

Appendix 11 – Phase 3a Project Status Meeting Documents



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# Project Alignment Meeting

EW Effectiveness Study Development – Phase III

**13 February 2017, 10:00 am – 12:00 noon**

**Via GoToMeeting:** <https://global.gotomeeting.com/join/743391645>

**Invited:**

Karen Dinicola, Ecology  
Art Jenkins, City of Spokane Valley  
Jon Morrow, City of Ellensburg  
Aimee Navickis-Brasch, HDR Engineering, Inc.

**Discussion Topics:**

1. Welcome
2. Consultant selection decision for remaining detailed study design proposals.
3. Scheduling meetings with Ecology Staff:
  - Scheduling monthly standing progress meetings (webinar style) with Ecology staff through the end of the project in June.
  - Scheduling in-person conceptual meetings with Ecology staff on 8 studies for 1 day in March.
  - Proposed public open house just prior to the May 16<sup>th</sup>-17<sup>th</sup> Stormwater Muni-Con in Yakima as pre-conference, conference, as well as web-based outreach.
  - Pre-final in-person review meeting with Ecology staff, Intended Lead Entity representatives and Participating Permittees Thursday morning after Muni-Con in Yakima.
4. Discussions with the EWSG regarding suggested permit language regarding requirements for effectiveness studies in the future.
5. Survey of lead entities: measuring readiness, wiliness, ability to produce detailed study design proposals, Inter-local Agreements
6. Review of Action Items and Assignments
7. Adjourn

Appendix 12 – Phase 3a Proposal Planning and Development Kickoff Meeting Documents

# EWA Phase 3a Effectiveness Studies Meeting

*Date | Time* | 3/8/2017 8:00 AM to 5:00 PM

*Location* | HDR, 2805 St Andrews Loop, Pasco  
(509)546-2040

*Topic* | Study Development Meeting:  
Kick-Off Meeting

*Conference Line* | None

## Meeting Handouts:

- 1a – Ecology Grant - Phase 3a Roles
- 1b - QAPP Table - Roles and Responsibility
- 2 - Phase 1 Research Proposal
- 3 - Phase 2 Study Idea Public Briefing
- 4 - EWA MS4 NPDES Permit: *(hard copy available at meeting)*
- 5 - Study location and target population (E&O) Information  
*(To be provided by Intended Lead Entity)*
- 6 – Study Readiness Score Matrix
- 7 – Effectiveness Study Schedule

## Invited:

- Key Collaborators
  - Martin Nelson, City of Kennewick
  - David Haws, Yakima County
  - Mark Melton, City of Richland
  - Teresa Reed-Jennings, City of Pasco
- Art Jenkins, City of Spokane Valley
- Aimee Navickis-Brasch, HDR
- Jay Decker, HDR

## Agenda Items

Topic	Presenter	Time allotted
<input type="checkbox"/> Roles and Responsibilities <i>(Handout 1a &amp; 1b)</i> <ul style="list-style-type: none"><li>➤ Objective: Begin discussions regarding the roles and responsibilities for Phase 3a in relation to the Ecology Grant as well as for the QAPP (i.e. intended lead entity, participating entity, Ecology)</li></ul>		15 minutes
<input type="checkbox"/> Refine/Update Conceptual Study Design <i>(Handouts 2 &amp; 3)</i> <ul style="list-style-type: none"><li>➤ Objective: 1) assess whether the conceptual study design aligns with the intended lead entity goals, objectives, and anticipated study outcome; 2) identify conceptual study design modifications</li></ul>		45 minutes
<input type="checkbox"/> Identify Regulatory Requirements <i>(Handout 4)</i> <ul style="list-style-type: none"><li>➤ Objective: Identify the regulatory requirements and conditions the study will address</li></ul>		10 minutes
<input type="checkbox"/> Study Location(s) & Target Population(s) <i>(Handout 5)</i> <ul style="list-style-type: none"><li>➤ Objective: Identify the proposed study location(s) and target population (E&amp;O only) OR discuss process for selecting the location and population</li></ul>		15 minutes
<input type="checkbox"/> Study Readiness Score <i>(Handout 6)</i> <ul style="list-style-type: none"><li>➤ Objective: Assess study readiness score for proceeding to next Effectiveness Study Phase</li></ul>		15 minutes
<input type="checkbox"/> Effectiveness Study Schedule <i>(Handout 7)</i> <ul style="list-style-type: none"><li>➤ Objective: Review proposed schedule format and content for Study (Phase 3a to Final Report)</li></ul>		15 minutes
<input type="checkbox"/> Meeting Wrap-up <ul style="list-style-type: none"><li>➤ Objective: Confirm assignments and action items</li></ul>		5 minutes

## Eastern Washington Effectiveness Study Phase 3a: Developing Detailed Study Design Proposals

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### Handout 1a – Roles & Responsibilities – Ecology Grant – phase 3a

#### Ecology

Ecology is funding phase 3a for the development of detailed study design proposals with a Grant Agreement with the City of Spokane Valley. Ecology also holds Municipal Stormwater Permits (Permit) with 18 cities and 6 counties in eastern Washington. Ecology will ultimately receive for approval detailed study design proposals from lead entities for 8-12 studies by June 30, 2017 in compliance with Permit.

#### The City of Spokane Valley

The City of Spokane Valley (City) is the Ecology grant recipient and is performing work for the Eastern Washington Effectiveness Studies Phase 3a as part of this grant. The City is the current lead entity and project manager for each study that the City develops through this phase with input from staff from other Eastern Washington Municipal Stormwater permit holders. Art Jenkins from the City is the overall program manager and project manager for each study design. The work the City will perform during this phase includes, but is not limited to:

- Soliciting a request for qualifications from consultants to perform detailed study design proposals.
- Leading a selection process to hire a consultant on each study design project and negotiates a consultant agreement with selected firm.
- Acting as the project manager for each design and the main point of contact.
- Working directly with key collaborators and participating permittees to receive input and feedback into the study design.
- Completing 95% detailed study design proposals to the point that can be adopted by any interested city or county by mid-June 2017 or sometime thereafter. 95% detailed study design proposals will not have “lead entities” specifically named as this will happen when an interested city or county adopts the design and completes it to 100%, secures any partnerships for implementation, and sends to Ecology for review. The City may or may not adopt and implement any or all of the proposals developed during phase 3a.

#### Key Collaborators

Key Collaborators include staff from counties and municipalities in eastern Washington that have a Municipal Stormwater permit with the State Department of Ecology. Key Collaborators will provide input and assistance in guiding the project design. They are interested in possibly implementing and carrying out the study design at a later date. They could become the lead entity of a study design at a later phase of the program, may be working to secure funding through the government organization they work for, or may be working to develop partnerships for future project phases.

## **Participating Permittees**

Participating Permittees during this phase are interested in the outcome of a study and may be involved in future phases of the study as it is further refined and possibly implemented. During this phase, staff from participating permittees may take an active interested role in attending all project meetings, reviewing deliverables and making comments, supporting the City and Key Collaborators during public briefings, or reviewing final deliverables. Participating permittees may be working on partnerships with Key Collaborators for future phases of the work and refinement of roles.

## **Consultants**

Consultants for this phase of the project will work directly for the City of Spokane Valley. All communication that may impact the project scope of work needs to be discussed with the City.

## 5.0 Organization and Schedule

The purpose of this section is to describe who is responsible for completing the tasks, when the tasks will be completed, and how the study will be funded.

### 5.1 Key Project Team Members: Roles and Responsibilities

**Proposal** – At a minimum include the Lead Entity, Participating Entities, Partner Entities, and the Ecology Reviewer.

Include key members of the project team, decision-makers, and/or stakeholders (i.e. lead and participating entities, project manager, test site owner/manager, analytical laboratory contacts, field personnel, third-party reviewer(s), etc.) and describe who is going to do what for the project.

Key Team Members	Role	Responsibility
Name Organization Phone Number Email	Lead Entity	Define
Name Organization Phone Number Email	Participating Entity	Define
Name Organization Phone Number Email	Partner Entity	Define
Name Organization Phone Number Email	Ecology Reviewer	Define
Name Organization Phone Number Email	Proposal Author	Define
Name Organization Phone Number Email	QAPP Author	Define
Name Organization Phone Number Email	Key Team Member Project Role	Define

Issuance Date: August 1, 2012  
Effective Date: August 1, 2014  
Expiration Date: July 31, 2019

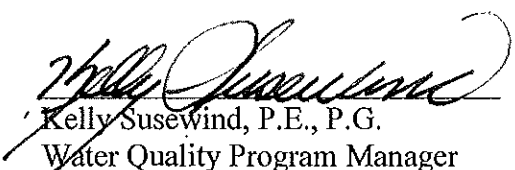
## **Eastern Washington Phase II Municipal Stormwater Permit**

National Pollutant Discharge Elimination System and  
State Waste Discharge General Permit for Discharges  
from Small Municipal Separate Storm Sewers  
in Eastern Washington

**State of Washington**  
**Department of Ecology**  
Olympia, Washington 98504-7600

In compliance with the provisions of  
The State of Washington Water Pollution Control Law  
Chapter 90.48 Revised Code of Washington  
and  
The Federal Water Pollution Control Act  
(The Clean Water Act)  
Title 33 United States Code, Section 1251 et seq.

Until this permit expires, is modified, or revoked, Permittees that have properly obtained coverage under this permit are authorized to discharge to waters of the state in accordance with the special and general conditions which follow.

  
Kelly Susewind, P.E., P.G.  
Water Quality Program Manager  
Department of Ecology





# Meeting Minutes

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*Date | Time | Varies*

*Location | HDR Offices (Pasco or Spokane)  
or phone conference*

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*Project | EWA Effectiveness Studies Phase 3a – Kick off Meeting*

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Meeting Reference Documents:

*See Meeting Agenda*

Attendees:

*See item six of the meeting minutes*

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## Meeting Minutes

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The meeting opened with the attendees introducing themselves. The following is a summary of the key points of the meeting discussion organized by the agenda topics. The first five items provide an overview of discussions that occurred during every meeting. Item six is broken down by each study and includes discussions that are unique to that study.

### 1. Roles and Responsibilities

- For this project the ‘intended lead entity’ for each study will be referred to as the ‘key collaborator’
- Art reviewed attachment 1a with the key collaborator(s) which focused on defining the roles of the City of Spokane Valley (CoSV), Ecology, and the key collaborator for the project.
- Aimee reviewed attachment 1b which is a Table from section 5 of the QAPP template. Specifically, at the completion of the work defined in the contract between HDR and the CoSV, the table will be blank or contain generic information. If the study is submitted to Ecology on June 30, 2017, the Key Collaborator is responsible for completing the table, so that is specific to their study, prior to submitting the Proposal to Ecology.
- Each Proposal will be completed to 95%. The remaining 5% are a few minor items which the key collaborator is responsible for completing prior to submitting the Proposal to Ecology. These items will either be blank or developed generically and highlight so that the Key collaborator knows what is needed to complete the Proposal.

### 2. Identify Regulatory Requirements

- Each key collaborator will need to identify the specific NPDES MS4 permit requirement(s) that their study will address. Each Key Collaborator was asked to review the permit and identify these requirements. If the requirements were not identified during the meeting, HDR will contact the key collaborator at a later date to discuss.

### 3. Study Location(s) & Target Population(s)

- The QAPP template requires that each proposal define one of the following: how the study location(s) and target population(s) were selected or define how they will be selected. If these items were not discussed during this meeting HDR will contact the key collaborator at a later date to discuss.

#### 4. Study Readiness Score Matrix

- Art developed a ranking system to assist in determining which studies are read to proceed to the next step. This was done because only 8 of the 14 studies need to be submitted to Ecology on June 30, 2017, and the ranking will assist in selecting the studies that are the readiest. The scoring was based on the following: potential funding for the subsequent phases, the wiliness of the key collaborator to proceed with the study, the EWSG score determined on June 30, 2016, and any steps the key collaborator had taken to advance the study.
- Scores for each study are shown on Handout 7.

#### 5. Effectiveness Study Schedule

- Aimee and Art reviewed the project schedule with the key collaborator highlight milestone dates and deliverables which include:
  - Periodic Project Status Update Meetings will be held via video conference for the key collaborators and the participating entities
  - Conceptual Study Design review meeting with Ecology is scheduled for March 22 and April 10<sup>th</sup>. During this meeting, the conceptual study designs (which will be updated based on the feedback from the key collaborator during this kickoff meeting) will be presented to Ecology for their review and comment. The goal of the meeting is to determine if the study meets Ecology's requirements for an effectiveness study and solicit their comments prior to developing the proposal for each study.
  - The grant required public briefing will be held on May 16 in Yakima at the same conference center as MuniCon prior to the start of day 1 conference workshops. During this open house style event, the studies will be presented by each key collaborator as a conference poster and the HDR team will be on hand to also answer questions. This will provide the public and Ecology with an opportunity to provide comments on each study before they are finalized.
  - 14 Conference Style Posters will be developed for the public briefing by HDR. This will include developing a poster template which will be used to guide the development of all 14 posters into a similar format. The key collaborators will have an opportunity to provide feedback on the poster templates as well as their study poster. The final posters will be on the WSC website prior to the conference and also up during the duration of MuniCon.
  - The final deliverable, Proposals for 8 studies, will be completed by HDR and submitted to the CoSV on June 16, 2017. If the study is selected as one of the studies that will be submitted to Ecology, it is the key collaborators responsibility to submit the study to Ecology by June 30, 2017.

