



Stormwater Action Monitoring Round 4 Study Selection Workshop Presentations

Studies and Reviews Informing Maintenance and Stormwater Manuals		
9:20 AM	Synthesis of Street Sweeping Research and Practices: Guiding Program Effectiveness and Waste Management (FP 01) Aimee Navickis-Brasch (Evergreen StormH2O) and Laurie Larson-Pugh (Washington Stormwater Center)	Jump to Presentation
9:35 AM	Development of a Catch Basin Model to Predict Sediment Accumulation and Clean Out Frequency (FP 04) Nigel Pickering (Geosyntech) and Angela Gallardo (King County)	Jump to Presentation
9:50 AM	Updated Infiltration Methods in the Stormwater Manuals (FP 06) Scott Kindred (Kindred Hydro) and Sarah Norberg (Tacoma)	Jump to Presentation
Studies Improving Understanding of 6PPD-Q Stormwater Management		
10:20 AM	Measuring street sweeping 6PPD-q whole environment load reductions (FP 02) Shelly Basketfield (Seattle Public Utilities)	Jump to Presentation
10:35 AM	Treatment effectiveness of a full-scale stormwater facility using high performance bioretention soil media for 6PPD-quinone and other toxic chemicals (FP 03) Jennifer Lanksbury (King County) and Jenée Colton (King County)	Jump to Presentation
Source Control Studies		
10:50 AM	Application of Continuous Monitoring and Adaptive Control for Water Quality and Flood Control for Flett Creek Ponds (FP 05) Kenneth Yu (Opti) and Dana de Leon (Tacoma)	Jump to Presentation
Studies and Reviews to Inform the Municipal Stormwater Permits		
11:20 AM	Annual Report Questions for Improved Regional Learning and Permittee Efficiency (FP 07) Bob Bernhard (King County)	Jump to Presentation
11:35 AM	Monitoring for Stormwater Contaminants of Emerging Concern in Western Washington (FP 08) Dana de Leon (Tacoma)	Jump to Presentation

Round 4

SAM Study Selection Workshop

August 29, 2023: 9am – 12:30 pm

Hybrid Workshop: Zoom and NWRO Office

Hosted by SWG and Washington State Department of Ecology

15700 Dayton Ave N, Shoreline, WA 98133



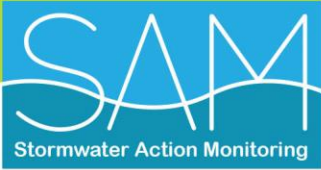
Ecology Sponsor Welcome

What we all are doing via SWG & SAM:

- Leveraging experience, expertise & geography
- Strategically answering stormwater questions to inform management actions and ensure quantifiable results
- Providing high-quality, credible and relevant data
- Pooling public funds for cost-effective monitoring studies
- Informing future BMPs, guidance and permit requirements
- Collaborating, sharing knowledge and building partnerships

Ecology has deep support for SWG and SAM.





Welcome to Stormwater Work Group's Round 4 SAM Solicitation Process Workshop

- Formed in 2008 to develop a strategic approach to monitoring and assessment.
- Permittees contribute to overall funding as an option under S8 of your permit options.
- SWG is the stakeholder oversight for the SAM Collaborative.
- SWG occasionally forms subgroups to conduct additional work, in this case the Effectiveness and Source ID subgroup led the effort to solicit SAM studies/projects.



Stormwater Action Monitoring (SAM) is

Collaborative

- Formal committee of stakeholders (Stormwater Work Group), caucuses, workshops, surveys and polls.

Regional

- Western Washington

Funded

- By municipal stormwater permittees: 93 cities, towns, counties; 2 ports; WSDOT
- In-kind from Ecology, WSDA, USGS, Redmond, Penn Cove Shellfish, Cedar Grove, hundreds of mussel monitoring volunteers

SAM's goals

- Improve stormwater management by evaluating the effectiveness of stormwater management actions and impacts to receiving waters.

www.ecology.wa.gov/SAM

Round 4 SAM Study Selection Process

Topic Priorities

July 2022

- *SWG re-formed their “SAM Study Selection Subgroup” (S⁴)
- *In November 2022 SWG decided the Priority Topics List for Round 4 solicitations



Proposal Reviews

January 2023

- *Solicitations began in January
- *13 Letters of Interest
- *S⁴ and Ecology Technical review of 8 Full Proposals



Study Selection

Sept 2023

- *8 Final proposal presentations at public workshop (**today**)
- *Caucus discussions and Permittee voting
- *SWG decides which projects to fund and timing considerations at the November 18, 2023 meeting



Round 4 Solicitation for SAM's Studies

- **Relevance:** New SAM study come from Permittees, consultants, agencies, and academia
- **Transferable findings:** SAM studies use Technical Advisory Committees to ensure utility to multiple jurisdictions and agencies
 - Inform councils, legislature, permits, and manuals
- **Quality Science:** SAM studies with sampling follow Ecology QA standards

SAM's Funds for Round 4

- SAM's revenue for Effectiveness Studies and Source ID projects is approximately \$7M a permit cycle (5 years)
- Round 4 Budget Availability is approximately \$2.5M including December 2025 payment
- The Round 4 proposals add up to ~\$4.4M and longest study span is about 4 years.
 - SWG can approve longer and more expensive projects for SAM funds
 - Ecology can phase the projects to pace with revenue

Workshop Details

- All presentations are available on the SAM website www.ecology.wa.gov/SAM.
- We hope the presenters leave some time for Q&A at the end of their timeframe
 - Virtually or in-person please Raise Your Hand to ask questions orally,
 - Write questions in the chat, or
 - Email the project lead or Brandi.

Sign up for a Technical Advisory Committee



Next Steps and Voting

- The Workshop materials on the SAM website have the study lead and presenter's emails. Feel free to ask them questions!
- Discuss these study proposals with your jurisdiction
- Top 3 voting will open tomorrow, runs through September 10, 2023
- Ecology's permit and SAM staff will send out instructions to Permittees that fund SAM
 - 95 Western WA cities, counties, and ports,
 - 3 Western WA Navy bases
 - WSDOT

Closing of Round 4 Solicitation Process

- SWG Meeting September 13, 2023
 - Hear about voting results
 - Hear PRO-C recommendations on available funds and timing
 - Caucuses will need to meet and build recommendations
- SWG Meeting November 15, 2023
 - Hear caucus recommendations
 - Members discuss and decide which projects to approve for SAM funds and timing considerations



It's a Wrap!

- Thank you all for coming out this morning.
- We will be around for some in-person conversations
- SAM website: www.ecology.wa.gov/SAM.
- Sign up to hear about SAM or SWG news at our GovDelivery [Subscriber Preferences Page](#)
- Sign up for Technical Advisory Committees

FP1: Synthesis of Street Sweeping Research & Practices: Guiding Program Development & Implementation

Laurie Larson-Pugh (WSU) Project Manager

Heidi Siegelbaum (WSU) Project Technical Advisor

Aimee Navickis-Brasch (Evergreen StormH2O) Consultant Project Manager

August 29, 2023



Study Purpose

- Develop guidance manual that will provide Permittees information/tools to assist with developing and/or improving street sweeping programs to support meeting MS4 permit requirements.
- Priority list question/topic: MAINTENANCE
 - Priority list developed before 10/17/22 preliminary draft MS4 Permit Sections
 - Requirements to develop/implement street sweeping program (by July 1, 2027) anticipated in the O&M Section of the 2024-2029 Municipal Stormwater Permits (MS4) Permits

Study Objective

Project Drivers:

- Street Sweeping Technical Sub-Group
- Regional Operations & Maintenance Program (ROAD Map) Group
- MS4 Permit Preliminary Draft Comments

Information
collected used to
develop Proposal

PLANNING

Develop Action Plan

Create action plan for manual development which includes collecting information/data and refining manual content outline

DEVELOPMENT

Implement Plan

Develop manual content by implementing action plan

TRAINING

Develop & Implement Training

Develop and implement training on manual content

Methodology

PLANNING

Develop Action Plan

Collect Input from:

Statewide Survey, SW Workgroup Meetings, TAC Meetings

Use input to:

- Refine manual outline
- Identify available data/sources*
- Identify staff to interview: cases studies, lessons learned, etc.

Additional Literature Search

Update/expand Proposal Table A1

Task Outcome – Action Plan

Detailed manual outline: sources & interviews identified by chapter & section; appendices content.

DEVELOPMENT

Implement Action Plan

Chapters Development:

- 3 Chapters simultaneously
- Synthesis of Literature
- Interviews to develop Case Studies, Lessons Learned, instructions for templates, etc.
- Use basic statistics to consolidate data (as needed)
- Examples & Templates developed from literature review & interviews.
- Identify & summarize gaps

TRAINING

Develop & Implement Training

- Develop curriculum by chapter
- Provide live webinar
- Record webinar
- Provide live training at MuniCon 2025

***Anticipated Voluntary Data Request**

- Street sweeping program costs, O&M plans, equipment information
- Street Sweeping & Decant: studies, materials data collected
- Templates/Forms
- Participate in Interviews (if volunteered during Planning)

Methodology Cont.

• Technical Advisory Group

- Target 15 Members
- 10 Members Confirmed
- Goal: balance of representatives who developed and implemented street sweeping programs.
- Role - provide input on:
 - Plan
 - Draft deliverables
 - Suggestions for resources
- Review items relevant to TAC members' experience

• Communication Plan

- WSC Website – host manual documents
- Extend draft review/comment to stormwater work groups



Study Results

- Guidance Manual
- Training
- Research Gaps & Future Research Recommendations
- Data collection guidance

- 1 Manual Introduction
- 2 Street Sweeping Water Quality Benefits
- 3 Identifying High Priority Areas
- 4 Establishing & Improving Street Sweeping Programs
- 5 Optimizing Street Sweeping Practices
- 6 Documenting & Tracking Street Sweeping Activities
- 7 Disposing Of Street Sweeping Waste
- 8 Cost Considerations: Establishing & Maintaining Programs
- 9 Other Considerations

Expected Outcomes

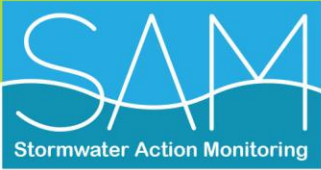
Support meeting new street sweeping permit requirements and provide guidance for items such as:

- Developing, improving, and right sizing a street sweeping program
- Identifying high priority areas
- Selecting a defensible way to assess and measure program benefits
- Establishing multi-department collaborations
- Improving efficiency/efficacy of existing programs and identifying variables that influence
- Estimating the quantity of street waste and size of decant facility needed
- Estimating program costs

Timeline and Budget

- Estimated project cost is \$362,502
- Timeline is estimated at 2 years to complete the project
- Recommend project occur asap to provide permittees time to prepare for July 1, 2027 (date listed in draft permits for implementing street sweeping program)

Q1 2024			Q2 2024			Q3 2024			Q4 2024			Q5 2025			Q6 2025			Q7 2025			Q8 2025		
J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
MANUAL PLANNING						MANUAL DEVELOPMENT												MANUAL TRAINING					



Contact Information

*Laurie Larson-Pugh
Washington State University
Project Manager*

*Heidi Siegelbaum
Washington State University
Project Technical Advisor*

*Aimee Navickis-Brasch
Evergreen StormH2O
Consultant Project Manager*

FP4: Development of a Catch Basin Model to Predict Sediment Accumulation and Clean Out Frequency

Angela Gallardo, King County

with Geosyntec Consultants

August 29, 2023



Our Team

- Angela Gallardo, King County – Project Lead
- Nigel Pickering, Geosyntec MN, Senior Engineer – Project Manager
- Christian Nilsen, Geosyntec WA, Senior Engineer – Watershed Modeling
- Al Preston, Geosyntec CA, Principal Engineer – Fluid Dynamics Modeling
- Rica Enriquez, Geosyntec MN, Senior Engineer – Catch Basin Modeling
- Dan Pankani, Geosyntec OR, Senior Engineer – Catch Basin Tool
- John Gulliver, University of Minnesota, Professor – Senior Advisor



Study Purpose

- Catch basins accumulate stormwater sediment and need to be cleaned out to keep functioning well
 - Currently inspections are annual for Phase I jurisdictions and every two years for Phase IIs
 - How often should they really be inspected and/or cleaned?
 - Is there a more time-efficient way to do this?
 - Can we find a way to more effectively reduce pollutants?
- **MAINTENANCE/MANUAL PRIORITY #4:** Develop or modify a model to predict catch basin accumulation for predicting maintenance frequencies.



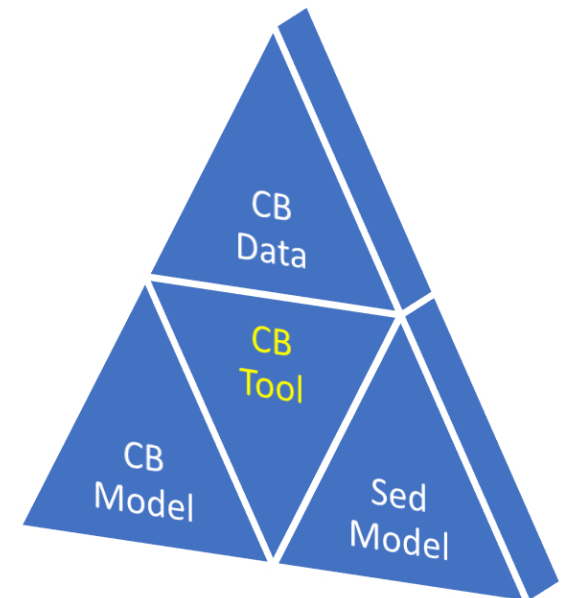
Study Objectives

- Create a simplified catch basin model to help MS4 permittees establish an optimal inspection and cleanout frequency for catch basin maintenance
- Advance our understanding of sediment dynamics in CBs and identify and/or modify existing models that capture those dynamics
- Make CB inspection and cleaning more predictable, reduce downstream pollution and reduce costs for stormwater permittees.



