural treatment BMP that has been altered for the effectiveness study, to accept runoff in a manner different from the originally evaluated BMP, but uses the same treatment process as the original approved BMP. This study goal includes developing a modified BMP design criteria that is approved by Ecology for general use on future projects. If approved, the BMP design criteria could be incorporated into Eastern Washington Stormwater Manuals.
4. Develop New Structural Treatment BMP: the study goal includes developing a new design criteria for a structural treatment BMP that is approved by Ecology for general use on future projects. If approved, the BMP design criteria could be incorporated into Eastern Washington Stormwater Manuals.

A distinction in the BMP classifications and study goals is made because these conditions will influence the experimental design particularly the QA/QC elements of the design. For example, the variables that directly affect a BMPs effectiveness, differ between the three classifications (i.e. structural, operational, and education & outreach). Subsequently the types and quality of data needed to evaluate effectiveness are also different along with the potential sources of error that may occur during the creation of the data. While Ecology has developed the QAPP guidance documents noted below, these documents do not address some of the conditions which are unique to the EWA Effectiveness Studies.

- Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies (Publication Number 04-03-030) published by Ecology in July 2004. Referred to as **Ecology QAPP Guidance Document** in this document and the QAPP Templates [2].
- Technical Guidance Manual for Evaluating Emerging Stormwater Treatment Technologies (Publication 11-10-061) published by Ecology in August 2011. Referred to as **Ecology TAPE Guidance Document** in this document and the QAPP Templates.

3.2 QAPP Template Introduction

To provide the EWSG with a consistent and efficient approach for developing the Proposal and QAPP, the EWA Effectiveness Study QAPP Templates were developed for each of the three BMP classifications: Structural, Operational, and Education & Outreach. The intent is that the QAPP Templates would be used, along with the **Ecology QAPP Guidance Document and TAPE Guidance Document,** to prepare the Proposal and QAPP for each of the EWA Effectiveness Studies. To assist the template user in developing a study that is consistent with these guidelines, the QAPP Templates are organized (to the extent possible) in a manner that is similar to these **Ecology Guidance Documents and Eastern Washington Stormwater Manuals.** A copy of the QAPP Templates is located in the Appendix 4, 5, and 6. The purpose of these templates are as follows:

1. Identify the differences in the information expected in a Proposal compared to a QAPP. (Table 3-2 provides an overview of these differences).
2. Provide guidance for preparing a Proposal and a QAPP that generally addresses conditions specific to studies that focus on Operational BMPs and Education & Outreach BMPs.
3. Provide guidance for preparing a Proposal and a QAPP for Structural Treatment BMPs that addresses the differences in Ecology Requirements based on the primary study goals. (See Section 3.1.1 for additional discussion on Structural Treatment BMPs).

3.2.1 Additional Requirements for Structural Treatment BMPs

Studies classified as structural treatment BMPs include additional requirements that should be considered during the development of experimental design. For example, studies with the goal of developing a new structural treatment BMPs, should follow the requirements defined in the **Ecology TAPE Guidance Document**. TAPE is a peer-reviewed regulatory certification process that defines the research protocol for evaluating a structural BMP with the intent of demonstrating that the BMP can achieve a specified treatment performance and acceptance criteria [5]. TAPE is applicable to all the EWA structural BMP effectiveness studies; however the process is generally more rigorous than necessary for studies that do not have the goal of developing a new BMP. Therefore, the focus of the Structural Treatment QAPP Template is to identify the differences between what is required for studies with the goal of evaluating (and comparing) effectiveness or developing a modified BMP studies compared to the requirements defined in the **Ecology TAPE Guidance Document**. An overview of these differences is located in the Structural BMP QAPP Template Appendix A.

3.3 Meetings

During the QAPP template development phase, several meetings were scheduled with Ecology along with some of the study leads and the EWSG. The following is a summary of the meetings along with the process that was used to develop the templates.

- August 15, 2016 – This meeting was held in Olympia with Ecology, the City of Spokane Valley, and the consultant. The purpose of the meeting was to provide Ecology with an overview of the 14 study ideas and define the expected content of the proposal. A copy of the meeting documents are located in Appendix 7.
- September 15th, 2016 - This meeting was held in Moses Lake with the EWSG and the consultant. The purpose of meeting was to provide the EWSG with an overview of the QAPP

template development process and schedule. A copy of the meeting documents are located in Appendix 8.

- September 29, 2016 – This meeting was held in Ellensburg with Ecology, the City of the Valley, the city of Ellensburg, and the consultant. During the meeting the city of Ellensburg to provide Ecology with a detailed overview of their effectiveness study and the consultant provided Ecology with an overview of the QAPP template content for operational and structural BMPs. The purpose of Ellensburg's presentation was to solicit comment from Ecology regarding the experimental design as well as the viability of using the study results to justify a condition in the next NPDES permit. In addition, the Ellensburg study also provided an example for explaining how the QAPP templates would be used. The purpose of presenting the QAPP templates was to solicit comments from Ecology on the templates which were incorporated into the final Templates. A copy of the meeting documents are located in Appendix 9.
- December 5, 2016 - This meeting was held in Ellensburg with the City of the Valley, the city of Ellensburg, the city of Wenatchee, the city of Kennewick, and the consultant. Ecology connected to the meeting from Olympia and Tacoma via a web conference link. During the meeting the city of Wenatchee and Kennewick provided Ecology with a detailed overview of their effectiveness study and the consultant provided Ecology with an overview of the QAPP template content for educational BMPs. The purpose of Wenatchee and Kennewick's presentations was to solicit comment from Ecology the experimental design. In addition, the two studies also provided an example for explaining how the QAPP template would be used for educational studies. The purpose of presenting the QAPP template was to solicit comments from Ecology on the templates which were incorporated into the final Templates. A copy of the meeting documents are located in Appendix 10.
- Mid December - The templates were submitted to Ecology along with members of the EWSG for review and comment. These comments were incorporated into the final templates which were published on January 9th, 2017 on the city of Spokane Valley's website.

Table 3-1 Overview of EWA Effectiveness Studies by Practice Classification & Common Goals

EWSG Rank 6/30/16	Study Idea Title	BMP Classification			Common Effectiveness Study Goals			
		E&O	Operational	Structural	Evaluate Practice Effectiveness	Compare Effectiveness of Practices	Develop Modified BMP	Develop New BMP
1	Modernizing Education and Outreach Strategies	X			X	X		
2	Use of Non-Vegetative Swale with Native Soils			X	X	X		X
3	Street Sweeping and Catch Basin Cleaning Comparison		X		X	X		
4	Mobile Contractor Illicit Discharge Education	X			X	X		
5	Sand Filter Vault BMP			X	X			X
6	Catch Basin Retrofit Device Placement			X	X	X		
6	BMP Inspection and Maintenance Responsibilities	X			X			
6	Seasonal Differences in Street Sweeping Material Removal		X		X	X		
9	Stormwater BMP Owner Awareness	X			X			
10	Determining Pollutant Contributions from Municipal Stormwater in EWA using GIS	X	X	X	X	X		
11	Media Thickness Study and/or Media Component Study			X	X	X	X	
12	Biochar Media Stormwater Treatment Study			X	X		X	
12	Sharp Ave. Porous Pavement Study			X	X			X[1]
14	Long-term Permeable Pavement Sidewalk Infiltration Performance			X	X			

1. This goal may change pending the results of the Washington Stormwater Center (WSC) permeable pavement study. Specifically, if permeable pavement is approved as a new treatment BMP prior to the start of this study, then this goal will not be applicable.