## 6. Refine/Update Conceptual Study Design

### City of Kennewick – Modernizing Education and Outreach Studies

8:00am to 10:00am on March 8, 2017 at the HDR Pasco Office

**Attendees:** Martin Nelson, City of Kennewick; Art Jenkins, City of Spokane Valley; Jay Decker, HDR; Aimee Navickis-Brasch, HDR

- **Desired Outcome** (reference item 7 on the Phase 1 Conceptual Study Design Document):
  - Evaluate how effective current E&O programs are working
- **Study Goals** (reference item 3 on the Phase 1 Conceptual Study Design Document):
  - Study focus – Broad look at all existing E&O programs in the Quad cities
  - Determine how effective those programs are for meeting their objectives. *Note: Previous campaigns were developed without objection – rather through collaborations with other cities.*
  - Identify methods for improvement (support objective of E&O message)
  - Determine what methods are most effective for distributing E&O messages
- **Conceptual Approach to Study** (reference item 6 on the Phase 1 Conceptual Study Design Document):
  - Select several existing E&O campaigns to evaluate as part of the study
  - Could use existing E&O programs that the Franklin Conservation District – is working
  - Study could focus on E&O programs in Quad cities since 90% of Kennewick's programs overlap with their programs
- **Survey Design Considerations** (reference item 6 on the Phase 1 Conceptual Study Design Document): Specific items that Kennewick would like to learn during this study include:
  - How is the E&O material being received?
  - Does the public read material?
  - Identify how they reaching people (i.e. school, at the fair, fliers, etc)
- **Target Population and Test Site** (reference item 6 on the Phase 1 Conceptual Study Design Document):
  - Existing opportunities for reaching the public and asking them questions (survey) include: Schools, Fair, Home & Garden Show, Website, Bus, Meetings with engineers/landscapers/developers
- **Data collection** (reference item 6 on the Phase 1 Conceptual Study Design Document): incorporate data collection approaches into existing approach for disseminating into E&O program
- **Study Phases:** The study proposal may include discussion of future phases which may include:
  - Once effective methods for disseminating message have been identified; the next phase could include Creating a tag or slogan in future and/or how to update existing E&O messages. Then distribute the tag or slogan using those dissemination methods

- Phase 1(current study): define baseline of existing programs in Kennewick and other quad cities (pilot study using all 4 quad studies)
- Phase 2 – expand study to include other areas in EWA or the regional
- **Location for Housing E&O Message:** Ecology or WSC website
- **Tag or Slogan ideas:** consider an older mascot and message such as Woodsy the Owl
  - Woodsy Means different things to different people
  - Narrow survey down to specific zip codes in the quad cities
- **Inventory of E&O programs** in the quad cities; Martin will provide to HDR, which may be evaluated during this study

Draft

## **Yakima County – BMP Inspection and Maintenance Responsibilities**

**10:00am to 12:00pm on March 8, 2017 at the HDR Pasco Office**

**Attendees:** David Hawes, Yakima County; Erick Geary, Yakima County; Art Jenkins, City of Spokane Valley; Jay Decker, HDR; Aimee Navickis-Brasch, HDR; Don Carpenter, Drummond Carpenter

- **Partner Entities:** add the city of Yakima to the list
- **Desired Outcome** (reference item 7 on the Phase 1 Conceptual Study Design Document):
  - Since the West side has implemented many programs focused on BMP inspection and maintenance responsibilities; the goal of this study is to learn from those studies so that Yakima County can develop their own program based on those lessons learned
  - Ultimate goal – develop program for EWA for BMP inspection and maintenance responsibilities
- **Survey Design Considerations** (reference item 6 on the Phase 1 Conceptual Study Design Document): Specific items that Yakima would like to learn during this study include:
  - What is being done
  - What is effective
  - How can EWA jurisdiction apply WWA approaches to their program
  - How has WWA addressed this requirement
  - Ask about the basis other jurisdictions had for selecting their approach to BMP Inspection and maintenance programs
- **Target Population** (reference item 6 on the Phase 1 Conceptual Study Design Document): Yakima County has a list of potential folks they would like to survey and they will provide HDR with this information
- **Conceptual Approach to Study** (reference item 6 on the Phase 1 Conceptual Study Design Document):
  - Broad look at many jurisdictions – survey
  - Dig deeper with 5 jurisdictions - interview
  - Look at how different types of inspections are addressed by jurisdictions (other than BMPs) such as sewer inspections
  - Engage the public on their input for how to address BMP inspection and maintenance especially on private property
  - Consider expanding net of the population included in the study to include semi-arid regions
  - Investigate how permit differences between study locations could influence BMP inspection and maintenance
  - How culture could influence a program is beyond the scope of this study but it might be worth adding questions about how culture may have influenced the development of existing programs or how it is influencing the existing program

particularly how BMP inspection and maintenance is addressed on private property

- Based on Don Carpenters experience working on LID implementation in his home state: he has found it successful to work with third party focus groups (at meeting with professionals) to test out details that won't necessarily come out in survey/interviews
- **Regulatory Requirements Study Will Address** (reference item 3 on the Phase 1 Conceptual Study Design Document): Permit – S5.6 Ci-V pg 25
- **Readiness Score:** Yakima County has ILA with other studies and funds available to conduct the study; as such their readiness score was upgrade to 3.7; Yakima County is committed to submitting the Proposal for this study to Ecology on June 30, 2017

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## City of Richland - Long-term Permeable Pavement Sidewalk Infiltration Performance

1:00pm to 3:00pm on March 8, 2017 at the HDR Pasco Office

**Attendees:** Mark Melton, City of Richland; John Bykonen, Pete Rogalsky, City of Richland; Art Jenkins, City of Spokane Valley; Jay Decker, HDR; Aimee Navickis-Brasch, HDR; Don Carpenter, Drummond Carpenter

- **Desired Outcome** (reference item 7 on the Phase 1 Conceptual Study Design Document):
  - Study would focus on evaluating the long-term performance data
  - Data could then be used to support the development of design guidance for permeable pavement along with approval for application of permeable pavement in the city of Richland (as well as the other Quad cities)
  - Data could also be used to develop recommendations for permeable pavement O&M
- **Potential Test Sites** (reference item 6 on the Phase 1 Conceptual Study Design Document):
  - Construct new permeable pavement side walk in four locations which includes: two test sites and two control sites
  - The test sites would not be maintained whereas the control sites would be maintained
  - Use the same permeable pavement specification for all sites
  - Locate grass buffer between permeable pavement sidewalk and street
  - One potential approach that could save the city money is to request that developers to install the permeable pavement in neighborhoods or other areas that are planning a future development
  - Since no specific test sites have been selected for this study, the process for selecting test sites that will be defined in the Proposal should focus on how test sites will be selected (as opposed to how sites were selected)
- **Equipment for Measuring Infiltration Rates:** the group discussed possible equipment options for measuring the infiltration rate of permeable pavement. The City of Richland indicated that they did not have a preference for which type of equipment that is used.
- **Study Readiness:** The public work director is committed to conducting this study so it will most likely be one of the 8 studies submitted to Ecology on June 30, 2017

## City of Pasco - Use of Non-vegetative Swale with Native Soils

3:00pm to 5:00pm on March 8, 2017 at the HDR Pasco Office

**Attendees:** Teresa Reed-Jennings, City of Pasco; Cynthia Suarez, City of Pasco; David Tanner, City of Pasco; Art Jenkins, City of Spokane Valley; Jay Decker, HDR; Aimee Navickis-Brasch, HDR

- **Desired Outcome** (reference item 7 on the Phase 1 Conceptual Study Design Document):
  - Develop a new BMP design guidance (that does not include plants and defines the range of properties in native soils that are suitable for providing treatment of SW runoff)
- **Potential Test Sites** (reference item 6 on the Phase 1 Conceptual Study Design Document): Commercial or Light industrial
- **Conceptual Approach to Study** (reference item 6 on the Phase 1 Conceptual Study Design Document):
  - Develop a specification that defines the properties (or range of properties) of native soils that are suitable to provide adequate treatment of SW runoff
  - Specification would be developed based on common citation from a literature search.
  - Conduct field testing of BMP
  - Follow TAPE process so that BMP is approved for general use designation on future projects.
  - If native soils are not sufficient for providing treatment of all pollutants; future studies may investigate different media amendments that could be added to native soils that target those pollutants
  - Future studies could focus on evaluating the effectiveness of the range of properties identified in the specification at multiple different locations in EWA
- **Study Readiness:** This study so it will most likely be one of the 8 studies submitted to Ecology on June 30, 2017. This study needs to be one of studies implemented 15 months after the QAPP is approved so that Pasco has time to secure the funds to conduct the study.
- **Potential Grant Funding:** This study should be designed such that it could be applied broadly to any location in EWA. That way there is a potential that the study could be funded by a Gross Grant.

**City of Spokane Valley – Determining Pollutant Contributions from Municipal Stormwater in Eastern WA using GIS**

**12:30pm to 4:30pm on March 15, 2017 at the HDR Spokane Office**

**Attendees:** Art Jenkins, City of Spokane Valley; Tom Dupuis, HDR; Aimee Navickis-Brasch, HDR

- **Desired Outcome** (reference item 7 on the Phase 1 Conceptual Study Design Document):  
Art was asked what he wants to do with results; the following is his response:
  - Pair down permit for existing 6 minimum control measures +3
  - Eliminate permit
  - Demonstrate that an alternative permit is needed for cities that have few if any stormwater outfalls
  - Unique conditions in EWA especially in CoSV – potentially CoSV would have their own permit
  - Desirable for study results to have a broader impact for semi-arid regions
- **Study Goals** (reference item 3 on the Phase 1 Conceptual Study Design Document):
  - Follow-up study to NERP – how have things changed
  - Demonstrate CoSV is unique
  - Show CoSV is not like Seattle or Chesapeake Bay
- **What are underlying assumptions used to develop the permit**
  - If you discharge to surface waters – assume you are polluting
- **Conceptual Approach to Study** (reference item 6 on the Phase 1 Conceptual Study Design Document):
  - GIS heat map – show that eliminating outfall reduces pollutants to water body
  - Narrow down to specific outfall
  - Others in Idaho are doing something similar
  - Use actual data from similar land use
  - Consider using Idaho’s outfall data and use as part of study data
  - Brian Cochran’s suggestions regarding USGS and impervious area mapping
  - In consideration of effectiveness argument – focus on areas still contributing
  - Investigate approach of other smaller Phase II cities, how did they address similar issues
  - Focus efforts on Cost effectiveness of SW Program
  - Focus on areas with outfalls
  - Remember UIC rule with respect to managing stormwater
  - \$/pound removed
- **Questions for Ecology:** Determine what counts for effectiveness studies

**Asotin County and City of Spokane Valley – Catch Basin Retrofit Device Placement  
1:00pm to 3:00pm on March 16, 2017 at the HDR Spokane Office**

**Attendees:** Matt Carlson, Asotin County; Art Jenkins, City of Spokane Valley; Tom Dupuis, HDR; Aimee Navickis-Brasch, HDR

- **Desired Outcome** (reference item 7 on the Phase 1 Conceptual Study Design Document):
  - Demonstrate benefits (other than UIC/Oil control) of using El and tees in catch basins (catch basin retrofit) such as sediment reduction
  - Reduce the number of required El's and Tees in catch basin (i.e. instead of installing them in every catch basin in a stormdrain network; install in the most downstream catch basin)
- **Trigger for Installing Tee or El in catch basins:** Key elements of the groups discussion regarding what would trigger for the requirement for installing a downturn el or tee in a catch basin included:
  - Matt needed to install a catch basin retrofit device on his **LID** retrofit project that Ecology funded (Matt Emailed HDR copies of the construction plan sheets)
  - They are a UIC requirement – spill control in areas w/out treatment before discharge to Dry well (see page 5-23 of Ecology's Guidance for UIC Wells that Manager Stormwater)
- **Conceptual Approach to Study** (reference item 6 on the Phase 1 Conceptual Study Design Document):
  - Focus on the Benefit of Sediment reduction using catch basin sump and retrofit device for reducing sediment, specifically: *How much does CB sump collect/respect to TSS + sediments when using CB retrofit device?*
  - Remove analytical testing for oil/grease from Phase 1 conceptual study approach
  - Will need to perform TSS testing + PSD, turbidity or just measure gross solids in catch basins (some measurement of that)
  - Challenges w/locating test / control sites
  - May need to normalize data from sites › should have same cumulative sediment
  - Need to define Some type of effectiveness measure for the 2 types of CB retrofits, this may include: Cost/pound of sediment to remove w/ El & Tee
- **Study Readiness:** Matt & Art both indicated this study will most likely not be one of the ones selected to go forward

## City of Wenatchee – Stormwater BMP Owner Awareness

10:00am to 12:00pm on March 30, 2017 at the HDR Spokane Office

**Attendees:** Jessica Shaw, City of Wenatchee; Paula Salter, City of Wenatchee; Art Jenkins, City of Spokane Valley; Aimee Navickis-Brasch, HDR

- **Study Objectives** (reference item 3 on the Phase 1 Conceptual Study Design Document):
  - Information about structural BMP O&M is provided to new property owners as part of the documentation they receive when they purchase the property. An objective of this study is to evaluate the effectiveness of the BMP O&M agreement for making home owners aware of their BMP maintenance responsibilities.
- **Desired Outcome** (reference item 7 on the Phase 1 Conceptual Study Design Document):
  - Use study findings to develop a targeted outreach campaign that will address any shortcoming identified in the current approach (BMP O&M documentation) and increase private property owner's awareness of BMP maintenance needs.
  - Recommendations for developing more stringent ordinances that specify who is responsible for BMP maintenance on private property, for example responsibility is shared by property owners in neighborhoods with Homeowners Associations
- **Conceptual Approach to Study** (reference item 6 on the Phase 1 Conceptual Study Design Document):
  - Collect background such as find out what other agencies are doing in EWA? This information will be used to help define approach for data collection and develop survey questions.
  - The survey will be administered using one on one interviews and/or focus group interviews with the target population.
- **Target Population** (reference item 6 on the Phase 1 Conceptual Study Design Document):
  - The target population will include either commercial or residential property owners who have BMPs on their property.
- **Regulatory Requirements Study Will Address** (reference item 3 on the Phase 1 Conceptual Study Design Document):
  - The following items in section S5 of the permit: E&O, O&M, and Post construction BMPs
  - For O&M this will include Refine City Ordinances to ensure adequate ongoing long-term maintenance of the BMPs (see page 23 of the permit), specifically should ordinance include more stringent requirements
- **Budget for study in the Proposal** will include an estimate for both hours to complete the work as well as the cost. That way the study budget will reflect the approach (i.e. hire consultant or complete with jurisdictional staff) the key collaborator intends to pursue for conducting the study
- **Study Readiness:** This study will go on the shelf after complete

**City of Spokane Valley – Seasonal Differences in Street Sweeping Material Removal  
1:00pm to 3:00pm on April 3, 2017 at the HDR Spokane Office**

**Attendees:** Art Jenkins, City of Spokane Valley; Roger Sutherland, Cascade Water Resources; Aimee Navickis-Brasch, HDR

- **Desired Outcome** (reference item 7 on the Phase 1 Conceptual Study Design Document):
  - Use the study results to define a targeted street sweeping program
  - Explain to council that the recent changes in weather patterns are triggering the need to modify street sweeping program & explain how street sweeping could be best spent: justify budget
- **Current Street Sweeping Program:**
  - Four primary types of conditions that require street sweeping:
    1. Spring Sweep – (pine needles drop off trees)
    2. Fall – Deciduous leaf drop – 3-4 weeks to pick up before snow flies
    3. Summer – Arterial maintenance sweep (summertime)
    4. Emergency street sweep
  - CoSV usually stops sweeping in mid-November and start up again in mid-February to early March
  - The CoSV sends out announcements prior to street sweeping asking residents to moved parked cars off the street
- **Study Goals** (reference item 3 on the Phase 1 Conceptual Study Design Document):
  - Use data to demonstrate what parts of street sweeping program are working and/or identify changes that need to be made for improving the program
  - Decide where to invest the CoSV money
  - Produce results that can be used to justify to council the cost for the street sweeping program
  - Create a framework for how street sweeping studies should be conducted
  - Emphasize how study could benefit stormwater program and save money
  - Dry wells can become clogged by sediment from roadways; as such a selling point of this study is that a new street sweeping program could: reduce drywell maintenance costs
- **Conceptual Approach to Study** (reference item 6 on the Phase 1 Conceptual Study Design Document):
  - Focus on accumulation of sediment; need to address how to measure accurate weights of sediment accumulation
  - Collect data on larger organic fraction on streets; consider impact on street sweeping program
  - Analytical testing will be conducted; need to decide how often samples would be collected
  - Use rain gauges to collect precipitation information

- **Test-Site** (reference item 6 on the Phase 1 Conceptual Study Design Document):
  - Not selected. Write up Proposal generically so study could be conducted in other cities; use CoSV as an example for how a test-site would be selected & when sweeping will occur
- **Study Readiness:** This study will go on the shelf after complete
- **CoSV population:** around 92,000

Draft

## Appendix 13 – Phase 3a Conceptual Study Designs

<b>1a. RESEARCH PROPOSAL TITLE</b> Modernizing Education and Outreach Strategies
<b>1b. BMP Classification:</b> <input type="checkbox"/> Structural <input type="checkbox"/> Operational <input checked="" type="checkbox"/> Education & Outreach

**2. RESEARCH PROBLEM DESCRIPTION**

The way people receive, process, and interact with educational materials is changing as technology evolves. As a result, strategies for distributing information that were effective in the past (i.e., brochures or posters), may not be as effective now (E. T. Schultz, 2014). New, more interactive media tools are becoming available, and, consequently, these tools can assist in improving education and outreach.

