Regional Stormwater Monitoring Program (RSMP) Effectiveness Studies

Workshop 2

May 6, 2014

RSMP Effectiveness Studies

Timeline

2010
Stakeholders recommend a regional monitoring strategy to Ecology and Puget Sound Partnership

2011
170+ ideas from permittees, others compiled into ranked list of 22 topics and questions

2012
Literature review completed; NPDES municipal stormwater permits issued

2013
Synthesize findings of literature review
Revised list of six topics; final budget

We Are Here

2014

Webinar
Two workshops
Approval by SWG
Study designs
Contracts

Studies begin in August

Today's outcomes

- **Today we are making recommendations**
  - Recommendations go to the Stormwater Work Group (SWG) for a final decision
    - Recommendations need to be well documented
    - Recommendations are permittee-driven but we want to hear from all of you
    - All of the information we consider today will go with the recommendations to the SWG
- **Who is here today?**

Today's agenda

- **Information we will consider**
  - Rankings by permittees
  - Budget estimates
  - Ecology staff review of pre-proposals
  - Presentations and discussion
- **How can we make these projects provide the best information for the permittees?**

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Results of the Survey of Permittees

Study: *Weighting method:* *Top choice gets 3 points, 2nd choice 2 points, 3rd 1 point*	Paired streams restora-tion	Bio-retention effective-ness	Catch basins	Can bio-retention prevent toxicity?	Treating highway runoff to Echo Lake	Source Control	Rain gardens & PCB cycling	Plants and fungi in bio-retention	Bio-retention hydrology	Quantify impact of rain gardens
	69	57	83	21	17	47	5	21	45	11
RANK	**2**	**3**	**1**	**6**	**8**	**4**	**10**	**6**	**5**	**9**

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Each choice gets 1 point	32	26	38	13	9	29	3	11	22	6
RANK	**2**	**4**	**1**	**6**	**8**	**3**	**10**	**7**	**5**	**9**

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Each dollar gets 1 point	695,563	566,138	760,759	466,345	118,871	563,139	56,797	388,369	498,585	87,633
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Rank	Project Title	Annual Expenditures August 2014 - July 2015	August 2015 - July 2016	August 2016 - July 2017	August 2017 - July 2018	Total	Cumulative total
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	TOTALS	**$ 1,757,465**	**$ 1,050,273**	**$ 443,550**	**$ 363,839**	**$ 3,615,127**	

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- **We will hear about all ten proposals today, in order of the permittees' collective interest in each. We will hear:**
  - Management question being answered
  - Approach and timeline to answer the question
  - How proponents are addressing issues raised at Workshop 1 and in the Ecology staff review of the pre-proposals
- **Today's discussions are important for making our recommendations**

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Project proposal presentations

Mining Existing Catch Basin Inspection and Maintenance Data

- **Management Action:**
  - Is the current permit requirement for annual catch basin inspection effective?
- **Timing:**
  - January 2015 – September 2016
  - (1 year, 9 months)
- **Total Cost:** $120,835

Mining Existing Catch Basin Inspection and Maintenance Data – Approach

- **Data Acquisition – Requesting:**
  - Data from all 90 Permittees
  - Inspection and maintenance records since 2007
  - Program designs and associated costs (not disposal)
- **Data Analysis Inspection and Maintenance Data**
  - Correlations with predictive factors (land use, traffic use, sump size)
  - Qualitative trends if temporally limited
  - Recommend standard data for collection
- **Data Analysis Cost-effectiveness**
  - Cost per unit standardized
  - Identify cost-efficiencies from data or permittees

Mining Existing Catch Basin Inspection and Maintenance Data – Outcomes, Distribution of Findings

- **Outcomes**
  - Information for jurisdictions to propose alternative inspection schedules
  - More standardized inspection and maintenance data
  - Sharing of cost-efficiencies in program implementation
- **Deliverables**
  - Database of available inspection and maintenance data
  - Report of findings
  - Website
  - Presentations to stormwater managers

