WASHINGTON STATE MUNICIPAL STORMWATER CONFERENCE

APRIL 24 & 25, 2019 • CITY OF SEATAC, WASHINGTON

In partnership with

WASHINGTON STORMWATER CENTER
ASSISTANCE • RESEARCH • TRAINING

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Funding provided by

DEPARTMENT OF ECOLOGY
State of Washington

WELCOME TO THE 2019 WASHINGTON STATE MUNICIPAL STORMWATER CONFERENCE!

The Washington Stormwater Center—in partnership with City of SeaTac, the Washington Department of Ecology, and our statewide conference advisory group—is pleased to welcome you to the 2019 Washington State Municipal Stormwater Conference (MuniCon 2019). This unique conference focuses on addressing high-priority issues and challenges faced by municipal NPDES permittees statewide. Throughout both days of the conference there are opportunities to meet with, talk to, and learn from stormwater managers from around the state. Workshops and presentation sessions are constructed so that there is ample time for idea exchange among the attendees.

As with most conferences, there are many people to recognize for helping make this conference possible—from the Washington Department of Ecology (our funder) and the City of SeaTac (our host) to the partners, advisors, presenters, keynote speaker, sponsors, and exhibitors—all have had a large role in putting together this statewide conference. We are especially thankful to this great group and have devoted a section in this program to list each of their names and organizations.

Thinking forward to MuniCon 2021 we are hoping to continue these valuable gatherings in the future. To assist us in developing the next conference that will provide attendees with the greatest benefit please complete the conference survey that will be emailed to you following the conference. We look forward to receiving your ideas and suggestions on how to grow the conference in future years.

Thank you all for your interest and support of this conference and welcome to MuniCon 2019!

Dr. John Stark
Director, Washington Stormwater Center

DAY 1 | April 24, 2019

7:30 AM — **Registration** — EXHIBITOR AREA

Workshops

WORKSHOP 1 — EMERALD AB

8:30 AM

No Morning Workshop

11:30 AM — **Registration**
Note: Meals are not provided Day 1; lunch is on your own.

1:00 PM

1

Stormwater Management Manual for Eastern WA
Doug Howie, Washington State Department of Ecology

4:30 PM

WORKSHOP 2 — CRYSTAL A

8:30 AM

No Morning Workshop

1:00 PM

2

Illicit Connection and Illicit Discharge (IC/ID) Field Screening and Source Tracing Training
Rebecca Dugopolski, Herrera; James Packman, Aspect Consulting

4:30 PM

WORKSHOP 3 — CRYSTAL C

8:30 AM

No Morning Workshop

1:00 PM

2

Education and Outreach | Social Marketing: What are the Principles for Success
Nancy Lee, Social Marketing Services, Inc.

4:30 PM

WORKSHOP 4 — CRYSTAL B

8:30 AM

1

Inspection Practices Under the Western Washington Phase II NPDES Stormwater Permit
City of Bellevue, Surface Water and Water Quality: Todd Dahlberg; Mike Krueger; Jerry Campbell; Brian Miller

1:00 PM

30 MIN

2

Inspection Practices Under the Western Washington Phase II NPDES Stormwater Permit (Repeat)
City of Bellevue, Surface Water and Water Quality: Todd Dahlberg; Mike Krueger; Jerry Campbell; Brian Miller

1 HOUR

4:30 PM

5:00 PM — **Networking Reception** — EXHIBITOR AREA

DAY 2 | April 25, 2019

7:00 AM — **Registration & Refreshments** — EXHIBITOR AREA

7:45 AM — **Welcome and Introduction**
John Stark, Washington Stormwater Center — EMERALD BALLROOM

8:00 AM — **Keynote**
Jay Manning, Cascadia Law Group — EMERALD BALLROOM

10 MIN

Breakout Sessions

CRYSTAL A	CRYSTAL B	CRYSTAL C	EMERALD AB
TRACK 1 EDUCATION & OUTREACH AND SOURCE CONTROL	**TRACK 2** RESEARCH AND GREEN STORMWATER INFRASTRUCTURE	**TRACK 3** STORMWATER PLANNING AND RETROFITS	**TRACK 4** INVESTIGATIONS & MAPPING, INSPECTIONS AND REVIEW
8:40 AM			
3 **Interpretation in Communications: Bridging the Gap to Public Understanding** *Michelle Perdue, Kitsap County*	6 **Results from a Regional Stream Status and Trends Monitoring Program** *Richard Sheibley, USGS*	9 **Phase I Structural Stormwater Control Requirements: What Phase IIs Should Know** *Ingrid Wertz, City of Seattle; Emma Trewhitt, Ecology*	12 **Mapping: Where You're Headed & How to Get There** *Jennifer Schmidt, Herrera*
15 MIN **9:25 AM**			
4 **Panel: Engaging Private Property Owners to Control Stormwater On-site** *Cari Simson, Urban Systems Design; Aaron Clark, Stewardship Partners; Jo Sullivan, King County; Derek Hann, Snohomish Conservation District; Mary Rabourn, King County*	6 **Bioretention Media Studies: Updates from SAM and EWA** *Isabella Burzynski, Nicole Chen and Leland O'Hanlon, Gonzaga University; Brandi Lubliner, Washington State Department of Ecology; Aimee Navickis-Brasch, Osborn Consulting*	10 **Small Footprint Urban Retrofit Case Study for Municipal/Industrial Applications** *Ross Dunning & Laura Weiden, Kennedy/Jenks Consultants*	13 **Latest Information on IDDE Field Screening and Source Tracing Methods** *Jeanne Dorn, King County; James Packman, Aspect Consulting*
9:55 AM — **Refreshments** — EXHIBITOR AREA			
10:25 AM			
5 **Sharing Outreach the Resource Reservoir, an Online Community** *Mary Rabourn, King County*	8 **Is Stormwater Harming Our Streams? Long-term Monitoring of Metals** *Daniel Nidzgorski, King County*	11 **Retrofits in Forbes Creek: Focus on Efficiency and Community Benefits** *Amy Carlson, Jacobs Engineering; Jenny Gaus, City of Kirkland*	14 **Municipal IDDE Program Update to Integrate Bacteria TMDL Screening** *Julie Brandt, Parametrix; Kristin Terpstra, City of Bothell*
15 MIN **11:10 AM**			
5 **Talking about Stormwater in Ways to Inspire People** *Heather Trim, Zero Waste Washington; Betsy Adams, City of Kirkland*	9 **Panel: Using Research Outcomes to Inform Solutions for Highway Runoff** *Lisa Rozmyn, WSC; Claire Duchet, Benjamin Leonard and Lane Maguire, WSU*	12 **Country Homes Boulevard Restoration Project: A Green Infrastructure/ LID Retrofit** *Colleen Little, Spokane County*	15 **Utilizing Asset Management Software for IDDE Tracking & Reporting** *Melissa Ivancevich, City of Shoreline*

