



Bioretention and Rain Garden Protocol Development

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Introduction and Overview of Project

Goal: Develop a rain garden and bioretention assessment protocol to monitor basic functions of rain gardens and bioretention facilities.

- Assess factors influencing their success and failure.
- Protocol is being developed to allow for:
 - Ease of implementation
 - Repeatability across large geographic scales
 - Consistent data from multiple implementers
 - Provide data of scientific and adaptive management value.
- Social Science Survey of Public Perceptions and factors influencing those perceptions

Overview of methods for the assessment protocol

- Literature review of monitoring and assessment methods
- Development of a big wish list
- Version 1 protocol, intentionally include too many metrics
 - Implement and evaluate
- Version 2- pair down v1 based on data quality and user feedback
 - Also create a “Rapid Assessment Protocol”
 - Implement and evaluate
- Version 3 full and rapid protocols: pair down v2 even further

Literature Review & Master Metrics List

Rain Garden / Bioretention Effectiveness Assessment Project Goals

1. What attributes of rain garden/bioretention functionality measured by volunteers and staff through visual observations and simple field or lab tests correlate best with functional success of the system?
2. What construction activities and maintenance actions identifiable by volunteers and staff have the greatest correlation with functional success of a rain garden/bioretention facility?
3. What attributes of rain garden/bioretention facilities correlate best with landowner perceptions of functional success, as measured by volunteers and staff through surveys and interviews?

Master List

Project Goal 1	Project Goal 2	Project Goal 3	Overarching Research Question	Function Assessed	Metric Catego	Assessment Methods	Recommendation for Use	Reason for Not Including
X				infiltration / Flow Control	Hydrology	Artificial Drawdown / Simulated Storm Testing	No	Requires access to water surges and very intrusive.
X				Infiltration	Hydrology	Infiltrometer Testing of Soils	No	Results are too variable, literature does not support
X				Infiltration	Hydrology	Continuous monitoring of inflow / outflow / overflow	No	Requires access to modeling equipment
X				infiltration	Hydrology	Bypass/overflow frequency	No	Storm sampling not viable for volunteer assessment

- Version 1 of the assessment protocol had an approximate total of 212 parameters (9 p.)
- Version 2 of the assessment protocol had a total of 170 parameters (7 p.)
- The rapid assessment protocol had a total of 106 parameters. (5 p.)

**Bioretention and Rain Garden Assessment Program
Functional Assessment Form
Version 2**

Team Names: Cell # or email:

1.		
2.		
3.		
4.		

I. BACKGROUND INFORMATION: *Please fill out all information, or circle all the options that apply*

Site Name			
Survey Date		Start time:	
		AM	PM
Address	Street Address	City	County
Rain Fall (from wunderground.com)	Today: _____ inches	Yesterday: _____ inches	Two Days Ago: _____ inches

II. SITE OVERVIEW:

Type of Site (check one)	Rain Garden	Bioretention	Unknown		
Source of 'Type' (Check one)	Verifiable Source (Describe) _____		Estimate (Describe) _____		
Age of Site (circle one)	<1 year	1 - 3 yr	3 - 5 yr	>5 years	unknown
Source of 'Age' (Check One)	Verifiable Source Describe: _____		Estimate Describe: _____		
Predominant land use around Site (Circle one)	Residential	Commercial	Industrial	Parkland	Agricultural

Page Recorder Name: 1

**Bioretention and Rain Garden Assessment Program
Rapid Functional Assessment Form**

Team Member Names: Cell # or email:

1.		
2.		
3.		
4.		

I. Background Information: *Please fill out all information, or circle all the options that apply*

Site Name			
Survey Date:		Start Time:	
		AM	PM
Address	Street Address	City	County
Rain Fall (from wunderground.com)	Today: _____ inches	Yesterday: _____ inches	Two Days Ago: _____ inches

II. Site Overview:

Type of Site (check one)	Rain Garden	Bioretention	Unknown		
Information Source of 'Type' (Check one)	Verifiable Source (Describe) _____		Estimate (Describe) _____		
Age of Site (circle one)	<1 year	1 - 3 yr	3 - 5 yr	5+ year	unknown
Information Source of 'Age' (Check One)	Verifiable Source Describe: _____		Estimate Describe: _____		
Predominant land use around site (Circle one)	Residential	Commercial	Industrial	Parkland	Agricultural