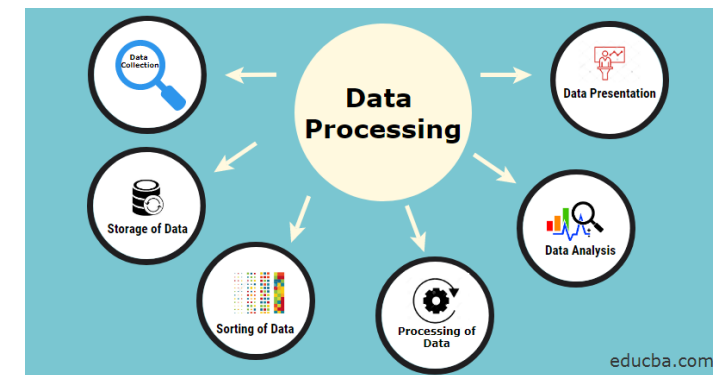
Methodology

- This is a model development study that will use existing catch basin data
- Primary tasks include:
 - collect and examine the existing sediment data
 - evaluate and select a watershed sediment model
 - evaluate and develop a catch basin model
 - create a simple usable catch basin tool
- Follow-on possibility with upcoming street sweeping requirement
 - quarterly from 2027
 - effect on CBs pre- and post- study possible



Collect and Examine the Existing Sediment Data

- Selection of CB locations (~100-200)
 - Distributed range of MS4 areas – 4-6 permittees
 - Range of impervious cover – low to high
 - Range of traffic conditions – low and high traffic areas
 - Range of land use/soil/slope conditions – low to high runoff
 - Range of CB drainage areas– low to high
 - Quality control of data via a data QAPP
- Permittees and Data Quality
 - Permittee selection based on willingness and data availability and quality
 - Quality checked with data management QAPP



Catch Basin Data Issues

- Previous Study
 - Phase II catch basin inspections were performed less often (~5 years)
 - Varying inspection methods among Phase II MS4s made comparison difficult
 - Circuit approach - not all areas were monitored under the same weather conditions
- Improvements
 - Permits updated to mandate more frequent catch basin inspections (1-2 years)
 - Inspection and maintenance data migrated to structured electronic databases
 - Phase I jurisdictions have moved away from the circuit approach
- Benefits for this Study
 - Improved data consistency
 - More data now available
 - Increased spatial coverage of available data



Watershed Sediment Model Selection

Model	Considerations
HSPF/LSPC	Existing model calibrated for King County's Water Quality Benefits Evaluation
EPA SWMM	Offers additional buildup/wash off algorithms compared to LSPC
WinSLAMM	Uses particle size distributions combined with probabilistic modeling

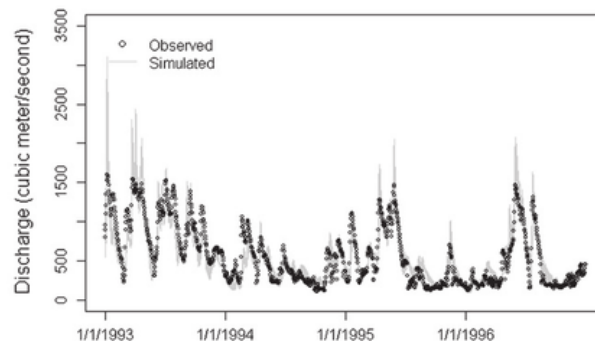
Evaluation based on:

- Data requirements/availability
- Ease of application
- Ability to predict observed sediment influent concentrations for a variety of storms and impervious land uses

Watershed Model Outputs

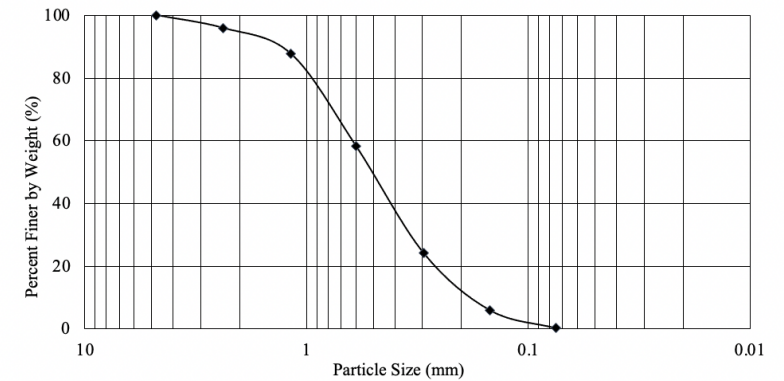
Hydrology

- Continuous simulation results
- One time-series per Hydrologic Response Unit



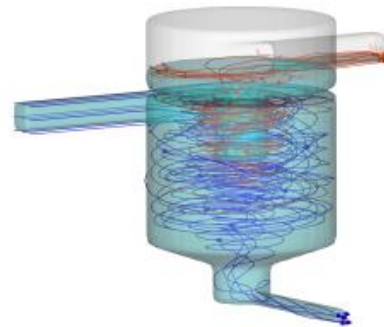
Sediment

- Sediment mass
- Particle size distributions

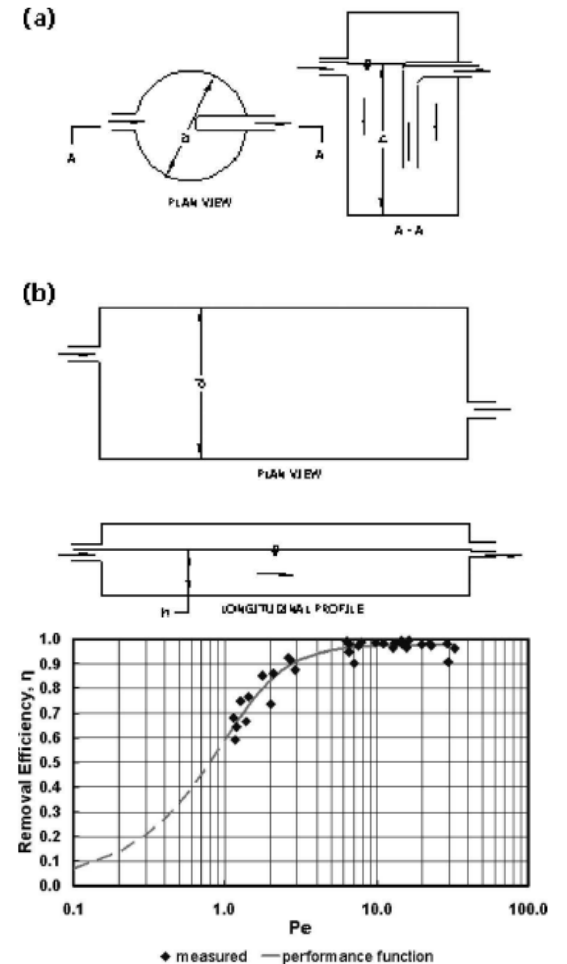


Evaluate and Develop a Catch Basin Model

- Catch basin (CB) model will enable estimates of sediment capture and therefore inform on required clean-out frequency
- CB models developed from studies and for specific designs/geometries/regions
 - Sizing Hydrodynamic Separators and Manholes (SHSAM)
 - Windows Source Loading and Management Model (WinSLAMM)
- This project will evaluate and refine model(s) based on field data
- Computational fluid dynamics (CFD) simulations
 - Enable evaluation of non-standard designs/geometries
 - Detailed understanding of the factors influencing sediment trapping

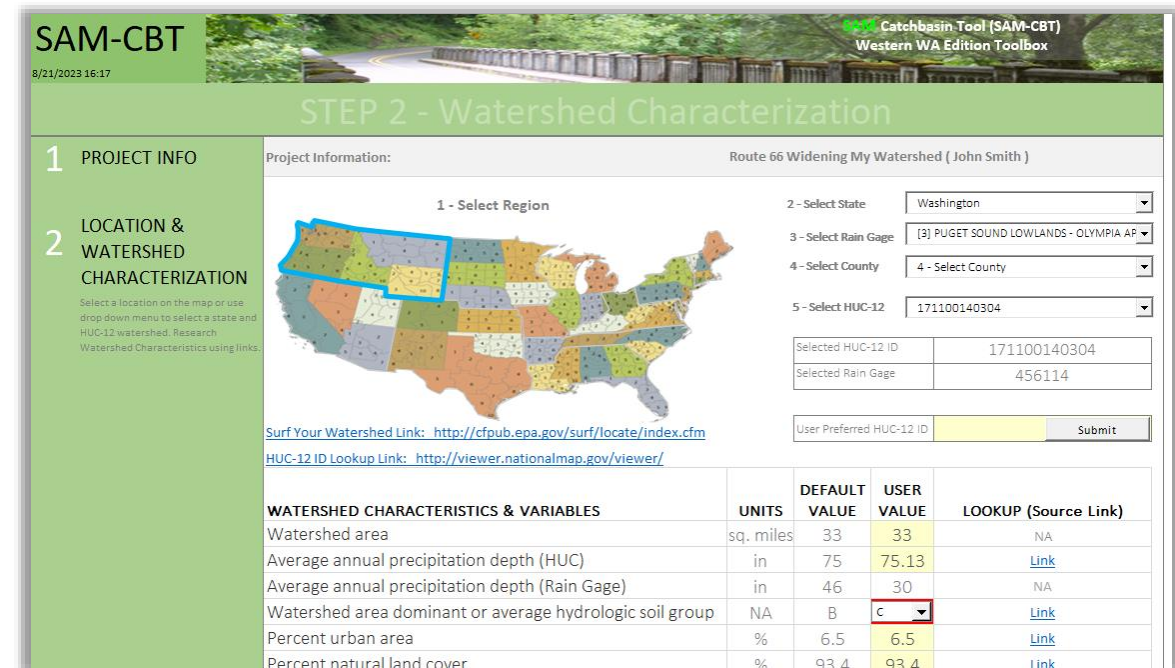


Source: Flow3D.com



Creating a Simple Usable Catch Basin Tool

- Easy-to-use tool to synthesize the findings of the previous two tasks
- Tailored to Western WA conditions but extendable
- Spreadsheet-based to start but extendable to a web interface



SAM-CBT
8/21/2023 16:17

Catchbasin Tool (SAM-CBT)
Western WA Edition Toolbox

STEP 2 - Watershed Characterization

1 PROJECT INFO

2 LOCATION & WATERSHED CHARACTERIZATION

Project Information: Route 66 Widening My Watershed (John Smith)

1 - Select Region

2 - Select State: Washington

3 - Select Rain Gage: [3] PUGET SOUND LOWLANDS - OLYMPIA AP

4 - Select County: 4 - Select County

5 - Select HUC-12: 171100140304

Selected HUC-12 ID: 171100140304
Selected Rain Gage: 456114

User Preferred HUC-12 ID: Submit

Surf Your Watershed Link: <http://cfpub.epa.gov/surf/locate/index.cfm>
HUC-12 ID Lookup Link: <http://viewer.nationalmap.gov/viewer/>

WATERSHED CHARACTERISTICS & VARIABLES	UNITS	DEFAULT VALUE	USER VALUE	LOOKUP (Source Link)
Watershed area	sq. miles	33	33	NA
Average annual precipitation depth (HUC)	in	75	75.13	Link
Average annual precipitation depth (Rain Gage)	in	46	30	NA
Watershed area dominant or average hydrologic soil group	NA	B	C	Link
Percent urban area	%	6.5	6.5	Link
Percent natural land cover	%	93.4	93.4	Link

Note: Tool mockup screenshot based on modified version of published Excel spreadsheet tool Geosyntec developed for NCHRP 25-37 [available online](#)

Study Results

- Deliverable 1: Catch basin sediment dataset that is comprehensive and curated
 - Useful for follow-on studies
- Deliverable 2: Watershed model to easily estimate sediment loads upgradient of catch basins
 - Could be used in stormwater planning efforts like street sweeping
- Deliverable 3: Catch basin model to predict sediment accumulating and saturation
 - Simplicity and accuracy
- Deliverable 4: Catch basin tool to assist permittees perform catch basin maintenance more intelligently
 - Time and cost savings through maintenance optimization
 - Improved downstream water quality

Expected Outcomes

- More reliable catch basin cleaning
 - Could change the MS4 permit cleaning frequency
- Reduce costs for stormwater permittees
 - Could help extend permittees budgets to other activities
- Reduce downstream pollution
 - Might count as a water quality credit



Timeline and Budget

- Estimated project cost is ~\$315,000
- Original project timeline was 2 years but based on initial review comments, we could consider a revised timeline of 3 years
- This project is not seasonal or deadline sensitive



Contact Information

- Angela Gallardo, King County, agallardo@kingcounty.gov, 206-919-0204
- Nigel Pickering, Geosyntec, npickering@geosyntec.com, 612-253-8214

NOTE: We are **looking for volunteers** for our Technical Advisory Committee. Please reach out to us if you are interested in this project.



FP6: Updated Infiltration Methods in the Stormwater Manuals

Calvin Taylor and Sarah Norberg (City of Tacoma)

J. Scott Kindred (Kindred Hydro, Inc.)

August 29, 2023



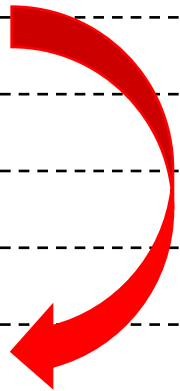
Study Purpose

- Address shortcoming in the stormwater manuals regarding infiltration:
 - Current approaches assumes 1-D vertical flow and are not accurate
 - PIT tests are expensive and difficult to conduct in urban neighborhoods
 - No method for predicting drywell capacity
 - Correction factors do not have a technical basis
 - Groundwater mounding analysis is not well defined
- Address Priority Topic 5: Research related to adaptations for the stormwater management manuals (i.e., infiltration testing methods)

Current test methods are not accurate

Infiltration Rate (I) for test facilities and full-scale infiltration facilities when hydraulic conductivity (K_s) = 4 inch/hr. Based on analytical model results that account for lateral flow.