11:40 AM — **Lunch** — EMERALD BALLROOM

	CRYSTAL A	CRYSTAL B	CRYSTAL C	EMERALD AB
	TRACK 1 EDUCATION & OUTREACH AND SOURCE CONTROL	**TRACK 2** RESEARCH AND GREEN STORMWATER INFRASTRUCTURE	**TRACK 3** STORMWATER PLANNING AND RETROFITS	**TRACK 4** INVESTIGATIONS & MAPPING, INSPECTIONS AND REVIEW
12:40 PM	15 **Sharp Avenue Pervious Pavement and Stormwater Infiltration Treatment Analysis** *Eric Lester, City of Spokane*	19 **Infiltration Feasibility Assessment to Successful Infiltration Design and Performance** *Jennifer Saltonstall, Associated Earth Sciences, Inc.; Curtis Koger, L.E.G., L.Hg.*	22 **Port Townsend Stormwater Management Plan** *Paul Fendt, Parametrix; Samantha Harper, City of Port Townsend*	27 **Implementing a Surface Water Infrastructure Inspection and Asset Management Program** *Theresa Thurlow, City of Federal Way*
15 MIN 1:25 PM	16 **Creative Integration of Diverse Organizations to Manage Stormwater** *Blair Scott and Darren Greve, King County; Marcia Davis, City of Spokane; Brandy Reed, King Conservation District*	19 **Enhancing the Functionality of Pervious Concrete Pavements** *Mohammadsoroush Tafazzoli, Washington State University*	23 **Bonney Lake Watershed Protection and Land Use Planning** *Paul Fendt, Parametrix; Jason Sullivan, City of Bonney Lake*	28 **Roadside Ditch Inventory, Inspection, and Maintenance Recommendations** *Rebecca Dugopolski, Herrera; Doug Navetski, King County*
1:55 PM	Refreshments — EXHIBITOR AREA			
2:25 PM	17 **Tips and Tricks for Developing an Engaging Source Control Program** *Danielle Driscoll and Kerry Neil, Snohomish County Public Works*	20 **Development of a New BMP: Sand Filter Sidewalk Vaults** *Jake Saxon, Spokane County; Taylor Hoffman-Ballard & Aimee Navickis-Brasch, Osborn Consulting*	24 **Swale on Yale: P3 Regional Impact** *David Schwartz, KPFF Consulting Engineers*	29 **Programmatic Approaches to Ensuring Long-term Performance of Post-Construction Stormwater Controls** *Jeremiah Lehman, Contech*
15 MIN 3:10 PM	17 **Using Lean/Kaizen to Make Source Control Inspections More Effective** *Kevin Buckley, Seattle Public Works; Jessica Branom-Zwick, Cascadia Consulting Group*	21 **Plant Selection for Stormwater Management** *Brandy Reynecke, Ecology*	25 **Our Green Duwamish Watershed Stormwater Strategy** *Todd Hunsdorfer & Carly Greyell, King County*	30 **Case Study: Compliance Success for Private Facility Inspection and Maintenance** *Laura Frolich, Snohomish County; Jody Lind, Snohomish County*
15 MIN 3:55 PM	18 **Common Source Control Problems and Innovative Routes to Compliance** *Alison Schweitzer, King County*	21 **Assessment Protocol for Determining Rain Garden and Bioretention Facility Effectiveness** *Robert Simmons, Washington State University*	26 **Kitsap County Stormwater Management Action Plan** *Brian Ward, HDR; Angela Gallardo, Kitsap County*	31 **Municipal Construction Stormwater Site Inspection Toolkit** *Rebecca Dugopolski, Herrera; Amy Georgeson, City of Tumwater*
4:30 PM	**Conference Concludes**			

7:30 am - 1:00 pm

Conference Registration

REGISTRATION DESK

Come check-in to the conference and meet your colleagues.

Please note: *Meals are not provided on Day 1; lunch is on your own. Please plan accordingly.*

8:30 - 11:30 am

Morning Workshop

WORKSHOP 4

CRYSTAL B
8:30 - 11:30 am

Inspection Practices Under the Western Washington Phase II NPDES Stormwater Permit

City of Bellevue, Surface Water and Water Quality: *Todd Dahlberg, Water Quality Supervisor; Mike Krueger, Storm & Surface Water Superintendent; Jerry Campbell, Stormwater Inspector; Brian Miller, Private Drainage Inspector*

The session will review private drainage inspection practices, as well as different types of inspections (municipal, industrial, residential, etc). Discussions will center on inspection techniques in the field, customer interactions, and ways to help customers comply with inspection requirements. Additional topics of interest include the different types of municipal facilities requiring inspections, how to perform the inspections, what inspectors are looking for and how they classify it for follow up, including whether the maintenance activity is subject to a permit timeline.

This topic will discuss:

- Importance of inspections
- Intent of inspections under the NPDES permit
- Overview of permit requirements
- Interpretation of related maintenance standards

1:00 - 5:00 pm

Afternoon Workshops

WORKSHOP 1

EMERALD AB
1:00 - 5:00 pm

Stormwater Management Manual For Eastern Washington

Doug Howie, Department of Ecology

The Stormwater Management Manual for Eastern Washington (SWMMEW) has been in place since 2004. In 2018, Ecology, along with a steering committee made up of permittees throughout eastern Washington updated the manual. The 2019 version of the SWMMEW corresponds to the requirements in the 2019 permit. This class will provide a guide to the 2019 SWMMEW including:

- Discuss where the document retained the language from the 2004 version and where it has changed,
- Provide guidance on how to distinguish between using the requirements for new and redevelopment described in the eight Core Elements and when to follow the UIC Rule,
- Provide guidance on how to interpret the requirements in the eight Core Elements,
- Describe how Source Controls relate to commercial and Industrial sites,
- Describe the 13 elements of the Construction SWPP,
- Answer questions from the participants that aren't directly addressed during the talk.

DAY 1
April 24

WORKSHOPS

WORKSHOP 2

CRYSTAL A
1:00 - 5:00 pm

Illicit Connection and Illicit Discharge (IC/ID) Field Screening and Source Tracing Training

Rebecca Dugopolski, Herrera; James Packman, Aspect Consulting

This training will provide an overview of field methods for detecting and tracing sources of illicit discharges (ID) and illicit connections (IC). The training content will be based on the 2013 IC/ID Field Screening and Source Tracing Guidance Manual and will include some of the changes that are proposed for the update to the IC/ID Field Screening and Source Tracing Guidance Manual due to be published in late 2019.