Page Recorder Name: Site Name & Date:

1

Use of Volunteers and Training



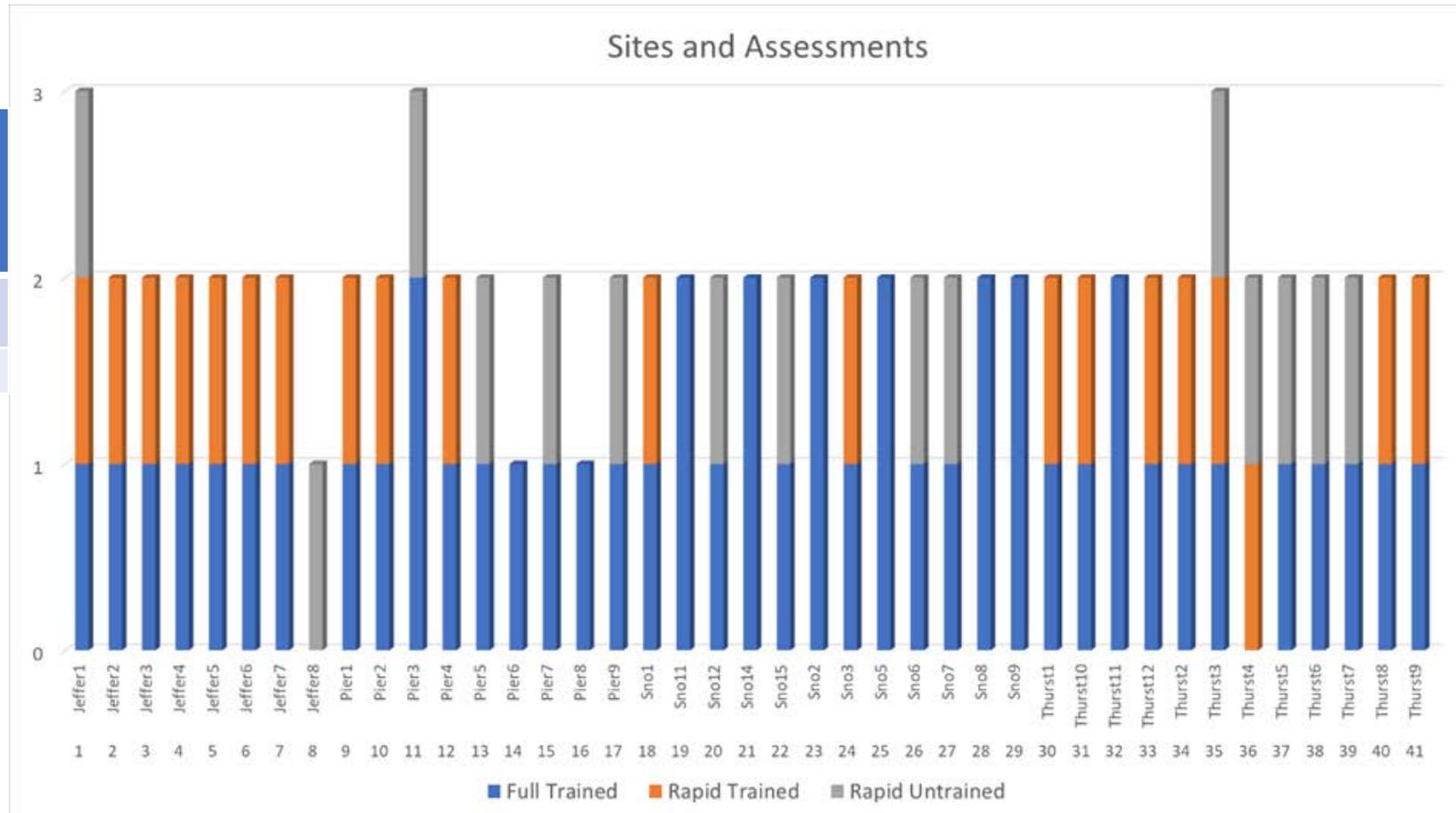
Training and Assessments

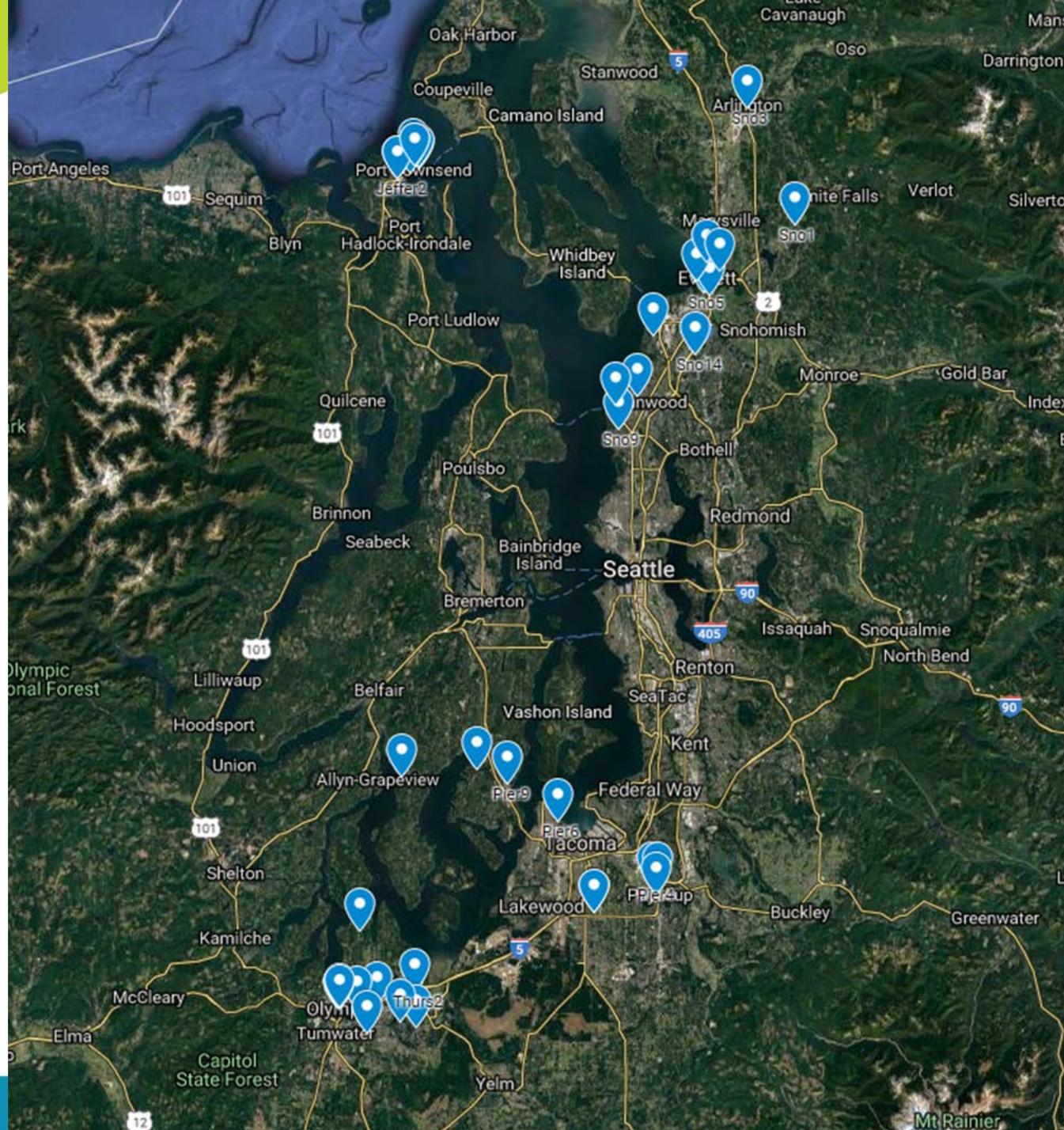
- **Version 1 – 35 Volunteers** were provided with 8 hours of training (Oct 2016 - Snohomish, Thurston and Jefferson)
- **Volunteers assessed 14 sites**, working in teams of 2-3, with each site repeated by a different team of volunteers to assess repeatability.
- **Version 2 – 77 Volunteers** were provided with 8 hours of training (July 2017 - Snohomish, Jefferson, Thurston, and Pierce)
- **Volunteers assessed 41 sites**, working in teams of 2-3, with each site repeated with either the rapid or full assessment by a different team (version 2).
- **35 Rapid and 47 Full assessments** were completed in all counties (version 2).
- **67 assessments** were completed by **trained volunteers** (version 2).
- **15 assessments** were completed by **untrained volunteers** (version 2).