Facility	Area (ft ²)	Ponding Depth (ft)	Max. Flow (gpm)	Infiltration Rate (I) (in./hr)	I/K_s
Seattle Simple	4.0	0.5	1.0	25	6.3
Small PIT	35	1	4.8	13	3.4
Large PIT	100	1	9.7	9.0	2.4
Full-Scale Facilities					
Small Bioretention Facility	300	1	22	7.1	1.8
Large Pond	10,000	5	578	5.7	1.4
Shallow Dug Drywell	100	5	23	22	5.6
Deep Dug Drywell	150	15	77	50	12.5



Study Objective

- Deliver infiltration facilities that are appropriately sized and designed to achieve water quality and flow control objectives
- Provide standardized procedures and guidelines that are accurate and easy to implement*
- Ensure that the level of site characterization, testing, and analysis is appropriate for the size of the project and potential risk
- Simplify the review process for the stormwater permitting agency

*Seattle Simple and PIT field procedures still valid with slight modifications and updated analysis method.

Methodology

- Start with existing infiltration guide based on 2-year study funded by EPA NEP program and managed by Ecology
- Conduct literature review of stormwater infiltration practices around the US to identify other useful advancements
- Facilitated technical review process
 - TAC includes professional facilitator, 7 geotech consulting firms, WSDOT, Ecology staff, and any municipal staff that would like to participate
 - Three workshops with TAC
 - Additional meetings with Ecology staff
 - Draft language provided to permittees for feedback at least once/quarter
- Presentations at conferences and stormwater group meetings

Study Results

- Written review of existing methods in use around the US
- Draft infiltration language after every workshop
- Drafts provided to interested permittees for review before first workshop and after 1st and 3rd workshops
- Final stormwater infiltration testing and design methods that are suitable for inclusion in Western and Eastern WA stormwater manuals*
- Microsoft Excel© workbook that automates the test analysis and sizing of full-scale facilities

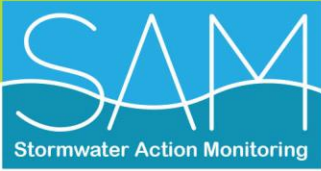
* Contingent on Ecology approval

Expected Outcomes

- Deliver infiltration facilities that are appropriately sized and designed to achieve water quality and flow control objectives
- Provide standardized procedures and guidelines that are accurate and easy to implement
- Ensure that the level of site characterization, testing, and analysis is appropriate for the size of the project and potential risk
- Simplify the review process for the stormwater permitting agency
- Final manual language should be suitable for equivalent manual permittees

Timeline and Budget

- Estimated project cost is \$153,630 (details on next slide)
- Project should be complete in 12 months, potential sooner
- The process will not be rushed
- Timeline depends on timing of Ecology review and complexity of feedback from permittees



Contact Information

- Please let us know if you would like to attend workshops or receive draft versions of infiltration language
- Contacts:
 - Calvin Taylor, City of Tacoma, (253) 625-1512, ctaylor5@cityoftacoma.org
 - Sarah Norberg, City of Tacoma (253) 208-0536, snorberg@cityoftacoma.org
 - Scott Kindred, Kindred Hydro, Inc., 206-660-5417, scottk@kindredhydro.com

FP#02: Measuring Street Sweeping 6PPD-q Whole Environment Load Reductions

Shelly Basketfield, Seattle Public Utilities

August 29, 2023



Study Purpose

Priority list question #9:

Stormwater management of 6PPD-quinone –

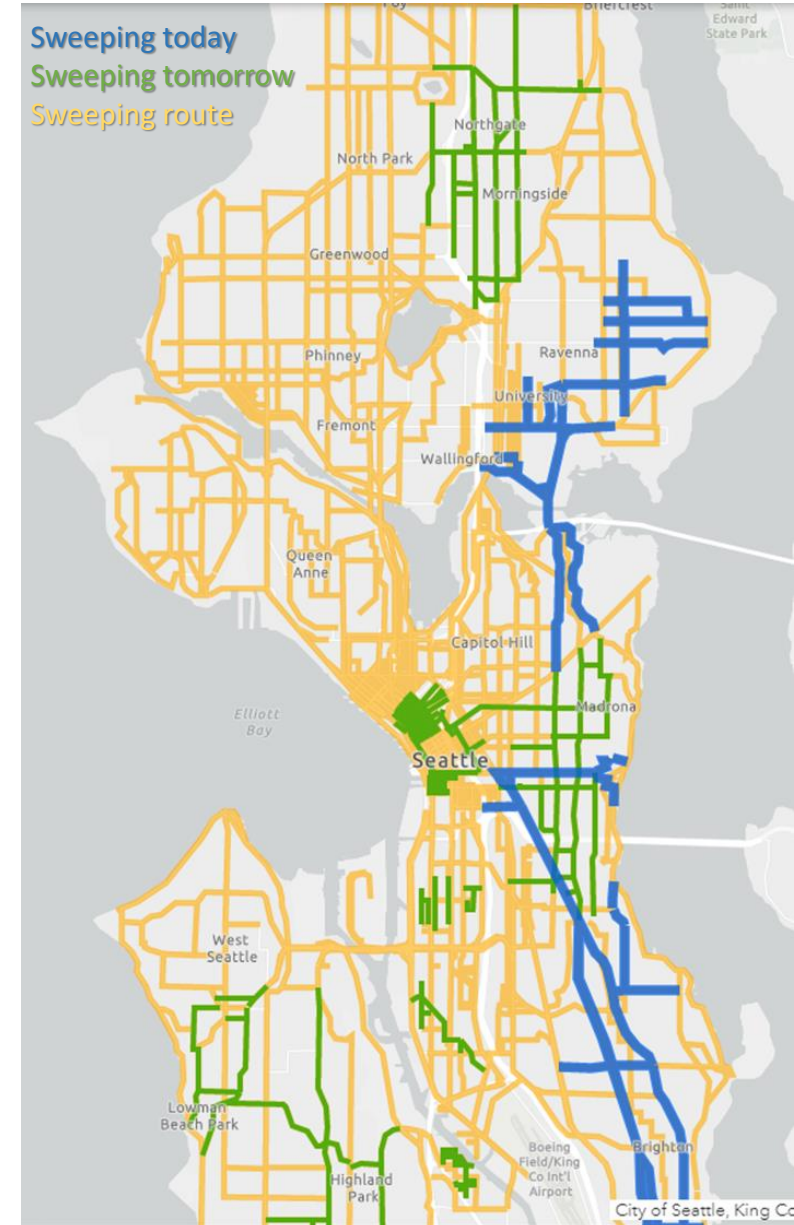
Study street sweeping to get more information about 6PPD/q removal.



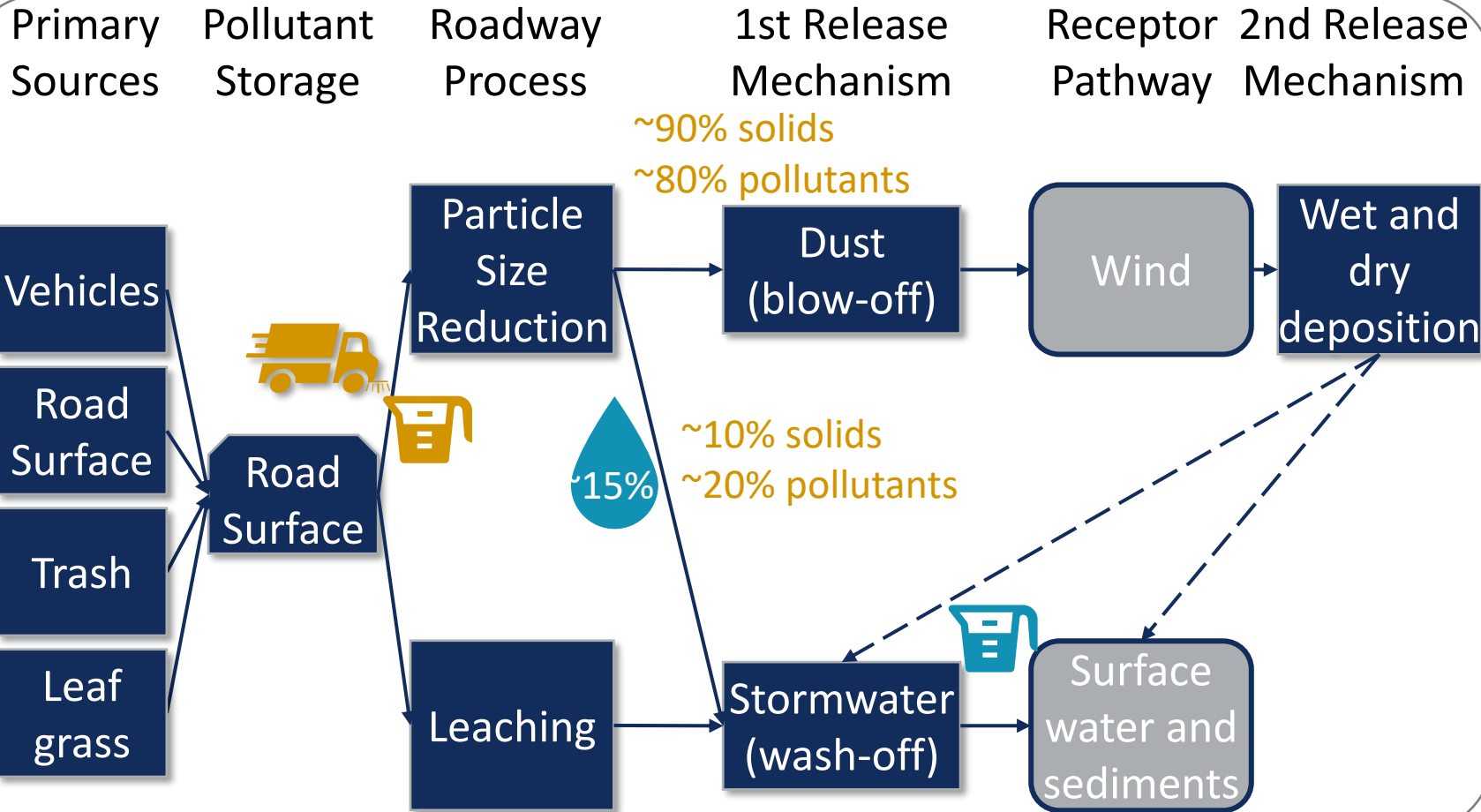
[This Photo](#) by Unknown Author is licensed under [CC BY](#)

Study Objective

- 1) Does street sweeping reduce 6PPD-q loads from fully built out urban arterials?
- 2) Are 6PPD-q and other parameter concentrations and pickup rates influenced by particle size, season, or location?
- 3) Can we detect a correlation between 6PPD-q and zinc, another tire contaminant, or TSS?

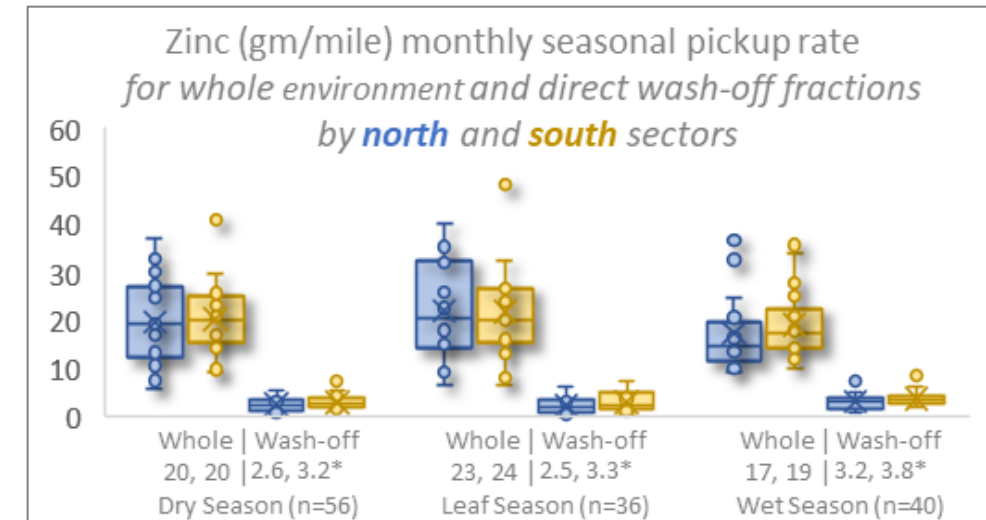
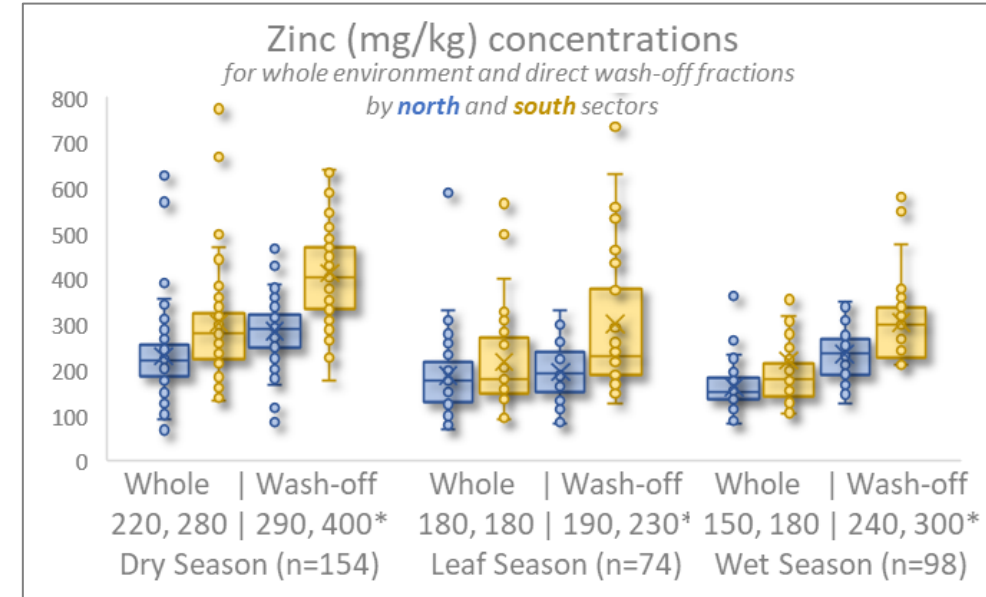