In addition, many existing stormwater educational programs were developed without specific learning objectives and/or it is unknown whether these programs are effective at achieving the learning objectives (i.e. increasing the target audience’s awareness of the impacts of stormwater pollution).

**3. RESEARCH OBJECTIVE**

The goal of this study is to evaluate the effectiveness of existing stormwater educational programs and outreach strategies. Effectiveness evaluation will focus on determining if the learning objectives of the educational program are achieved, and if educational materials are being received and read using existing outreach strategies.

Evaluate Effectiveness     Compare Effectiveness     Develop Modified BMP     Develop New BMP

**4. LITERATURE SEARCH AND RESEARCH IN PROGRESS SUMMARY**

Modernized Dissemination Strategies for E&O Programs: As technology has evolved, strategies for disseminating E&O messages and materials have expanded to include modern communication tools. However, with more options come more choices for jurisdictions, specifically identifying effective strategies for reaching a large and diverse audience. A 2014 national survey of stormwater organizations explored this question and found the most common strategy for disseminating information to a large audience focused on modern communication tools; specifically, internet advertising, websites, social media (Facebook and Twitter), emails, as well as online webinars and videos. Additional noted benefits of these approaches included simple and inexpensive implementation and easy methods for measuring the effectiveness of the new communication tool (NCT) tool for reaching the public, including using built in features to track how often the tool is accessed (E. T. Schultz, 2014). The study also found that when the target audience is small, traditional methods for disseminating E&O were most successful, including sending letters and face-to-face interactions.

Examples of Modern Communication Tools: There are a growing number of examples where E&O programs use modern communication tools to disseminate environmental messages. The following table summarizes a few examples of these modern tools.

Tool	Overview
Websites	Stormwater organizations use websites to promote their organization and to provide a clearinghouse of information and resources. Carolina Clear is a regional stormwater organization focuses on educating and involving the public in protecting waterways and preventing pollution. <a href="http://www.clemson.edu/public/carolinaclear/water_quality/idde/">http://www.clemson.edu/public/carolinaclear/water_quality/idde/</a>
Social Media	Stormwater organizations incorporate their slogan into social media including; What’s up Stormwater?, Stormwater Matters, and Stormwater Steve.
Email Listserve	Many organizations, such as Ecology, use listserves to distribute information via email to the public. <a href="http://www.ecy.wa.gov/maillist.html">http://www.ecy.wa.gov/maillist.html</a>
Apps	Rain Garden is an apps that provides the public with guidance for installing rain gardens. <a href="http://nemo.uconn.edu/tools/app/raingarden.htm">http://nemo.uconn.edu/tools/app/raingarden.htm</a>
Games	Stormwater Sentries and Runoff are two game apps that focus on educating the public about the impacts of stormwater runoff. <a href="https://appsto.re/us/9xwnN.i">https://appsto.re/us/9xwnN.i</a> and <a href="http://www.timmonsgis.com/projects/stormwater-sentries">http://www.timmonsgis.com/projects/stormwater-sentries</a>

## 5. Geographic Scope and Urgency of Research

How broadly will the results of this research apply?

Nationally     Pacific Northwest     WA Only     Eastern WA  
 Western WA     Puget Sound Basin     Interior PNW

How quickly will you need the results of this research?

ASAP     Within 6 months     Within 1 year     Within 2 years  
 Within 5 years     Ongoing

## 6. Conceptual Research Approach

The study approach includes the following primary elements:

1. Develop an inventory of existing jurisdictional stormwater education programs, including the applicable lesson plans and/or educational materials (i.e. brochures, email, mailers, etc.); identify the target audiences, and typical locations for outreach (i.e. schools, professional meetings, public events, etc.).
2. Define a criterion for selecting the E&O programs that will be evaluated as part of the study. For example, select educational programs that: have been implemented for more than 1 year, that have established educational materials (i.e. brochures, lesson plans, etc.), and that will have the target audience in attendance where possible when the survey responses are collected.
3. Identify methods for modernizing outreach strategies. This will include a literature search and contacting other jurisdictions that have already incorporated more modern and interactive dissemination techniques into their stormwater public education programs.
4. Design a survey that will identify the target audiences': awareness of the educational program, understanding of the program objectives, how they received educational materials (i.e. mail, internet, public event, etc.), the most common way they receive information (i.e. mail, internet, television, etc.), and demographics. The survey will include less than a dozen yes/no, multiple choice, and open ended questions. The survey will request certain demographics of the respondents, to gauge preferred methods of receiving outreach and education messages. A target or goal for sample size (number of respondents) for each of the E&O programs will be generally described in the Proposal and defined, with respect to the specific educational program, in the QAPP. The sample size goal will be based on the type of educational program evaluated and include a control group and/or before and after responses. Below is an example of how the sample size may be determined.
  - a. For example, if an educational program for a 4<sup>th</sup> grade elementary school students is selected, the entire class would be given a survey before and after participating in the educational program. Then the before and after responses would be compared to determine how effective the program is for meeting the educational learning objectives. If the program is implemented at several schools, the survey could be administered at each of the schools and the results would then be compared between schools.
  - b. For other educational programs that include a larger target audience, other methods may be used, and may include consideration of those who have been exposed to the educational program and those who have not (control groups). Responses would be collected from both groups and then compared to assess whether the responses are similar or different.
5. *The survey will be administered (and responses collected) over one year during existing public outreach opportunities such as Schools, Fair, Home & Garden Show, Website, Bus, and professional meetings with engineers/landscapers/developers/businesses.*

*Responses will be analyzed to determine baseline data regarding the target audiences' understanding of existing education programs and how the target audience receives educational information. The information will be used to improve existing educational programs and modernized outreach strategies.*

## **7. POTENTIAL MANAGEMENT CHANGES RESULTING FROM RESEARCH FINDINGS**

Based on the study results, modernized outreach will be incorporated into the jurisdictions' outreach programs and used to improve the jurisdictions' existing stormwater education programs. Results from this study may also be used develop a tag or slogan that could be disseminated using modernized outreach strategies.

## **8. ESTIMATED COST AND TIMING**

This study would take between 1 to 2 years. An estimated hours and range of costs for conducting the study will be included in the Detailed Study Design Proposal, and is dependent upon the level of work performed by participants.

## **References**

E. T. Schultz. (2014). *An Analysis of Stormwater Education and Outreach Efforts Locally and Throughout the Nation*. Retrieved from Montpelier,VT:

### 1. RESEARCH PROPOSAL TITLE

Use of Non-Vegetation Swale with Native Soils

**1b. BMP Classification:**     Structural                       Operational                       Education & Outreach

### 2. RESEARCH PROBLEM DESCRIPTION

A number of BMPs included in the Stormwater Management Manual for Eastern Washington (e.g., bioinfiltration swales and vegetated filter strips) include installation of plants as part of the design. While these plants or their root structure may enhance pollutant removal and/or infiltration capacity and aesthetics, they also create extra maintenance needs, including watering and mowing. In some of the dryer parts of Eastern Washington, the irrigation water required to keep the plants alive during the summer months often exceeds the annual amount of regional rainfall by tenfold. Additionally, during drought years, the availability of irrigation water is often severely restricted, resulting in survivability issues for the plants. In addition, some infiltration BMPs require engineered soils (i.e. bioretention ponds) which requires jurisdictions to remove and replace native soils. Engineered soils and excavation is costly, so if native soils could provide the required treatment, these BMPs may be constructed more cost effectively. *This study would evaluate if these BMPs are able to provide adequate treatment of runoff in the absence of plants and using native soils.*

### 3. RESEARCH OBJECTIVE

The goals of this study are to: 1) Test the feasibility of a 'no plants' option for an infiltration BMP that are typically vegetated and determine what pollutants they will treat in arid and xeriscaping locations; and 2) Develop a design specification that defines the physiochemical properties of native soils that are suitable for providing treatment of stormwater runoff.

Evaluate Effectiveness     Compare Effectiveness     Develop Modified BMP     Develop New BMP

### 4. LITERATURE SEARCH AND RESEARCH IN PROGRESS SUMMARY

Plants are known to improve the stormwater treatment performance of BMPs particularly for nutrient uptake [1, 2]. However most of the nutrient uptake occurs in the spring and early summer when negative growth is maximum. In order to sustain the nutrient uptake, vegetation must be cut back and removed from the BMP prior to the dormant season or the vegetation that is left will decay and release nutrients back into the soils [1]. This creates a challenge for jurisdictions located in semi-arid climates with extended dry periods and limited maintenance budget.

Extensive studies have been conducted to identify the physiochemical properties of engineered soils that appear to influence the efficacy of the stormwater treatment performance. For example, TSS removal rates correlate with permeability rates between 2 to 6 inches/hour [5] and a uniformity coefficient ( $d_{60}/d_{10}$ ) of less than 4 [36]. Whereas dissolved metal removal is often associated with the sorptive properties of the soils including cation exchange capacity [3]. Additional characteristics that correlate with the stormwater treatment performance of engineered soils include gradation, organic content, and media thickness [2, 4-6]. Many of these properties are found in native soils as such may be **suitable** for providing equivalent treatment performance at a substantially lower cost compared to engineered soils.

### 5. Geographic Scope and Urgency of Research

*How broadly will the results of this research apply?*

\_\_\_ Nationally    \_\_\_ Pacific Northwest    \_\_\_ WA Only     x  Eastern WA

\_\_\_ Western WA    \_\_\_ Puget Sound Basin     x  Interior PNW

How quickly will you need the results of this research?

ASAP  Within 6 months  Within 1 year  Within 2 years

Within 5 years  Ongoing

## 6. Conceptual Research Approach

The study approach includes the following primary tasks:

1. Develop a specification that defines the physiochemical properties (or range of properties) of native soils that are suitable for providing stormwater treatment. This will include conducting an extensive literature search and identifying properties based on common citations in the literature. *This will include evaluating whether results from the WWA RSMP study (focused on developing a bioretention specification) are applicable to this study.* If the results are applicable, they will be considered in the development of the specification for defining suitable properties of native soils.
2. Verify (through analytical testing) that the properties of the native soils at the proposed test site are within the range of suitable properties identified in the specification.
3. Design and construct an infiltration BMP (i.e. bioinfiltration swale or bioretention pond) following the design guidance in the Ecology Stormwater Manual for Eastern Washington (or an equivalent manual) except native soils (that meet the new specification) will be used and no plants will be installed. The BMP will be equipped with an automated water quality monitoring system capable of collecting influent and effluent water quality samples. The typical jurisdiction maintenance will be performed on the BMP.
4. The infiltration rate would be measured every four months for two years.
5. Water quality sampling will be collected from qualifying rainfall events for a total of 12 events. Stormwater influent and effluent samples will be collected and submitted to an Ecology certified lab for analytical testing of the following constituents: TSS, dissolved Cu and Zn, total phosphorus, and total petroleum hydrocarbons.
6. Following each rainfall event visual observation of the site will be documented including weed growth, evidence of vandalism, impacts to the BMP from blowing sands, etc.
7. The data will be evaluated to determine which pollutants 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.

Future studies will focus on evaluating the effectiveness of the range of properties identified in the specification at multiple different locations in eastern Washington. In addition, future studies may also investigate different media amendments that could be added to native soils to provide targeted pollutant removal.

## 7. POTENTIAL MANAGEMENT CHANGES RESULTING FROM RESEARCH FINDINGS

The anticipated outcome of this study is a new BMP design guidance (that does not include plants and defines the range of properties in native soils that are suitable for providing treatment of stormwater runoff) and maintenance guidance that is approved for general use for future projects.

## 8. ESTIMATED COST AND TIMING

The duration of this study will be about 3 years. The approximate cost would be \$300,000. This estimate includes development of a QAPP; a literature search to develop the suitable native specification; labor costs and equipment (installation of water quality system); collecting samples and analytical testing of TSS,

dissolved Cu and Zn, total phosphorus, and total petroleum hydrocarbons; data analysis; development of a final report; and a 10% project management budget for the lead jurisdiction. This estimate does not include the cost to purchase land at the test site (i.e., the study is done on existing property) or construct the test site.

#### References

1. Davis, A.P., et al., *Water quality improvement through bioretention media: Nitrogen and phosphorus removal*. Water Environment Research, 2006. **78**(3): p. 284-293.
2. Barrett, M.E., M. Limouzin, and D.F. Lawler, *Effects of media and plant selection on biofiltration performance*. Journal of Environmental Engineering, 2012. **139**(4): p. 462-470.
3. Brady, N.C. and R.R. Weil, *The nature and properties of soils*. 1996: Prentice-Hall Inc.
4. AHBL and HDR, *Eastern Washington Low Impact Development Guidance Manual*. 2013, Washington State Department of Ecology: Puyallup, WA.
5. Ecology, *Eastern Washington Stormwater Manual*. 2004, Washington State Department of Ecology: Olympia, WA.
6. Hunt, W.F. and W.G. Lord, *Bioretention performance, design, construction, and maintenance*. 2006: NC Cooperative Extension Service.

### 1a. RESEARCH PROPOSAL TITLE

BMP Inspection and Maintenance Responsibilities

**1b. BMP Classification:**     Structural                       Operational                       Education & Outreach

### 2. RESEARCH PROBLEM DESCRIPTION

Privately-owned structural BMPs represent a unique problem for ensuring long-term maintenance. Complications can arise from access issues for inspection (e.g., an inspector may not have permission to enter private property), and failure to maintain structural BMPs may occur due to lack of interest, unclear and changing ownership, lack of incentive, or limited funding. 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 general strategies were identified for evaluation:

- City/County performs inspection of structural BMPs but requires that the property owner to hire a qualified contractor to conduct necessary maintenance and provide proof that the maintenance has been completed
- 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
- City/County performs maintenance but the BMP remains under private ownership and the property owner pays the City/County for the service
- 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.