Table 3-2 Overview of Content: Detailed Study Design Proposal vs. QAPP

QAPP Elements	Phase 3a Detailed Study Design Proposal	Phase 3b QAPP
Title Page, Distribution List, Table of Contents	✓	Update as needed
Executive Summary		✓
Introduction and Background		
Introduction to SW Management Practice: describe the BMP (Structural, Operational, or E&O) that is the focus of the study	✓	
Problem Description: define the problem and why the problem needs to be solved	✓	
Results of Previous Studies		✓
Regulatory Requirements	✓	
Project Overview		
Study Goal(s): describe the reason(s) for conducting the study	✓	
Study Description & Objectives: describe how the study goals will be accomplished	✓	
Study Location and Target Population (E&O only): Identify and provide a short description of the study location and target population, include maps	General	Specific
Data Needed to Meet Objectives: provide a brief description of data needs	✓	
Tasks Required to Conduct Study: define the tasks needed to complete the study	Preliminary	Finalize
Potential Constraints: describe conditions that may impact the project schedule, budget, or scope	Preliminary	Finalize
Organization and Schedule		
Key Team Members: Roles and Responsibilities	Lead Entity & Participating Permittees	All Key Team Members
Project Schedule, Budget, and Funding Sources	Preliminary	Final
Quality Objectives		
Define how the study will verify data is scientifically and legally defensible. *Note: Data Quality Indicators vary depending on the study classification*		✓
Experimental Design		
Study Design Overview: provide an overview of the study design; level of detail similar to executive summary	✓	
Selection Process - Describe the process for selecting the test-site location and the target population (E&O)	General	Final
QAPP Elements	Phase 3a Detailed Study Design Proposal	Phase 3b QAPP
BMP Sizing/Function: describe how the BMP works (i.e. describe BMP Design Criteria, operating procedures, etc.)	General	Final
Data to be Collected: Define ***what*** data will be collected, location for collection, frequency, etc.	Preliminary	Final

Data Collection Process/Design (except E&O): Define ***how*** data will be collected, describe the system design, provide plan sheets, identify equipment, etc.	Conceptual	Final
Implementation of Program During Study (E&O only)	Conceptual	Final
Other E&O Programs: identify other E&O programs that may influence the study results		✓
Instrument Design & Development (E&O Only)		
Define the instrument(s) that will be used during the study along with the process used to develop and validate the instruments		✓
Sampling Procedures (except E&O)		
Define procedures for collecting samples		✓
Measurement Procedures (except E&O)		
Define procedures for measuring data		✓
Quality Control		
Define procedures for minimizing error during the field and lab activities		✓
Data Management Plan Procedures		
Describe procedures for managing/storing data and other documents collected during the study		✓
Audits		
Describe what will be audited including process/procedures, schedule, frequency, etc.		✓
Data Verification & Usability Assessment		
Describe methods for evaluating data quality and usability for meeting project objectives	Preliminary	Final
Data Analysis Methods		
Describe methods for how the data will be analyzed and presented (i.e. graphs) in the final reports	Preliminary	Final
Reporting		
• Report Content – define final report content • Dissemination of Project Documents – describe how the QAPP, reports, fact sheets, etc. will be distributed & where information will be stored	Preliminary Dissemination Only	Final
References	✓	✓
Appendix	✓	✓

4 Phase 3a: Detailed Study Design Proposal Development

4.1 Process for Developing the Proposals

Phase 3a began in March of 2017 with the primary goal of developing 8 detailed study design proposals. The process for developing the proposals including planning for the developing of the proposals followed by developing the proposals. The planning portion focused the consultant developing a Phase 3a conceptual study design write up with input collected during meetings with the intended lead entity, participating entities, Ecology, and the public. The input received from was then incorporated into the Proposal for each study. The Proposals were developed following the guidance outlined in the QAPP templates.

4.2 Meetings

Meetings were a key part of planning for and developing the proposals. This included three primary types of meetings which are summarized in the subsequent sections. Copies of the meeting agenda, reference documents, and minutes are located in the Phase 3a Appendicies.

4.2.1 Project Status Meetings

Project status meetings were held with the City of Spokane Valley, Ecology, and the consultant for the purpose of reviewing the overall project and grant status. This included a kick-off meeting to review the phase 3a project schedule and scope, followed by monthly meetings. Meetings were held in the spring of 2017 on the following dates: April 6th, 11th, 17th, 18th; May 9th, and May 30th. A copy of the meeting documents are located in Appendix 11.

4.2.2 Proposal Planning and Development Meetings

Proposal planning and development meetings were held with the intended lead entity, participating entities, the City of Spokane Valley, and the consultant for the proposal of supporting the development of the proposals. Other outcomes of these meetings included the selection of the 8 studies which were submitted to Ecology on June 30, 2017 along with the identification of the roles and responsibilities for each participating entity. These meetings included:

- Kick-off Meetings – 8 kick-off meetings were held with each of the intended lead entities to assess whether modifications were needed to the conceptual study designs developed prior to Phase 3a. In particular, the conceptual study designs from Phase 1 were reviewed and compared with the intended lead entities desired outcomes for the study (i.e. how the study results might be used to modify the leads stormwater management program). In addition, two conceptual study designs were developed for study ideas that emerged following Phase 1. The two studies included: *Use of Non-Vegetative Swale with Native Soils and Determining Pollutant Contributions from Municipal Stormwater in EWA using GIS*. (*The conceptual study designs modified or developed during Phase 3a are referred to as the Phase 3a conceptual study designs in this report*.)These meetings were held on: March 8th, 15th, 16th, 30th, and April 3rd, 2017. A copy of the meeting documents are located in Appendix 12. A copy of the final conceptual study designs are located in Appendix 13.

- Study Progress Meetings – following the kickoff meetings, meetings were scheduled via web conferencing with the City of Spokane Valley, the intended lead and participating entities, as well as the consultant. The purpose of the meetings was to review the consultant's progress on the development of studies and solicit input from the meeting attendees which assisted the consultant in the development of the Phase 3a conceptual designs, the study posters, and the Proposals. In addition, the types of possible roles and responsibilities for the participating entities were also identified and discussed during these meetings. These meetings were held on: April 20th and June 1st, 2017. A copy of the meeting documents are located in Appendices 14 and 15.