Duplication of assessments

Version 2 Assessments

Training Level	Full Protocol (47)	Rapid Protocol (35)
Trained (67)	47	20
Untrained (15)	0	15





Analysis of pilot data - version 2

Summary of Cosine Similarity Values for repeated sites and different sites

Type of repeated assessment	Median of repeated site similarity (range) and sample size	Median of different site similarity (range) and sample size
Full Protocol w/ Trained Volunteers replicates	0.78 (0.49-0.97) n=8	0.5 (0.14-0.92) n=56
Full Protocol w/ Trained Volunteers vs. Rapid Protocol w/ Trained Volunteers	0.78 (0.32-0.95) n=18	0.70 (0.15-0.96) n=306
Full Protocol w/ Trained Volunteers vs. Rapid Protocol w/ Untrained Volunteers	0.81 (-0.05-0.95) n=12	0.52 (-0.01-0.88) n=132
Rapid Protocol w/ Trained Volunteers vs. Rapid Protocol w/ Untrained Volunteers	0.94 (0.84-0.97) n=3	0.675 (0.58-0.9) n=6

Findings from these results:

- **The protocol provides replicable results**
(strong consistency in assessments of the same site between different implementers)
- **Extensive training is not necessary**
(consistency in assessments between trained and untrained implementers)
- **The rapid assessment should provide the level of detail necessary** to indicate if further actions are needed at a site, as well as to provide direction for future maintenance and some design considerations.

Flagging Criteria

Parameter	Measurement Metric	Flagging Condition
Hydrology		
Rainfall	Two Days Ago (in)	LINK WITH STANDING WATER
Overflow 1, 2, 3	Directs water away? Yes = Y, No = N, None = X	"N" TRIGGERS
Inflow Blockage	None, Trace = <.5%, 0 .5-5%, 6-25%, 26-50%, 51-75%, 76-95%, >96%	YELLOW FLAG 6-25% BLOCKED RED FLAG > 25% BLOCKED
Overflow Blockage	None, Trace = <.5%, 0 .5-5%, 6-25%, 26-50%, 51-75%, 76-95%, >96%	YELLOW FLAG - 6-25% BLOCKED RED FLAG >25% BLOCKED
Erosion	Zone 1, 2, 3	RED FLAG - MODERATE OR EXTENSIVE EROSION
Hydrology Description	Describe concerns not identified through other metrics	DETERMINE IF CONCERN IS A PROBLEM NEEDING CORRECTION

Hydrology Parameters	# of Red Flags	% Sites Red flagged
Mulch depth zone 1A	45	96%
Mulch depth zone 1C	43	91%
Mulch depth zone 2	43	91%
Mulch depth zone 1B	41	87%
Mulch depth zone 3	41	87%
Cover bare ground zone 1	9	19%
1 Blocked inflow	7	15%
Cover bare ground zone 3	7	15%
Cover bare ground zone 2	6	13%
Overflow concerns	5	11%
2 Blocked inflows	5	11%
Blocked sheet inflow	5	11%

Vegetation Parameters	# of Red Flags	% Sites Red flagged
Evergreen plant vigor zone 1	35	74%
Groundcover plant vigor zone 1	34	72%
Groundcover plant vigor zone 2	27	57%
Evergreen plant vigor zone 2	22	47%
Herbaceous plant vigor zone 3	20	43%
Herbaceous plant vigor zone 1	19	40%
Groundcover plant vigor zone 3	19	40%
Deciduous plant vigor zone 1	17	36%
Herbaceous plant vigor zone 2	17	36%
Evergreen plant vigor zone 3	15	32%
Deciduous plant vigor zone 2	14	30%
Problem plants zone 2	7	15%
Problem plants zone 3	7	15%
Problem plants zone 1	5	11%