### 3. RESEARCH OBJECTIVE

The objective of this study is to gather information from Washington and semi-arid seasonal region 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 ultimate objective is to develop a prototype program for operation and maintenance (O&M) of privately owned structural BMPs for Eastern Washington (EWA) jurisdictions.

Evaluate Effectiveness     Compare Effectiveness     Develop Modified BMP     Develop New BMP

### 4. LITERATURE SEARCH AND RESEARCH IN PROGRESS SUMMARY

There was not any literature identified specifically related to designating responsibility for maintenance of privately owned BMPs. However, it is clear from discussions with Eastern Washington stormwater managers, as well as guidance documents published by municipalities in other states, that the challenge of long-term BMP maintenance is not unique to Eastern Washington, and that there are a variety of strategies for addressing this challenge. As part of the development of the Western Washington LID Operations and Maintenance (O&M) Guidance Document, an advisory committee on administrative issues was convened and maintenance of privately-owned BMPs was one of the topics discussed and summarized in the Western Washington LID O&M Guidance Document (Herrera 2013).

## 5. Geographic Scope and Urgency of Research

How broadly will the results of this research apply?

Nationally     Pacific Northwest     WA Only     Eastern WA  
 Western WA     Puget Sound Basin     Interior PNW

How quickly will you need the results of this research?

ASAP     Within 6 months     Within 1 year     Within 2 years  
 Within 5 years     Ongoing

## 6. Conceptual Research Approach

A survey will be conducted of approximately 15 to 20 municipalities in Washington State and other semi-arid seasonal regions to determine how they address the long-term needs of privately-owned structural BMPs. The survey will cover:

- Define the strategy that the jurisdiction currently uses for inspection and maintenance responsibility
- Estimated number of structural BMPs in the jurisdiction
- Number of structural BMPs inspected each year
- Number of enforcement actions taken as a result of those inspections
- Funding mechanisms (e.g., cost share or fee programs for implementing the selected strategy (if applicable))
- Potential inspection or enforcement cost savings through implementation of the selected strategy
- Issues with access or other private property legalities
- Issues of local traditions or “culture” that could affect O&M
- Issues with enforcement or implementation strategies by different agency programs

Stormwater managers from these municipalities will then be interviewed (5 to 10) to further discuss their perceptions of the advantages and shortcoming of their programs. Focus groups may be used in lieu of or in addition to interviews. As part of the recruitment process, it will be important to capture the opinions of jurisdictions that are and are not experiencing problems with their O&M protocols. It will also be important to convey why they should participate since messaging is important for response rates.

## 7. POTENTIAL MANAGEMENT CHANGES RESULTING FROM RESEARCH FINDINGS

More effective models for ensuring that privately owned BMPs are maintained on a regular basis may be identified through the proposed research effort. Development of recommendations for a prototype program or draft O&M manual to be adopted by EWA jurisdictions where appropriate.

## 8. ESTIMATED COST AND TIMING

This survey study would take less than a year to complete. An estimated cost for conducting the study will be included in the Detailed Study Design Proposal.

## References

Herrera. 2013. Western Washington Low Impact Development (LID) Operation and Maintenance (O&M) Guidance Document. Prepared for the Washington State Department of Ecology by Herrera Environmental Consultants and Washington Stormwater Center. July 2013.

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### 1a. RESEARCH PROPOSAL TITLE

Seasonal Differences in Street Sweeping Material Removal

**1b. BMP Classification:**     Structural                       Operational                       Education & Outreach

### 2. RESEARCH PROBLEM DESCRIPTION

Street sweeping is a proven technique for removing solids and associated pollutants from roadways. There have been a number of street sweeping studies that correlate higher pollutant removal with greater sweeping frequency. However, these studies were largely performed in more urbanized areas and focused on evaluation of the effectiveness of street sweeping at regular sweeping intervals (e.g., twice monthly, monthly, and semi-annual). No studies were identified that address the climate conditions and considerations such as seasonal wind-borne inputs faced by Eastern Washington permittees. Only a few have addressed the importance of removing winter sediment built up during the spring thawing period. Research has also shown that pollutant removals from street sweeping are greatest when sweeping occurs during the time periods in which material accumulation is high.

While routine sweeping may be a reasonable strategy in areas with consistent pollutant accumulations, it may not be the most cost-effective strategy in areas with large seasonal fluxes. There may be strategies for maximizing the effectiveness of street sweeping that are driven more by region and time of year rather than by routine time intervals (e.g., monthly). A targeted study for Eastern Washington could help stormwater managers make more informed decisions about where and when to focus their efforts to optimize street sweeping effectiveness.

### 3. RESEARCH OBJECTIVE

The objective of this study is to evaluate seasonal and potentially regional differences in sediment and pollutant accumulations (using pollutant removal through sweeping as a surrogate measure). The information collected will be used by permittees to optimize the cost-effectiveness of their street sweeping programs.

Evaluate Effectiveness     Compare Effectiveness     Develop Modified BMP     Develop New BMP

### 4. LITERATURE SEARCH AND RESEARCH IN PROGRESS SUMMARY

There is a large body of research that documents the effectiveness of street sweeping as a stormwater BMP for reducing sediment and pollutant loads. A wide range of sediment and pollutant removal rates attributable to street sweeping are reported (Law et al. 2008). The most important variables affecting pollutant removal rates appear to be sweeper type, and sweeping frequency (Sutherland et al. 1997, Law et al. 2008). The highest removal rates were consistently realized using high efficiency, regenerative air vacuums at a twice weekly frequency. At lower sweeping frequencies, or with less efficient equipment, much lower pollutant removal rates were reported.

Municipalities in Eastern Washington, and elsewhere, commonly target street sweeping to coincide with patterns in deposition (e.g., leaf accumulation, and winter sanding), in lieu of, or in addition to regular sweeping. No studies were identified that quantify pollutant removal associated with these seasonally timed sweeping events; nor were any studies identified that evaluated the effectiveness of seasonally adjusted street sweeping frequency based on climatic factors such as wind-blown inputs.

## 5. Geographic Scope and Urgency of Research

*How broadly will the results of this research apply?*

Nationally  Pacific Northwest  WA Only  Eastern WA

Western WA  Puget Sound Basin  Interior PNW

*How quickly will you need the results of this research?*

ASAP  Within 6 months  Within 1 year  Within 2 years

Within 5 years  Ongoing

## 6. Conceptual Research Approach

Up to four communities representing different regions of Eastern Washington (test-areas) could be selected for monitoring. Arterials and representative local roadways in each selected community would be swept on a monthly basis (half the test-areas every two weeks). The staggering of sweeping events allows for greater capture of variability in deposition (e.g., wind deposits) events. By sweeping the entire test-area rather than individual, specific roadway segments, possible factors that could affect loading such as land use, roadway surface type, and traffic volumes are accounted for, even though they wouldn't be studied individually; and more representative data will be obtained.

For each sweeping event, the amount of material collected will be weighed and its volume estimated and recorded (per mile of roadway). On a minimum of a quarterly basis (a minimum of four total samples per year of at least 1000 grams will be collected during the course of the study), samples will be mechanically sieved and analyzed to establish their particle size distribution (PSD) and their organic material fraction by weigh and volume. The sediment fractions will be composited back into three fractions (i.e. less than 63 microns; 63 to 250 microns; and 250 to 2000 microns and analyzed for specific pollutants (e.g., copper and zinc). In addition, nutrient analysis will be conducted on the organic fraction that is retained by the 2000-micron sieve. Statistical analysis will be used to identify whether there are significant factors (e.g., timing, region) affecting the amount of material removed by each sweeping event (a surrogate for sediment deposition rate). Graphical analysis will be used to characterize the volume and weight of material and associated pollutants removed with each sweeping event to help identify patterns or differences between regions.

If possible, sweepers of the same type (e.g., high efficiency or regenerative air) and age should be used in each of the selected communities where the study would be conducted to allow for comparability of results among communities. However, because the study is only looking at mass pick up in individual communities, and not efficiency (percent of deposited load removed), the sweepers do not have to be the same. However, it has been shown that different types of sweepers generally have different pick up efficiencies which can change the physical characteristics of the material that is removed.

## 7. POTENTIAL MANAGEMENT CHANGES RESULTING FROM RESEARCH FINDINGS

The timing of street sweeping events may be better focused on the time(s) of year when it will have the greatest effect on material removal which is when accumulations are high. This may improve the effectiveness of street sweeping programs by increasing the amount of material removed, and may save jurisdictions money, because they can scale back street sweeping when it will have less impact which could be during the dry summer months.

## **8. ESTIMATED COST AND TIMING**

Sampling for this study would be conducted over a 2-year period during the sweeping season (generally considered to be March- October). The approximate cost of the study would be about \$200,000 assuming four communities are selected. This estimate includes development of a QAPP, coordination, laboratory analysis, labor associated with sample collection and volume estimates for sweeping events, data QA, a final report, and a 10% project management budget for the lead jurisdiction. This estimate does not account for equipment (sweeper) purchase and does not include the cost of sweeper operation, sweeper operator wages, or the purchase of scales for weighing loads.

## **References**

Law, N.L., K. DiBlasi, and U. Ghosh. 2008. Deriving reliable pollutant removal rates for municipal street sweeping and storm drain cleanout programs in the Chesapeake Bay basin. Prepared by the Center for Watershed Protection. September 2008.

Sutherland, R.C. and S.L. Jelen. 1997. Contrary to conventional wisdom, street sweeping can be an effective BMP. *Advances in Modeling the Management of Stormwater Impacts*. 5:179-190.

### 1. RESEARCH PROPOSAL TITLE

Catch Basin Retrofit Device Placement

**1b. BMP Classification:**     Structural                       Operational                       Education & Outreach

### 2. RESEARCH PROBLEM DESCRIPTION

A spill control separator is a standard catch basin that is retrofit with a downturned elbow or tee. These retrofits are used to retain a limited volume of pollutants that float on the water such as oil or antifreeze (Ecology, 2006). Spill control devices are required for UICs located in high-use sites (excluding high vehicular traffic areas) and in locations where oil spills are likely during the life span of a project (Ecology, 2006). Catch basin retrofits are also thought to improve the effectiveness of catch basins for removing gross solids and the pollutants associated with them. Catch basins without retrofits are thought to do little to remove floatables and oils, because the primary removal mechanism of a typical, deep sump catch basin is settling.

The presence of these retrofits is reported to cause difficulties for routine maintenance and cleaning, especially in smaller catch basins. This is due to the lack of space for the vacuum hose to easily reach the bottom of the catch basin sump. As a result, the devices are sometimes removed and may not be reinstalled correctly, or at all. Given the access difficulties in smaller catch basins with these devices installed, a study would help determine how retrofits can be applied most effectively to maximize their benefit and minimize maintenance burdens, and provide more cost-effective treatment (e.g., dollars per pound of gross solids and oils removed).

### 3. RESEARCH OBJECTIVE

The objective of this research is to evaluate oils and gross solids removal differences between two, similarly sized and located catchments; one in which a downturned elbow type retrofit is only installed at the most downstream catch basin and one in which retrofits are installed at multiple locations within the catchment. If targeted application (i.e., downstream installations) of downturned elbows is shown to be equally effective, identifying locations within the municipal separate storm sewer system (MS4) where these retrofits have the greatest benefit would help to prioritize where they 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 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.

Evaluate Effectiveness     Compare Effectiveness     Develop Modified BMP     Develop New BMP

### 4. LITERATURE SEARCH AND RESEARCH IN PROGRESS SUMMARY

A few recent studies (Mullen 2003; Smith 2010) have clearly documented the effectiveness of hoods, snouts and tees for improving the effectiveness of catch basins and removing solids and oils. Documented removal rates for solids varied widely, and range from about 30 to 80 percent (Smith 2010), depending on the material trapped. All of the studies identified performed a direct comparison between retrofitted and typical catch basins. However, none of these studies documented system-wide effectiveness where only selected catch basins are retrofitted. Also, none of the studies reviewed addressed the reported maintenance problems in small catch basins with retrofits installed and no studies were located from a semi-arid, western climate.

### 5. Geographic Scope and Urgency of Research

*How broadly will the results of this research apply?*

Nationally     Pacific Northwest     WA Only     Eastern WA  
 Western WA     Puget Sound Basin     Interior PNW

How quickly will you need the results of this research?

ASAP  Within 6 months  Within 1 year  Within 2 years

Within 5 years  Ongoing

## 6. Conceptual Research Approach

Small paired catchments (e.g., two sides of the same street or large parking lots) will be selected for monitoring. Catchments will be selected that contain a series of catch basins connected to the same endpoint. In one catchment, each catch basin would contain a retrofit device; in the other, only the final catch basin in the series would be retrofitted. At specific intervals (e.g., monthly) the quantity of gross solids will be measured in each of the catch basins in both test catchments. The total amount of material removed would be quantified for each system, with the area normalized to account for differences in drainage area between the watersheds, and compared. Depending on the sites selected, the means of quantifying gross solids might vary (e.g., periodic manual removal and weighing of material collected, turbidity measured in runoff in and out of the catchment or basin, etc.). Removal of oils and other hydrocarbons would be measured by collecting grab samples periodically from the catch basin. The flow rate of stormwater coming into and out of the catch basins would also be measured during storm events. The research will also document the typical installation costs, along with operation and maintenance costs, so that a cost-effectiveness evaluation (\$/lb. removed) can be included in the findings.

An alternative research approach would be to establish a more controlled test site, likely in partnership with a university extension program (e.g., WSU). Paired catchments could be established within the site, similar to as described above, but runoff events could be simulated and samples of the influent and effluent would be more controlled way instead of sampling actual rainfall/runoff events.

## 7. POTENTIAL MANAGEMENT CHANGES RESULTING FROM RESEARCH FINDINGS

If it is shown that targeted, downstream installations of simple catch basin retrofits is as effective as installing catch basin retrofits in every catch basin, documented access and maintenance difficulties could be substantially reduced. This outcome would also allow for more cost-effective deployment of these types of devices and demonstrate how they can be used in combination with other practices such as source controls and sweeping to meet overall water quality goals such as 80% removal of solids and effective control of oils and hydrocarbons.

## 8. ESTIMATED COST AND TIMING

This study would take approximately **X** months to complete and cost around **\$X**. This cost estimate includes QAPP development, field labor for sample collection, laboratory costs, data QA and preparation, coordination, preparation of a final report, and a 10% project management budget for the lead jurisdiction. This cost estimate does not include the cost of retrofit parts.

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**1. RESEARCH PROPOSAL TITLE**

Stormwater BMP Owner Awareness

**1b. BMP Classification:**     Structural                       Operational                       Education & Outreach

**2. RESEARCH PROBLEM DESCRIPTION**

The permit clearly specifies that the responsibility for upkeep and ensuring the continued function of structural stormwater BMPs falls on the property owner. However, many property owners are unaware of these responsibilities, and when a property has changed hands many times, may not even know the BMP exists. Additionally, municipal staff sometimes have difficulty conducting permit-specified inspections of structural BMPs because property owners are not aware that BMP inspections are required to take place. Increasing property owner’s awareness of the obligation and need to routinely maintain structural BMPs to ensure their proper function, may help improve the condition and long-term performance of BMPs. This problem is nation-wide and is not limited to Eastern Washington, so the results of this study may have wide-reaching impacts.