Methodology



Study Results

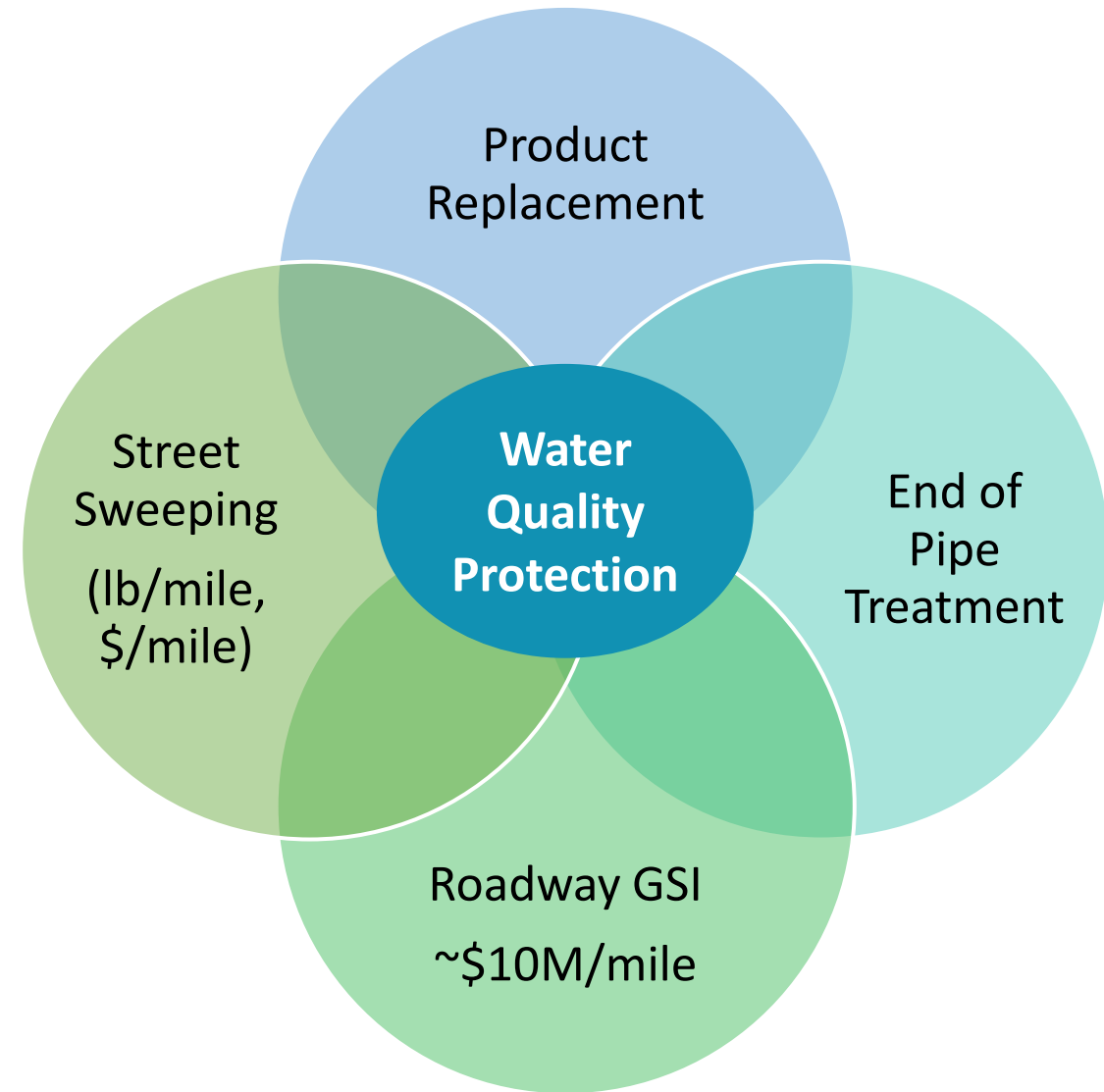
- 1) Street sweeping dataset characterizing concentration and pickup rates, including 6PPD-q.
- 2) Summary and comparison of concentration and pickup rate data by location, particle size, and season.
- 3) Correlations between 6PPD-q and other parameter concentrations if present.

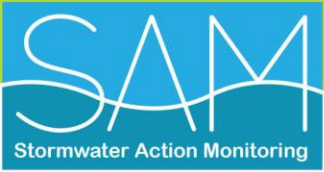


Example work product. * indicates median values.

Expected Outcomes

- 1) **Short-term:** An increase in sweeping frequency on roadways with high traffic flow and/or density.
- 2) **Mid-term:** Inclusion of sweeping in the right mix of BMPs for cost-effective 6PPD-q reductions.
- 3) **Future:** More reliance on source control BMPs to supplement structural BMP performance under climate change.



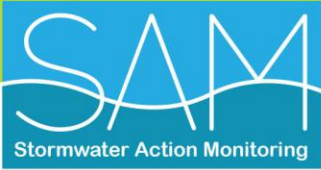


Timeline and Budget

Project cost: ~ \$764k

Timeline: ~ 4+ years to complete the project

Kickoff	Begin Sample Collection	End Sample Collection	Final Report
Plan (3 to 6 months)	Execute (~\$764k over 36 months)		Close (6 to 9 months)
QAPP (\$ in kind)	\$4,720/sample x 3 years x 25 samples/location x 2 locations + QA/QC samples (sample collection, laboratory analysis, data validation). 2 annual reports (\$ in kind)		Final report, SWG presentation, SAM Factsheet (\$ in kind)

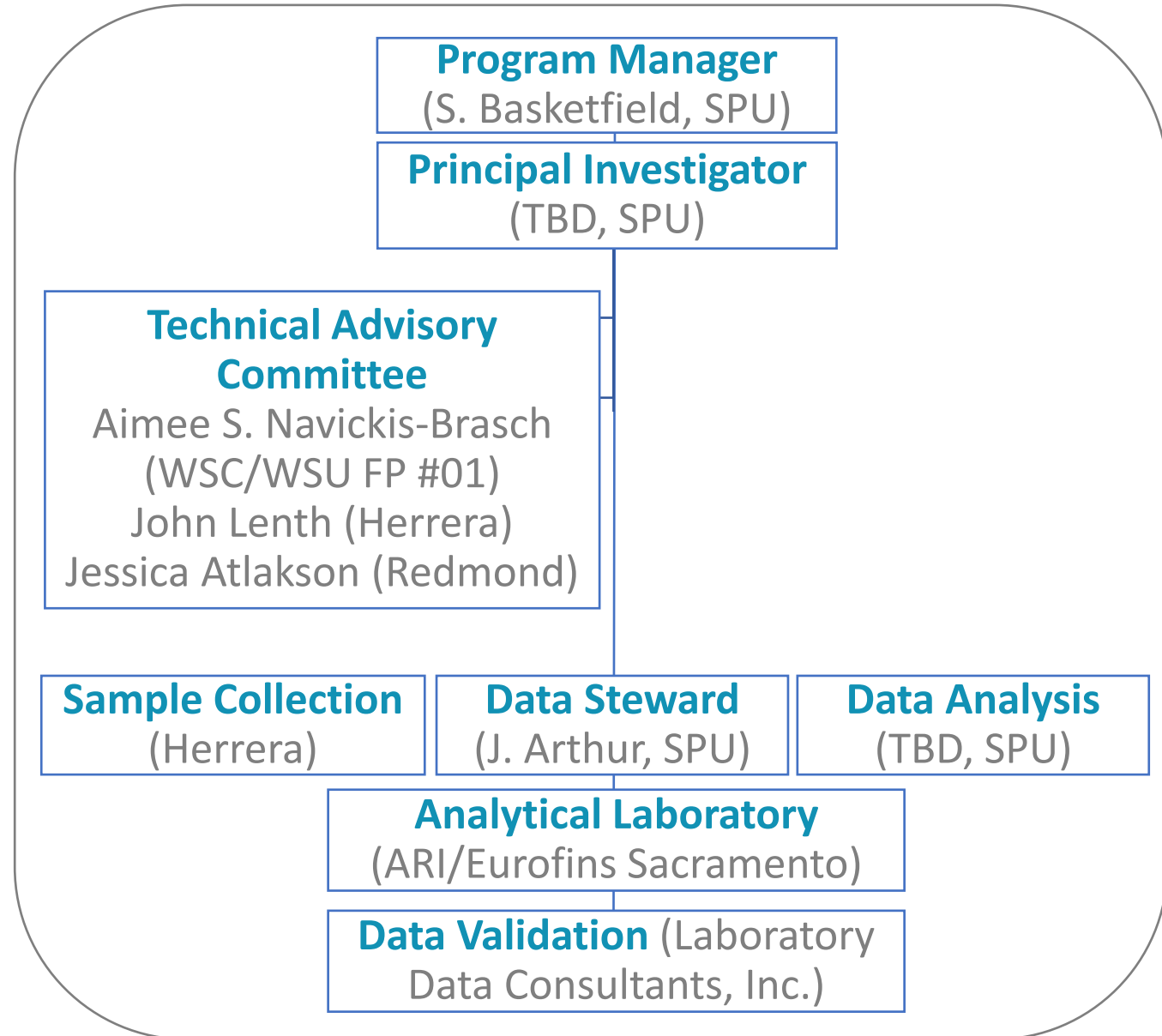


Contact Information

Shelly Basketfield

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206.849.2531



FP3: Treatment effectiveness of a full-scale stormwater facility using high performance bioretention soil media for 6PPD-q and other toxic chemicals

Jennifer Lanksbury & Jenée Colton, King County

August 29, 2023



Study Purpose

- Test the effectiveness of Ecology-approved HPBSM at decreasing 6PPD-q concentration and aquatic toxicity of stormwater at a full-scale bioretention facility.

Addresses the following stormwater management of 6PPD-q priority list topic:

Identify new BMPs that effectively reduce 6PPD/q, (e.g., in HPBSM).

Study Objectives

- Measure reduction of 6PPD-q and other stormwater contaminants in treated stormwater effluent relative to influent at a full-scale bioretention facility
- Test if acute toxicity to juvenile coho salmon and daphnia is reduced or eliminated
- Test if 6PPD-q removal performance of a new facility changes over time
- Explore whether other water quality parameters in influents correlate strongly with 6PPD-q concentrations

Methodology

- This is a sampling study of influent and effluent at a full-scale bioretention facility in Bellingham
- **Geneva Bioretention Pilot Project**

Geneva Bioretention Pilot Project



Methodology

- Sampling and analysis for this study leverages TAPE monitoring already planned by Whatcom County at Geneva via a QAPP.
- Monitoring of influent/effluent by Whatcom Co. will include:
 - TSS, PSD, hardness
 - total and dissolved copper and zinc
 - nitrate/nitrite, TKN, total and ortho-phosphorus
 - fecal coliform

Methodology

- This study will add the following measurements to influent/effluent:
 - 6PPD-q concentrations
 - Aquatic toxicity monitoring - changes in relative rates of mortality or behavioral changes in juvenile coho salmon and daphnia
 - Concentrations of PFAS, PAHs, additional metals
 - DOC, pH, oxidation reduction potential, specific conductance
- Sampling over 2 years (2024-2025) and multiple storm events
 - 15 storms for chemical analyses
 - 4 storms for acute toxicity testing

Study Results

- Final report summarizing project methods and findings
- New WQ dataset of 6PPD-q and toxicity reduction at a full-scale bioretention facility, available in EIM
- Web-based project dashboard for easily downloadable data
- Findings presented to SAM workgroup, Permittees, and other parties
- SAM Fact Sheet

Expected Outcomes

- Validation of laboratory testing – compare in-situ treatment performance of HPBSM against prior lab tests for 6PPD-q and metals.
- Provides first data on treatment effectiveness of HPBSM for organic contaminants (e.g., PFAS, PAHs).
- Informs on effective use of HPBSM where compost-based BSM is prohibited or ill-advised due to nutrient and metals release.
- Provides more accurate treatment effectiveness estimates for developing 6PPD-q mitigation plans at regional/watershed scales.
- Improves understanding of cost-effectiveness of HPBSM at full-scale, helping agency leaders decide how best to invest limited resources for 6PPD-q treatment.

Current Timeline and Budget

- Estimated project cost is \$267,000
- Estimating ~2 years to complete project
 - Geneva construction to be complete by end of September 2023
 - Study schedule is January 2024 to February 2026
- **Looking to include other sites in this project**
 - Do you have a BSM facility fitted with HPBSM?
 - Please contact us to discuss joining this study!

Contact Information

- Chelsea Mitchell, chemitchell@kingcounty.gov
- Jennifer Lanksbury, jlanksbury@kingcounty.gov, (206) 263-3674
- Jenée Colton, jenee.colton@kingcounty.gov, (206) 477-4075

- Technical Advisory Committee (TAC) recruiting:
 - Looking for volunteers from SWG, other local NPDES permittees, Ecology
 - Please contact us if you are interested in being on our TAC!