Questions: Catch Basins

Paired Urban Small Stream Watershed Restoration Effectiveness Study

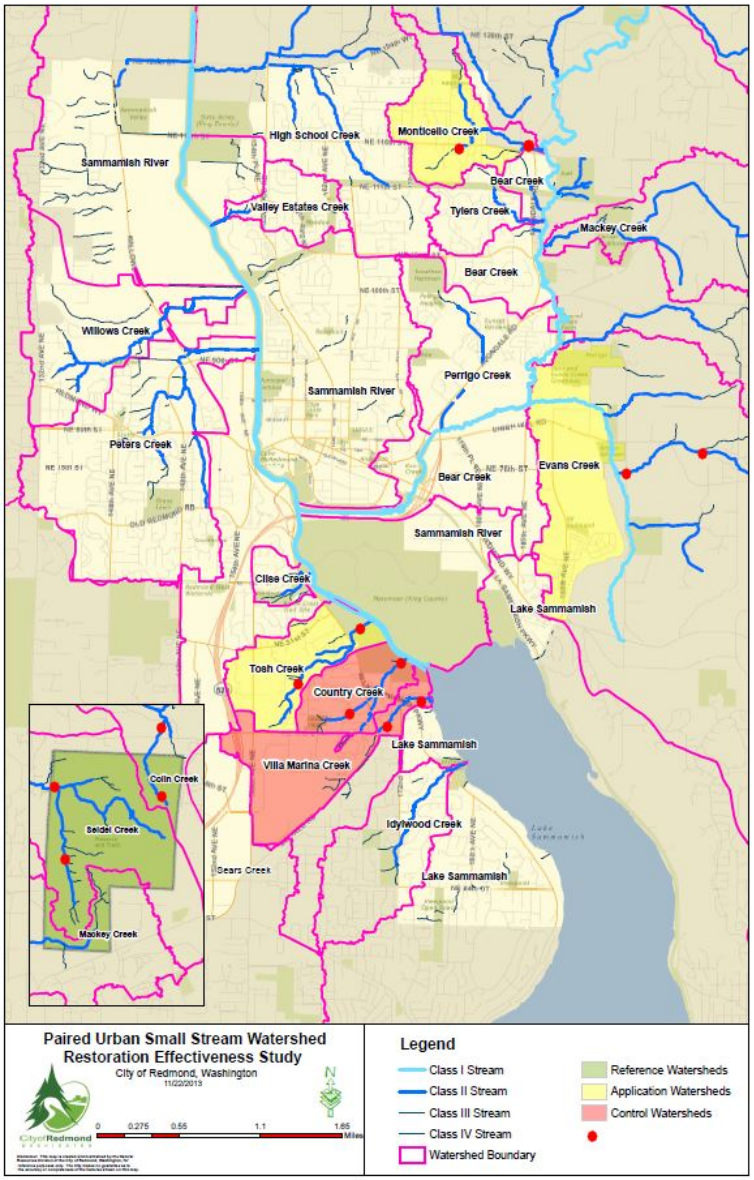
Management Actions Studied:

- Can beneficial uses be fully restored in small streams that are moderately impacted by urbanization through the focused implementation of stormwater BMPs (structural and nonstructural) in their associated watersheds?

Estimated Project Duration:

- 10 years
- Interim results/report

2014-2018 cost: $1,008,366



Paired Urban Small Stream Watershed Restoration Effectiveness Study

- **Effectiveness Study Question:**
  - How are collective installations of stormwater retrofits working to protect receiving waters at receiving water scale?
- **How we will answer the question:**
  - Paired watershed analysis includes 2 control watersheds, 2 reference watersheds, and 3 application watersheds.
  - In-stream measurements at 2 permanent sites in each stream and 2 rover sites (16 sites).
- **Parameters:**
  - Biological Physical Habitat, Sediment Quality, Chemistry and Physical Water Quality, and Hydrology.
- **Frequency:**
  - Varies from continuous to annual to once every 5 years.
- **Compare base flow and storm events**