**3. RESEARCH OBJECTIVE**

The objective of this study is to:

1. Assess the effectiveness of current public outreach and education efforts for notifying property owners of BMP maintenance responsibility.
2. Gauge the current level of property owner awareness of maintenance needs and responsibilities for structural BMPs on their property.
3. Determine how the property owner learned about their BMP maintenance needs and responsibilities.

Evaluate Effectiveness     Compare Effectiveness     Develop Modified BMP     Develop New BMP

**4. LITERATURE SEARCH AND RESEARCH IN PROGRESS SUMMARY**

Difficulties with ensuring maintenance of BMPs located on private property have been documented in the literature. Rafter (2007) highlighted many impediments to maintenance of privately owned BMPs such as; owner awareness, access issues, and expense. These issues were also identified as problems by the Eastern Washington PAG. The same article (Rafter 2007) also identified possible models for allocating maintenance responsibilities. Many municipalities have some published information on their websites about BMPs and their maintenance (e.g., Metropolitan St. Louis Sewer District 2015), but no assessments of the effectiveness of these materials were identified.

**5. Geographic Scope and Urgency of Research**

*How broadly will the results of this research apply?*

Nationally     Pacific Northwest     WA Only     Eastern WA  
 Western WA     Puget Sound Basin     Interior PNW

How quickly will you need the results of this research?

ASAP  Within 6 months  Within 1 year  Within 2 years  
 Within 5 years  Ongoing

## 6. Conceptual Research Approach

This study is aimed at assessing BMP owner awareness of maintenance needs and responsibilities as well as understanding how the BMP owner learned about BMP maintenance. The target population is commercial or residential property owners with a range of BMP types on their land (e.g., filters, detention ponds, vegetated filter strips, bioretention swales). The desired sample size is TBD but will include a minimum of 12 property owners. Background data will be collected (i.e. contacting other jurisdictions, literature search, etc.) to determine how other agencies are addressing BMP owner maintenance needs and responsibilities. This information will be used to develop targeted questions for BMP owners and define an approach for collecting data (i.e. a survey, focus group, etc.). In addition, an inventory of existing education and outreach opportunities will be developing that may inform new property owners about BMP O&M will be identified prior to starting the study.

The questionnaire will be designed to gauge the BMP owner's awareness of the maintenance and inspection requirements of the BMPs on their property and determine how the BMP owner learned about these requirements. Surveys will likely be conducted face to face so that the researcher can verify the respondent's answers on-site. Focus groups may be used to collect information such as from property owners in neighborhoods with Homeowners Associations.

The following is an example of the type and subject areas that maybe included in the questionnaire:

- Do you have any stormwater BMP on your property?
- Where is the BMP located?
- What is the purpose of the BMP?
- How did you obtain information about the BMP on your property?
- How frequently is the BMP maintained? What does that maintenance entail?
- Who maintains the BMP?
- Have municipal staff ever asked you if they may inspect the BMP? Did you let them?
- What is the best way for you to receive information from the local jurisdiction?

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, will be used to develop recommendations for education and outreach campaign targeted at increasing BMP owner awareness.

## 7. POTENTIAL MANAGEMENT CHANGES RESULTING FROM RESEARCH FINDINGS

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 owners identified by this survey. Results from this study may also be used to develop more stringent ordinances that address BMP maintenance responsibility on private property or educating a different target audience that has direct contact with new property owner.

## **8. ESTIMATED COST AND TIMING**

This project could be completed in less than a year and would cost approximately \$30,000. This estimate includes development of the survey questions, coordination with the review team and potential survey participants, a final report, and a 10% project management budget for the lead jurisdiction.

## **References**

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Rafter, Dan. 2007. The Messy Business of Maintaining BMPs: Who's responsible for best management practices? Stormwater Magazine. September 2007.

**1a. RESEARCH PROPOSAL TITLE**

Determining Pollutant Contributions from Municipal Stormwater in EWA using GIS

**1b. BMP Classification:**     Structural                       Operational                       Education & Outreach

**2. RESEARCH PROBLEM DESCRIPTION**

A number of municipalities in Eastern Washington, and elsewhere in the semi-arid interior northwest, have stormwater management facilities and practices, along with stormwater flows and pollutant loads that are very different than those associated with larger cities in wetter climates. These smaller cities in drier climates often have soils conditions in at least parts of their overall municipal jurisdiction that allows for effective infiltration of stormwater. In some cases, this will be authorized and implemented through the Underground Injection Control (UIC) process, in some places it may be simply facilitated by road systems with flush-shoulders (no curbs and gutters) with flows that disperse into adjoining grassy areas, often via sheet flow. These latter areas may have been developed prior to Low Impact Development (LID) program requirements, but they effectively achieve many of the goals of the LID programs. Because of the effectiveness of infiltration, a number of these municipalities are able to disconnect large portions of their jurisdictions from outfalls that discharge to waters of the state or U.S.

As a result of all of the above, the smaller, drier cities inherently generate lower stormwater flows and consequently lower pollutant loads than larger, wetter cities. And the smaller, drier cities often discharge a smaller portion of those flows and loads generated to surface waters.

A number of the municipalities implement the requirements of the MS4 program throughout their entire jurisdiction, either because that is the expectation of the permit, or because for some management practices it may be more administratively convenient to adopt it everywhere. One factor that encourages uniformity in programs is that stormwater managed under the MS4 requirements establishes compliance with the UIC requirements.

Although utilizing a uniform stormwater management program throughout divergent portions of the stormwater system may be more administratively convenient in some cases, it may not result in the most effective, or cost-effective, control of pollutants to surface waters and groundwater. Moreover, the pollutants of concern related to surface waters are often different than those for groundwater. Surface waters may be commonly impaired or impacted by pollutants such as metals, oils, phosphorus, sediment and bacteria, or toxics such as PAHs and PCBs. Pollutants of concern for groundwater are those most likely to leach through the soil profile and impact drinking water aquifers or wells, or possibly migrate to surface water via shallow groundwater pathways. These pollutants of concern for groundwater are often soluble or do not readily adsorb to soils. Soluble pollutants in stormwater may include road salts, nitrate, and total dissolved solids. It is also likely that some pollutants and targeted stormwater practices will overlap MS4 surface water and UIC objectives, for example, street sweeping to remove winter-applied sand to roads will benefit both surface waters impaired for sediment and prevent clogging of UIC facilities.

Stormwater management practices, both structural and non-structural, are not equally effective for all types of pollutants, and especially regarding soluble pollutants of concern for groundwater versus the other pollutants of more concern for surface waters.

### 3. RESEARCH OBJECTIVE

This study effort would evaluate and characterize several stormwater programs in several smaller, drier municipalities, and in particular, map and segregate those areas within each jurisdiction that discharge to surface water outfalls from those that rely on infiltration (both UIC-like and LID-like). The study would identify which, if any, different stormwater management practices are currently being used in the three types of areas: 1) drainage and discharge to surface waters, 2) underground injection, and 3) LID-like infiltration; and also estimate or document stormwater program costs for each main program area. The study will evaluate if targeted management practices in each of the three types of areas can be used to prioritize program activities in each area to control pollutants of most concern for surface water discharges versus pollutants of concern for infiltration and groundwater protection. With this prioritization, the research will demonstrate effectiveness on a dollar per pound of pollutant removed for the overall jurisdiction.

Evaluate Effectiveness    Compare Effectiveness    Develop Modified BMP    Develop New BMP

### 4. LITERATURE SEARCH AND RESEARCH IN PROGRESS SUMMARY

A number of not so large cities in climates similar to Eastern Washington have conducted extensive monitoring of runoff quantity and quality over many years. An example is the Boise, Idaho metropolitan area which includes various co-permittees covered by a Phase I MS4 permit (Boise, Ada County Highway District, Idaho Transportation Department, etc.). This data is available to the public and could be used to evaluate and characterize stormwater pollutants of concern for surface waters and ground waters in Eastern Washington. Use of available data, such as the Boise data, would be much more cost effective and provide more timely completion of the study than an extensive monitoring program in several Eastern Washington cities, which would be required over multiple years for multiple parameters.

As noted earlier, a number of smaller cities in Eastern Washington and Idaho, because of the drier climate and other factors, have been able to disconnect substantial portions of their jurisdictions from outfalls to waters of the state or U.S. This information on outfall disconnection is also available from a number of jurisdictions. A survey of jurisdictions will inform the research regarding how prevalent and successful disconnection is in the interior northwest, and thus how effective this practice is in reducing stormwater pollutant loads to surface waters.

### 5. Geographic Scope and Urgency of Research

*How broadly will the results of this research apply?*

Nationally    Pacific Northwest    WA Only    Eastern WA    Western WA  
 Puget Sound Basin    Interior PNW

*How quickly will you need the results of this research?*

ASAP    Within 6 months    Within 1 year    Within 2 years    Within 5 years  
 Ongoing

### 6. Conceptual Research Approach

The scope of this study would use existing mapping of several storm sewer systems and outfall

locations, inputting data to a GIS database along with characterizing the contributing basins area (specifically the percentage of impervious areas and land use). The initial contribution of pollutants will be estimated using monitoring programs and studies that report relevant regional averages of stormwater characteristics (i.e. pollutant types and concentrations) from similar land uses (e.g., Boise area monitoring data). Pollutants of concern for surface waters will be focused on those often targeted by total maximum daily loads or similar watershed water quality improvement plans, and those often monitored or regulated in MS4 permits. For pollutants of concern for groundwater, road salt, nitrate and TDS will, at a minimum, be considered.

The initial data collection would focus on GIS Stormwater Mapping along with information needed to characterize potential stormwater pollutants including: information on land use(s), topography, basins discharging to surface waters, soils/climate, etc. Outfall disconnection since a given baseline year (e.g., 2006, prior to the effective date of the first MS4 permit cycle in EWA) will also be documented. Information on management practices being used in the three types of areas within each jurisdiction (surface water discharges, UIC-like areas, and LID-like areas) and costs associated with the main elements of the stormwater programs will also be collected to be used for effectiveness demonstration (e.g., \$/lb. removed).

Comparative analyses and graphics will be developed that represent the selected smaller cities, in various soils/climate types, and with varying degrees of proportionate discharges to surface water outfalls and to infiltration systems discharging to soils and potentially ground waters, and degrees of outfall disconnectedness. These will include total pollutant loads from the jurisdiction, unit loads (e.g., pounds per acre), and \$/lb removed for the entire jurisdiction compared to the portion of the jurisdiction with surface water outfalls.

## 7. POTENTIAL MANAGEMENT CHANGES RESULTING FROM RESEARCH FINDINGS

The outcome of the study is to estimate how effective, using a metric such as \$/lb removed, stormwater management programs are in reducing polluted runoff to surface water bodies and to groundwater via infiltration practices. This will allow jurisdictions, and the MS4 permits applicable to them, to focus priority on and differentially target areas that contribute pollutant loads of concern to surface waters and those to ground waters, which are likely to be different pollutants and involve different management practices targeted to the specific pollutants for each type of area. Stormwater management activities likely will still be needed relative to flood management and groundwater protection (e.g., UIC programs), but the nature and cost of those activities may be different than those discharging to surface waters, especially impaired surface waters. **A specific outcome could be that the geographic area of MS4 permit coverage is limited to the portion of the jurisdiction served by the MS4 outfalls to surface waters, and that those subject to UIC program implement practices to comply primarily with the UIC regulations, and those that are not subject to the MS4 and UIC regulations be managed only in accordance with local stormwater ordinances and programs.**

## 8. ESTIMATED COST AND TIMING

Shared costs have been estimated at \$XX,XXX.

**1a. RESEARCH PROPOSAL TITLE**

Soil Media Thickness Study

**1b. BMP Classification:**     Structural                       Operational                       Education & Outreach

**2. RESEARCH PROBLEM DESCRIPTION**

There are numerous studies on treatment media for bioretention ponds and bio-infiltration ponds. However, study findings vary regarding the appropriate depth of the media, or the appropriate mix of media materials for optimum treatment. This is especially true for semi-arid regions like Eastern Washington. The Stormwater Management Manual for Eastern Washington requires a minimum media depth of 6 inches for bioinfiltration swales and the Eastern Washington Low Impact Development Guidance Manual requires a depth of 12 to 24-inches depending on the target pollutant. Media and excavation is costly, so if the required treatment performance can be realized with thinner media depths, bioinfiltration and bioretentionBMPs may be constructed more cost effectively.

**3. RESEARCH OBJECTIVE**

This study will help to determine optimal media depths for maximizing performance and cost effectiveness bioinfiltration BMPs in Eastern Washington.

Evaluate Effectiveness     Compare Effectiveness     Develop Modified BMP     Develop New BMP

**4. LITERATURE SEARCH AND RESEARCH IN PROGRESS SUMMARY**

Soils media mixes that are used to provide treatment of stormwater runoff are also referred to as treatment soils or engineered soils or bioretention soil media (BSM) mixes. The majority of research on this topic has focused on BSM mixes. The composition of these mixes varies nationally, however most are composed of topsoil, sand, and organic materials [1-3]. Specification for these mixes typically include requirements for gradation, cation exchange capacity, organic content, saturated hydraulic conductivity, and media thickness [1-4]. While the composition and specifications for BSM mixes will influence the efficacy of the stormwater treatment performance some consistent findings in the literature related to media thickness indicate that a thinner BSM mix could be effective. Specifically, treatment of TSS and heavy metals primarily occurs in the top (4 to 8-inches) of the BSM mix [4-7]. Thinner mixes may also reduce nutrient leaching from the organic materials contained in the BSM mix which has been a concern with the 60:40 BSM mix in Washington state [8]. In particular, nutrient leaching has been reduced by locating organic materials only in the plant root zone [9, 10] as opposed to a mixing the organic materials throughout the full depth of the BSM mix.

The 60:40 BSM mix specified in the Eastern Washington Low Impact Development manual is composed of 60% sand and 40 compost. This mix was developed and has been evaluated in the field in Western Washington [11-14] where mean annual precipitation depth is higher and the wet season is longer compared to the semi-arid climate in eastern Washington. Findings from this study will provide needed research to evaluate the performance of the 60:40 mix in a semi-arid region which could direct the development of future treatment soil or BSM specifications that are optimum for BMPs located in eastern Washington.

### 5. Geographic Scope and Urgency of Research

How broadly will the results of this research apply?

Nationally     Pacific Northwest     WA Only     Eastern WA  
 Western WA     Puget Sound Basin

How quickly will you need the results of this research?