FP 5 - Application of CMAC for Water Quality and Flood Control for Flett Creek Ponds



August 29, 2023

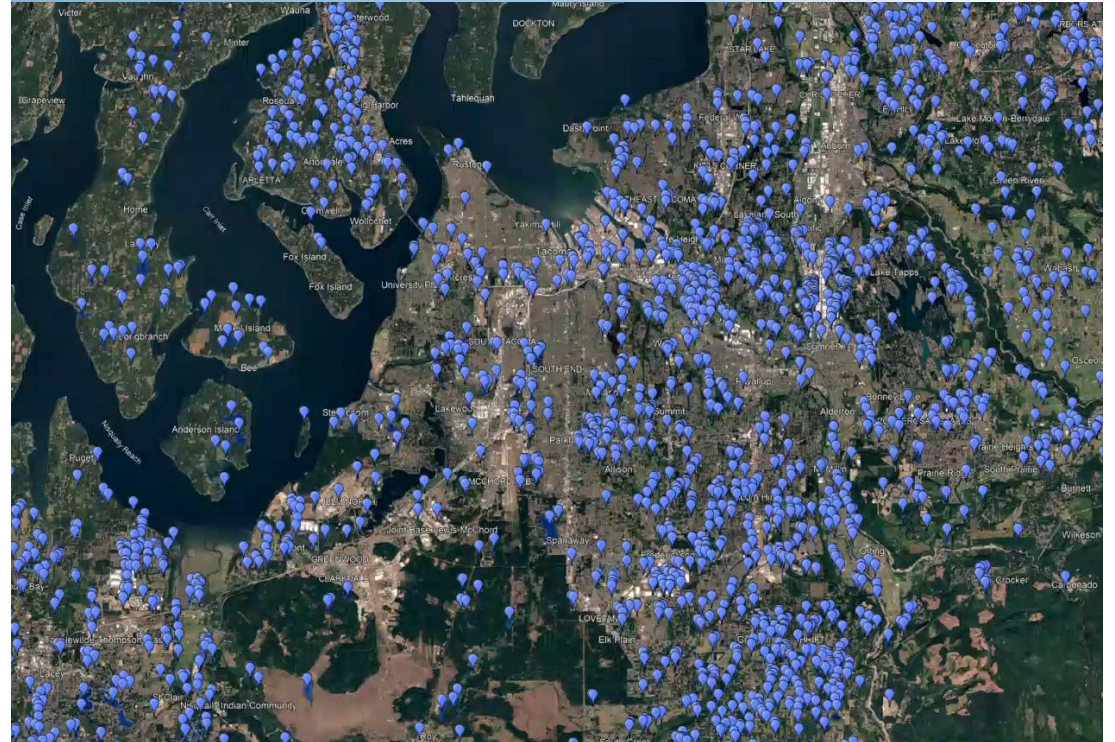


Study Purpose – Priority List Topic 19

Stormwater Challenges

- Competing goals to manage both quantity and quality
- Climate resiliency
- Limited space, high construction costs in urban stormwater systems
- Maintaining aquatic life habitat

7000+ potential sites in 5 Counties



Study Objective

Passive Gray



Quantity



Passive Green



Quality



Smart

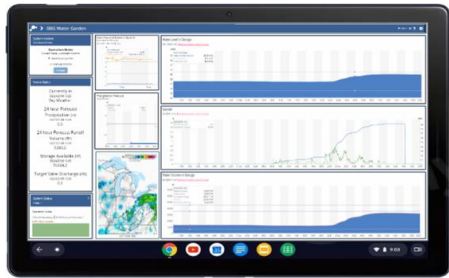


Adaptive Control



Resilient Community

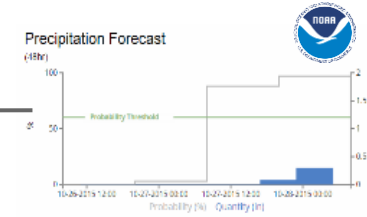
Smart Stormwater Continuous Monitoring and Adaptive Controls (CMAC)



Cloud Software



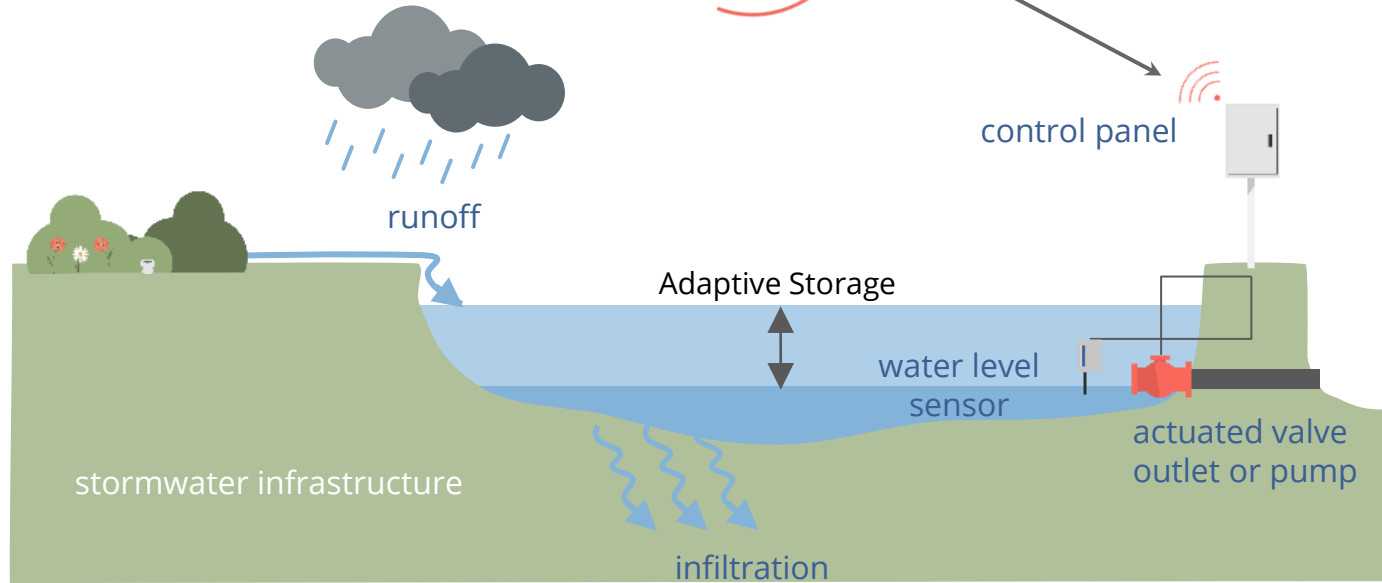
web-based dashboard



control panel

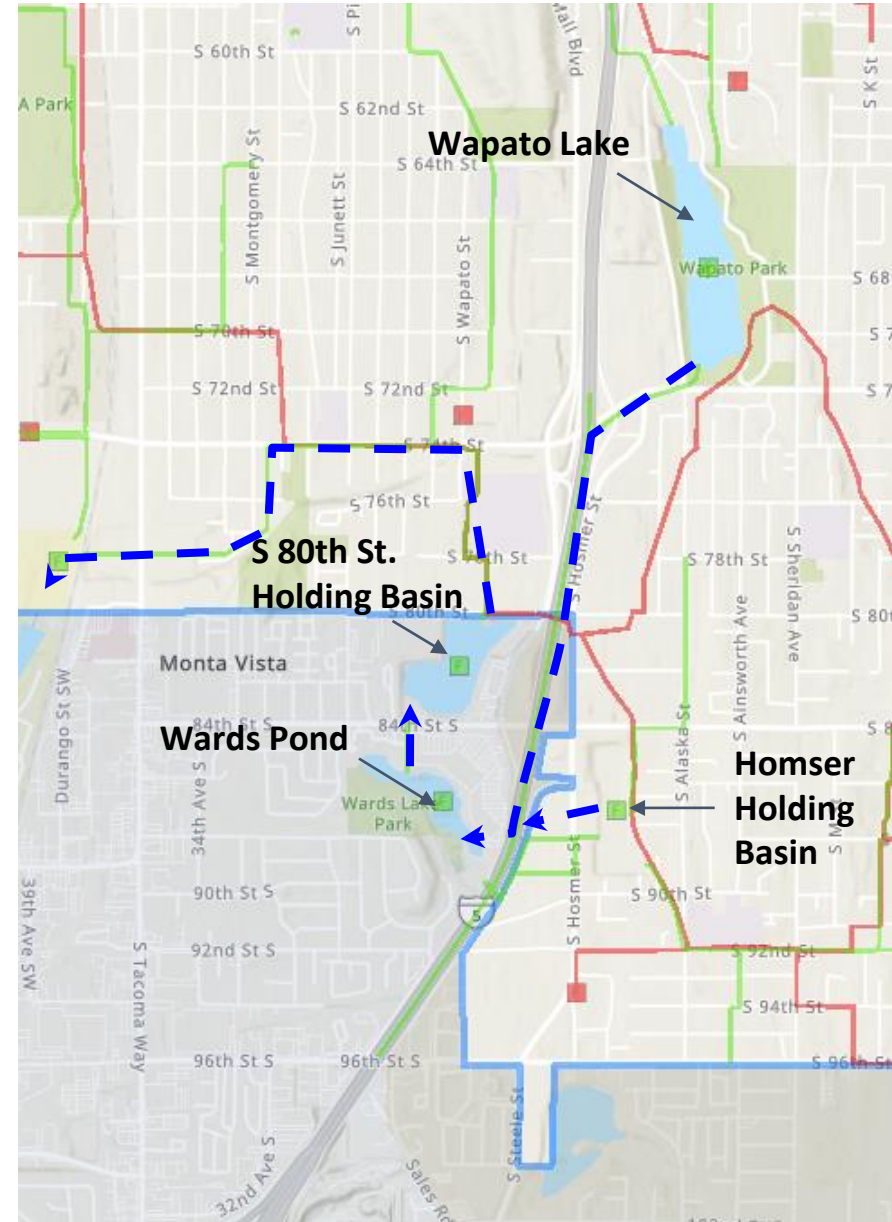


Field Hardware

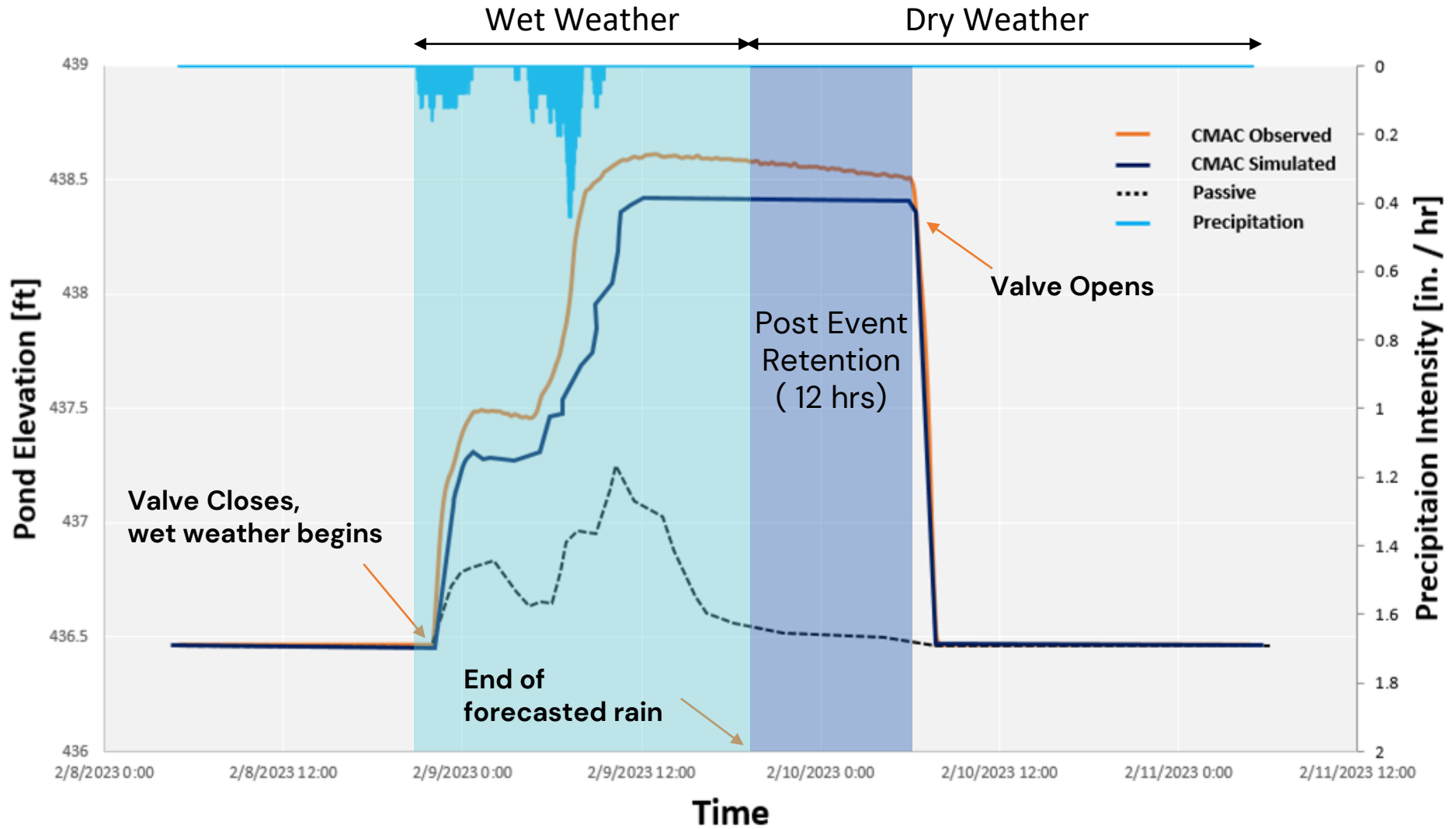


Methodology

- Build on knowledge and experience from local CMAC site installations to watershed-wide implementation
- Modelling and simulations to support CMAC retrofit
- Compare and analyze passive design versus CMAC retrofit solutions