4.2.3 Proposal Review Meetings

Proposal review meetings were held for the purpose of soliciting feedback during the development of study Proposals. The following is a summary of the two types of proposal review meetings which were held:

- Ecology Review – meetings with the City of Spokane Valley, Ecology, the intended lead entity, and the consultant were held during which the Phase 3a conceptual study designs were reviewed. The purpose of these meetings was to determine if the Phase 3a conceptual study designs met Ecology requirements for effectiveness studies and solicit Ecology's feedback on the proposed experimental design prior to developing the proposals. These meetings were held on April 10th, 18th, 19th; and May 1st, 2017. A copy of the meeting documents are located in Appendix 16.
- Public Briefing – a two hour public briefing was held with the EWSG, Ecology, the consultant, and the public on May 17, 2017 prior to the start of the Washington State Municipal Stormwater Conference in Yakima. The purpose of the meeting was to present conceptual study design for all 13 of the conceptual study ideas and comments from the public comment on the studies. This was achieved by developing posters which summarized the following for each study. A copy of the study posters along with the public comments are located in the Appendix 17.
    - Background: Introduction to the BMP, Problem Description, Results of Prior Studies, and Regulatory Requirements (the study will address)
    - Project (Study) Overview: Study Goal, Study Location and Target Population, Study Description, and Tasks Required to Conduct Study
    - Project Schedule, Proposed Project Team, Data Needed to Meet Objectives, Potential Management Changes Resulting from Study Findings, and Final Reporting

4.3 Outcomes and Summary of Studies

A total of 8 ½ studies were developed from the GROSS Grant funding. Table 4-1 provides a summary of each of the studies that were developed from the GROSS Grant funds. The copy of the detailed study design proposal is located in Appendices 18 through 26.

During the development of the detailed study design proposals, one of the studies received comments that it was attempting to answer two questions with one study and would be more

acceptable if it was split into two studies. The questions within the second highest ranked study, “The Use of Non-Vegetative Swale with Native Soils”, were separated into two proposals, the first question answering if vegetation is really needed in swales or not was merged into the “Bioretention Soil Media Study”. The second question on the viability of using native soils vs engineered soils will be answered in a modified proposal at a later date. Work that had already been completed regarding the second question was encapsulated in the ½ study that can be found in Appendix 26.

Of the study proposals developed from the GROSS Grant funding, 3 were submitted to Ecology on June 30th. The remaining 5 ½ proposals are submitted to Ecology through this grant deliverable and may be used in the future by key collaborators or other interested parties. Additionally, Eastern Washington permittees outside of this grant submitted 5 studies to Ecology by June 30, 2017.

The participating entities are identified within each proposal and also summarized in Tables 4-2 and 4-3. Note that gray shading in these tables indicates proposals that were not sent to Ecology as part of the initially meeting permit requirements, however these proposals are ready for implementation at a future date.

Table 4-1 Summary of Detailed Study Design Proposals Developed from GROSS Grant

Elementary School Stormwater Education[1,2,3]
Study Purpose (Goal): The goal of the study is to evaluate the short-term effectiveness of the Drain Rangers education program in EWA. Effectiveness will be measured based on changes in the students understanding of selected learning objectives immediately after participating in this program. The Drain Rangers curriculum includes 10 lesson plans each of which has different learning objectives. This study will only evaluate those learning objectives that align with the EWA NPDES MS4 Phase II permit requirements for E&O. Specifically, increase student understanding and awareness of the following: Students will describe what stormwater is; Students will describe how pollutants get into stormwater and pollute waterways; and Students will describe actions they can take to prevent pollutants for entering waterways and to keep waterways clean. Study Description and Objectives: This study will pilot test the Drain Rangers Stormwater Education program in elementary schools in EWA. This will include using the Drain Rangers curriculum that was developed for EWA as part of a 2015-2017 GROSS Grant. Prior to the start of this study, the WWA Drain Rangers final report (due June 30, 2017) will be reviewed to determine if the findings or recommendation could improve the effectiveness of the EWA educational program. This may result in modification to the existing EWA Drain Ranger curriculum or the teacher training materials. Teacher training workshops will be offered to the teachers who participate in the pilot study. The purpose of the workshop is to provide teachers with background on the curriculum concepts as well as guidance for consistently implementing the curriculum in their classrooms. The curriculum will be implemented by the student's teachers during the regular school hours. Students will be given surveys designed to assess the students' knowledge of the learning objectives immediately before and after they participate in the educational program. The effectiveness of the Drain Rangers programs will be evaluated by comparing the differences in student's responses to the pre and post surveys. Anticipated Outcomes: The anticipated outcome is an understanding of the effectiveness of the Drain Rangers Stormwater Education program for increasing a student's understanding and awareness of stormwater. Expected Modifications to the Stormwater Program: Adopt the Drain Rangers education program at more schools in eastern Washington.
BMP Inspection and Maintenance Responsibilities[1,2,3]
Study Purpose (Goal): The purpose of this Effectiveness Study is to determine the best O&M strategy for privately owned stormwater BMPs in EWA. There are multiple strategies currently employed for inspection and maintenance of privately owned BMPs involving combinations of third-party inspectors, contractors, and municipal staff. Commonly, the private party that owns the BMP is responsible for all maintenance; however, there may be other strategies or models, such as public ownership and maintenance responsibility, which could support better long-term performance of BMPs. The following four potential strategies were identified during a preliminary investigation conducted by Yakima County: 1) City/County performs inspection of structural BMPs but requires the property owner to hire a qualified contractor to conduct necessary maintenance and provide proof that the maintenance has been completed; 2) City/County requires structural BMP owners to contract with a third-party inspector and provide an inspection certification letter to the City/County, as well as proof that any required maintenance has been completed; 3) City/County performs maintenance but the BMP remains under private ownership and the property owner pays the City/County for the service; and 4) City/County assumes ownership, and responsibility for maintenance. Funding could be through existing stormwater fees and/or a onetime

payment by the property owner or other means. These four potential strategies will be evaluated during this Effectiveness Study and other strategies might be identified during the investigation.

Study Description and Objectives: This project will gather information from WA and similar semi-arid jurisdictions (when applicable) to learn novel and effective ways that municipalities are meeting the challenge of ensuring ongoing maintenance of structural BMPs on private property. The long-term aspiration is to develop a prototype E&O program or pilot for an O&M manual of privately owned structural BMPs for EWA jurisdictions. Both of which would improve decision-making of municipal stormwater operators and increase the effectiveness of their programs. The objectives of this investigation are: Gather information on how jurisdiction are meeting the challenge of ensuring ongoing operations and maintenance of privately owned structural BMPs; Synthesize and provide the information to municipal stormwater operators so they can compare their own programs to other jurisdictions; Identify which O&M BMP strategies are more commonly being implemented by jurisdictions; and Identify which O&M BMP strategies are the best option for jurisdictions in EWA.

The goals and objectives of this study will be achieved by developing and implementing a survey of select MS4 jurisdictions in WA and other similar semi-arid regions in the Columbia Basin (Oregon and Idaho) to determine how they address the long-term needs of privately owned structural BMPs. As part of the recruitment process, it will be important to capture a range of opinions from various jurisdictions within the region. A subset of stormwater managers from these municipalities will then be interviewed to further discuss their perceptions of the advantages and shortcoming of their programs. Finally, focus groups may be used in lieu of, or in addition to, interviews to validate findings.