Paired Urban Small Stream Watershed Restoration Effectiveness Study

- **Study Outcomes:**
  - Quantify the receiving water response to structural and non-structural stormwater controls when applied through a focused, watershed approach.
  - First 3.5 years will establish baseline conditions among application, control, and reference watersheds through monitoring at fixed in-stream stations. This will be useful for other small lowland stream comparisons in western WA.
- **Deliverables:**
  - Robust dataset for quantifying stream health based on physical, chemical, and biological indicators
  - QAPP, data reports, final report
- **How we will share results?**
  - Presentations to APWA, permit coordinators, Salmon Recovery Councils, and a professional conference. Data will be made available on a case-by-case basis. Reports will be posted on Redmond's website.

Questions: Paired Streams

Effectiveness of Bioretention in Reducing Stormwater Flows, Pollutants and Toxicity

- Management Action:
  - Evaluate performance of bioretentions in reducing stormwater impacts in receiving waters
- Timing:
  - Sampling during winters of 2014-2015 and 2015-2016
  - Results available in technical memos in 2015 and 2016
  - Completion of final report in December 2017
  - Total study time 3 years, 3 months
- Total Cost: $563,014

Measuring effectiveness of bioretention

How are collective installations of stormwater retrofits working?

- ✓ *Look for opportunities to measure current condition and monitor receiving water after retrofits are applied.*

Which combinations of retrofit BMPs & LID in a basin are most effective?

- ✓ *…Measure changes in the stream's water quality and hydrology in response to retrofits being implemented.*
- ✓ *Compare BMPs and combinations for specific pollutants.*

- Quantify flows, pollutant loads & toxicity of stormwater before and after treatment from 2 independent Federal Way retrofits
    - Analyze a nutrients, metals, bacteria, PAHs, PCB congeners during 16 storms over 2 years
    - Compare quality of water from bioretention outlets vs. water from adjacent wetland pond
- Monitor water flow and quality in Hylebos Creek to assess the impact of bioretentions on receiving waters

Effectiveness of Bioretention in Reducing Stormwater Flows, Pollutants and Toxicity

- Outcomes
  - Information regarding performance of regionally relevant bioretention systems
  - Comprehensive analysis of effectiveness in reducing flows, wide range of pollutants, and toxicity
  - Refine expectations regarding LID performance, and possible recommendations for future SWMMWW
- Deliverables, Distribution of Findings
  - QAPP detailing study plan and analyses
  - Two technical memos with data summaries for each year of sampling
  - Project website
  - Two presentations to stormwater managers
  - Final report of findings, with comparison to other regional bioretentions

Questions: Bioretention

Stormwater Source Control at Small Businesses: Regional Analysis and Framework

Management actions addressed:

- Inspections that include assessing stormwater source control at businesses and commercial properties to meet municipal NPDES permit requirements for Public Education and Outreach, Illicit Discharge Detection, and Controlling Runoff from Development.

Timeline:

- Commence work as soon as possible in Fall 2014.
- Key deliverables in October and December 2015.
- Publish and present results by June 2016.

Total budget: *$93,600*

Stormwater Source Control at Small Businesses: Regional Analysis and Framework

Effectiveness questions:

Source Control Inspections of Existing Sites: all questions addressed to the extent possible based on available data, particularly:

- Inspection frequency, compliance rates for different BMPs, working with property owners vs. business owners, and barriers to BMP implementation.
- Combining or better coordinating source control inspections.

Approach:

1. Use data from permittees' existing inspection programs to address the effectiveness questions.
2. Summarize information about permittees' existing inspection programs and existing coordination efforts within jurisdictions and among agencies.
3. Publish results on Ecology website and present findings at forums including stormwater managers groups and conferences.

Stormwater Source Control at Small Businesses: Regional Analysis and Framework

Deliverables

1) a database of information from existing inspection programs in jurisdictions,
2) a report with answers to the effectiveness questions about inspection frequency, compliance rates with different BMPs, and barriers to source control BMP implementation,
3) survey results with information about the structure of jurisdictions' inspection programs,
4) survey results with information about business needs and perceptions of stormwater source control inspections,
5) a report and guidance document that presents a framework for improving coordination within jurisdictional departments and among agencies.