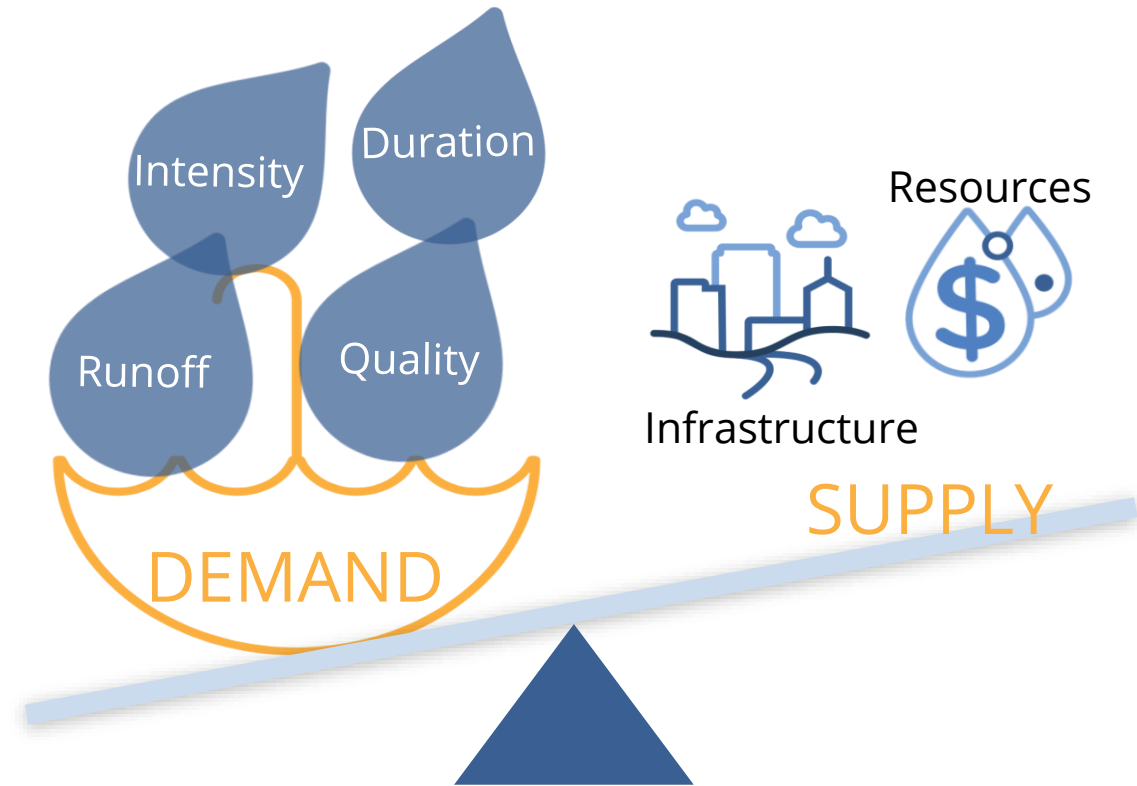
Modelling and Simulations



Study Results

Regional CMAC implementation guidance document

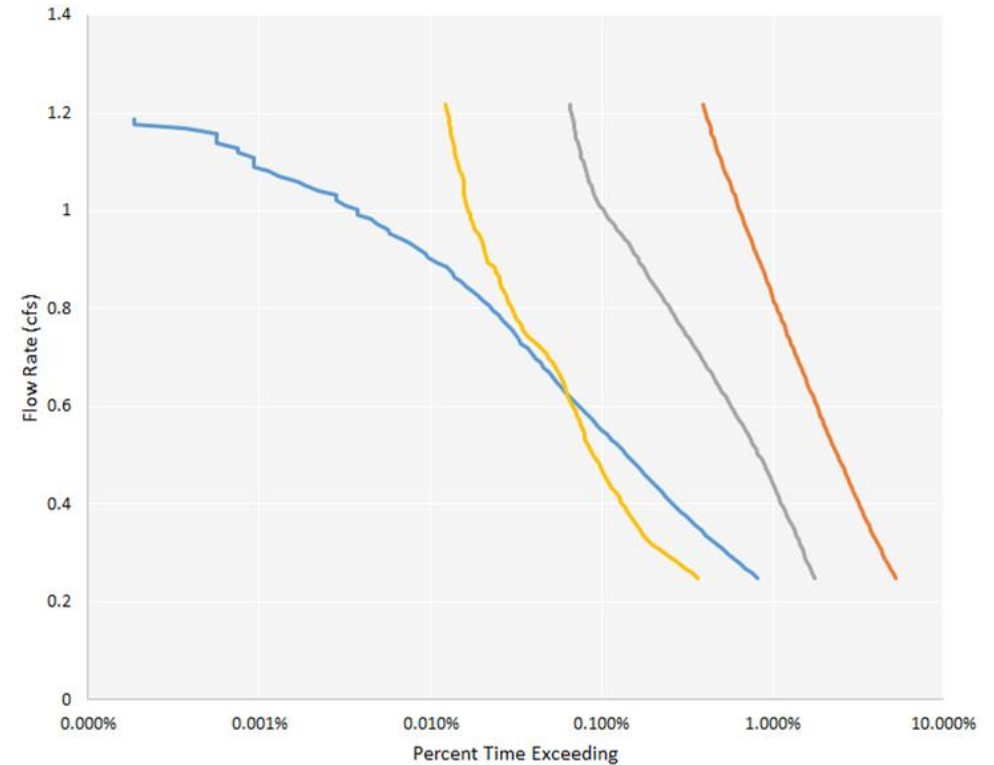
- Assess control hardware retrofit feasibility
- Optimize watershed wide CMAC software configurations and summarize assumptions
- Conduct cost-benefit analysis and planning estimates



Expected Outcomes

- Framework to implement CMAC technology across the region
- Behavioral changes in stormwater management practices
 - Manual, reactive control to automated, adaptive control
- Demonstrate how CMAC decisions can support multi-objective implementations at the watershed level

Redmond, WA - Whistler Ridge Pond



- Pre - Development
- Post - Development, Unmitigated
- Post - Development, Passive Design
- Post - Development, Passive Design, CMAC Retrofit



Timeline and Budget

Project Budget : \$233,798

Table 1. Schedule

Task	CONSULTANT HOURS	OPTI HOURS	Total Hours	Start	End	Duration (days)
Task PM Project Management and Administration	City of Tacoma In-Kind Hours			1/2/2024	2/17/2025	412
Task 1 - Flett Creek Drainage Basin Stormwater System Model	599	16	615	1/2/2024	6/6/2024	155
Task 2 – CMAC - Smart Control System	20	318	338	6/6/2024	10/12/2024	128
Task 3 - Systems Integration, Site Retrofit Feasibility, Cost-Benefit, Reporting	40	365	405	10/12/2024	2/17/2025	128
Summary	659	699	1358	1/2/2024	2/17/2025	412



Contact Information

Dana B. de Leon, P.E.
Assistant Division Manager
Environmental Programs Group
City of Tacoma

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Email : ddeleon@cityoftacoma.org

FP7: Annual Report Questions for Improved Regional Learning

Bob Bernhard, King County
James Packman, Aspect Consulting



August 29, 2023



Study Purpose

Purpose

- Revise the annual report questions for Illicit Discharge Detection and Elimination (IDDE) and Source Control.

Genesis of Study

- Ad Hoc Permittee Committee on Annual Reports, recommendations from White Paper.

Why is this Study needed?

- Improve the ability to analyze annual report data for better regional learning.
- Basis for recommendations on 2029 permit.

Priority Topic Question Addressed

14. Improve future Permit annual report questions for quantifying data for regional learning by analyzing Annual Report data, including analysis of narrative questions.



Study Objective

Can the NPDES MS4 general permit IDDE and source control annual report questions be revised in a manner that will exponentially improve the useability of the data while minimizing the burden on the permittees' level of effort to input the required data?



Study Methodology

1. Review and quantify annual report data

- Data QC for standardization.
- No permittee data requests (obtain data via PARIS).
- Include two years of data as reported for: 2023 and 2024.

2. Analyze data

- Graphing, tabulation, and statistics
- Answer questions about stormwater pollution: by region, pollutant, source, business type, and more.

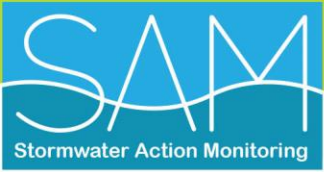
3. Survey permittees and interview Ecology staff

- Data analysis results
- What questions to answer with data?
- How are data currently used?

4. White Paper

- Synthesize data analysis findings and results from survey and interview.
- Develop recommended revised annual report questions.
- Guidance for how to answer annual report questions.





Expected Study Results

1. Methodology for Data Quantification and Analysis

- Turning qualitative responses into quantitative data.

2. Technical memorandum on the data review and analysis.

3. Memorandum of Survey and Interview Findings

4. White paper

- Recommended revised annual report questions for IDDE and Source Control
- Guidance for answering annual report questions

5. TAC Meeting Minutes

6. Presentation to SWG and municipal stormwater permittees

7. Study Schedule and Fact Sheet

Timeline and Budget

- Estimated project cost: \$364,345
 - Level of effort based on previous experience
 - Standardizing narrative answers is time-consuming process
- Estimated project timeline: 2½ years
 - Preferred schedule 2024-2026
- No permit-related time sensitivity
 - Recommendations feed into 2029-2034 permit



Expected Study Outcomes

- No change in policy or to stormwater manuals.
 - Better use of existing policy (permit) and manuals (guidance).
 - Better use and value of permittee time with recording and reporting program data.
- Methodology to analyze data and compare over time.
 - Standardized answers = consistent data quality
 - Use annual report data to help adaptively manage IDDE and source control programs.
- Data analysis can help answer questions about stormwater pollution.
- Opportunity for permittees to guide and define what source control and IDDE data are included in permit annual reports.

Contact Information



King County

Bob Bernhard, Source Control Program Manager, King County
Department of Natural Resources

rbernhard@kingcounty.gov



James Packman, Associate Hydrologist, Aspect Consulting

jpackman@aspectconsulting.com, 206-263-8979

- Call for more TAC members!
 - Current TAC: Pierce County, Snohomish County, Kitsap County, Clark County, City of Bellingham
 - Seeking: Phase II permittees and Ecology representative

FP8: Monitoring for Stormwater Contaminants of Emerging Concern in Western Washington



Dana de Leon – City of Tacoma

Ed Kolodziej – University of Washington (Tacoma/Seattle)

Dylan Ahearn – Herrera Environmental Consultants, Inc.



HERRERA



James Packman – Aspect Consulting, LLC



August 29, 2023

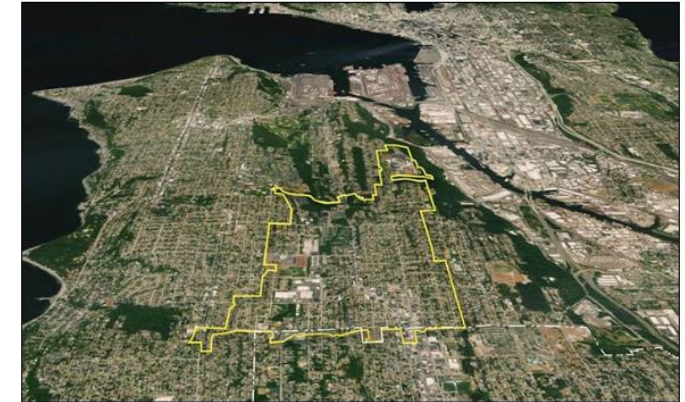
Study Purpose

- Context: 2007-2012 NPDES Permit Required Outfall Monitoring for all Municipal Phase I's and the Ports – S8.D.
 - Required to monitor Commercial, Industrial, LDR, and HDR basins.
 - Up to 85 stormwater parameters.
 - 67 sediment parameters.
 - Final Ecology Report is here: [Western Washington NPDES Phase I Stormwater Data Characterization: Final Findings from 2007-2012.](#)
- The resultant data has proven invaluable for stormwater managers and is used in [many planning level models](#) to this day.

Study Purpose

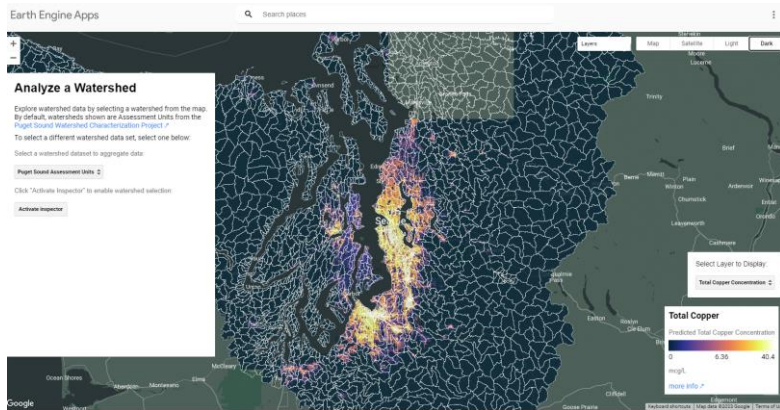
2007-2012 S8.D DATA IN USE TODAY

[Longfellow Starts Here - Utilities | seattle.gov](http://seattle.gov/utilities/longfellow-starts-here)



The South Delridge community (South Delridge, Roxhill, Westwood, Highland Park, Riverview, and Puget Ridge neighborhoods).

[The Nature Conservancy StormwaterHeatmap](#)

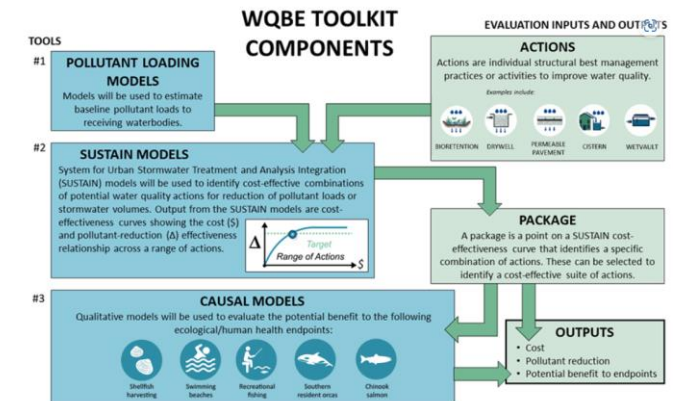


[Tacoma Watershed Insights](#)

Tacoma Watershed Insights
Plan stormwater solutions for a cleaner, healthier Tacoma

- Map Explorer**: Visualize the existing state of the stormwater BMP system. Search for specific facilities, and explore subbasins, pollutant heat maps, and reference imagery.
- WQ Results Viewer**: Evaluate BMP performance, pinpoint potential retrofit sites, identify viable approaches to treat stormwater and improve Tacoma's receiving waters.
- Decision Support**: Prioritize investments and allocate resources more effectively through an understanding of life-cycle costs and project benefits.
- Scenario Builder**: Ensure decisions help improve watershed conditions for all community members. Help promote equitable and sustainable outcomes in stormwater project and enhance neighborhoods for everybody.