This training will include the following hands-on components:

- Team exercise: Work with your team to trace illicit discharge source(s). Can you find the illicit discharge(s) and spend less money than the other teams?
- Field equipment demo stations: Practice using test kits and test strips at 10 different stations: ammonia, color, pH, turbidity, chlorine/fluoride, surfactants, hardness, nitrate, dye testing, and smoke testing.
- Proper sampling techniques: Discuss strategies and considerations for collecting catch basin/manhole water samples and/or surface water samples.

WORKSHOP 3

CRYSTAL C
1:00 - 5:00 pm

Education and Outreach | Social Marketing: What Are the Principles for Success

Nancy Lee, Social Marketing Services Inc.

Sponsored by King County This half day workshop will begin by defining and distinguishing the Social Marketing option for citizen behavior change. A Ten Step Framework for developing a strategic social marketing plan will be shared and—for each step—a description, case study, and principle for success will be presented. Attendees will have an opportunity to draft key components of a plan to address a citizen behavior change effort of individual or team interest, including selecting a priority audience, desired behavior, and identifying potential audience barriers and benefits to be addressed.

Case Studies Panel (moderated by Nancy Lee)
10 minute max presentation, 20 minute Q&A

1. Cammy Mills, Kitsap County Public Works: *Audience Research on the Cheap*
2. Dave Ward, Kitsap County Department of Community Development: *Social marketing to improve your internal programs*
3. Mary Rabourn, King County: *Basic steps for multicultural projects*
4. Heather Trim, Zero Waste Washington: *Evaluation basics*

WORKSHOP 4 (REPEAT)

CRYSTAL B
1:30 - 4:30 pm

Inspection Practices Under the Western Washington Phase II NPDES Stormwater Permit

City of Bellevue, Surface Water and Water Quality: *Todd Dahlberg, Water Quality Supervisor; Mike Krueger, Storm & Surface Water Superintendent; Jerry Campbell, Stormwater Inspector; Brian Miller, Private Drainage Inspector*

Repeat of morning session. See description on page 1.

5:00 - 7:30 pm
EXHIBITOR AREA

Networking Reception

Join your fellow stormwater professionals for an evening of sharing, networking and fun. Hors d'oeurvres and beverages will be served.

BREAKOUT SESSIONS

7:00 - 7:45 am

EXHIBITOR AREA

Registration & Refreshments

Get organized for your day and meet with colleagues over a light continental breakfast.

7:45 - 8:30 am

EMERALD BALLROOM

Welcome and Introduction

John Stark, Washington Stormwater Center

7:45 - 8:30 am

EMERALD BALLROOM

Keynote Address

Jay Manning, Cascadia Law Group

JAY J. MANNING *Jay rejoined Cascadia Law Group after more than six years as Director of the Department of Ecology and Chief of Staff for Governor Christine Gregoire. His practice focuses on environmental and energy issues. Jay provides consulting and legal services to clients involved in significant issues of public policy, major projects seeking government approval and/or funding and on difficult management challenges. Jay has significant experience in all areas of environmental law and policy, including state, federal and local regulatory programs. He has worked extensively in administrative, judicial and legislative and congressional settings. His practice focuses on making clients successful in avoiding litigation and achieving positive outcomes on projects, policy improvements and important transactions. Jay is chair of the Puget Sound Partnership's Leadership Council and serves on the Eastern Washington University Board of Trustees.*

In 1987 Congress amended the Clean Water Act to require the regulation of stormwater discharges. Since then, a stormwater regulatory system has been developed and implemented. Much progress has been made in the intervening 32 years. Washington's municipalities have invested very significantly in developing infrastructure, regulatory and management systems and human resources to manage the stormwater generated within their jurisdictions and have taken us from a system that focused on preventing flooding and property damage to one that does both of those things, but also dramatically reduces pollution loading, stabilizes stream flows and protects aquatic biota.

While progress has been made, more progress is necessary. The majority of stormwater generated within the state remains unregulated. With some significant exceptions, stormwater BMPs are rudimentary and achieve a fairly low level of removal efficiency. To protect salmon, Orca's and people, we need to continue to push the development of treatment technologies and management systems, expand coverage of stormwater permits, invest more public and private dollars into stormwater management and generally move the stormwater management system in Washington to a significantly more effective level.

8:40 - 11:40 am

Morning Breakout Sessions

TRACK 1: EDUCATION & OUTREACH AND SOURCE CONTROL

CRYSTAL A
8:40 am

Interpretation in Communications: Bridging the Gap to Public Understanding

Michelle Perdue, Kitsap County

MICHELLE PERDUE *Michelle has over fifteen years of experience in municipal stormwater, with a focus on communications. Her work has included such diverse projects as a major interagency stormwater management group rebranding, the design of national award-winning interpretive signage for Kitsap's first stormwater park, and managing outreach and information for several major construction projects. Prior to joining Kitsap County, Michelle was the Municipal NPDES Stormwater Permit Manager for the City of Moses Lake.*

ABSTRACT. As someone who has an entire stormwater program to manage, communication seems like the least of your worries. However, your message is meaningless if it doesn't get consumed. Data tells us how much people's brains can consume at one time—so why are we consistently trying to "stuff more in" and wondering why they aren't getting the message?

In today's world there is a lot of competition for people's attention. Jurisdictions need to get savvier about the way we are communicating to ensure our message is getting through. If your audience doesn't HAVE to listen to you, why would they?

From outreach messaging to behavior change to training sessions, crafting your communications so that people take away just what you want them to is critical. The interpretive approach uses proven techniques to help you make those connections to your audience. It translates difficult scientific and technical terms into everyday language, bridging the gap between science and public understanding.

CASE STUDY: SIGNAGE. Kitsap County worked with a consultant in 2012 to produce a suite of signs identifying green stormwater BMPs. The results were outstanding for their time, and the signs were widely shared.

Five years later, the world has changed, including people's attention spans. The existing signs are now dated and no longer effective. With the lessons learned from an interim pilot project which applied interpretive principles to signage design, Kitsap is now applying this knowledge to the original BMP signs to renew them.

We will also present examples of how jurisdictions can apply interpretive principles to publications, web pages, and presentations to strengthen their overall communications and develop more focused messaging.

LEARNING OBJECTIVES. No matter what region you reside in, the need to clearly convey your message on a day to day basis is critical to your mission. The learning objectives for this presentation are:

- Why jurisdictions should care about good communications
- Strategic framing of messages: how to boil your message down to its most essential elements
- Designing your message to meet the audience where they are
- Understanding the psychology behind why people consume the materials they do, and how to make your message the one that gets read
- Helping you know what good messaging and design looks like, so that you can apply it whether you're designing your own materials, or hiring a consultant or designer to do the work
- Applicability: how these principles can apply to all your communications

This presentation will feature at least one case study of a project that will demonstrate the use of interpretive principles, including specific challenges faced during the course of the project and lessons learned.