The **outcome** from this study will be information to help permittees improve the efficiency and effectiveness of their existing inspection programs for stormwater source control at businesses and commercial properties.

Questions: Source Control

Bioretention Hydrologic Performance Study

- **Management Action Addressed**:
  Low Impact Development:
  Flow and Pollutant Reduction Benefits
  Need better sizing (performance) information to avoid facility bypass in moderate rainfall events
  - Fundamental "Adaptive Management" feedback to the hydrologic performance assessment of bioretention facilities around the region – how are constructed facilities doing hydrologically? *Regionally applicable, and NPDES permit applicable.*
  - Two year study (two wet seasons), with the results coming ahead of the 2017 deadline for Phase II LID requirements.
  - Monitor 10 facilities for two wet seasons – $467,000

Bioretention Hydrologic Performance Study

- **Approach** :
  - Monitor the frequency and duration of overflows at constructed bioretention facilities, and compare those results with the expected overflows from the original design.
  - The original engineering design model will be run with the rainfall observed at the facility, and the results compared to the actual observed performance.
  - Facility data will be collected to support development of hypotheses about why there is (or is not) a difference between the modeled and observed outcomes:

    –surface infiltration rate –soil grain size –groundwater fluctuation –vegetation composition and density

Bioretention Hydrologic Performance Study

Key Outcome:

inform the design and construction process for bioretention facility performance,

and it will be regionally applicable and directly applicable to the NPDES permit.

Deliverables:

- ***Facility Selection Criteria Checklist***
- ***20 Nominated Facilities Assessed for Selection***
- ***10 Facilities Selected for Monitoring***
- ***Two Wet Seasons of Monitoring***
- ***Modeling Comparison Between Design and Actual Performance***
- ***Additional Site Data***
- ***Final Report***

Questions: Hydrologic Performance

Bioretention for reducing toxicity to coho salmon exposed to urban runoff

Management action addressed:

Low Impact Development (LID): Flow and pollutant reduction benefits to receiving waters.

- How are collective installations of stormwater retrofits working to protect receiving waters at receiving water scale?

Retrofits: Water quality and habitat benefits of retrofit efforts.

- Which combinations of retrofit BMPs and LID in a basin are most effective at reducing stormwater impacts in receiving waters?

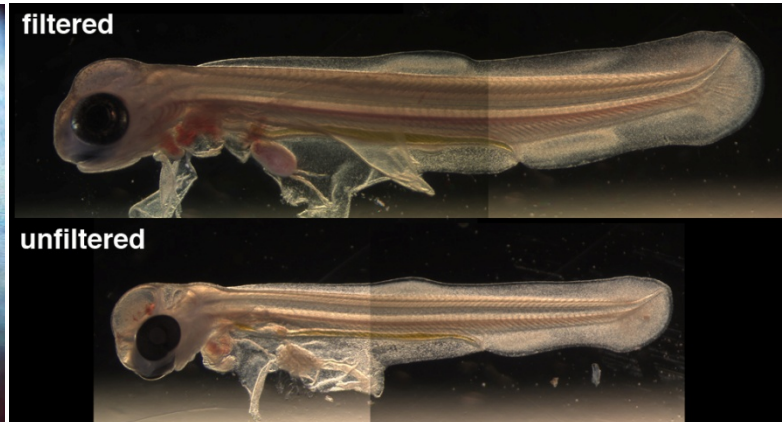
Total budget requested: $136,396

Project duration: 1 year

Project timing: 2014-2015

Approach

- Capture highway runoff (Oct-Mar)
- Transport to Suquamish Tribal hatchery at Grovers Creek
- Treat runoff with bioretention at realistic volumes and infiltrations
- Expose coho to untreated runoff and runoff treated with bioretention
- Monitor survival and toxicity in coho adults and embryos
- Repeat throughout spawning and egg development period