Anticipated Outcomes: Identify methods employed by other jurisdictions for addressing inspection and maintenance of privately owned BMPs.

Expected Modifications to the Stormwater Program: It is envisioned that more effective models for ensuring regular maintenance of privately owned BMPs may be identified through the proposed research effort. This could lead to the development of recommendations for a prototype O&M program or draft O&M manual that individual EWA jurisdictions could adopt when appropriate.

Bioretention Soil Media Study [1,2,3]

Study Purpose (Goal): The purpose of this is study is to evaluate the influence of vegetation on the runoff treatment performance of bioretention ponds. In particular, determine whether a bioretention pond without vegetation can achieve Ecology's treatment goals for basic and dissolved metals, Copper (Cu) and Zinc (Zn). The selected BSM for this study will be either the bioretention media specification that is under development in WWA, or, the default bioretention specification (60:40 mix) defined in the EWA LID Manual. The process for selecting the BSM will depend primarily upon timing. Specifically, results from the WWA study need to be available and/or of sufficient detail to serve as a BSM specification that can be installed in the field prior to October 2019 (estimated start of data collection). Otherwise the default BSM mix (60:40) will be used.

Study Description and Objectives: This is a paired study with a dual-cell pond constructed at the test-site. Each cell contains the same type and configuration of BSM except one is vegetated with grass and the other is nonvegetated. A parking lot contributes runoff (influent) to the pond which is equally distributed to both cells. An impermeable liner, installed under both cells, captures infiltrated runoff (effluent) which is conveyed in underdrains to a manhole. The test-site is equipped with an automated monitoring system that collections composite samples (influent and effluent) and continuously records rainfall depth as well as flow measurements. Composite samples will be collected from 12 qualifying rainfall events this will include collecting one influent and two effluent samples from each storm. Samples will be tested for the required and screening parameters as defined in TAPE for basic and dissolved metals. The study is expected to extend through 2 wet seasons. The infiltration

performance of each pond will also be evaluated. The data will be evaluated to determine whether there is a significant difference in the treatment performance between the two ponds and to determine if the nonvegetated pond meets Ecology's treatment performance requirements defined in TAPE. The scope of work for this study includes submitting a TAPE application that enters the modified BMP into the evaluation program, submitting the quality assurance project plan (QAPP), and a technical evaluation report (TER) to Ecology and the TAPE board of external reviewers (BER) as part of the process for approving a modified BMP.

The goal of this study will be achieved by meeting the following objectives: Determine the pollutant removal efficiency for each pond by measuring and comparing the pollutant concentrations in the influent and effluent; Determine whether the pollutant removal efficiency of the nonvegetation pond is significantly different than the vegetated pond by comparing the effluent pollutant concentrations; Determine infiltration performance of each pond over the duration of the study by measuring infiltration; Determine whether the nonvegetated pond achieved the Ecology treatment performance goals; and Summarize study findings into a report and develop recommendations for next steps: if some or all of the treatment performance goals are achieved, recommendations will include approving of the modified BMP for general use on future projects.

Anticipated Outcomes: If the study goals are met, the results will be used to justify the development of a modified BMP (i.e., Bioretention ponds without vegetation) that is approved for 'general use' on future projects.

Expected Modifications to the Stormwater Program: A new bioretention BMP (without vegetation) that could be used on future projects for meeting NPDES permit goals.

Catch Basin Retrofit Device Replacement [2,3]

Study Purpose (Goal): The goal of this study is to determine if spill control devices installed in multiple catch basins in a storm sewer network are as effective for removing pollutants as one spill control device installed at the most downstream end of a system prior to discharge to a UIC.

Study Description and Objectives: This study will evaluate oils and gross solids removal differences between two similarly sized and located catchments; one in which a retrofit is only installed at the most downstream location in the catchment (test) and one in which the same retrofit is installed at multiple locations within the catchment (control). The catchments to be compared will be located near one another, and each catchment selected will contain a storm sewer network with a series of connected catch basins that discharge to the same endpoint. The study will also document installation as well as operation and maintenance costs which will be used to assess cost effectiveness of the two catchment types. The study goals will be achieved by meeting the objectives: Determine the effectiveness (pollutant removal and cost) of one retrofit installed in a catch basin at the most downstream end of a storm sewer network; Determine the effectiveness (pollutant removal and cost) of installing retrofits in each catch basin within a storm sewer network; Determine which of the two approaches is more effective; and Based on the study findings, summarize recommendations for placement of retrofits in storm sewer networks that provide the greatest benefit in terms of pollutant removal and cost

Anticipated Outcomes: The effectiveness of spill control devices, for removing pollutants, installed in multiple catch basins in a storm sewer network compared to one spill control device installed at the most downstream end of a system.

Expected Modifications to the Stormwater Program: Results from this study could assist MS4s in prioritizing where retrofits are used, inform catch basin design to facilitate compatibility and reasonable maintenance procedures, and optimize cost-effectiveness ($/lb.). The study may also provide key information that could be used (after the study is complete) to determine how catch basin retrofits can be used in combination with other management practices, such as source controls and sweeping, could achieve water quality goals such as 80% removal of solids.

Seasonal Differences in Street Sweeping [2,3]

Study Purpose (Goal): The goal of this study is to evaluate the effectiveness of street sweeping during different seasons. Specifically to determine how seasonal differences influence the sweeper pick-up (as a surrogate measure for actual accumulation) with respect to sediment quantity and characteristics of sediment, organics, and associated pollutant accumulations resulting from different combinations of a community's land use/street type categories. The information collected will be used to estimate the pollutant removal effectiveness of an existing street sweeping program during different seasons.

Study Description and Objectives: This two year study includes streets sweeping an eastern Washington community during three different time periods (seasons) of year which correspond to different types of roadway accumulation conditions and climate. These three seasons include: spring when roadway sediment accumulation is typically high from winter climate conditions; fall following the pine needle and leaf drop, and routine sweeping which occurs at regular frequencies between the spring and fall sweep. Prior to commencing the study, GIS will be used to delineate street sweeping grids, based on land use/street type combinations, and identify sweeping routes and sample locations for the study. Monthly during each sweeping event, the sweeping load will quantified by measuring the weight and estimating the volume. The area where the sample was collected from will be defined based on the length of curb and land use. Five times each year samples from the sweeping load will be collected and analyzed to characterize the physical and chemical properties; this data will be assessed for relationships to the land use. The quantity of material collected during each of the three time periods and from different land use areas will evaluated to determine which seasons and locations had the largest quantity of material is removed. The data collected will be used to calibrate a computer model, Simplified Particulate Transport Model (SIMPTM). The model will use historical rainfall data to simulate the build-up, wash-off and street sweeper pick-up from the study area and predict pollutant reductions based on street sweeping occurrences. The results from the model, along with the results from the comparison of material quantities, will be used to recommend a targeted street sweeping program that removes the most pollutants.