CRYSTAL A
9:25 am

Panel: Engaging Private Property Owners to Control Stormwater On-site

Aaron Clark, Ph.D., Stewardship Partners; Jo Sullivan, King County RainWise Program; Cari Simson, Urban Systems Design; Derek Hahn, P.E., Snohomish Conservation District; Mary Rabourn, King County Department of Natural Resources and Parks

AARON CLARK *Aaron Clark is Director of Strategic Partnerships with Stewardship Partners.*

JO SULLIVAN *Jo Sullivan is a Project Manager for the King County RainWise Program.*

CARI SIMSON *Cari Simson is the owner of Urban Systems Design.*

DEREK HAHN, P.E. *Derek Hahn is a Design Engineer for Snohomish Conservation District.*

MARY RABOURN *Mary Rabourn is a Community Stewardship Specialist/Project Program Manager for King County Department of Natural Resources and Parks.*

ABSTRACT. Across the Puget Sound region, cities, counties, conservation districts, and non-profits are offering incentives, cost-shares, and other implementation models for private landowners to improve water quality and flow control through installation of rain gardens and cisterns. As municipalities work to control stormwater statewide, private land can be incorporated into their larger planning efforts to help meet NPDES permits, while also engaging the public through meaningful projects.

Our panel of regional experts will guide attendees through the basic overview of each program with information about program costs, successes and lessons-learned, as well as efforts to address equitable access to the programs. The panel will provide tangible tools, tactics and metrics for municipalities that are considering a private property program to address their NPDES permit, including how to engage low-income, people of color, Veterans, and other populations that do not typically engage in stormwater programs.

PROGRAMS REPRESENTED:

- City of Seattle/King County's RainWise rebate program has rebated over 1600 projects (2.17 million square feet of roof area captured) on residential, commercial and large roof buildings such as places of worship.
- Snohomish Conservation District's cost share and implementation model provides design/construction support and labor instead of a rebate; their program has installed over 500 projects and employs a military Veteran construction crew for implementation.
- Stewardship Partners' regional grant-funded incentive programs include a revolving loan and two small equity grants; they've provided thousands of dollars for equity grants and helped leverage and support large projects across King County.

- King County's incentive program (in pilot phase) for residential and commercial property owners in unincorporated King County will install projects that manage stormwater through rain gardens, cisterns, removal of impervious pavement and tree planting. Their program will be designed to address equity and help retrofit properties built before LID/GSI became required.

CRYSTAL A
10:25 am

Sharing Outreach the Resource Reservoir: An Online Community

Mary Rabourn, King County

MARY RABOURN *See page 4.*

ABSTRACT. Creating outreach materials? There is science, data and best practices behind human design, messages, and evaluation. If you share the too common challenge of fulfilling many or all of the NPDES requirements, finding the time create a program or materials using those practices can be daunting. The Reservoir was designed and created by permittees help with that challenge. Users can find programs and materials to use for research, outreach, to be part of a larger program, or customize and apply to their projects. We will show how you can use the tool or consider building your own or how online strategies may help manage information. The best part: knowing how to see, access, and build on what is being done and be more successful in your outreach

LEARNING OBJECTIVES. The Reservoir's online library is accessible to all permittee that request a login. Users can save time in accessing existing resources. There are contacts, images, graphics and other creative elements. It includes program background on research, approaches, evaluation. Outreach experience is crowdsourced as users add their tested materials to share.

- How to info on Resource Reservoir
- Tips on creating online tools
- Easy access to outreach tools
- Yes, related to creating online tool and strategy
- Providing access to high quality ready to use outreach programs and materials.

CRYSTAL A
11:10 am

Talking About Stormwater in Ways to Inspire People

Heather Trim, Zero Waste Washington; Betsy Adams, City of Kirkland

HEATHER TRIM *Heather has more than 25 years of experience in environmental work. Heather joined Zero Waste Washington as Executive Director in 2016 and works to reduce upstream sources of waste, get toxic chemicals out of products, reduce plastic pollution. Previously, at Futurewise and People for Puget Sound, she worked to prevent runoff from entering our waterways, improve shoreline management practices and policies and address a range of issues from community sustainability, habitats, and climate change. She works closely with a number of community partners in Seattle and throughout Washington and runs the King County ECONet list serve.*

BETSY ADAMS *Betsy Adams is an Environmental Education and Outreach Specialist for Kirkland Public Works' Surface Water Group. Since 2007, Betsy has led extensive program creation and implementation in Kirkland for pollution prevention, pet waste, car washing, stream stewardship and Natural Yard Care. She has led numerous LID program efforts including a residential rain garden program; rain garden workshops; the Yard Smart Rain Rewards LID retrofit rebate program; and helped lead the stormwater messaging work group, looking to make LID and stormwater concepts more understandable and resonant with target audiences. Betsy has been a STORM (Stormwater Outreach for Regional Municipalities) Steering Committee member since 2013.*

ABSTRACT. In order to reduce water pollution and excess flow problems associated with stormwater, Stormwater Outreach for Regional Municipalities (STORM) agencies, in partnership with nonprofit and other agency staff, conducted a research project to improve language and messaging used to describe stormwater, with a special focus on Low Impact Development/Green Infrastructure. This research project used a modified social marketing approach to look at words and messaging used to convey awareness and action to the public.

The goal was to deeply examine and question previous assumptions about stormwater messaging and to develop high impact, effective messaging that can be used consistently by all throughout the region. We had some surprising and interesting results.

This presentation will present the outcomes of this effort, including focus group and survey results. Tips and suggested wording will be included.

LEARNING OBJECTIVES. Effective communication is a critical part of the required education components of the NPDES permits. This presentation will provide specific (and tested) messaging and communications framing.

BREAKOUT SESSIONS

TRACK 2: RESEARCH AND GREEN STORMWATER INFRASTRUCTURE

CRYSTAL B
8:40 am

Results from a Regional Stream Status and Trends Monitoring Program

Rich Sheibley, USGS

RICH SHEIBLEY *Rich Sheibley is a research hydrologist with the U.S. Geological Survey and has been with them since 2008. His specialty is in water quality in streams and rivers with a focus on nutrient cycling and groundwater surface water interactions. He is a member of the Stormwater Workgroup and involved in the data collection, analysis and program design for the Stormwater Action Monitoring (SAM) program for small streams status and trends work.*