Bioretention for reducing toxicity to coho salmon exposed to urban runoff

Outcomes

- Detailed chemical composition of multiple runoff events
- Effectiveness of bioretention for improving water chemistry across multiple treatment events
- Ability of bioretention to prevent toxicity to adult coho for multiple storms
- Ability of bioretention to prevent toxicity to coho embryos across multiple exposure events

Deliverables

- Final report (2015)

Communications

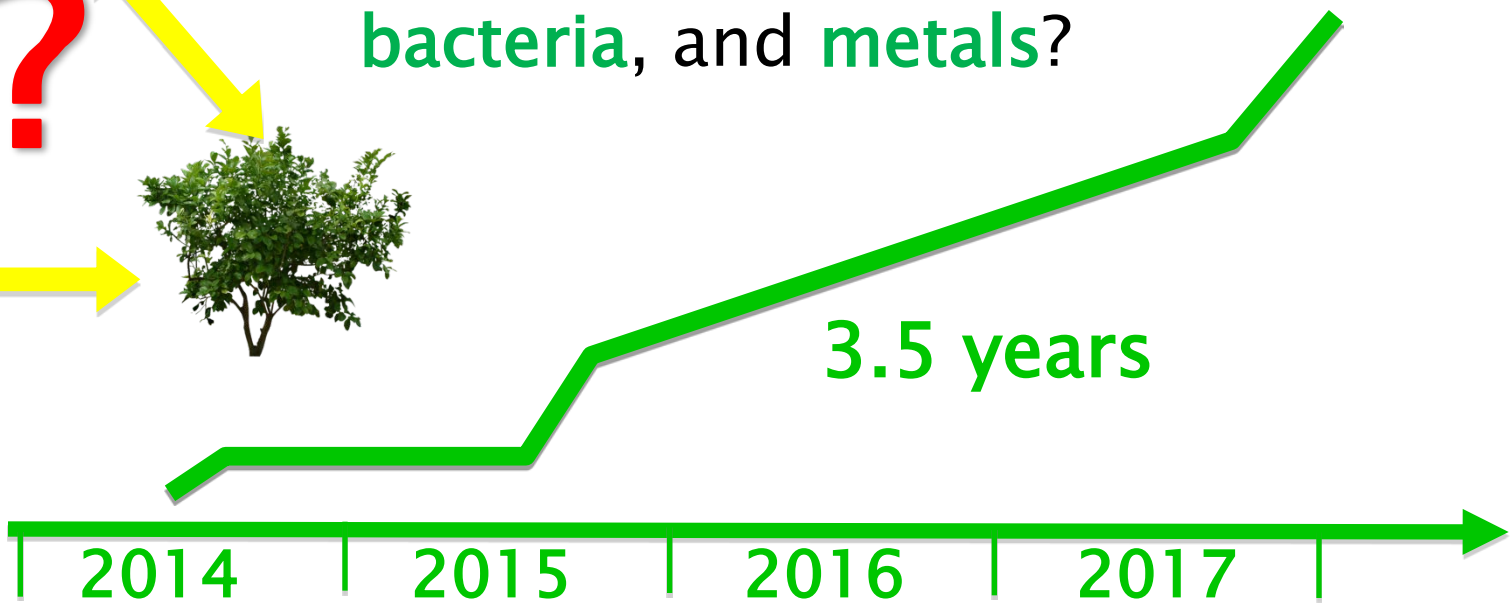
- Report, presentations, peer-reviewed paper, online database