The study goals will be achieved by the completing the following objectives: Determine the street sweeping routes, frequency of street sweeping, and sample locations for the proposed study; Determine the physical and chemical characteristics of the sweeper loads; and correlate these characteristics for each of the targeted sweeping operations; Determine the quantity of materials removed from each of the targeted sweeping efforts (season and land use): including sediment, organics and other associated pollutants found in stormwater; Determine the effectiveness of the sweeping program by comparing the quantity of materials removed from each of the targeted sweeping efforts; the efforts with the largest material removal and estimated pollutant reductions (from modeling) will be considered the most effective; Summarize the study results and recommend improvements to the lead entities sweeping program in terms of seasons and land use; and Determine the cost associated with the jurisdictions current street sweeping program and recommended program; assess the cost benefit for improving stormwater quality and other ancillary benefits of the sweeping program.

Anticipated Outcomes: The estimated pollutant removal of an existing street sweeping program during different seasons and determine which seasons have the highest pollutant removal.

Expected Modifications to the Stormwater Program: The results will be used to develop recommendations that permittees could use to optimize the street sweeping program's sediment, organic and associated pollutant removals and improve the cost-effectiveness of their programs.

Stormwater BMP Owner Awareness [2,3]

Study Purpose (Goal): This study focuses on evaluating the effectiveness of programs (ordinances or other regulatory mechanism) implemented by permittees that address property owners O&M requirements for structural BMPs. In particular, the effectiveness of the documents and the process (i.e. O&M Plan provided to the property owner when they receive their property title) are for notifying and informing the property owner of the BMP maintenance needs and their responsibilities. For the purpose of this study, effectiveness will be measured based on the following: The property owner's awareness of the structural BMP on their property; The property owner's awareness of the BMPs O&M needs; The property owner's awareness of their responsibilities for providing the BMP O&M; and How the property owner learned about the BMP and their O&M responsibilities.

Study Description and Objectives: This case study will survey either commercial or residential property owners with BMPs on their property that are located within a specific jurisdiction that is subject to the Phase II NPDES MS4 permit. The study location has not been determined. The desired sample size will be determine based upon the total population of property owners with BMPs. Prior to developing the study quality assurance project plan (QAPP), background data will be collected. This will include developing an inventory of the property owners in the study area. This information will be used to identify the participants (target audience) for the study and to determine the sample size. In addition, information regarding how other permittees are addressing similar BMP O&M permit requirements will be collected (i.e. contacting other jurisdictions, literature search, etc.) including whether/how they have evaluated the effectiveness of these programs. This information will be used to develop targeted questions for BMP owners. In addition, a search for other existing BMP O&M education and outreach programs within the study area will be conducted to identify potential sources of information that may influence participant's responses.

A survey questionnaire will be developed that is designed to gauge the property owner's awareness of the BMP O&M needs and their responsibilities as well how the property owner learned about these requirements. Additional questions maybe asked of property owners who are aware of the BMP O&M requirements regarding how they maintain the BMP. Surveys will likely be administered over the phone or face to face. Finally, focus groups may be used in addition to interviews to validate findings. Data from this study will be evaluated to determine the level of awareness and where there may be information gaps in BMP owner awareness. Results from this study, along with background information collected at the start of the study, and response from the additional survey questions (i.e. how property owners maintain their BMP) will be used to develop recommendations for education and outreach campaign targeted at increasing BMP owner awareness.

The goals of this study will be achieved by meeting the following objectives: Determine the target population for this study; Design a questionnaire for measuring the property owners awareness of BMP O&M; Determine the target populations awareness of BMP O&M; Summarize the results and provide the information to the local jurisdiction; and Identify ways to improve the E&O program so that property owners are more aware of BMP O&M.

Anticipated Outcomes: The effectiveness of programs (ordinances or other regulatory mechanism) implemented by permittees that address property owners O&M requirements for structural BMPs. Specifically the propery owners awareness of the BMP and their responsibilities for providing the BMP O&M.

Expected Modifications to the Stormwater Program: Based on the results of this study, recommendations for a targeted education and outreach campaign could be developed to address, specifically, the awareness shortcomings of BMP property owners identified by this survey. Results from this study may also be used to develop more detailed processes or procedures that address BMP maintenance responsibility on private property or educating a different target audience that has direct contact with new property owner (i.e. realtors).

Determine Pollutant contributions MS4 SW in EWA GIS [2,3]

Study Purpose (Goal): The goal of this study is to evaluate the combined effectiveness of the jurisdictions typical stormwater management practices and activities in each of the three areas that apply different approaches to managing stormwater discharges including: 1) drainage and discharge to surface waters (outfalls), 2) UICs, and 3) LID and LID-like infiltration. Effectiveness will be based on the estimated cost of the stormwater management programs and activities (using a metric such as $/lb) that reduce polluted runoff to surface water bodies and to groundwater via infiltration practices.

Study Description and Objectives: This study would evaluate and characterize several stormwater programs and activities from jurisdictions similar to the study area, and in particular, map and segregate those areas within each jurisdiction that discharge to surface water outfalls; areas from those that rely on infiltration (both UIC-like and LID-like). The study would identify if there are any differences in the stormwater management practices currently being used in the three types of areas; and also estimate or document stormwater program costs for each program area/activity for which data are available. The study will estimate how effective, using a metric such as $/lb removed, stormwater management programs and activities are in reducing polluted runoff to surface water bodies and to groundwater via infiltration practices.

For some activities, a direct estimate of costs and pollutants removed can be obtained from specific activity costs and removals already documented by the jurisdiction. For example, annual pollutant loads from each of the three types of areas in a given jurisdiction could be estimated for a given outfall to a receiving stream. In this hypothetical example, assume it is an older area in a commercial district that currently has only minimal stormwater containment or treatment. Also assume the stream is impaired due to phosphorus discharges. Assume also that through a planned redevelopment, it will be possible to capture and infiltrate, and hence mostly disconnect, the entire drainage to this outfall due to suitable local soils and groundwater levels. The existing annual loading of phosphorus from this area could be estimated with a Simple Method tool (e.g., GIS-based tool such as PLOAD or WinSLAMM) using local hydrology and the Boise area event mean concentration for a commercial area. That loading would be essentially eliminated with redevelopment, but the loading of various pollutants to groundwater may increase. Those increased loadings (say of nitrate or total nitrogen) could be similarly estimated. The cost per pound of phosphorus removed would be calculated with the costs associated with the infiltration BMPs. One scenario could include a UIC infiltration system and another assuming bioswale infiltration. A third scenario might include non-infiltration phosphorus treatment BMPs. The example in this paragraph is hypothetical, but the actual study would focus on real areas within the jurisdiction(s).

The goals of this study will be achieved by the following measures: Delineate and characterize the land areas (for each participating jurisdiction and the Boise metro area) where the different approaches to managng stormwater discharges are applied; Characterize the stormwater

management programs and activities that occur in the three different types of areas for each jurisdiction participating in the study; Determine the effectiveness of the combined stormwater management program activities and practices in each of the three areas with different approaches to managing stormwater discharges; and Summarize the study results and provide stormwater managers in EWA with recommendations for a targeted stormwater management program based upon an areas approach to managing stormwater discharges: 1) drainage and discharge to surface waters (outfalls), 2) UICs, and 3) LID and LID-like infiltration.