[Water Quality Benefits Evaluation - King County](#)



Study Purpose

- But are the S8.D data still current?
- During 2007-2012, no data were collected for PFAS, 6PPDQ, microplastics, and other emerging CECs we now know are important
- Purpose of this study:
 - Generate a dataset that would augment and update 2007-2012 S8.D data and produce long-term benefits by helping inform future stormwater management decisions and populate planning level models.
- Addresses Priority Topic 16 directly:
 - “Regional stormwater discharge monitoring study (Appendix 9, WWA Permit) to characterize emerging pollutants in stormwater, e.g., 6PPDQ, PFAS, micro- and nano-plastic contamination in stormwater.”

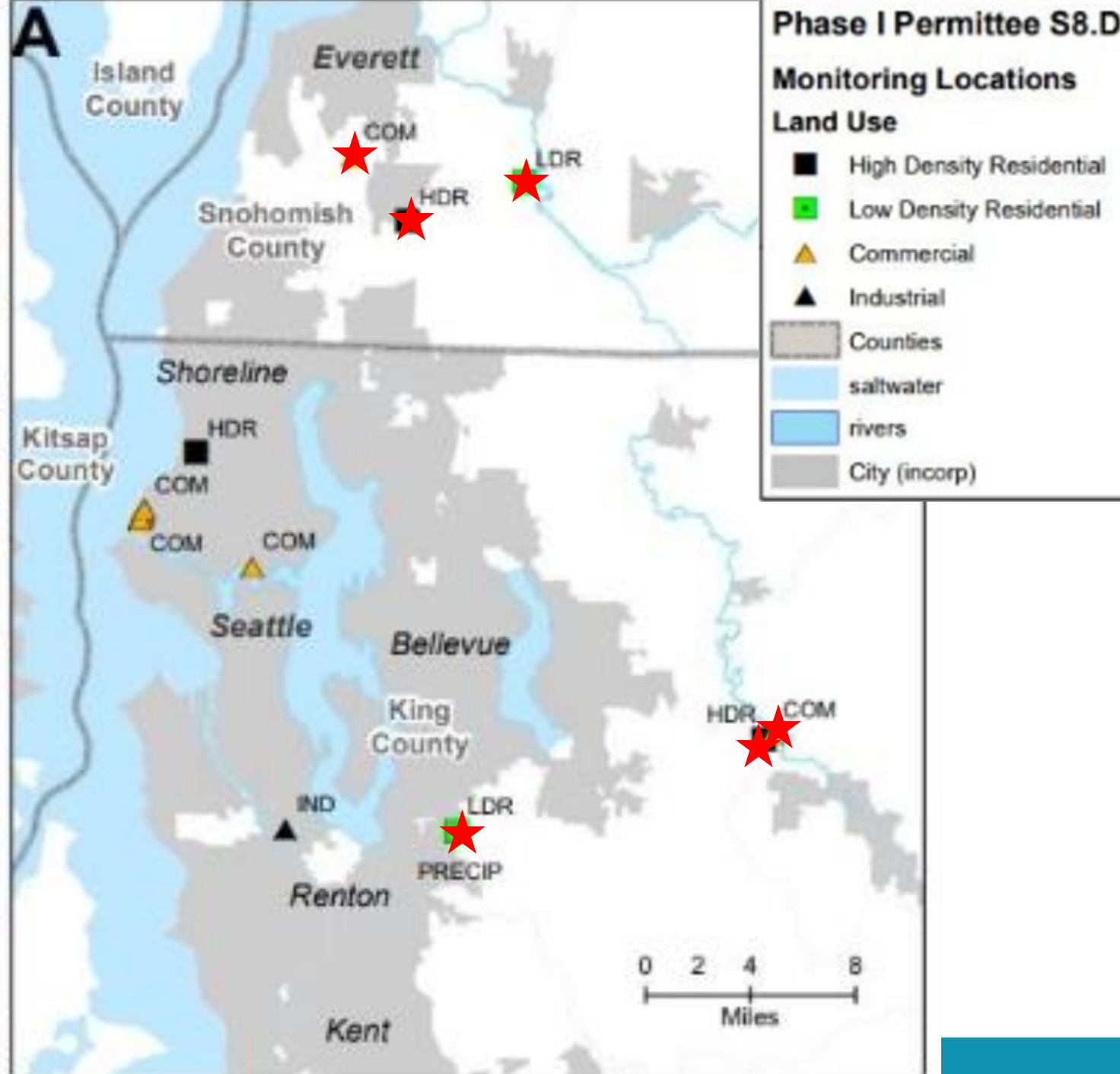
Study Objectives

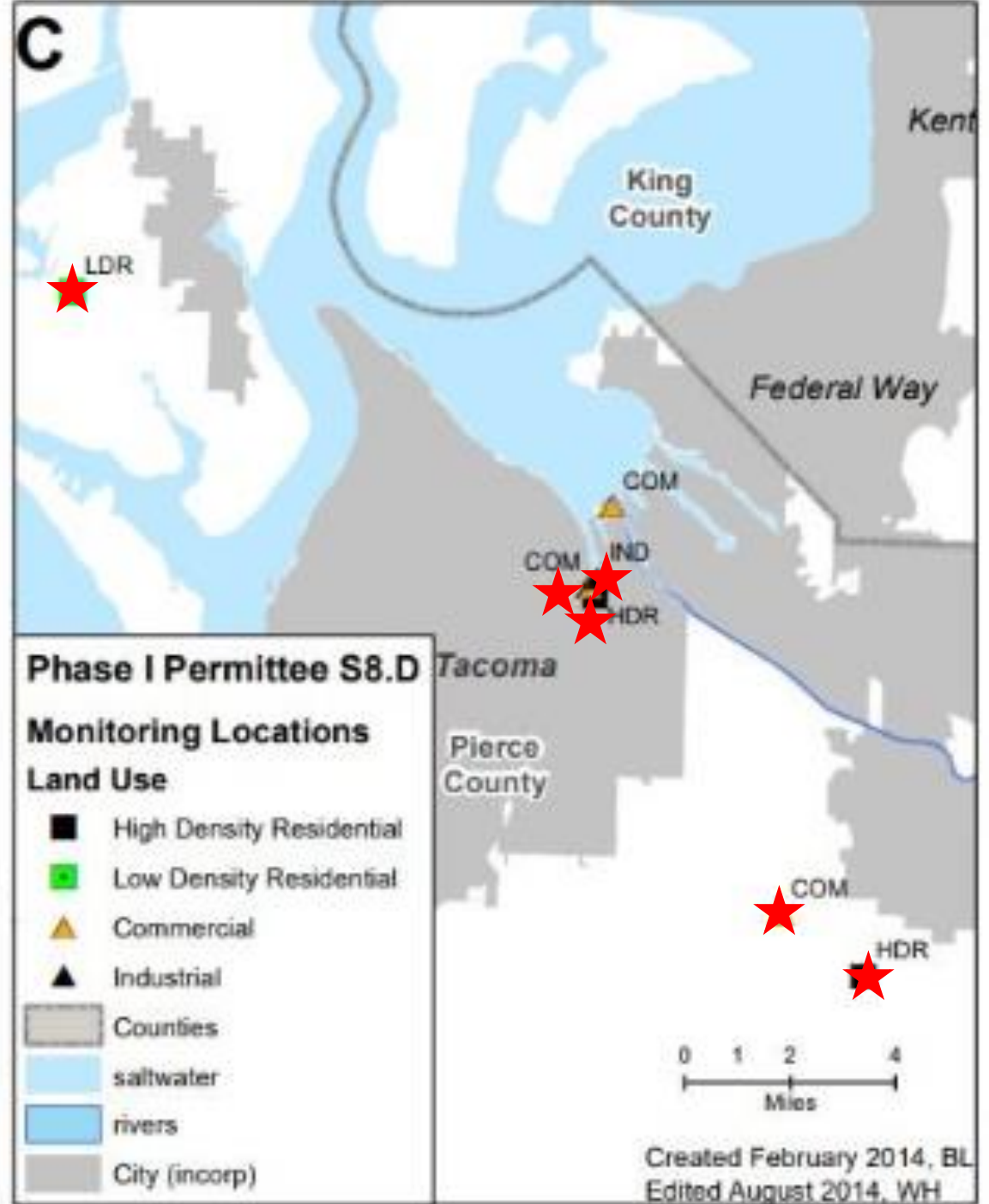
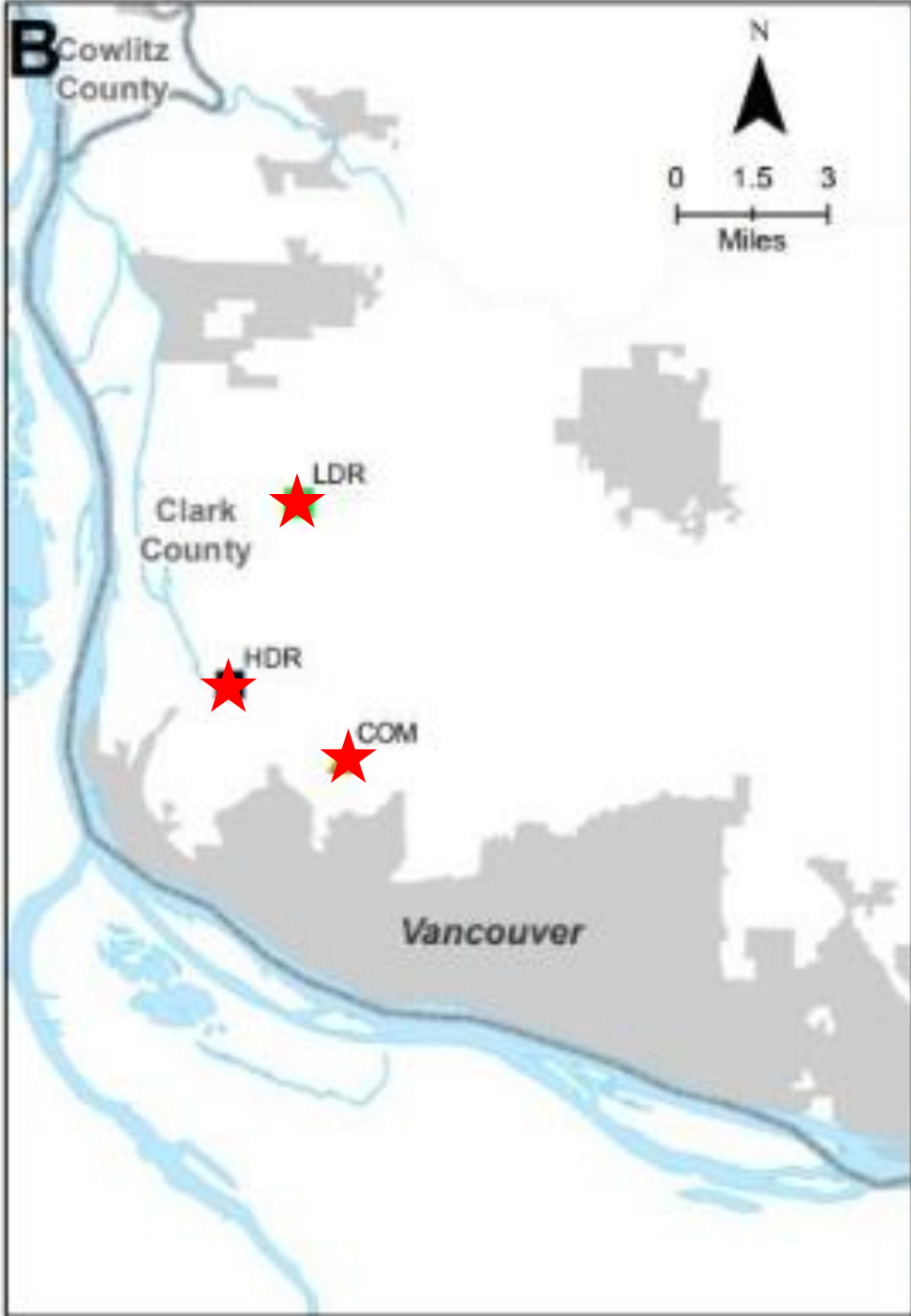
1. Review literature for a wide range of CECs (beyond 6PPD/TWP/PFAS) and build a dataset associated with key land uses: Industrial, Commercial, High Density Residential, Highway, and Low Density Residential.
2. Collect water and sediment samples and recollect data at the same locations sampled during the 2007-2012 S8.D monitoring. How has stormwater quality changed over the last decade? What about new CECs at these locations?
3. Synthesize the monitoring data and literature data into a report, factsheet, presentations, and project data dashboard for Permittees to use in their modeling and stormwater management efforts.