ABSTRACT. In 2015, the condition of Puget Sound Lowland streams was evaluated by collecting data for stream invertebrates, algae, water quality, sediment quality, and instream and riparian habitat at approximately 100 sites across the region. In addition, riparian and watershed-scale land cover data were compiled to aid in the evaluation of factors associated with poor (or good) biological condition. The study was the first large-scale regional assessment of stream condition conducted as part of the Stormwater Action Monitoring (SAM) program, a collaborative, regional stormwater monitoring program funded by more than 90 Western Washington municipal stormwater permittees. We used boosted regression trees and a relative risk/attributable risk analysis to determine the most important human and natural factors explaining poor biological condition in the region. Key stressors driving poor Benthic Index of Biotic Integrity (B-IBI) scores were landscape-scale watershed characteristics, physical habitat, nutrients, sediment zinc, and stream substrate characteristics. Watershed and riparian canopy cover were found to be the most important stressors to B-IBI scores at the regional scale. For the trophic diatom index, the most important factors causing poor condition were mean summer total phosphorus and nitrogen concentrations and watershed urban development. Identified key stressors and stream status in this study can help water managers to develop effective restoration and management practices. Results also provide unbiased regional estimates of stream condition that can provide context for local Puget Sound jurisdiction monitoring data. SAM plans to continue gathering stream status and trend data in the region. Over time it is expected that this monitoring effort will tell us whether our overall management strategies, including stormwater management, are improving stream health.

LEARNING OBJECTIVES. Permittees will see the results of the permittee-funded 2015 Stormwater Action Monitoring Puget Lowland stream study and implications for management. Permittees will see example of monitoring tools/techniques that might be useful within their own jurisdictions. Lessons learned from this study will inform changes to the study design as the program moves forward.

CRYSTAL B
9:25 am

Bioretention: What Have the SAM Studies Shown Us?

Isabella Burzynski, Nicole Chen and Leland O'Hanlon, Gonzaga University; Brandi Lubliner, Washington State Department of Ecology; Aimee Navickis-Brasch, Osborn Consulting

ISABELLA BURZYNSKI *Isabella is currently a senior civil engineering major at Gonzaga University, expected to graduate May of 2019. She had an internship with Associated Earth Sciences, Inc. during the summer of 2018 and plans to work there after graduation. Isabella spent most of her time working on construction sites as a geotechnical consultant, using a nuclear gauge to measure soil compaction and informing contractors of the results. She also inspected the construction of bioretention cells, observed the placement of lock-and-load walls, and conducted laboratory tests involving soils, including Proctor and sieve analyses.*

NICOLE CHEN *Nicole is a senior civil engineering major at Gonzaga University, expected to graduate in May 2019. She worked at Otak as a water resources intern during the summer of 2018 and is currently working at HDR, Inc. Nicole worked with project engineers to design stormwater pipe networks and created best management practice details and figures for a master stormwater plan. In 2018, Nicole participated in ASCE's Water Filter Competition where she helped design a sustainable and effective water filter that community members could use after a natural disaster.*

LELAND O'HANLON, EIS *Leland is currently a senior at Gonzaga University, expected to graduate in May 2019. He spent the summer of 2018 working with WCE where he spent most of his time on site with contractors observing and inspecting deep line sewer. He also spent time doing small redlines on subdivision plan sheets and working on HEC-RAS to create a flood plain analysis for an open channel. Relevant Course Work: Stormwater Management, Hydraulic Engineering, Fluid Mechanics, Hydrology, Environmental Engineering, Sustainable Systems and Design, Soil Mechanics Experience: Civil Engineering Intern, Whipple Consulting Engineers, Spokane Valley, WA Summer 2018*

BRANDI LUBLINER *Brandi Lubliner, PE, is the SAM coordinator at the Department of Ecology. She has 20 years of stormwater study and project management experience. Since 2014, she has managed the SAM program budgets, contracts, deliverables, and communications for this new collaborative program under the municipal stormwater permits. She also provides quality assurance for Eastern Washington stormwater monitoring studies.*

AIMEE NAVICKIS-BRASCH *Aimee Navickis-Brasch, PhD, PE, has 25 years of experience in stormwater management, including a robust combination of expertise in design, planning, research, curriculum development and classroom instruction, and policy development. She has spent the majority of her career working on projects in eastern Washington (EWA) and is also an adjunct engineering professor at Gonzaga University. Aimee has a PhD in Civil Engineering and her research focuses on applied stormwater research.*

WHAT HAVE THE SAM STUDIES SHOWN US. Bioretention is a commonly applied LID best management practice (BMP) for new developments and for added treatment in older developments. The magnitude and costs to adapt infrastructure necessary to manage stormwater in Washington State is substantial. Stormwater managers want to know that these facilities perform as intended for flow control and which pollutants are treated so that they can confidently install them in new and redevelopment projects across their jurisdictions.

Stormwater Action Monitoring (SAM) is a cooperative monitoring program under the municipal stormwater permits in western WA. SAM has eleven studies to date focused on some aspect of the bioretention best management practice (BMP); hydrologic performance, sizing, the engineered soil medium, toxicity removal, pollutant removal, maintenance, and owner perceptions.

So far, the studies confirm that properly designed and located bioretention facilities perform well, providing the model predicted flow control, measurable water quality benefits, and if maintained are well received by the public. Studies are also trying to improve the bioretention soil media to reduce phosphorus export and maintenance needs.

This talk will cover objectives and findings where available for the SAM bioretention studies. Come hear about performance to model expectations, media blends being tested for a no/low phosphorus export, several retrofit experiences with vastly different sized facilities, contaminant treatments, facility owner perceptions on bioretention, plant survival, and more.

LEARNING OBJECTIVES. SAM studies are specifically intended to provide stormwater managers and decision makers scientific information to improve their programs, permits and manuals.

BIORETENTION MEDIA THICKNESS AND COLD CLIMATE STUDY. This project focuses on monitoring and evaluating the effectiveness of a dual cell bioretention pond that is located on Gonzaga University's campus in Spokane, Washington. The cells each contain the Ecology approved bioretention soil media (BSM) which is composed of 40% compost and 60% sand. The primary difference between the cells is one cell was constructed to the required minimum depth of 18-inches and the other to a depth of 12-inches. Spokane County constructed this test-site in the fall of 2014 as part of their NPDES MS4 permit requirements for monitoring, specifically evaluating the effectiveness of stormwater BMPs. The study is being conducted in partnership with Gonzaga University and each year a team of senior civil engineering students contribute to the study. The goal of the effectiveness study is to evaluate and compare the runoff treatment performance of two different depths of BSM. If the results of the study indicate that the treatment performance of the two cells is statistically insignificant, the results will be used to justify a modification to the Ecology approved design guidance for bioretention areas that reduces the minimum depth to 12-inches. In addition, the goal of the study is to understand the influence of cold climates and deicers on the treatment performance of this BMP.

LEARNING OBJECTIVES. The objective of this presentation is:

- Describe how Spokane County is partnering with Gonzaga University to meet their effectiveness study requirements and how this approach could be applied by other permittees to meet similar requirements.
- Provide an overview of results collected to date including comparing results from this study to similar studies conducted in WWA.
- Discuss lessons learned in field monitoring structural BMPs and adjustment that we made to improve the quality of the data collected.