Anticipated Outcomes: Determine the effectiveness of the jurisdictions typical stormwater management practices and activities in each of the three areas that apply different approaches to managing stormwater discharges including: 1) drainage and discharge to surface waters (outfalls), 2) UICs, and 3) LID and LID-like infiltration.

Expected Modifications to the Stormwater Program: Results from this study will allow jurisdictions, and the MS4 permits applicable to them, to prioritize and differentially target areas that contribute pollutant loads of concern to surface waters and to groundwaters, which are likely to involve different pollutants and different management practices targeted to the specific pollutants for each type of area. Stormwater management activities related to flood management and groundwater protection (e.g., UIC programs) will likely still be needed, but the nature and cost of those activities may be different than those discharging to surface waters, especially impaired surface waters.

Long-term PP Sidewalk Infiltration Performance [2,3]

Study Purpose (Goal): The purpose of this study is to evaluate the effectiveness of a pervious concrete (PC) sidewalk as a structural BMP in Eastern Washington including the operation and maintenance (O&M) requirements. The effectiveness evaluation will focus on the useful life span of the material with respect to infiltration performance and deterioration in surface condition. If the infiltration performance and durability of PC sidewalks are stable over time, with either routine or periodic maintenance, then PC may be adopted by more jurisdictions as a stormwater flow control BMP in appropriate locations. The study will also inform municipal stormwater managers about the type and frequency of required maintenance for PC to ensure long-term performance. Results from this study may be used to improve permeable pavement design guidance for sidewalks and recommend O&M procedures for Eastern Washington. When appropriate, the findings could be transferred to roads.

Study Description and Objectives: This is a paired study with four block-long PC sidewalk segments constructed at two locations. Two of the segments will be in commercial setting (one test and one control) and two will be located in a residential setting (one test and one control). The control sites will undergo routine maintenance as described in the EWA LID Manual. Maintenance techniques generally include either pressure washing or mechanical vacuum sweeping or a combination of the two. The test segments will undergo no maintenance during the entire investigation. The routine PC maintenance listed in the EWA LID Manual was not specifically established for sidewalks so this study will determine if the type and frequency of maintenance recommended is appropriate for sidewalk applications. In addition, previous research conducted on PC, has shown that maintenance can increase the infiltration rate of clogged pervious concrete; however previous research is based on road applications in non-EWA locations. This study will serve to determine if PC will perform similarly under EWA conditions and whether the type and frequency of maintenance on PC sidewalks should be adjusted. The objectives of this effectiveness study are to: determine the useful life span of PC sidewalks; determine the infiltration capability over time at sites with and without maintenance; evaluate durability based on visual observations of deterioration in surface condition; recommend maintenance protocols (type and frequency) of PC in sidewalk applications; and synthesize and provide study results to stormwater operators in EWA so they can determine the usefulness of PC sidewalks for their jurisdictions.

Anticipated Outcomes: The useful life span of the material with respect to infiltration performance and deterioration in surface condition.

Expected Modifications to the Stormwater Program: If the infiltration performance and durability of PC sidewalks are stable over time, with either routine or periodic maintenance, then PC may be adopted by more jurisdictions as a stormwater flow control BMP in appropriate locations. The study will also inform municipal stormwater managers about the type and frequency of required maintenance for PC to ensure long-term performance. Results from this study may be used to improve permeable pavement design guidance for sidewalks and recommend O&M procedures for Eastern Washington. When appropriate, the findings could be transferred to roads.

Use of Non-Vegetated Swale with Native Soils [2,3,4]

Study Purpose (Goal): The goal of this study is to evaluate the effectiveness of a modified bioretention BMP. The modification is to the engineered soils specification: in lieu of using the default 60:40 mix specification, a native soil specification would be used. The modified bioretention BMP will be sized following the existing bioretention design guidance defined in the EWA LID Manual. The effectiveness evaluation will focus on determining whether a bioretention BMP constructed using the native soil specification without vegetation can achieve Ecology's treatment goals for basic (TSS) and dissolved metals, Copper (Cu) and Zinc (Zn).

Study Description and Objectives: The study proposed will likely include multiple phases to meet the study goal: Phase 1 develop the specification and Phase 2 field evaluation.

- Develop a specification that defines the physiochemical properties (or range of properties) of native soils that are suitable for providing stormwater treatment. This will may include conducting an extensive literature search and identifying properties based on common citations in the literature.
- Verify (through analytical testing of the soils) that the properties of the native soils that will be used at test site(s) are within the range of suitable properties identified in the specification.
- Design and construct the bioretention BMP following the design guidance in the Ecology Stormwater Manual for EWA (or an equivalent manual) except without vegetation and using the native soils specification
- Design and install an automated water quality monitoring system capable of collecting composite influent and effluent water quality samples; monitoring flow rates; and measuring rainfall depth.
- Collect water quality samples from a minimum of 12 qualifying events.
- Visually observe the site after each rainfall event to document weed growth, evidence of vandalism, impacts to the BMP from blowing sand, etc.
- Analyze the data and evaluate whether the pollutant reduction meet Ecology's treatment performance requirements defined in TAPE. This study also includes submitting a TAPE application that enters the new BMP into the evaluation program, and submitting a technical evaluation report to Ecology and the TAPE board of external reviewers (BER) for review and approval. The BER for this study will be composed of experts from EWA.

Anticipated Outcomes: Develop a specification for native soils that defines the physiochemical properties necessary for treatment and determine whether the a BMP constructed using the native soil specification without vegetation can achieve Ecology's treatment goals for basic (TSS) and dissolved metals, Copper (Cu) and Zinc (Zn).

Expected Modifications to the Stormwater Program: If Ecology's treatment goals for basic (TSS) and dissolved metals, Copper (Cu) and Zinc (Zn). are achieved, the results will be used to justify the development of a modified BMP that is approved for 'general use' on future projects (Ecology).

1. Study was one of the 8 submitted to Ecology on June 30, 2017
2. ***Participating Entities****: See Tables 4-2 and 4-3 for a summary of the proposed roles for each study along with a definition of the responsibilities.*
3. ***Method for Reporting Results:*** *All results will be reported on the lead entities jurisdictions website.*
4. *The detailed study design proposal was only partially developed because the EWSG decided to select a different study for the June 30, 2017 submittal to Ecology.*