ASAP     Within 6 months     Within 1 year     Within 2 years  
 Within 5 years     Ongoing

### 6. Conceptual Research Approach

A dual cell bioinfiltration pond was constructed adjacent to the parking area at Gonzaga University's Rudolph Fitness Center. The ponds each contain the 60:40 bioretention soil media mix except one of the treatment cells has a media depth of 12 inches, the other has a media depth of 18 inches. Influent and effluent from each of the treatment cells will be collected during qualifying storm events using both manual and automated sampling techniques. Samples will be analyzed for identified constituents of concern (TSS, metals, total phosphorus, total petroleum hydrocarbons). Influent and effluent concentrations for each of the treatment cells will be compared to determine treatment efficiency of each of the cells; and the treatment efficiencies of each cell will be compared to each other. From this analysis, differences in treatment efficiency and performance attributable to the different media depths.

### 7. Potential Management Changes Resulting from Research Findings

Results from this study will help inform the design of bioinfiltration and bioretention BMPs to improve treatment performance and cost effectiveness.

### 8. ESTIMATED COST AND TIMING

The project is estimated to cost \$190,000 over two years.

### References

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### 1. RESEARCH PROPOSAL TITLE

Use of Non-Vegetation Swale with Native Soils

**1b. BMP Classification:**     Structural                       Operational                       Education & Outreach

### 2. RESEARCH PROBLEM DESCRIPTION

A number of BMPs included in the Stormwater Management Manual for Eastern Washington (e.g., bioinfiltration swales and vegetated filter strips) include installation of plants as part of the design. While these plants or their root structure may enhance pollutant removal and/or infiltration capacity and aesthetics, they also create extra maintenance needs, including watering and mowing. In some of the dryer parts of Eastern Washington, the irrigation water required to keep the plants alive during the summer months often exceeds the annual amount of regional rainfall by tenfold. Additionally, during drought years, the availability of irrigation water is often severely restricted, resulting in survivability issues for the plants. In addition, some infiltration BMPs require engineered soils (i.e. bioretention ponds) which requires jurisdictions to remove and replace native soils. Engineered soils and excavation is costly, so if native soils could provide the required treatment, these BMPs may be constructed more cost effectively. *This study would evaluate if these BMPs are able to provide adequate treatment of runoff in the absence of plants and using native soils.*

### 3. RESEARCH OBJECTIVE

The goals of this study are to: 1) Test the feasibility of a 'no plants' option for an infiltration BMP that are typically vegetated and determine what pollutants they will treat in arid and xeriscaping locations; and 2) Develop a design specification that defines the physiochemical properties of native soils that are suitable for providing treatment of stormwater runoff.

Evaluate Effectiveness     Compare Effectiveness     Develop Modified BMP     Develop New BMP

### 4. LITERATURE SEARCH AND RESEARCH IN PROGRESS SUMMARY

Plants are known to improve the stormwater treatment performance of BMPs particularly for nutrient uptake [1, 2]. However most of the nutrient uptake occurs in the spring and early summer when negative growth is maximum. In order to sustain the nutrient uptake, vegetation must be cut back and removed from the BMP prior to the dormant season or the vegetation that is left will decay and release nutrients back into the soils [1]. This creates a challenge for jurisdictions located in semi-arid climates with extended dry periods and limited maintenance budget.

Extensive studies have been conducted to identify the physiochemical properties of engineered soils that appear to influence the efficacy of the stormwater treatment performance. For example, TSS removal rates correlate with permeability rates between 2 to 6 inches/hour [5] and a uniformity coefficient ( $d_{60}/d_{10}$ ) of less than 4 [36]. Whereas dissolved metal removal is often associated with the sorptive properties of the soils including cation exchange capacity [3]. Additional characteristics that correlate with the stormwater treatment performance of engineered soils include gradation, organic content, and media thickness [2, 4-6]. Many of these properties are found in native soils as such may be **suitable** for providing equivalent treatment performance at a substantially lower cost compared to engineered soils.

### 5. Geographic Scope and Urgency of Research

*How broadly will the results of this research apply?*

\_\_\_ Nationally    \_\_\_ Pacific Northwest    \_\_\_ WA Only     x  Eastern WA

\_\_\_ Western WA    \_\_\_ Puget Sound Basin     x  Interior PNW

How quickly will you need the results of this research?

ASAP  Within 6 months  Within 1 year  Within 2 years

Within 5 years  Ongoing

## 6. Conceptual Research Approach

The study approach includes the following primary tasks:

1. Develop a specification that defines the physiochemical properties (or range of properties) of native soils that are suitable for providing stormwater treatment. This will include conducting an extensive literature search and identifying properties based on common citations in the literature. *This will include evaluating whether results from the WWA RSMP study (focused on developing a bioretention specification) are applicable to this study.* If the results are applicable, they will be considered in the development of the specification for defining suitable properties of native soils.
2. Verify (through analytical testing) that the properties of the native soils at the proposed test site are within the range of suitable properties identified in the specification.
3. Design and construct an infiltration BMP (i.e. bioinfiltration swale or bioretention pond) following the design guidance in the Ecology Stormwater Manual for Eastern Washington (or an equivalent manual) except native soils (that meet the new specification) will be used and no plants will be installed. The BMP will be equipped with an automated water quality monitoring system capable of collecting influent and effluent water quality samples. The typical jurisdiction maintenance will be performed on the BMP.
4. The infiltration rate would be measured every four months for two years.
5. Water quality sampling will be collected from qualifying rainfall events for a total of 12 events. Stormwater influent and effluent samples will be collected and submitted to an Ecology certified lab for analytical testing of the following constituents: TSS, dissolved Cu and Zn, total phosphorus, and total petroleum hydrocarbons.
6. Following each rainfall event visual observation of the site will be documented including weed growth, evidence of vandalism, impacts to the BMP from blowing sands, etc.
7. The data will be evaluated to determine which pollutants 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.

Future studies will focus on evaluating the effectiveness of the range of properties identified in the specification at multiple different locations in eastern Washington. In addition, future studies may also investigate different media amendments that could be added to native soils to provide targeted pollutant removal.

## 7. POTENTIAL MANAGEMENT CHANGES RESULTING FROM RESEARCH FINDINGS

The anticipated outcome of this study is a new BMP design guidance (that does not include plants and defines the range of properties in native soils that are suitable for providing treatment of stormwater runoff) and maintenance guidance that is approved for general use for future projects.

## 8. ESTIMATED COST AND TIMING

The duration of this study will be about 3 years. The approximate cost would be \$300,000. This estimate includes development of a QAPP; a literature search to develop the suitable native specification; labor costs and equipment (installation of water quality system); collecting samples and analytical testing of TSS,

dissolved Cu and Zn, total phosphorus, and total petroleum hydrocarbons; data analysis; development of a final report; and a 10% project management budget for the lead jurisdiction. This estimate does not include the cost to purchase land at the test site (i.e., the study is done on existing property) or construct the test site.

#### References

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### 1a. RESEARCH PROPOSAL TITLE

BMP Inspection and Maintenance Responsibilities

**1b. BMP Classification:**     Structural                       Operational                       Education & Outreach

### 2. RESEARCH PROBLEM DESCRIPTION

Privately-owned structural BMPs represent a unique problem for ensuring long-term maintenance. Complications can arise from access issues for inspection (e.g., an inspector may not have permission to enter private property), and failure to maintain structural BMPs may occur due to lack of interest, unclear and changing ownership, lack of incentive, or limited funding. 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 general strategies were identified for evaluation:

- City/County performs inspection of structural BMPs but requires that the property owner to hire a qualified contractor to conduct necessary maintenance and provide proof that the maintenance has been completed
- 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
- City/County performs maintenance but the BMP remains under private ownership and the property owner pays the City/County for the service
- 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.

### 3. RESEARCH OBJECTIVE

The objective of this study is to gather information from Washington and semi-arid seasonal region 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 ultimate objective is to develop a prototype program for operation and maintenance (O&M) of privately owned structural BMPs for Eastern Washington (EWA) jurisdictions.

Evaluate Effectiveness     Compare Effectiveness     Develop Modified BMP     Develop New BMP

### 4. LITERATURE SEARCH AND RESEARCH IN PROGRESS SUMMARY

There was not any literature identified specifically related to designating responsibility for maintenance of privately owned BMPs. However, it is clear from discussions with Eastern Washington stormwater managers, as well as guidance documents published by municipalities in other states, that the challenge of long-term BMP maintenance is not unique to Eastern Washington, and that there are a variety of strategies for addressing this challenge. As part of the development of the Western Washington LID Operations and Maintenance (O&M) Guidance Document, an advisory committee on administrative issues was convened and maintenance of privately-owned BMPs was one of the topics discussed and summarized in the Western Washington LID O&M Guidance Document (Herrera 2013).

## 5. Geographic Scope and Urgency of Research

How broadly will the results of this research apply?

Nationally     Pacific Northwest     WA Only     Eastern WA  
 Western WA     Puget Sound Basin     Interior PNW

How quickly will you need the results of this research?

ASAP     Within 6 months     Within 1 year     Within 2 years  
 Within 5 years     Ongoing

## 6. Conceptual Research Approach

A survey will be conducted of approximately 15 to 20 municipalities in Washington State and other semi-arid seasonal regions to determine how they address the long-term needs of privately-owned structural BMPs. The survey will cover:

- Define the strategy that the jurisdiction currently uses for inspection and maintenance responsibility
- Estimated number of structural BMPs in the jurisdiction
- Number of structural BMPs inspected each year
- Number of enforcement actions taken as a result of those inspections
- Funding mechanisms (e.g., cost share or fee programs for implementing the selected strategy (if applicable))
- Potential inspection or enforcement cost savings through implementation of the selected strategy
- Issues with access or other private property legalities
- Issues of local traditions or “culture” that could affect O&M
- Issues with enforcement or implementation strategies by different agency programs

Stormwater managers from these municipalities will then be interviewed (5 to 10) to further discuss their perceptions of the advantages and shortcoming of their programs. Focus groups may be used in lieu of or in addition to interviews. As part of the recruitment process, it will be important to capture the opinions of jurisdictions that are and are not experiencing problems with their O&M protocols. It will also be important to convey why they should participate since messaging is important for response rates.

## 7. POTENTIAL MANAGEMENT CHANGES RESULTING FROM RESEARCH FINDINGS

More effective models for ensuring that privately owned BMPs are maintained on a regular basis may be identified through the proposed research effort. Development of recommendations for a prototype program or draft O&M manual to be adopted by EWA jurisdictions where appropriate.

## 8. ESTIMATED COST AND TIMING

This survey study would take less than a year to complete. An estimated cost for conducting the study will be included in the Detailed Study Design Proposal.

## References

Herrera. 2013. Western Washington Low Impact Development (LID) Operation and Maintenance (O&M) Guidance Document. Prepared for the Washington State Department of Ecology by Herrera Environmental Consultants and Washington Stormwater Center. July 2013.

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### 1a. RESEARCH PROPOSAL TITLE

Seasonal Differences in Street Sweeping Material Removal

**1b. BMP Classification:**     Structural                       Operational                       Education & Outreach

### 2. RESEARCH PROBLEM DESCRIPTION

Street sweeping is a proven technique for removing solids and associated pollutants from roadways. There have been a number of street sweeping studies that correlate higher pollutant removal with greater sweeping frequency. However, these studies were largely performed in more urbanized areas and focused on evaluation of the effectiveness of street sweeping at regular sweeping intervals (e.g., twice monthly, monthly, and semi-annual). No studies were identified that address the climate conditions and considerations such as seasonal wind-borne inputs faced by Eastern Washington permittees. Only a few have addressed the importance of removing winter sediment built up during the spring thawing period. Research has also shown that pollutant removals from street sweeping are greatest when sweeping occurs during the time periods in which material accumulation is high.

While routine sweeping may be a reasonable strategy in areas with consistent pollutant accumulations, it may not be the most cost-effective strategy in areas with large seasonal fluxes. There may be strategies for maximizing the effectiveness of street sweeping that are driven more by region and time of year rather than by routine time intervals (e.g., monthly). A targeted study for Eastern Washington could help stormwater managers make more informed decisions about where and when to focus their efforts to optimize street sweeping effectiveness.

### 3. RESEARCH OBJECTIVE

The objective of this study is to evaluate seasonal and potentially regional differences in sediment and pollutant accumulations (using pollutant removal through sweeping as a surrogate measure). The information collected will be used by permittees to optimize the cost-effectiveness of their street sweeping programs.

Evaluate Effectiveness     Compare Effectiveness     Develop Modified BMP     Develop New BMP

### 4. LITERATURE SEARCH AND RESEARCH IN PROGRESS SUMMARY

There is a large body of research that documents the effectiveness of street sweeping as a stormwater BMP for reducing sediment and pollutant loads. A wide range of sediment and pollutant removal rates attributable to street sweeping are reported (Law et al. 2008). The most important variables affecting pollutant removal rates appear to be sweeper type, and sweeping frequency (Sutherland et al. 1997, Law et al. 2008). The highest removal rates were consistently realized using high efficiency, regenerative air vacuums at a twice weekly frequency. At lower sweeping frequencies, or with less efficient equipment, much lower pollutant removal rates were reported.

Municipalities in Eastern Washington, and elsewhere, commonly target street sweeping to coincide with patterns in deposition (e.g., leaf accumulation, and winter sanding), in lieu of, or in addition to regular sweeping. No studies were identified that quantify pollutant removal associated with these seasonally timed sweeping events; nor were any studies identified that evaluated the effectiveness of seasonally adjusted street sweeping frequency based on climatic factors such as wind-blown inputs.

## 5. Geographic Scope and Urgency of Research

*How broadly will the results of this research apply?*

*Nationally*  *Pacific Northwest*  *WA Only*  *Eastern WA*

*Western WA*  *Puget Sound Basin*  *Interior PNW*

*How quickly will you need the results of this research?*

*ASAP*  *Within 6 months*  *Within 1 year*  *Within 2 years*

*Within 5 years*  *Ongoing*

## 6. Conceptual Research Approach

Up to four communities representing different regions of Eastern Washington (test-areas) could be selected for monitoring. Arterials and representative local roadways in each selected community would be swept on a monthly basis (half the test-areas every two weeks). The staggering of sweeping events allows for greater capture of variability in deposition (e.g., wind deposits) events. By sweeping the entire test-area rather than individual, specific roadway segments, possible factors that could affect loading such as land use, roadway surface type, and traffic volumes are accounted for, even though they wouldn't be studied individually; and more representative data will be obtained.

For each sweeping event, the amount of material collected will be weighed and its volume estimated and recorded (per mile of roadway). On a minimum of a quarterly basis (a minimum of four total samples per year of at least 1000 grams will be collected during the course of the study), samples will be mechanically sieved and analyzed to establish their particle size distribution (PSD) and their organic material fraction by weigh and volume. The sediment fractions will be composited back into three fractions (i.e. less than 63 microns; 63 to 250 microns; and 250 to 2000 microns and analyzed for specific pollutants (e.g., copper and zinc). In addition, nutrient analysis will be conducted on the organic fraction that is retained by the 2000-micron sieve. Statistical analysis will be used to identify whether there are significant factors (e.g., timing, region) affecting the amount of material removed by each sweeping event (a surrogate for sediment deposition rate). Graphical analysis will be used to characterize the volume and weight of material and associated pollutants removed with each sweeping event to help identify patterns or differences between regions.