Questions: Reduce Toxicity

Break

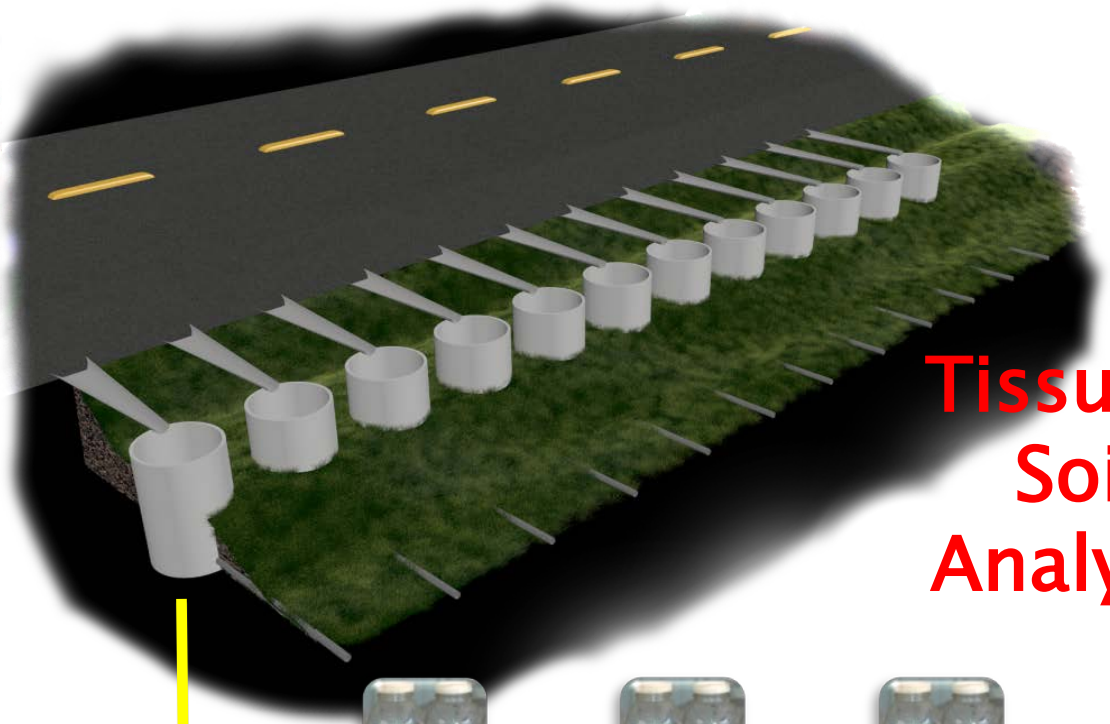
Field Test of Plants and Fungi on Bioretention Performance Over Time

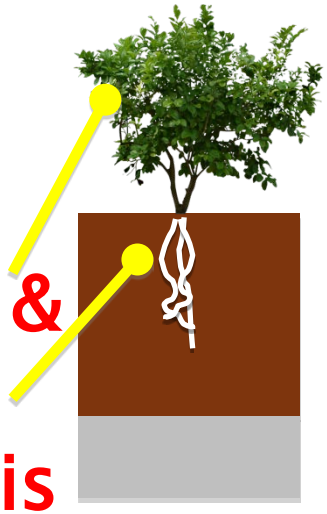
What **soil amendment** and bioretention soil mixes combined with **plant** selection combines optimum removal of **nutrients**, **bacteria**, and **metals**?



$343,579

Experimental Design





Tissue &
Soil
Analysis

K_s K_s K_s K_s K_s K_s K_s K_s

2014 2015 2016 2017

Data Outcomes & Deliverables

Baseline Cu & P Leaching Data for Organic Compost

Update SMMWW

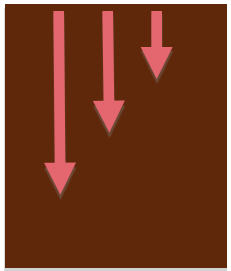
Stormwater BMP Database

Update Infiltration Rates to WWHM

Maintenance

Fate of Pollutants

Cu



Questions: Soil Amendments

Effectiveness of LID Retrofits for Treating Highway Runoff to Echo Lake

Retrofits: Water quality and habitat benefits

- There is a need for local field studies evaluating effectiveness of LID retrofits:
  - How well do LID bioretention features, installed according to 2005 SWMMWW, reduce pollutants from highway runoff?
  - How well does the overall retrofit reduce pollutants in the basin's stormwater system, and can we see an effect in the quality of the receiving water body?
- Schedule: August 2014 – July 2018
- Total Cost: $480,595