CRYSTAL B
10:25 am

Is Stormwater Harming Our Streams? Long-term Monitoring of Metals

Daniel Nidzgorski, King County

DANIEL NIDZGORSKI *Dr. Daniel Nidzgorski is an ecosystem ecologist who studies carbon, nitrogen, and phosphorus cycling, especially in urban and suburban landscapes where our everyday actions and decisions affect local water quality. He works for King County Natural Resources with a focus on lake and stream water quality, which includes public-health projects as well as watershed management and stormwater linkages. He is also passionate about advancing equity and social justice in the sciences, mentoring students, and developing engaging and effective scientific communications.*

ABSTRACT. Water-quality problems in urban and suburban streams are commonly blamed on stormwater pollution—but actual pollutant data for the receiving streams are much more limited. To understand the extent and nature of toxicity due to metals, we analyzed 18 years (1993-2010) of metals concentrations in wet-weather streamflow from 33 stream stations across King County, Washington. We assessed aquatic and human-health toxicity using state and federal regulatory water quality standards (WQSs), plus non-regulatory salmonid-specific screening values (SSVs) since concentrations below the WQSs have been shown to harm salmonids. In addition, we tested for long-term trends, and compared stormflow and baseflow concentrations (during 2001-2003 when metals were also measured in baseflow).

To begin identifying and addressing pollution sources, we used a stoichiometric signal of weathering inputs (which includes both natural and human-accelerated erosion). When weathering is the dominant input, total concentrations of many metals have been shown to correlate well with total iron concentrations, since iron is naturally present at high enough concentrations to dwarf anthropogenic non-weathering inputs.

Metals in wet-weather streamflow caused some potential aquatic toxicity, especially for salmonids. Mercury concentrations were frequently above the chronic WQS: 70% of streams had at least one exceedance. Copper, lead, and zinc concentrations were commonly above the SSVs (30% of all samples from all streams for copper, >30% for copper, and >90% for zinc).

Concentrations of most metals in most streams were well-correlated with iron. This suggests that the major source of these metals of concern was increased erosion (either natural or human-accelerated), rather than other types of pollutants. The iron-correlation analysis also identified a few streams that had multiple metals from non-weathering sources and would benefit from detailed pollution tracking.

Chromium, copper, lead, and nickel concentrations showed regional decreases over time. Calcium and magnesium concentrations increased, which can reduce the adverse effects of toxic metals. However, several individual streams had increasing trends in one or more toxic metals, so water quality has not improved universally.

LEARNING OBJECTIVES.

1. Metals in streams are a widespread concern, especially for salmonids.
2. Metals concentrations have been decreasing over time.
3. Iron correlations offer a useful tool for separating pollution sources from weathering sources, whether persistent patterns or isolated events.

CRYSTAL B
11:10 am

Panel: Using Research Outcomes to Inform Solutions for Highway Runoff

Lisa Rozmyn, Washington Stormwater Center; Claire Duchet, Benjamin Leonard and Lane Maguire, Washington State University

LISA ROZMYN *Lisa Rozmyn is the Assistant Director for the Washington Stormwater Center. In this role she focuses on bringing stormwater science and research to businesses, municipalities and citizens throughout Washington State, as well as nationally and internationally. Previously, Lisa was the Business Resource Program Manager for the WSC where she has been employed for 7 years. Lisa earned a B.S. in Environmental Science from the Evergreen State College. Prior to joining the Center, Lisa was with the Department of Ecology for 17 years working in a variety of stormwater, water quality and hazardous waste capacities.*

CLAIRE DUCHET *Claire is a post-doctoral research associate in aquatic ecotoxicology at the Washington State University Puyallup Research and Extension Center. Among others, she is currently testing the efficiency of bioretention systems and permeable pavement to reduce the toxic effects of stormwater road runoff on aquatic invertebrates. Before joining WSU, Claire was a post-doc studying mosquito oviposition and community ecology in temporary aquatic habitats at the University of Haifa, Israel.*

BENJAMIN LEONARD *Benjamin Leonard is a PhD student at the Washington State University Puyallup Research and Extension Center, where he studies the ways that green stormwater infrastructure can be used to mitigate the potentially harmful effects that stormwater road runoff has on our regional aquatic life. His research focuses on the assessment of compost amended biofiltration swales, permeable pavement, and native trees as stormwater BMPs.*

LANE MAGUIRE *Lane Maguire is a graduate research assistant at the Washington State University Puyallup Research and Extension Center. She received her B.S. in Environmental Science from the University of Oklahoma in 2017. She is currently evaluating the longevity of varying bioretention depths for preventing acute toxicity from urban stormwater runoff in the hopes of optimizing biorentention design guidelines.*

ABSTRACT. Both U.S. E.P.A. and Washington State Department of Ecology write municipal storm water permits for transportation activities, such as for Washington State Department of Transportation. Many of these are for roadways. WSU research indicates that roadway runoff is causing harm to coho salmon. Although we have found that highway runoff is a threat to aquatic life and possibly human health, WSDOT and our researchers are partnering to develop solutions. This—in combination with WSDOT's NPDES permitting requirements—is helping to protect water quality. A panel of researchers will discuss what we've learned about highway runoff, what are current and possible future solutions and what are the next steps to mitigate and eliminate runoff pollution from roads and highway systems.

LEARNING OBJECTIVES. WSDOT is a statewide municipality with coverage under an individual MS4 permit. Both eastern and western Washington municipalities will learn about the work WSDOT is doing statewide, and be given the opportunity to find out what the WSDOT permit requires in and near their jurisdictions. This will allow for ongoing and future collaborative efforts for the protection of water quality statewide.

TRACK 3: STORMWATER PLANNING AND RETROFITS

CRYSTAL C
8:40 am

Phase I Structural Stormwater Control Requirements: What Phase IIs Should Know

Ingrid Wertz, City of Seattle; Emma Trewhitt, Washington State Department of Ecology

INGRID WERTZ *Ingrid Wertz is a Strategic Advisor for the Drainage and Wastewater Division of Seattle Public Utilities. She has over 20 years of experience in water quality, stormwater management and related regulations. She received her MSE in Civil and Environmental Engineering from the University of Washington.*

ABSTRACT. There is a new requirement in the draft Phase I permit (S5.C.7) that Permittees must achieve a designated number of points for their structural stormwater control projects during the 2019-2024 permit term. This will require millions of dollars in investments in retrofitting existing developed areas and other projects to address stormwater impacts not controlled by other permit requirements. Phase IIs currently do not have a structural stormwater control requirement; however, the Phase I requirement may inform future Phase II permits.