If possible, sweepers of the same type (e.g., high efficiency or regenerative air) and age should be used in each of the selected communities where the study would be conducted to allow for comparability of results among communities. However, because the study is only looking at mass pick up in individual communities, and not efficiency (percent of deposited load removed), the sweepers do not have to be the same. However, it has been shown that different types of sweepers generally have different pick up efficiencies which can change the physical characteristics of the material that is removed.

## 7. POTENTIAL MANAGEMENT CHANGES RESULTING FROM RESEARCH FINDINGS

The timing of street sweeping events may be better focused on the time(s) of year when it will have the greatest effect on material removal which is when accumulations are high. This may improve the effectiveness of street sweeping programs by increasing the amount of material removed, and may save jurisdictions money, because they can scale back street sweeping when it will have less impact which could be during the dry summer months.

## **8. ESTIMATED COST AND TIMING**

Sampling for this study would be conducted over a 2-year period during the sweeping season (generally considered to be March- October). The approximate cost of the study would be about \$200,000 assuming four communities are selected. This estimate includes development of a QAPP, coordination, laboratory analysis, labor associated with sample collection and volume estimates for sweeping events, data QA, a final report, and a 10% project management budget for the lead jurisdiction. This estimate does not account for equipment (sweeper) purchase and does not include the cost of sweeper operation, sweeper operator wages, or the purchase of scales for weighing loads.

## **References**

Law, N.L., K. DiBlasi, and U. Ghosh. 2008. Deriving reliable pollutant removal rates for municipal street sweeping and storm drain cleanout programs in the Chesapeake Bay basin. Prepared by the Center for Watershed Protection. September 2008.

Sutherland, R.C. and S.L. Jelen. 1997. Contrary to conventional wisdom, street sweeping can be an effective BMP. *Advances in Modeling the Management of Stormwater Impacts*. 5:179-190.

### 1. RESEARCH PROPOSAL TITLE

Catch Basin Retrofit Device Placement

**1b. BMP Classification:**     Structural                       Operational                       Education & Outreach

### 2. RESEARCH PROBLEM DESCRIPTION

A spill control separator is a standard catch basin that is retrofit with a downturned elbow or tee. These retrofits are used to retain a limited volume of pollutants that float on the water such as oil or antifreeze (Ecology, 2006). Spill control devices are required for UICs located in high-use sites (excluding high vehicular traffic areas) and in locations where oil spills are likely during the life span of a project (Ecology, 2006). Catch basin retrofits are also thought to improve the effectiveness of catch basins for removing gross solids and the pollutants associated with them. Catch basins without retrofits are thought to do little to remove floatables and oils, because the primary removal mechanism of a typical, deep sump catch basin is settling.

The presence of these retrofits is reported to cause difficulties for routine maintenance and cleaning, especially in smaller catch basins. This is due to the lack of space for the vacuum hose to easily reach the bottom of the catch basin sump. As a result, the devices are sometimes removed and may not be reinstalled correctly, or at all. Given the access difficulties in smaller catch basins with these devices installed, a study would help determine how retrofits can be applied most effectively to maximize their benefit and minimize maintenance burdens, and provide more cost-effective treatment (e.g., dollars per pound of gross solids and oils removed).

### 3. RESEARCH OBJECTIVE

The objective of this research is to evaluate oils and gross solids removal differences between two, similarly sized and located catchments; one in which a downturned elbow type retrofit is only installed at the most downstream catch basin and one in which retrofits are installed at multiple locations within the catchment. If targeted application (i.e., downstream installations) of downturned elbows is shown to be equally effective, identifying locations within the municipal separate storm sewer system (MS4) where these retrofits have the greatest benefit would help to prioritize where they 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 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.

Evaluate Effectiveness     Compare Effectiveness     Develop Modified BMP     Develop New BMP

### 4. LITERATURE SEARCH AND RESEARCH IN PROGRESS SUMMARY

A few recent studies (Mullen 2003; Smith 2010) have clearly documented the effectiveness of hoods, snouts and tees for improving the effectiveness of catch basins and removing solids and oils. Documented removal rates for solids varied widely, and range from about 30 to 80 percent (Smith 2010), depending on the material trapped. All of the studies identified performed a direct comparison between retrofitted and typical catch basins. However, none of these studies documented system-wide effectiveness where only selected catch basins are retrofitted. Also, none of the studies reviewed addressed the reported maintenance problems in small catch basins with retrofits installed and no studies were located from a semi-arid, western climate.

### 5. Geographic Scope and Urgency of Research

*How broadly will the results of this research apply?*

Nationally     Pacific Northwest     WA Only     Eastern WA  
 Western WA     Puget Sound Basin     Interior PNW

How quickly will you need the results of this research?

ASAP  Within 6 months  Within 1 year  Within 2 years

Within 5 years  Ongoing

## 6. Conceptual Research Approach

Small paired catchments (e.g., two sides of the same street or large parking lots) will be selected for monitoring. Catchments will be selected that contain a series of catch basins connected to the same endpoint. In one catchment, each catch basin would contain a retrofit device; in the other, only the final catch basin in the series would be retrofitted. At specific intervals (e.g., monthly) the quantity of gross solids will be measured in each of the catch basins in both test catchments. The total amount of material removed would be quantified for each system, with the area normalized to account for differences in drainage area between the watersheds, and compared. Depending on the sites selected, the means of quantifying gross solids might vary (e.g., periodic manual removal and weighing of material collected, turbidity measured in runoff in and out of the catchment or basin, etc.). Removal of oils and other hydrocarbons would be measured by collecting grab samples periodically from the catch basin. The flow rate of stormwater coming into and out of the catch basins would also be measured during storm events. The research will also document the typical installation costs, along with operation and maintenance costs, so that a cost-effectiveness evaluation (\$/lb. removed) can be included in the findings.

An alternative research approach would be to establish a more controlled test site, likely in partnership with a university extension program (e.g., WSU). Paired catchments could be established within the site, similar to as described above, but runoff events could be simulated and samples of the influent and effluent would be more controlled way instead of sampling actual rainfall/runoff events.

## 7. POTENTIAL MANAGEMENT CHANGES RESULTING FROM RESEARCH FINDINGS

If it is shown that targeted, downstream installations of simple catch basin retrofits is as effective as installing catch basin retrofits in every catch basin, documented access and maintenance difficulties could be substantially reduced. This outcome would also allow for more cost-effective deployment of these types of devices and demonstrate how they can be used in combination with other practices such as source controls and sweeping to meet overall water quality goals such as 80% removal of solids and effective control of oils and hydrocarbons.

## 8. ESTIMATED COST AND TIMING

This study would take approximately **X** months to complete and cost around **\$X**. This cost estimate includes QAPP development, field labor for sample collection, laboratory costs, data QA and preparation, coordination, preparation of a final report, and a 10% project management budget for the lead jurisdiction. This cost estimate does not include the cost of retrofit parts.

## References

Mullen, T.J. 2003. Maximum Utility for Minimum Cost: Simple Structural Methods for Stormwater Quality Improvement. World Water & Environmental Resources Congress. American Society of Civil Engineers (ASCE).

Smith, Kirk P. 2010. Effectiveness of Catch Basins Equipped with Hoods in Retaining Gross Solids and Hydrocarbons in Highway Runoff, Southeast Expressway, Boston, Massachusetts, 2008-09. Prepared for the U.S. Department of the Interior and the U.S. Geological Survey in cooperation with the Federal Highway Administration and the Massachusetts Department of Transportation.

Ecology. (2004). Eastern Washington Stormwater Manual. Retrieved from Olympia, WA

Ecology. (2006). *Guidance for UIC Wells that Manage Stormwater*. Olympia, WA: Washington State Department of Ecology.

**1. RESEARCH PROPOSAL TITLE**

Stormwater BMP Owner Awareness

**1b. BMP Classification:**     Structural                       Operational                       Education & Outreach

**2. RESEARCH PROBLEM DESCRIPTION**

The permit clearly specifies that the responsibility for upkeep and ensuring the continued function of structural stormwater BMPs falls on the property owner. However, many property owners are unaware of these responsibilities, and when a property has changed hands many times, may not even know the BMP exists. Additionally, municipal staff sometimes have difficulty conducting permit-specified inspections of structural BMPs because property owners are not aware that BMP inspections are required to take place. Increasing property owner’s awareness of the obligation and need to routinely maintain structural BMPs to ensure their proper function, may help improve the condition and long-term performance of BMPs. This problem is nation-wide and is not limited to Eastern Washington, so the results of this study may have wide-reaching impacts.

**3. RESEARCH OBJECTIVE**

The objective of this study is to:

1. Assess the effectiveness of current public outreach and education efforts for notifying property owners of BMP maintenance responsibility.
2. Gauge the current level of property owner awareness of maintenance needs and responsibilities for structural BMPs on their property.
3. Determine how the property owner learned about their BMP maintenance needs and responsibilities.

Evaluate Effectiveness     Compare Effectiveness     Develop Modified BMP     Develop New BMP

**4. LITERATURE SEARCH AND RESEARCH IN PROGRESS SUMMARY**

Difficulties with ensuring maintenance of BMPs located on private property have been documented in the literature. Rafter (2007) highlighted many impediments to maintenance of privately owned BMPs such as; owner awareness, access issues, and expense. These issues were also identified as problems by the Eastern Washington PAG. The same article (Rafter 2007) also identified possible models for allocating maintenance responsibilities. Many municipalities have some published information on their websites about BMPs and their maintenance (e.g., Metropolitan St. Louis Sewer District 2015), but no assessments of the effectiveness of these materials were identified.

**5. Geographic Scope and Urgency of Research**

*How broadly will the results of this research apply?*

Nationally     Pacific Northwest     WA Only     Eastern WA  
 Western WA     Puget Sound Basin     Interior PNW

How quickly will you need the results of this research?

ASAP  Within 6 months  Within 1 year  Within 2 years  
 Within 5 years  Ongoing

## 6. Conceptual Research Approach

This study is aimed at assessing BMP owner awareness of maintenance needs and responsibilities as well as understanding how the BMP owner learned about BMP maintenance. The target population is commercial or residential property owners with a range of BMP types on their land (e.g., filters, detention ponds, vegetated filter strips, bioretention swales). The desired sample size is TBD but will include a minimum of 12 property owners. Background data will be collected (i.e. contacting other jurisdictions, literature search, etc.) to determine how other agencies are addressing BMP owner maintenance needs and responsibilities. This information will be used to develop targeted questions for BMP owners and define an approach for collecting data (i.e. a survey, focus group, etc.). In addition, an inventory of existing education and outreach opportunities will be developing that may inform new property owners about BMP O&M will be identified prior to starting the study.

The questionnaire will be designed to gauge the BMP owner's awareness of the maintenance and inspection requirements of the BMPs on their property and determine how the BMP owner learned about these requirements. Surveys will likely be conducted face to face so that the researcher can verify the respondent's answers on-site. Focus groups may be used to collect information such as from property owners in neighborhoods with Homeowners Associations.

The following is an example of the type and subject areas that maybe included in the questionnaire:

- Do you have any stormwater BMP on your property?
- Where is the BMP located?
- What is the purpose of the BMP?
- How did you obtain information about the BMP on your property?
- How frequently is the BMP maintained? What does that maintenance entail?
- Who maintains the BMP?
- Have municipal staff ever asked you if they may inspect the BMP? Did you let them?
- What is the best way for you to receive information from the local jurisdiction?

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, will be used to develop recommendations for education and outreach campaign targeted at increasing BMP owner awareness.

## 7. POTENTIAL MANAGEMENT CHANGES RESULTING FROM RESEARCH FINDINGS

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 owners identified by this survey. Results from this study may also be used to develop more stringent ordinances that address BMP maintenance responsibility on private property or educating a different target audience that has direct contact with new property owner.

## **8. ESTIMATED COST AND TIMING**

This project could be completed in less than a year and would cost approximately \$30,000. This estimate includes development of the survey questions, coordination with the review team and potential survey participants, a final report, and a 10% project management budget for the lead jurisdiction.

## **References**

Metropolitan St. Louis Sewer District. 2015. The ABC's of Private Post-Construction Stormwater BMP Ownership. Metropolitan. St. Louis Sewer District Division of Environmental Compliance. [www.stimsd.com](http://www.stimsd.com) Accessed March 2015

Rafter, Dan. 2007. The Messy Business of Maintaining BMPs: Who's responsible for best management practices? Stormwater Magazine. September 2007.

**1a. RESEARCH PROPOSAL TITLE**

Determining Pollutant Contributions from Municipal Stormwater in EWA using GIS

**1b. BMP Classification:**     Structural                       Operational                       Education & Outreach

**2. RESEARCH PROBLEM DESCRIPTION**

A number of municipalities in Eastern Washington, and elsewhere in the semi-arid interior northwest, have stormwater management facilities and practices, along with stormwater flows and pollutant loads that are very different than those associated with larger cities in wetter climates. These smaller cities in drier climates often have soils conditions in at least parts of their overall municipal jurisdiction that allows for effective infiltration of stormwater. In some cases, this will be authorized and implemented through the Underground Injection Control (UIC) process, in some places it may be simply facilitated by road systems with flush-shoulders (no curbs and gutters) with flows that disperse into adjoining grassy areas, often via sheet flow. These latter areas may have been developed prior to Low Impact Development (LID) program requirements, but they effectively achieve many of the goals of the LID programs. Because of the effectiveness of infiltration, a number of these municipalities are able to disconnect large portions of their jurisdictions from outfalls that discharge to waters of the state or U.S.

As a result of all of the above, the smaller, drier cities inherently generate lower stormwater flows and consequently lower pollutant loads than larger, wetter cities. And the smaller, drier cities often discharge a smaller portion of those flows and loads generated to surface waters.

A number of the municipalities implement the requirements of the MS4 program throughout their entire jurisdiction, either because that is the expectation of the permit, or because for some management practices it may be more administratively convenient to adopt it everywhere. One factor that encourages uniformity in programs is that stormwater managed under the MS4 requirements establishes compliance with the UIC requirements.

Although utilizing a uniform stormwater management program throughout divergent portions of the stormwater system may be more administratively convenient in some cases, it may not result in the most effective, or cost-effective, control of pollutants to surface waters and groundwater. Moreover, the pollutants of concern related to surface waters are often different than those for groundwater. Surface waters may be commonly impaired or impacted by pollutants such as metals, oils, phosphorus, sediment and bacteria, or toxics such as PAHs and PCBs. Pollutants of concern for groundwater are those most likely to leach through the soil profile and impact drinking water aquifers or wells, or possibly migrate to surface water via shallow groundwater pathways. These pollutants of concern for groundwater are often soluble or do not readily adsorb to soils. Soluble pollutants in stormwater may include road salts, nitrate, and total dissolved solids. It is also likely that some pollutants and targeted stormwater practices will overlap MS4 surface water and UIC objectives, for example, street sweeping to remove winter-applied sand to roads will benefit both surface waters impaired for sediment and prevent clogging of UIC facilities.