Methodology

- Step 1: Literature Review
 - Focus on historical data available, other tire- or vehicle-derived CECs, and sampling methodologies. Update monitoring to modern CECs and issues.
- Step 2: QAPP and Sampling Plan
 - Leverage TAC membership to find best sites
 - Need 2 additional industrial basins!
 - Determine sites and delineate basins





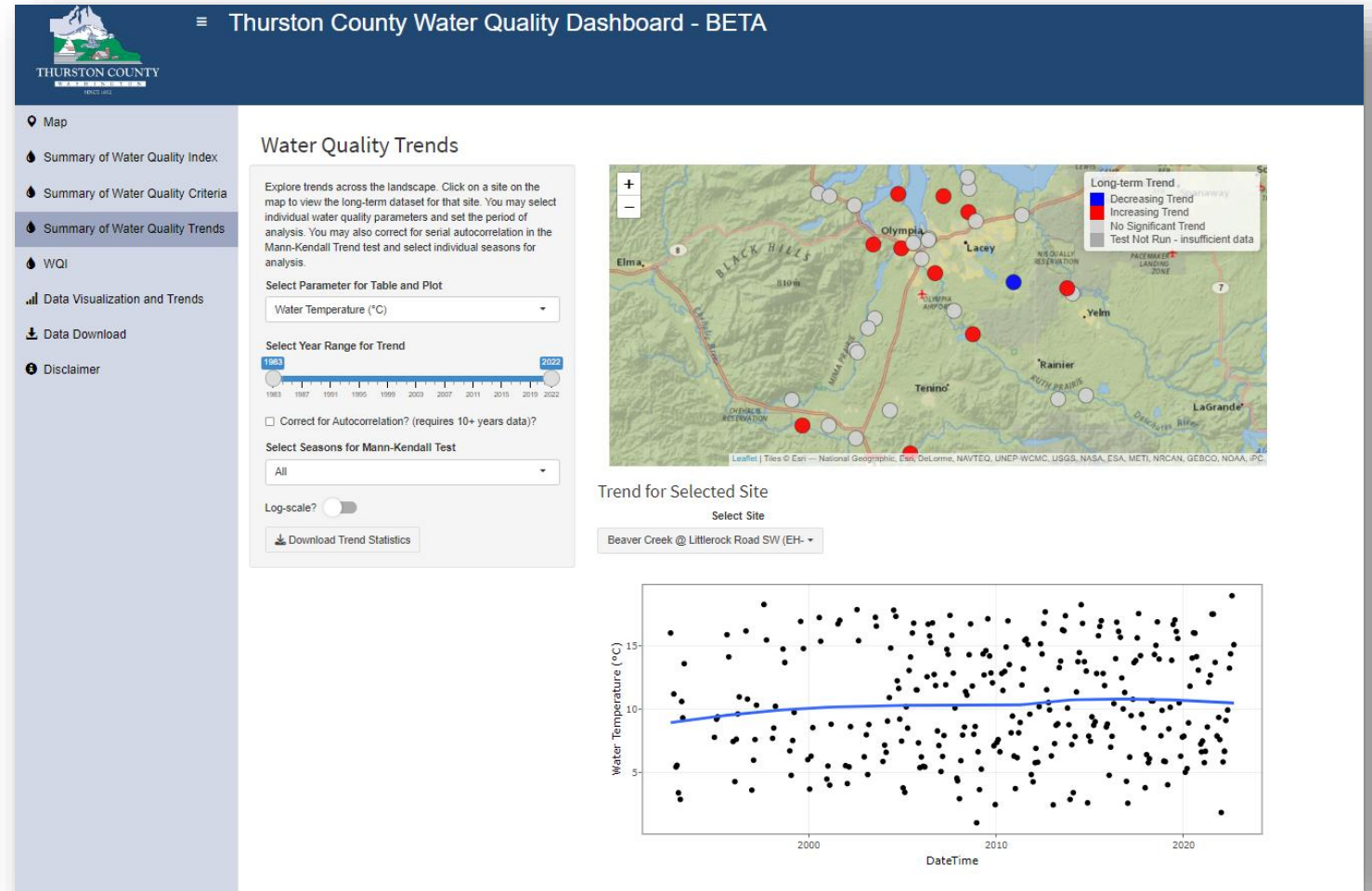


Methodology

- Step 3: Deploy Equipment and Conduct Monitoring
 - Two water years of sampling: 2025-2026 and 2026-2027
 - Following 2007-2012 S8D protocol for grab sampling, but only 9 events per year instead of 14. Some composite sampling (\$\$\$) for direct comparison.
 - Sediment traps deployed at all stations and monitoring for all 2007-2012 parameters and select additional CECs like PFAS, 6PPDQ, and roadway CECs.
 - Also, will collect broad-spectrum High Resolution Mass Spectrometry (HRMS) data amenable to archival and retrospective analysis.

Study Results

- Step 4: Manage and Share Results
 - White Paper
 - QAPP
 - Final Report and Fact Sheets on Ecology website
 - Data EIM submittal
 - Data will be made widely available using R-Shiny



Expected Outcomes

- This project will produce:
 - A foundational dataset for future stormwater management planning which is widely available, well organized, and easily accessed.
 - Valuable data for siting Structural Stormwater Controls (Section S5.C.7).
 - A dataset useful for comparing changes in stormwater sediment chemistry and treatment outcomes over the past 10 years.
 - Non-targeted HRMS spectra can be used as a digital archive of samples which will be a valuable resource for retrospective analysis of new CECs.
- This project is the continuation of the original Ecology monitoring requirement which spawned the SAM program

Timeline

Table 2. Project Schedule.	
Task	Schedule
Task 1: Project Management and Technical Advisory Committee	January 2024 – December 2027
Deliverable: Invoice and progress reports	Semi-annually
Deliverable: TAC meeting minutes	Quarterly
Task 2: Review of CEC Literature and Available Data	January 2024 – April 2024
Deliverable: Literature Review Report	June 2024
Task 3: Planning for Monitoring	January 2024 – December 2024
Deliverable: QAPP	December 2024
Task 4: Sample Collection and Monitoring	March 2025 – March 2027
Deliverable: Sampling event summaries	March 2025 – March 2027
Task 5: Data Management and Analysis	March 2025 – June 2027
Deliverable: Data Management and EIM submittal	September 2027
Deliverable: Data dashboard	June – October 2027
Deliverable: Final report	October 2027
Task 6: Communication Plan and Reporting	January 2024 – December 2027
Deliverable: Schedule	February 2024
Deliverable: Presentations	October – December 2027
Deliverable: SAM fact sheet	November 2027



Budget by Year and SAM Funding Cycle

Tasks	Deliverable	Current SAM Funding Cycle		Next SAM Funding Cycle		TOTAL
		2024	2025	2026	2027	
Task 1 - Project Management and Technical Advisory Committee	D 1.1 TAC meetings	\$ 5,366	\$ 5,564	\$ 5,798	\$ -	\$ 16,728
	D 1.2 Quarterly progress reports, invoices	\$ 18,726	\$ 24,447	\$ 25,638	\$ 11,778	\$ 80,590
Task 2 - Review CEC Literature and Available Data	D 2.1 Technical memorandum	\$ 99,001	\$ -	\$ -	\$ -	\$ 99,001
Task 3 - Planning for Monitoring	D 3.1 Sampling QAPP	\$ 188,295	\$ -	\$ -	\$ -	\$ 188,295
Task 4 - Sample Collection and Monitoring	D 4.1 Sampling event summaries	\$ -	\$ 271,065	\$ 339,327	\$ 203,875	\$ 814,267
Task 5 - Data Management and Analysis	D 5.1 EIM data submittals	\$ -	\$ 46,878	\$ 50,306	\$ 74,498	\$ 171,681
	D 5.2 Data dashboard	\$ -	\$ -	\$ -	\$ 28,826	\$ 28,826
	D 5.3 Comprehensive report	\$ -	\$ -	\$ -	\$ 128,676	\$ 128,676
Task 6 - Communication Plan and Reporting	D 6.1 Communication Plan and Schedule	\$ 2,697	\$ -	\$ 1,878	\$ -	\$ 4,574
	D 6.2 Presentations: SWG, permittees, TBD	\$ -	\$ -	\$ -	\$ 26,241	\$ 26,241
	D 6.3 Fact Sheet	\$ -	\$ -	\$ -	\$ 6,552	\$ 6,552
Lab Fees not covered by UW	Sediment Samples	\$ -	\$ 31,748	\$ 31,748	\$ 31,748	\$ 95,245
	Water Samples	\$ -	\$ 112,545	\$ 112,545	\$ 112,545	\$ 337,634
	TOTAL BY YEAR	\$ 314,085	\$ 492,247	\$ 567,239	\$ 624,739	\$ 1,998,310
	TOTAL BY FUNDING CYCLE	\$806,332		\$1,191,978		

Contact Information

- Dana de Leon, PE - ddeleon@cityoftacoma.org
- Looking for **Phase II** and **Ecology** TAC members. Please contact Dana if interested.

Current TAC

Name	Affiliation
Ani Jayakaran	WSU-Puyallup
Bob Hutton	Clark County
Brad Archibold	WSDOT
Carla Milesi	WA Stormwater Center
Carol Falkenhayn Maloy	Pierce County
Dana DeLeon	City of Tacoma
David Batts	King County
Dylan Ahearn	Herrera
Ed Kolodziej	UW-Tacoma
James Packman	Aspect
Jim Crawford	King County
John Herrmann	Snohomish County
Jennifer Arthur	City of Seattle

SAM Workshop 2023, Round 4 RFP

Questions from Zoom chat

General Questions

Jeremy Graham, City of Olympia asks:

I have a question for voting. In the information distributed in emails it was my understanding we would be hearing about the proposed SAM studies today, while the voting would begin in September. Is this still the case? I'm a little confused because I believe Don mentioned voting today.

Chelsea Morris answers:

Permittee voting opens on August 30 and closes on September 10. The results will be presented to Stormwater Workgroup at the September 13 meeting. Stormwater Work Group will decide on which projects to fund at the November 15 meeting.

FP 4 – Development of a Catch Basin Model to Predict Sediment Accumulation and Clean Out Frequency

Nigel Pickering & Angela Gallardo

Larry Schaffer, Thurston county asks:

Do you see the catch basin model having applicability beyond projecting catch basin sediment loading? For example, for helping to inform street sweeping prioritization efforts? -- Larry Schaffer, Thurston Co.

Angela Gallardo answers:

Larry, that's the part 2 Nigel briefly mentioned. It would be great to look at data from the same areas after the sweeping requirements kick in. We could also look at similar drainage areas that are in jurisdictions with sweeping programs vs no sweeping programs to see impacts.

We could do the second option I mentioned in this round.

Jeremy Graham, City of Olympia asks:

I think I heard that existing data would be able to be submitted for the CB study by municipalities. Is there a plan to submit a call for data to municipalities? Beyond just a request to participate on the TAC or in the study?

Angela Gallardo answers:

Yes, if the study is funded, we'll want to make sure the TAC agrees on the drainage areas etc we want to focus on then we'll send out a request for data.

FP 2 – Measuring Street Sweeping 6PPD-q Whole Environment Load Reductions

Shelly Basketfield

Melanie May asks:

for the street sweeping 6ppd-q study what kind of sweeper will you be using?

Answer: regenerative

Jeremy Graham asks:

Will the study identify roadway types/differences? Curbed vs ditched?

Answer: mostly curbed

Todd Hunsdorfer asks:

Question for SPU - Is there a concern that the tire wear particles are too small for the sweeper to pick up?

Shelly Basketfield answers:

Researchers (Järnskog et al 2020) have shown that street sweeping collects tire and roadwear particles ([Occurrence of tire and bitumen wear microplastics on urban streets and in sweepsand and washwater - ScienceDirect](#)). Preliminary sample results from the City of Seattle (n=20) show median 6PPD-q concentrations of 76 and 64 ug/kg with coefficients of variation of 0.6 and 1.2 for the less than 250 um fraction and the whole sample, respectively.

FP 3 – Treatment Effectiveness of a Full-Scale Stormwater Facility Using High Performance Bioretention Soil Media for 6PPD-quinone and Other Toxic Chemicals

Jenee Colton and Jennifer Lanksbury

Keith Estes asks:

Will the study be including a midpoint sampling collection between the Type 1 HPBSM and the polishing layer?

Jennifer Lanksbury answers:

As far as we know, Whatcom County is not planning on including a midpoint sampling collection between the primary layer and the polishing layer. The samples we will include the influent and final effluent from the Geneva Bioretention Facility.

Victoria Deycard asks:

is there evidence in the bench studies that the removal of 6ppd-q is related to removal of TSS?

Jennifer Lanksbury answers:

So far, we have been able to conduct our bench testing of the BSMs with influent from one storm in 2023. Our preliminary results do indicate a relationship between TSS and 6PPD-q, and all of the treatment types appear relatively effective at removal of 6PPD-q. These results are consistent with what Ecology has reported seeing - association of 6PPD-q with solids.

FP 5 – Application of Continuous Monitoring and Adaptive Control for Water Quality and Flood Control for Flett Creek Ponds

Kenneth Yu and Dana de Leon

Larry Schaffer asks:

Is this a proprietary technology?

Kenneth Yu answers:

Continuous monitoring and adaptive controls (CMAC) is non-proprietary. CMAC is deployed throughout the country and has been verified by independent research efforts, Opti is a provider of CMAC technology. Please see this TAPE approval document for more info:

https://optirtc.com/assets/images/resources/regulatory/approvals/WA_TAPE_Approval_11-1-18.pdf?_cchid=05831aaec5395e4b6bfcf84764479e51

Todd Hunsdorfer asks:

Is there a plan for results to provide feedback to the way structural stormwater control point are calculated?

Kenneth Yu answers:

Point calculation methodology was not explicitly in the proposal, but we can discuss incorporating with the City of Tacoma. This study will provide data to inform the point calculation methodology.

Anne Dettelbach asks:

is Flett Watershed highly urban? is it primarily industrial, residential, etc.? Thinking about how transferable results will be to other jurisdictions...

Dana de Leon answers:

It is a mix of commercial, some industrial and residential with IS drainage.

CMAC is applicable to stormwater assets in both urban and rural settings with different hydrologic conditions. This study explores the implementation of CMAC at a watershed level. -

- Kenneth

FP 8 – Monitoring for Stormwater Contaminants of Emerging Concern in Western Washington

Dana de Leon, Dylan Ahearn, Ed Kolodziej

Todd Hunsdorfer asks:

is there a plan for building the dashboard to allow for future data collection?

Dylan Ahearn answers:

Short answer is yes. The plan is to have the dashboard built in R-Shiny. It would be open source with the code all documented on a public GitHub repository. If Ecology would like to update it in the future it would be a simple exercise in adding records to the backend database. We could have this hosted for free on an Ecology R-Shiny instance or figure out another hosting option which works for everyone.