This presentation will provide a high-level overview of the incentive point methodology in the draft Phase I permit including allowable project types, how points are assigned, and required points for compliance.

In addition, Phase Is will share their perspectives on some of the strengths and challenges associated with this draft permit requirement. Phase Is will also talk about the work to date to advocate for further study of the point framework through additional technical and stakeholder input during the 2019-2024 permit term. The objective of the further study is to make recommendations for future permit requirements to better direct investments to projects with the highest priority environmental outcomes. Phase IIs would be key participants in this process.

LEARNING OBJECTIVES. This presentation will benefit all permittees by raising awareness of the Phase I permit requirements and the work being done to achieve effective results. It will identify strengths and challenges associated with the draft Phase I S5C7 Structural Stormwater Control requirements, and is intended to generate support for further study and stakeholder input on this requirement during the 2019-2024 permit term to improve the efficiency of permit compliance by better directing investments to projects with the highest priority environmental outcomes in future permits.

CRYSTAL C
9:25 am

Small Footprint Urban Retrofit Case Study for Municipal/Industrial Applications

Ross Dunning and Laura Weiden, P.E., Kennedy/Jenks Consultants

ROSS DUNNING *Ross Dunning is Kennedy/Jenks companywide stormwater practice leader located in Federal Way, WA. Ross is a licensed civil engineer with extensive experience in the fields of industrial stormwater management and permit compliance including source control, conveyance, and treatment evaluation and design. Ross is a recognized leader in the stormwater regulatory arena with a long history as an advocate for ports and business. He has assisted dozens of industrial and muncipal clients including most of the Northwest Ports to address their NPDES permit requirements.*

ABSTRACT. The Port of Port Angeles (Port), situated on the Port Angeles Harbor on Washington State's Olympic Peninsula, is a distribution hub for Pacific Northwest forest products across the globe. Log handling and import/export operations at the Port's Terminal 3 wharf and upland support and adjacent cargo surge areas (Marine Terminal) support hundreds of jobs, fueling the local economy. Marine Terminal runoff may also entrain pollutants impactful to receiving waters. When stormwater monitoring indicated improvements were needed, the Port engaged Kennedy/Jenks Consultants (KJ) to assist with development of conveyance and treatment alternatives. Considering numerous vendor-supplied and non-proprietary technologies, KJ recommended a centralized, low-impact, vegetated, biofiltration approach based on a very successful system operating at a Port of Tacoma, WA (PoT) logyard terminal.

The Port agreed, initiating a phased program to upgrade its Marine Terminal conveyance and treatment systems. Like most over-water structures, Marine Terminal wharf runoff drained directly to the harbor through vertical deck drains and horizontal scuppers along wharf access ramps and the bullrail. Several collection and conveyance options were considered to capture and convey this water inland for treatment including under-wharf piping, re-grading wharf and access ramp surfaces, installing gutters, etc. Considering tidal and storm surge concerns, required operational grades, and construction costs the Port selected to abandon existing drainage structures, build-up the bullrail, and re-grade the wharf to drain inland. Upland areas would also be re-paved draining runoff from the Marine Terminal through a new collection system and pump station, sending required flows to a less crucial neighboring area for treatment.

During construction of Marine Terminal wharf and conveyance improvements in 2016, the Port conducted a site-specific pilot study to nail down the basis of design for a vegetated biofiltration system expanding on the protocol supporting the PoT logyard design. Pilot study results from testing multiple flowrates, considering both hydraulic capacity and pollutant effectiveness, showed impressive water quality improvement at infiltration rates up to 24 inches per hour using City of Seattle-specified biofiltration soil media (BSM).

Applying lessons learned from four years of PoT logyard operations, and considering site-specific pilot testing results, K/J designed a three-stage biofiltration system constructed in the fall of 2018. The treatment train includes a preliminary coarse aggregate filtration cell, followed by a vegetated biofiltration component, with a third polishing cell with appropriate media specified if found to be necessary based on preliminary performance monitoring.

This paper will detail the work performed to bring this important project to fruition from initial runoff characterization, pilot testing, preliminary and final design, through construction, startup, preliminary operations, and extended monitoring. The information presented will be relevant to industrial, commercial, and municipal owners, operators, planners, and engineers seeking big water quality improvements in small available spaces.

LEARNING OBJECTIVES. This paper will detail the work performed to bring this important project to fruition from initial runoff characterization, pilot testing, preliminary and final design, through construction, startup, preliminary operations, and extended monitoring. The information presented will be relevant to industrial, commercial, and municipal owners, operators, planners, and engineers seeking big water quality improvements in small available spaces.

- How will this benefit permittees in Eastern and/or Western Washington? This paper will discuss retrofit solutions applicable to both sides of the Cascade Range.
- What tools will permittees take away from this presentation? Design approaches and real-world data applicable to their projects.
- Does this presentation identify specific challenges and/or lessons learned? - Yes from this project and it's predecessors.
- How will this presentation improve efficiency of municipal permit compliance? Providing effective retrofit solutions for tight spaces.

CRYSTAL C
10:25 am

Retrofits in Forbes Creek: Focus on Efficiency and Community Benefits

Amy Carlson, Jacobs Engineering; Jenny Gaus, City of Kirkland

AMY CARLSON *Amy is a Consultant Project Manager for the North Rose Hill Stormwater Retrofit Project.*

JENNY GAUS *Jenny Gaus has worked with surface water at municipal government agencies for the last 20+ years. She has assisted with the development of the City of Kirkland's Surface Water Utility since its founding in 1998, working on topics and projects such as NPDES Municipal Stormwater Permit compliance, stream and water quality monitoring, utility master planning, and capital project identification. Currently Jenny is specializing in stormwater retrofit planning to improve flows and water quality in Kirkland's streams. She enjoys finding the places where stormwater facilities can help to achieve other City goals, and developing projects that benefit the community and the environment. Jenny has a bachelor's degree in Civil Engineering from MIT, and a master's degree in Ecosystems Analysis from the University of Washington.*

ABSTRACT. The task facing all of us as stormwater practitioners is how best to retrofit our stormwater system to meet ecological outcomes that contribute to meeting recovery targets for Puget Sound. Investments made across the Puget Sound area over the last decade have provided information on which technologies and approaches are most applicable in different scenarios. Other challenges include planning and designing these retrofits most efficiently with limited resources, and how and where to implement these retrofits to reduce the impact on, and provide benefit to, the community. This presentation describes lessons learned by the City of Kirkland on delivery efficiencies and on providing community benefits, while achieving goals of water quality and peak flow reduction by means of stormwater retrofit projects planned for the North Rose Hill Basin of the Forbes Creek Watershed.