Additional Findings:

- **The assessment protocol can provide an overall indication** of a rain garden or bioretention facility's current state and inform the appropriate maintenance action needed to restore some aspects of effectiveness.
- **The vegetation metrics in version 1 would inform future design considerations** and long term management strategies. For that reason, protocol version 1 may be useful for specific research and design goals.
- **Photo points utilized in version 1 would provide long term records** and may provide some clarifying information on specific concerns for asset management staff without requiring an additional site visit, however is not necessary for basic assessment purposes.
- **Vegetation assessment information can be variable** between assessment implementers and seasons. Vegetation data should be interpreted with an awareness of its inherent variability under this protocol.

Protocol: What it can do

Can do:

- Flag important functional issues
 - Hydrology
 - Vegetation and Public Perception
- Flag facilities that are prone to issues (general or specific)
- Indicate the issues and guide remediation
- Be implemented with little or no training and at a low relative cost
- Help standardize assessment data and identify common issues worth tackling at a regionally coordinated scale.



Protocol: What it can't do

Can't do:

- Precisely quantify hydrologic performance
- Precisely quantify overall effectiveness of one facility nor the bioretention as a whole
- Quantify treatment performance



Tools and materials available & coming soon

- Final protocols
 - Full protocol
 - Rapid protocol
 - Training materials and instructions and datasheets (Excel)
- A cohort of WSU Extension professionals available to support future implementation across the region (local or larger scales)
- Literature review: Social Science Study on Public Perceptions;
- Available on the SAM website early Q2 2019.

How to use the protocol (jurisdictions)

- Implement it yourself with existing staff
 - Addition of assessment protocol (rapid or full or your own a la carte version) to existing asset management program, maintenance program, or monitoring program
 - Create your own community-based/ volunteer/ internship/ job training program
- Create a monitoring/assessment program in partnership with a local group
 - WSU Extension: ready to go volunteer programs: Master Gardeners, Stream Stewards, Beach Watchers etc..
 - Others: DIRT Corps; Stream teams; Conservation Districts...

Rain Garden Community Survey Summary

Chrys Bertolotto

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Demographics

- 58 Respondents
- 59% own one rain garden; 33% own two.
- 72% of rain gardens are 1 or 2 years old.
- 87% own a rain garden; 86.5% are private residential landowners; 91% are original rain garden owners.
- 48% are from King County, with Snohomish and Thurston making up an additional 33%.

Maintenance Perceptions

- 86% feel their rain gardens are very well or moderately well maintained.
- 81% believe they (“self”) are responsible for maintenance, with 8% hiring maintenance.

Time PER YEAR to complete various maintenance tasks.

Weeding was omitted from the maintenance task list and was mentioned by four individuals. Two other time options were given (5 – 9 hours and more than 10 hours) and were not a majority selection for any task.

Less than 5 hours	Not needed
Mulching	Fertilizing
Removing Trash / Clearing Inflow / Outflow	Insect / Animal Issues
	Watering
Pruning	Sign Maintenance
Monitoring	Removing Dirt
	Replacing Plants

How do Rain Gardens Meet Expectations of Respondents?

Issue	Far Surpasses Expectations	Exceeds Expectations	Meets Expectations	Doesn't Meet Expectations	Far Below Expectations
Overall	9.3%	48.8%	39.5%	0%	0%
Beautify Yard / Landscape	18.6%	30.2%	48.8%	2.3%	0%
Create Green / Friendly Neighborhood Spaces	4.9%	12.2%	75.6%	4.9%	2.4%
Required by Permit	3.1%	5.1%	84.4%	0%	9.4%
Prevent Flooding on Property	7.3%	31.7%	61%	0%	0%
Create Wildlife Habitat	9.3%	20.9%	67.4%	2.3%	0%
Reduce Water Pollution	16.3%	25.6%	55.8%	0%	2.3%

The Future: Next steps for regional coordinated monitoring and assessment

- Data collection mobile app
- Additional modules:
 - Photographs
 - Overflow/bypass monitoring
 - Web based database for extensive information about rain gardens and bioretention facilities in each jurisdiction



Thank You!!