Echo Lake Retrofit Study Design

Evaluate Effectiveness of Retrofit Components:

- Rain Gardens, Filterra® – enhanced, phosphorus treatment
  - Compare inlet and outlet chemistry of 6 installations for 6-8 storms during 2015/16
- Detention Tank System – flow control treatment
  - Compare inlet and outlet chemistry and flow for 6-8 storms during both 2014/15 and 2015/16

Effects to Receiving Water Body?

- Leverage data from KC Small Lakes Monitoring Program
  - Compare nutrient and bacteria data pre-retrofit (2001-2012) and post-retrofit (2015-2017)

Echo Lake Retrofit Outcomes

Outcomes:

- Effectiveness of retrofitted stormwater BMPs in reduction of suspended solids, nutrients, bacteria, total and dissolved metals, diesel/motor oil, PAHs, PCBs and toxicity. Flow reduction will also be considered.
- Possible benefits to receiving water quality (nutrients & bacteria) from a collective stormwater retrofit project.
- Results can be used to guide recommendations and requirements in future SWMMWW and refine expectations about LID performance.

Deliverables & Distribution of Findings:

- QAPP, Echo Lake historical data memo, final data report
- EIM data submittal, two presentations, project website

Questions: Echo Lake Retrofit

Puyallup, WSU Extension & Stewardship Partners: Quantifying the Impact of Real World Rain Gardens and Bioretention across Puget Sound and Identifying Key Factors for Success/Failure

Timeline:	2014-2016:	Protocol Development, Testing, and Optimization
	2015-2017:	Pilot Data Collection and Analysis
	2017:	Final Report on Analysis Implementation Handbook for Permittees Proposal for Coordinated Rollout of Collaborative Monitoring Region-wide

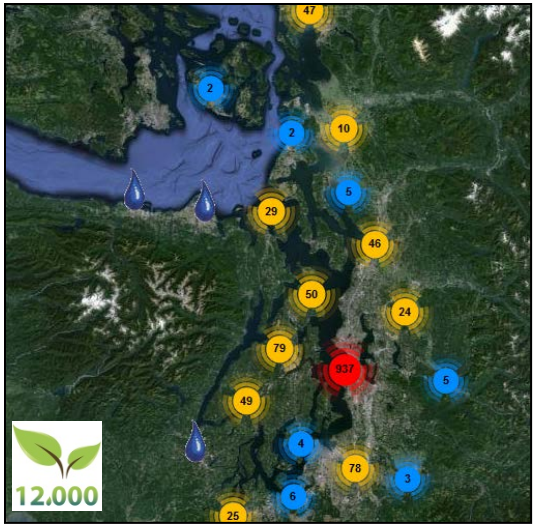
Total Proposed Budget for 2014-2018: $175,000

CITY OF PUYALLUP STATE OF WASHINGTON

WASHINGTON STATE UNIVERSITY EXTENSION

STEWARDSHIP PARTNERS
Helping Landowners Preserve the Environment

Approach



Guided by 2 clear goals:

1. **Create** a monitoring **tool** that is **easy to implement** and generates useful, **replicable** data at **local and regional** scales for the long-term monitoring and adaptive management of rain garden and bioretention implementation and BMPs.
2. Collect **baseline data** on **effectiveness** of existing rain gardens and bioretention and **contributing factors** to their success and failure.