Table 4-2 Summary of Participating Entity Roles for Each Study

Study Number	Project Title	Cities														Counties					
		Asotin	Clarkston	East Wenatchee	Ellensburg	Kennewick	Moses Lake	Pasco	Pullman	Richland	Spokane	Spokane Valley	Walla Walla	Wenatchee	West Richland	Yakima	Asotin CO	Chelan CO	Douglas CO	Spokane CO	Walla Walla CO	Yakima CO
01-01	Elementary School Stormwater Education	2,3,7,8	2,3,7,8			ILE		x	2	1,2,3 6,7,8		3,8*				2,3	2,3,7,8					2
03-15	Street Sweeping and Catch Basin Cleaning Comparison	2,3,7,8	2,3,7,8		ILE		2,6				2	3,8*	1?,2, 3,9	2	3		2,3,7,8					
04-02	Mobile Contractor Illicit Discharge Education			1,2,3	2	2		x	2			2, 7	1?,2, 3,9	ILE 1,2,3, 4,8,9		2		1,2,3	1,2,3			2
05-28	Sand Filter Vault BMP						2		2			3,7*,8*			3					ILE		
06-09	BMP Inspection and Maintenance Responsibilities							x				3,8*				1,3					2,3,6	ILE
11-27	Bioretention Soil Media Study						2	x	2			3,8*			3	2				ILE	2,3	1?,2,**
12-14	Sharp Avenue Porous Pavement										ILE	2*,3, 7*,8*								X		
12-24	Garland Storm Gardens with Biochar Amended Soils										ILE	2*,3, 7*,8*								X		
06-16	Catch Basin Retrofit Device Replacement					x			1,2,3			ILE					ILE					
06-18	Seasonal Differences in Street Sweeping			x	x	x		x				ILE				1,2		2	2			
09-07	Stormwater BMP Owner Awareness			x	x	x		x	2					ILE 2		2,3		2	2,3			
10-29	Determine Pollutant contributions MS4 SW in EWA GIS						2					ILE				5,8						
14-12	Long-term PP Sidewalk Infiltration Performance									ILE		ILE										

Key: x - Participant w/out designated role; ILE - Intended Lead Entity; XX-XX = 2 digit rank from Phase 2 and Sequential Study Idea #; 1-Financial Support; 2-Reviewer; 3-Advisory Board Lead / Member; 4-QAPP Author; 5-Lab Services; 6-Data Collector; 7-Auditor; 8-Data Verifiers; 9-Final Report Author, * only if needed; **Can also provide QA/QC on designs, etc.;

Table 4-3 Suggested Participating Entity Roles and Responsibilities

Role	Responsibility
Financial Support	Provide lead entity with financial contributions toward their cost of executing the study
Reviewer	Review and provide comments (either technical review or QA/QC for grammar, etc.) on the study documents prior to the lead entity submitting the documents to Ecology. Documents include: Quality Assurance Project Plan (QAPP) and the Final Report
Advisory Board Lead/Member	The goal of a technical advisory group (TAG) is to provide insight, suggestions, and professional opinions over the course of the research study. The expectations of the TAG members may include: attending/participating in project status meetings (either by phone or in person); and review/comment on the research materials (i.e. QAPP, data collected, data analyzed, study reports, etc.)
QAPP Author	The QAPP Author is responsible for developing the contents of the QAPP as defined in the QAPP Template through Ecology approval of the QAPP.
Lab Services	For jurisdictions that have an Ecology approved lab that can conduct the analytical testing planned for the study, the participation role could include conducting the analytical testing for the lead entity at your jurisdictions lab.
Data Collector	Data collectors are responsible for collecting some or all of the data during the data collection phase of the study. This includes following the standard operating procedures (SOPs) for data collection as defined in the QAPP (see section 8.0 of the QAPP Templates for additional discussion on SOPs).
Auditor	Auditors are responsible for conducting audits to verify the study conforms to the plan and procedures defined in the Ecology approved QAPP (see section 11 of the E&O QAPP Template or section 12 of the Operational and Structural QAPP Template for additional discussion on audits). This may include: • Verify the staff collecting the data has been trained and are following the SOPs for data collection as defined in the QAPP as well as being present when the data is collected. • Verify the data management procedures are being followed as defined in the QAPP including review all the data records to ensure they are consistent, correct and complete, with no errors or omissions. This may include traveling to the site where the data is stored and reviewing the data records compared to the QAPP Data Management Plan.
Data Verifiers	Data verifiers will review the analyzed data and verify the analysis is correct. This may include: verifying that the data collected in the field matches the data records and reviewing the data analyzed for errors. For qualitative data (i.e. open ended questions) the data verifier (also referred to a peer debriefing) will assist with validating the codes/themes compared to the data collected to determine if they have the same results as the researcher.
Final Report Author	The final report author is responsible analyzing the data and summarizing the findings of the study into a report as defined the QAPP Template sections 14.0 and 15.0 or section 13.0 and 14.0 for E&O Studies

5 Lessons Learned to Date (GROUP Draft)

Background

As part of Grant Task 3 of the Eastern Washington Effectiveness Study Development Phases 2 & 3 project, the City of Spokane Valley is scoped to deliver the following to the Washington State Department of Ecology (Ecology):

- **Task 3.B.** The RECIPIENT will ….. facilitate the EWSG to reflect on lessons learned through the process of developing these study ideas and implementation plans to recommend changes to the requirements of S8.B and C in the current permit that could improve the next permit.
- Under **Task Goal Statement**: ….. RECIPIENT will deliver recommendations for how to identify and implement effectiveness studies in future permit cycles.

This document attempts to capture the input received on "lessons learned" going through the Study Development Process from the Eastern Washington Stormwater Group (EWSG) to meet the Grant Task 3 deliverable.

Note: the majority of the EWSG felt that this grant deliverable should not have been included in the agreement with the City of Spokane Valley and Ecology. It is premature to speculate changes when the study development process has not been fully completed. In view of this, members of the group expressed that this review be considered a draft preliminary, subject to additional comment and changes, and not suggest the official stance of the any individual or the EWSG group.

DRAFT PRELIMINARY Review of Study Development Process

Members of the Eastern Washington Stormwater Group (EWSG) have expressed the following preliminary summary of ideas, comments, and recommendations to help inform future effectiveness study development efforts.

Comments are denoted as either:

POSITIVE: If participants appreciated something from the study development process to date, those comments were noted "Positive".
CHALLENGE: If a comment described a difficulty or problem, it was noted as "Challenge".

Suggestions and opinions from the group that give direction in dealing with the comments are presented as bulleted lists below each comment as follows:

- "**RECOMMEND:**" If there was a recommendation suggested that appeared to have a majority of support from the group, it is listed as "Recommend"
- "**IDEA:**" Relates a possible way of dealing with a certain issue; may not reflect the opinions of the entire group
- "**CONCERN:**" If there was a dissenting view to a comment, recommendation, or idea, it is listed below that comment as "Concern"

Preliminary Comments

POSITIVE: The current Eastern Washington Stormwater permit did not require end-of-pipe basin characterization monitoring, status and trends monitoring, or in-stream type monitoring to prove how well stormwater management programs are working. In lieu of this list of monitoring types, effectiveness studies were required. In most cases in eastern Washington, it would be difficult to institute, and in many cases impossible, to collect enough data in a timely fashion for the types of monitoring listed except for effectiveness studies. This is due to the semi-arid and arid climates found in eastern Washington. The group appreciates Ecology's acknowledgement of the limitations to perform certain types of monitoring because of climate and topography.

- **Recommend:** Continue to waive types of monitoring that are difficult to implement due to climate, topography, and the nature found in the majority of permitted eastern Washington jurisdictions.

CHALLENGE: Requiring municipal jurisdictions to perform studies runs counter to typical city and county operations. Effectiveness studies and short-term monitoring activities lend better to academic research and/ or scientists.