Stormwater management practices, both structural and non-structural, are not equally effective for all types of pollutants, and especially regarding soluble pollutants of concern for groundwater versus the other pollutants of more concern for surface waters.

### 3. RESEARCH OBJECTIVE

This study effort would evaluate and characterize several stormwater programs in several smaller, drier municipalities, and in particular, map and segregate those areas within each jurisdiction that discharge to surface water outfalls from those that rely on infiltration (both UIC-like and LID-like). The study would identify which, if any, different stormwater management practices are currently being used in the three types of areas: 1) drainage and discharge to surface waters, 2) underground injection, and 3) LID-like infiltration; and also estimate or document stormwater program costs for each main program area. The study will evaluate if targeted management practices in each of the three types of areas can be used to prioritize program activities in each area to control pollutants of most concern for surface water discharges versus pollutants of concern for infiltration and groundwater protection. With this prioritization, the research will demonstrate effectiveness on a dollar per pound of pollutant removed for the overall jurisdiction.

Evaluate Effectiveness    Compare Effectiveness    Develop Modified BMP    Develop New BMP

### 4. LITERATURE SEARCH AND RESEARCH IN PROGRESS SUMMARY

A number of not so large cities in climates similar to Eastern Washington have conducted extensive monitoring of runoff quantity and quality over many years. An example is the Boise, Idaho metropolitan area which includes various co-permittees covered by a Phase I MS4 permit (Boise, Ada County Highway District, Idaho Transportation Department, etc.). This data is available to the public and could be used to evaluate and characterize stormwater pollutants of concern for surface waters and ground waters in Eastern Washington. Use of available data, such as the Boise data, would be much more cost effective and provide more timely completion of the study than an extensive monitoring program in several Eastern Washington cities, which would be required over multiple years for multiple parameters.

As noted earlier, a number of smaller cities in Eastern Washington and Idaho, because of the drier climate and other factors, have been able to disconnect substantial portions of their jurisdictions from outfalls to waters of the state or U.S. This information on outfall disconnection is also available from a number of jurisdictions. A survey of jurisdictions will inform the research regarding how prevalent and successful disconnection is in the interior northwest, and thus how effective this practice is in reducing stormwater pollutant loads to surface waters.

### 5. Geographic Scope and Urgency of Research

*How broadly will the results of this research apply?*

Nationally    Pacific Northwest    WA Only    Eastern WA    Western WA  
 Puget Sound Basin    Interior PNW

*How quickly will you need the results of this research?*

ASAP    Within 6 months    Within 1 year    Within 2 years    Within 5 years  
 Ongoing

### 6. Conceptual Research Approach

The scope of this study would use existing mapping of several storm sewer systems and outfall

locations, inputting data to a GIS database along with characterizing the contributing basins area (specifically the percentage of impervious areas and land use). The initial contribution of pollutants will be estimated using monitoring programs and studies that report relevant regional averages of stormwater characteristics (i.e. pollutant types and concentrations) from similar land uses (e.g., Boise area monitoring data). Pollutants of concern for surface waters will be focused on those often targeted by total maximum daily loads or similar watershed water quality improvement plans, and those often monitored or regulated in MS4 permits. For pollutants of concern for groundwater, road salt, nitrate and TDS will, at a minimum, be considered.

The initial data collection would focus on GIS Stormwater Mapping along with information needed to characterize potential stormwater pollutants including: information on land use(s), topography, basins discharging to surface waters, soils/climate, etc. Outfall disconnection since a given baseline year (e.g., 2006, prior to the effective date of the first MS4 permit cycle in EWA) will also be documented. Information on management practices being used in the three types of areas within each jurisdiction (surface water discharges, UIC-like areas, and LID-like areas) and costs associated with the main elements of the stormwater programs will also be collected to be used for effectiveness demonstration (e.g., \$/lb. removed).

Comparative analyses and graphics will be developed that represent the selected smaller cities, in various soils/climate types, and with varying degrees of proportionate discharges to surface water outfalls and to infiltration systems discharging to soils and potentially ground waters, and degrees of outfall disconnectedness. These will include total pollutant loads from the jurisdiction, unit loads (e.g., pounds per acre), and \$/lb removed for the entire jurisdiction compared to the portion of the jurisdiction with surface water outfalls.

## **7. POTENTIAL MANAGEMENT CHANGES RESULTING FROM RESEARCH FINDINGS**

The outcome of the study is to estimate how effective, using a metric such as \$/lb removed, stormwater management programs are in reducing polluted runoff to surface water bodies and to groundwater via infiltration practices. This will allow jurisdictions, and the MS4 permits applicable to them, to focus priority on and differentially target areas that contribute pollutant loads of concern to surface waters and those to ground waters, which are likely to be different pollutants and involve different management practices targeted to the specific pollutants for each type of area. Stormwater management activities likely will still be needed relative to flood management and groundwater protection (e.g., UIC programs), but the nature and cost of those activities may be different than those discharging to surface waters, especially impaired surface waters. **A specific outcome could be that the geographic area of MS4 permit coverage is limited to the portion of the jurisdiction served by the MS4 outfalls to surface waters, and that those subject to UIC program implement practices to comply primarily with the UIC regulations, and those that are not subject to the MS4 and UIC regulations be managed only in accordance with local stormwater ordinances and programs.**

## **8. ESTIMATED COST AND TIMING**

Shared costs have been estimated at \$XX,XXX.

**1a. RESEARCH PROPOSAL TITLE**

Soil Media Thickness Study

**1b. BMP Classification:**     Structural                       Operational                       Education & Outreach

**2. RESEARCH PROBLEM DESCRIPTION**

There are numerous studies on treatment media for bioretention ponds and bio-infiltration ponds. However, study findings vary regarding the appropriate depth of the media, or the appropriate mix of media materials for optimum treatment. This is especially true for semi-arid regions like Eastern Washington. The Stormwater Management Manual for Eastern Washington requires a minimum media depth of 6 inches for bioinfiltration swales and the Eastern Washington Low Impact Development Guidance Manual requires a depth of 12 to 24-inches depending on the target pollutant. Media and excavation is costly, so if the required treatment performance can be realized with thinner media depths, bioinfiltration and bioretentionBMPs may be constructed more cost effectively.

**3. RESEARCH OBJECTIVE**

This study will help to determine optimal media depths for maximizing performance and cost effectiveness bioinfiltration BMPs in Eastern Washington.

Evaluate Effectiveness     Compare Effectiveness     Develop Modified BMP     Develop New BMP

**4. LITERATURE SEARCH AND RESEARCH IN PROGRESS SUMMARY**

Soils media mixes that are used to provide treatment of stormwater runoff are also referred to as treatment soils or engineered soils or bioretention soil media (BSM) mixes. The majority of research on this topic has focused on BSM mixes. The composition of these mixes varies nationally, however most are composed of topsoil, sand, and organic materials [1-3]. Specification for these mixes typically include requirements for gradation, cation exchange capacity, organic content, saturated hydraulic conductivity, and media thickness [1-4]. While the composition and specifications for BSM mixes will influence the efficacy of the stormwater treatment performance some consistent findings in the literature related to media thickness indicate that a thinner BSM mix could be effective. Specifically, treatment of TSS and heavy metals primarily occurs in the top (4 to 8-inches) of the BSM mix [4-7]. Thinner mixes may also reduce nutrient leaching from the organic materials contained in the BSM mix which has been a concern with the 60:40 BSM mix in Washington state [8]. In particular, nutrient leaching has been reduced by locating organic materials only in the plant root zone [9, 10] as opposed to a mixing the organic materials throughout the full depth of the BSM mix.

The 60:40 BSM mix specified in the Eastern Washington Low Impact Development manual is composed of 60% sand and 40 compost. This mix was developed and has been evaluated in the field in Western Washington [11-14] where mean annual precipitation depth is higher and the wet season is longer compared to the semi-arid climate in eastern Washington. Findings from this study will provide needed research to evaluate the performance of the 60:40 mix in a semi-arid region which could direct the development of future treatment soil or BSM specifications that are optimum for BMPs located in eastern Washington.

### 5. Geographic Scope and Urgency of Research

How broadly will the results of this research apply?

Nationally     Pacific Northwest     WA Only     Eastern WA  
 Western WA     Puget Sound Basin

How quickly will you need the results of this research?

ASAP     Within 6 months     Within 1 year     Within 2 years  
 Within 5 years     Ongoing

### 6. Conceptual Research Approach

A dual cell bioinfiltration pond was constructed adjacent to the parking area at Gonzaga University's Rudolph Fitness Center. The ponds each contain the 60:40 bioretention soil media mix except one of the treatment cells has a media depth of 12 inches, the other has a media depth of 18 inches. Influent and effluent from each of the treatment cells will be collected during qualifying storm events using both manual and automated sampling techniques. Samples will be analyzed for identified constituents of concern (TSS, metals, total phosphorus, total petroleum hydrocarbons). Influent and effluent concentrations for each of the treatment cells will be compared to determine treatment efficiency of each of the cells; and the treatment efficiencies of each cell will be compared to each other. From this analysis, differences in treatment efficiency and performance attributable to the different media depths.

### 7. Potential Management Changes Resulting from Research Findings

Results from this study will help inform the design of bioinfiltration and bioretention BMPs to improve treatment performance and cost effectiveness.

### 8. ESTIMATED COST AND TIMING

The project is estimated to cost \$190,000 over two years.

### References

1. Carpenter, D.D. and L. Hallam, *Influence of Planting Soil Mix Characteristics on Bioretention Cell Design and Performance*. JOURNAL OF HYDROLOGIC ENGINEERING, 2010. **15**(June): p. 404-416.
2. Hunt, W.F., Davis, A. P., Traver, R. G., *Meeting Hydrologic and Water Quality Goals through Targeted Bioretention Design*. JOURNAL OF ENVIRONMENTAL ENGINEERING, 2012: p. 698-707.
3. Barrett, M.E., M. Limouzin, and D.F. Lawler, *Effects of media and plant selection on biofiltration performance*. Journal of Environmental Engineering, 2012. **139**(4): p. 462-470.
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### 1. RESEARCH PROPOSAL TITLE

Long-term Permeable Pavement Sidewalk Infiltration Rate

**1b. BMP Classification:**     Structural                       Operational                       Education & Outreach

### 2. RESEARCH PROBLEM DESCRIPTION

Permeable pavement is more expensive than conventional paving materials; so its function as a stormwater BMP in addition to being a viable and long-lasting surface is critical for its cost justification. Permeable pavement usage for sidewalks is becoming more common in Eastern Washington. However, there are concerns that the infiltration performance and durability of the pavement may be reduced because of Eastern Washington's (EWA) harsh climate. Specifically, there are concerns that large seasonal temperature variation resulting in frequent freeze-thaw cycling may shorten the durable lifespan of the surface, and that wind-blown deposition of fine sediments may cause clogging and reduction in infiltration rate of the pavement, limiting its effectiveness as a stormwater BMP.

### 3. RESEARCH OBJECTIVE

The purpose of this study is to evaluate the effectiveness of permeable pavement sidewalk as a BMP in Eastern Washington (EWA). The effectiveness evaluation will focus on the useful life span of the material with respect to:

- The infiltration performance over time at sites with and without maintenance.
- Durability based on visual observations of deterioration in surface condition of permeable pavement over time compared to conventional pavement.

Results from this study may be used to improve permeable pavement design guidance for sidewalks and recommend O&M procedures for EWA. When appropriate, the findings will be transferred to roads.

Evaluate Effectiveness     Compare Effectiveness     Develop Modified BMP     Develop New BMP

### 4. LITERATURE SEARCH AND RESEARCH IN PROGRESS SUMMARY

Numerous studies regarding infiltration performance and longevity of permeable pavement have been conducted in recent years. While these studies have been fairly rigorous, and conducted in a range of locations and climates, there are still questions about how permeable pavement would perform in Eastern Washington's dry, windy environment with cold winters and hot summers. Several studies (e.g., Liebens et al. 2012, Schauss et al. 2009) address performance in cold climates where freeze thaw cycling is common, and have shown that when appropriate asphalt or cement mixes are used, the durability of the pavement can nearly equal that of conventional paving materials; and that infiltration performance does not suffer as a result of freeze thaw cycling.

Sediment loading and clogging of permeable pavement is frequently studied at the pilot scale to simulate lifetime loading of permeable pavement. Not surprisingly, these studies have shown that higher sediment loading rates correlate with decreasing infiltration rates (Pezzaniti et al., 2009). No studies were identified that evaluated the infiltration performance of permeable pavement where wind inputs are a concern at the field scale

Several guidance documents (i.e., EPA 1999), specifically recommend against using permeable pavement where wind-blown inputs are a concern. Given the extent to which the performance and longevity of permeable pavement has been studied, there are good models to follow for experimental designs and procedures. The

most appropriate for measuring infiltration rates of permeable pavement in Washington is ASTM C1701 "Standard Test Method for Infiltration Rate of in Place Pervious Concrete."

## 5. Geographic Scope and Urgency of Research

*How broadly will the results of this research apply?*

Nationally  Pacific Northwest  WA Only  Eastern WA

Western WA  Puget Sound Basin  Interior PNW

*How quickly will you need the results of this research?*

ASAP  Within 6 months  Within 1 year  Within 2 years

Within 5 years  Ongoing

## 6. Conceptual Research Approach

Block-long test segments of permeable pavement sidewalks will be constructed in at approximately four locations with similar land use areas. Two of these sites will be dedicated as control sites with routine maintenance performed. The other two will be dedicated as test sites. No maintenance (i.e., sweeping, vacuuming, pressure washing) will occur even if a decrease in infiltration performance is observed at the test sites. The segment locations should be where there is a grass buffer strip between the roadway and the sidewalk, to ensure that snow and associated street debris is not deposited onto the sidewalk by plowing. Two of the locations will be in commercial setting (one test and one control) and two will be located in a residential setting (one test and one control).

Infiltration rate of each of the sidewalk segments will be measured twice yearly for a period of at least 10 years. Infiltration measurements will be taken at 10 locations to account for spatial variability in infiltration rate. Infiltration rate over time will be graphed to determine if, and how fast, a decrease in infiltration rate occurs. Visual observations of the condition of the pavement will be made on an annual basis. These evaluations will consist of qualitative visual assessments. As part of the inspection process, an effort will be made to categorize depositions on the pavement that might cause clogging.

## 7. POTENTIAL MANAGEMENT CHANGES RESULTING FROM RESEARCH FINDINGS

If it is found that the infiltration performance of sidewalk applications of permeable pavement holds up over time, with little or no maintenance in Eastern Washington, permeable pavement may be adopted by jurisdictions as a stormwater BMP in appropriate locations.

## 8. ESTIMATED COST AND TIMING

The study duration will be 10 years, with the option to extend the study indefinitely. An estimated cost for conducting the study will be included in the Detailed Study Design Proposal.

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