Protocol Development

- Team of experts, regional audience of stakeholders, master list of metrics
- Trial implementation
- Revise and re-implement
- Publish and distribute protocol

Data Collection and Analysis

- Train volunteers to collect data, 4-6 localities for pilot
- Compile and analyze data to:
  1. Optimize Protocol
  2. Quantify effectiveness
  3. Identify key factors in success/failure
- Develop proposal for scaled-up collaborative

Outcome	Deliverables	Distribution
Improved ability to monitor rain garden and bioretention installations for function and contributing factors	Optimized **streamlined monitoring protocol** implementable on local scale and **replicable** across regional scale	**Publication** in **journals**, **website**, and **direct** electronic delivery to potential implementers
Increased knowledge base of impacts on stormwater	Report on baseline **quantification of impacts** (volume control, failure rates)	**Publication** in **journals**, **website**
Improved **strategies** for effective **implementation**	Report on **factors** that influence **success/ failure**	**Publication** in **journals**, **website**
Ability to **implement region-wide long term monitoring** and adaptive management	**Proposal** for implementing a **collaborative region-wide monitoring** program	**Publication** in **journals**, **website**, and **presentation** to RSMP group

Questions: Quantify Rain Garden Impact

Efficacy of Rain Gardens at Permanently Retaining PCBs

- **Documentation of PCB removal is lacking**
  - Review found reductions in TSS, nutrients and metals but studies on organic toxics were absent
  - PCBs are chemicals of high concern due to extremely low WQS, bioaccumulation, and their widespread occurrence in stormwater
- **LID and retrofit management questions addressed:**
  - Are rain gardens effective at removing PCBs?
  - Are rain gardens permanently removing PCBs from the urban stormwater–atmosphere cycle?
  - Are rain gardens an effective retrofit BMP to reduce PCB loadings to receiving waters?
- **Schedule:** August 2014 – January 2017

Total cost: $316,756

PCB Retention Study Design

- **Goal:** Develop Western WA specific understanding of PCB removal by rain gardens including potential re-volatization vs. long term soil sequestration
- **4 study rain gardens in Kirkland, Redmond, Seattle, unincorporated Kitsap County**
- **Collect:**
  - Site-specific rainfall data
  - Flow paced water samples
    - 6 stormwater inflow samples
    - Up to 2 stormwater overflow samples
  - Composite soil samples taken quarterly in approximately Feb, May, Aug, and Nov.
- **Analyze water and soil for PCB congeners, TSS, and TOC**
- **Develop wet season removal rates and annual mass balance of inflows, outflows, and soil sequestration**

PCB Retention Study Outcomes

- **Deliverables**
  - QAPP with preliminary site conceptual PCB model
  - Field data report
  - Final project report with: PCB rain garden wet season and annual mass balance, revised site conceptual PCB model
- **Education and Outreach**
  - Project website, presentations to community groups and landscape professionals in King, Pierce, Snohomish and Kitsap counties, presentation to permittees
  - *Possible* peer-reviewed journal publication
- **Outcomes**
  - Regional understanding of PCB removal by rain gardens including efficacy at addressing PCB loads to receiving waters
    - Incorporation of study results and conclusions into future stormwater and LID design manual revisions

Questions: PCB Retention

Break

Money

Does cost play in? If so, how?

Do we want to fund all of the projects?

What about sequencing?

- Which should start this year?
- Which might be delayed?

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How many of you approve this ranked list of projects?

Projects #1 through #5, plus #7 (second #6 of tie)

- Permittee representatives in favor: 16
- Permittee representatives against: 2
- Others in favor: 17
- Others against: 4

Why not? Are there any red flags in this list?

- Add #6 (first #6 of tie) and #8
- Maybe do #9 as a pilot project?

Discussion

Review our recommendations:

- **List and sequencing**
- **Changes needed to address concerns**
- **Contract review process**
  - Pooled Resources Oversight Committee
  - Other expert review
- **4 of 6 priority topics are addressed in this round**
- **When should we go through this process again?**

Next steps

At the SWG meeting on May 14:

- Discuss the recommendations and provide feedback

At the SWG meeting on June 11:

- Approve recommendations to send them to Ecology

Over the summer:

- Contracting; SOW review by committee
- First project begins after August 15

Another round of proposals in 2 years?

Thank you for coming!

We appreciate your participation in both of these workshops, and all of the work by the project proponents and partners in the interim.