- **Recommend:** Best Management Practices (BMPs) should be studied and tested by a larger organization such as Ecology or Universities, especially more costly structural or operational type studies. State and Federal governments in general have staff and resources that are more interested, better versed, and more focused than local jurisdictions to perform research, data collection, and studies.
- **Idea:** Exempt programs meeting permit requirements. Exemptions should be made for communities that allow for an independent audit of their stormwater programs and substantially meet permit requirements to protect surface water quality
- **Idea:** Where new or unproven BMPs are implemented, local jurisdictions could work on a limited basis with larger organizations (such as Ecology or WSU) to provide input on how BMPs can be best implemented and to study the effectiveness of those BMPs to prove application and worth.
- **Idea:** Ecology could hire a management consulting firm to evaluate the current methods of obtaining effectiveness studies (whether it should even be a permit requirement), structure, and which vested parties should fund (State, local, federal, private, or mix) to return the best return on investment to the citizens of Washington, to prove effectiveness of known or new stormwater BMPs (non-proprietary).

CHALLENGE: Individual jurisdictions do not necessarily know or understand how much work is required to meet Ecology staff expectations for approvals of detailed study design proposals and the Quality Assurance Program Plans. Since each study can vary greatly depending on type, size, and locations required to answer study question(s), it is hard to know what determines a successful study project.

- **Idea:** Move to a program that allows for jurisdictions to show success through more discrete and measurable means, such as tracking the total quantity of material removed from catch basins or the total area swept and amounts of material removed, rather than through effectiveness studies.

POSITIVE: Ecology allowed several years to complete certain tasks that required collaboration between the various permitted jurisdictions in eastern Washington. This allowed needed time to create a phased, structured, and coordinated program.

- **Recommend:** Continue to allow adequate time in the process to brainstorm ideas, develop those ideas into detailed study design proposals, gain approval of QAPPs, allow time for local jurisdictions to budget for implementation, and complete final reporting.

CHALLENGE: The permit requires that 24 eastern Washington jurisdictions deliver 8-12 detailed study design proposals by a certain date. This requirement is problematic and sets jurisdictions and Ecology up for potential legal challenge(s). What happens if collectively these jurisdictions deliver only 7 study design proposals? What if they deliver 13? Are all or some of the jurisdictions in jeopardy of receiving a notice of violation?

- **Recommend:** Some other measurement should be discussed with the EWSG and possibly implemented. The measurement should clearly demonstrate a jurisdiction's compliance with the permit requirement without reliance on entities that are outside of a jurisdiction's control.

POSITIVE: Ecology staff has made themselves available to help jurisdictions in the discussion, development, and implementation of study ideas as part of meeting S8.B requirements.

- **Recommend:** Continue to provide staff technical assistance to inform, especially on what would probably be accepted for the next phase of the life of a study.

CHALLENGE: Jurisdictional staff changes interrupts and suspends work on studies; affecting also the coordination between jurisdictions on individual studies.

- **Recommend:** Continue to look for ways to allow flexibility in the program to help jurisdictions deal with issues that may be outside of their control like staff turn-over or internal jurisdictional organization changes.
- **Idea:** Allow for a jurisdiction to apply and act as the program coordinator to ensure continuity from year to year, between and with current and future studies, as well as ongoing development of new studies.

POSITIVE: Ecology allowed flexibility in the permit for the eastern Washington permitted jurisdictions to form whatever alliances, agreements, or partnerships in their best interests to meet the permit requirements.

- **Recommend:** Continue program flexibility and choice for each jurisdiction to meet permit requirements on their own or as a team with others.

POSITIVE: Outside of the permit, Ecology provided funding to help jurisdictions in the coordination and facilitation of ideas for effectiveness studies, developing study design proposals, and designing Quality Assurance Project Plan templates eased the burden of the initial permit requirements in S8B. This helped in developing better study ideas that will be more applicable to the municipal setting.

- **Recommend:** Continue to provide fiscal assistance either through Grants of Regional or Statewide Significance or other funding mechanism(s) to develop and further completion of permit-required effectiveness studies.

CHALLENGE: Effectiveness studies tend to vary in project size, cost, and length of time it will take to collect and analyze meaningful results. Some studies can be inexpensive and others much more expensive. Without a long term benefit identified that supports BMPs, more expensive studies may not move forward without dedicated funding sources.

- **Idea:** An independent cost/ benefit analysis (CBA) could be accomplished as an evaluation of each study design proposal. The CBA should look at all environmental as well as fiscal returns on the investment to do the study. This could help to justify attempting larger cost study projects to potential funding sources if the return on investment could be shown to outweigh the initial cost.
- **Idea:** Larger budget studies typically address structural-type BMPs. Could these types of studies be funded by those that would benefit the most from the work?

CHALLENGE: Determining the equitable amount for each jurisdiction to provide in resources, whether in-kind or direct funding is difficult to estimate and justify. Some jurisdictions have very little flowing to surface waters of the State, yet because of population are included to receive a permit and are required to participate in effectiveness studies.

- **Idea:** Look into alternative methods of funding to, and participation from, jurisdictions based on the total annual storm runoff volume from Municipal Separate Storm Sewer Systems to surface waters of the State. Allow possible waivers of certain permit requirements (in this context, effectiveness studies and/ or types of effectiveness studies) if the jurisdiction meets one of the following example criteria:
    - total annual discharge is in bottom 20% of all state dischargers with a permit
    - the discharge levels per capita are in the bottom 20% of all state permitted dischargers.

  Conversely, require additional study requirements from areas that are in the top 20% of permitted dischargers for both total discharge volume and per capita discharge levels.

CHALLENGE: Permit minimum measure descriptions are either direct, indirect, or at times somewhat vague. The challenge seems to be to make the measures specific enough to get water quality benefits, while maintaining flexibility for permitted jurisdictions to choose BMPs that are applicable and appropriate for their locations.

- **Idea:** Work with local jurisdictions represented through steering committees and stake holder meetings to develop or further refine guidance manuals for program components, including education and outreach. If a jurisdiction decides to allow certain BMPs to be deployed, that jurisdiction would know how to measure success with each component through the guidance manual associated with that minimum measure.

CHALLENGE: Determining what success looks like for education and outreach programs are difficult to measure the amount of pollution reductions from that one activity.

- **Idea:** Encourage Ecology to provide statewide education and outreach programs. A statewide campaign by Ecology would lend consistency to some of the general stormwater pollution prevention messages and support local efforts.

6 References

Ecology, *Eastern Washington Phase II Municipal Stormwater Permit*, S.o.W.D.o. Ecology, Editor. 2012: Olympia, WA.

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Herrera Environmental Consultants, Phase 1: Development of Effectiveness Study Questions for Eastern Washington Permittees. 2015: City of Spokane Valley Website.

EPA, Urban Stormwater BMP Performance Monitoring. 2002: Washington D.C.

Ecology, Technical Guidance Manual for Evaluating Emerging Stormwater Treatment Technologies. 2011: Olympia.

7 Appendices