Despite City of Kirkland's stormwater management efforts, Forbes Creek remains 303(d) listed for fecal coliform bacteria, temperature and dissolved oxygen. The Water Quality Index was noted as 30, or Poor in 2014. The Biological Index of Biotic Integrity is also in the Poor range at 14-18. The North Rose Hill sub-basin was chosen for this planning effort because the 230-acres comprises about 13% of the Forbes Creek watershed area, and yet contributes about 30% of the peak flow during a 2-year storm event. The North Rose Hill basin is mainly residential developed before modern stormwater management standards were in effect and before this area was incorporated into the City of Kirkland in the early 1980s.

The City of Kirkland is the recipient of a Washington State Department of Ecology grant that funded planning activities that included site identification, soils/geologic analysis, public engagement, and hydrologic modeling that were used to inform 30% design for three identified retrofit projects and the preparation of an implementation plan that includes funding strategies tied to the identified projects. This presentation will describe the City of Kirkland's efforts to conduct these planning and pre-design activities efficiently to maximize return on investment. In addition, this presentation will also describe how the City of Kirkland balanced sometimes competing desires of the community with the water quality and hydrologic needs of the projects.

LEARNING OBJECTIVES. We will share lessons learned on the North Rose HIll Subbasin stormwater retrofit project within the City of Kirkland that have to do with efficiency (from site identification through preliminary design). We will also share lessons learned in modifying concepts and designs to reflect community preferences and to maximize opportunities for community benefit.

CRYSTAL C
11:10 am

Country Homes Boulevard Restoration Project a Green Infrastructure/LID Retrofit

Colleen Little, Spokane County

COLLEEN LITTLE *BSCE from Gonzaga University, 1995 David Evans and Associates, Inc. 1997 to 2000 (road and drainage design EIT) Spokane County, Development Services, Road and Drainage Plan Review Project Engineer / Project Manager for Spokane County's regional stormwater (all retrofit) facilities from 2008 to present One of the Spokane County Representatives on the Stormwater Management Manual for Eastern Washington Co-author of the Spokane Regional Stormwater Manual, which is the jurisdictional design manual for Spokane County, City of Spokane, and City of Spokane Valley (adopted in 2008).*

ABSTRACT. The Country Homes Boulevard Restoration Project converted a mile-long, 30-foot-wide, asphalt V-ditch channel into a beautiful water quality stormwater retrofit facility in 2014. The entire project, aside from median islands at each end that serve as entry features to the project corridor, is within a FEMA designated floodplain. The V-ditch conveyance channel was replaced by a 48-in squashed pipe which was buried under a fully- landscaped bioinfiltration swale. 18 inches of highly organic bioengineered soil was used for pollutant capture and treatment, and to encourage healthy plant growth. The $2.1 million dollar project was funded by two stormwater grants from Washington State Department of Ecology totaling $1.75 million dollars. Both grant awards were 75/25 match funding; Spokane County's 25% match was facilitated through stormwater fees collected in high impact drainage areas in need of stormwater retrofit. The conclusions or analysis that I would present would include that the project was a success despite the significant challenges that go along with a full-scale construction project within a 25,000 ADT arterial corridor; i.e., keeping one lane open, facilitating school bus schedules, very tight equipment work-zone corridor, year-round groundwater complications, and citizen concerns about finished product, costs, maintenance, and disruption to their lives during construction.

LEARNING OBJECTIVES. The primary learning objectives for the presentation would include:

- Navigating FEMA CLOMR / LOMR process when proposing a significant overhaul / rehabilitation within a floodplain corridor (timing, permitting, public process)
- Mile-long water quality facility (large multi-segmented bioinfiltration swale concept; hybrid with plants, shrubs, trees and ornamental grasses vs sod); Bio-engineered soil (mix design, challenges); 25,000 plants used in facility (need, purpose, goals, how procured, sight distance challenges, soil regeneration)
- Current maintenance versus maintenance goals long-term
- LID Green Infrastructure as current trend; Lessons learned, and future goals

TRACK 4: INVESTIGATIONS & MAPPING, INSPECTIONS AND REVIEW

EMERALD AB
8:40 am

Mapping: Where You're Headed & How to Get There

Jennifer Schmidt, Herrera

JENNIFER SCHMIDT *Jennifer Schmidt, GISP is the Spatial Science Manager at Herrera Environmental Consultants. Jennifer has 14 years of experience using GIS, database development, and data science to help her municipal clients solve environmental problems. She is passionate about using technology strategically to streamline processes, save time, and make the most out of data.*

ABSTRACT. Beginning August 2021, all mapping requirements referenced in the Phase I and Western Washington Phase II Municipal Stormwater Permits must be in electronic format with fully described mapping standards. However, the scope of these requirements is broad, and it can be challenging for jurisdictions to determine how best to leverage their existing data to meet them. The goal of this presentation is to help attendees break down the mapping requirements from these permits into specific steps that can be implemented in GIS. We will go over each of the mapping criteria in Section 5.C of the permits in detail and discuss strategies for how to approach them in GIS using specific examples from local municipalities. We will look at questions like:

- What is the difference between outfalls and discharge points and how do you identify them in GIS without conducting an exhaustive field inventory?
- How do you determine how close a point needs to be from a waterbody in GIS to be considered a discharge point, and how does slope factor into these considerations?
- What are some approaches for automating the mapping of the contributing drainage areas for tributary conveyances to known outfalls?
- How can you identify areas that don't discharge stormwater to surface water over large geographic areas?

In addition, we will present a couple examples of how GIS can be used to map areas that are infeasible for implementing specific BMPs like bioretention or permeable pavement using specific criteria provided in the 2014 (and 2019) SWMMWW.

LEARNING OBJECTIVES.

- How will this benefit permittees in Eastern and/or Western Washington? This session will help permittees develop or refine their strategy to meet the electronic mapping requirements that are effective in 2021.
- What tools will permittees take away from this presentation? We will provide permittees with tangible strategies for meeting the permit mapping requirements in GIS.
- Does this presentation identify specific challenges and/or lessors learned? We will discuss some limitations of GIS data, when field work is really the best route, and issues that we have had to address while working through this process with different municipalities.
- How will this presentation improve efficiency of municipal permit compliance? We will try to clearly and succinctly summarize what the mapping requirements are and how to use GIS to meet them.

EMERALD AB
9:25 am

Illicit Connections, Illicit Discharges, and Identifying Sources of Stormwater Pollution: Latest Information on IDDE Field Screening and Source Tracing Methods

Jeanne Dorn, King County; James Packman, Aspect Consulting

JEANNE DORN *Jeanne Dorn is a water quality planner at King County Stormwater Services. She has created and manages Permit-required and other projects to screen for pollution sources. Projects include conveyance screening, fecal coliform total daily loads (FC TMDLs), and shellfish harvest area pollution identification and correction (PIC). She has successfully implemented new bacteria screening methods, including in-house testing for bacteria coupled with DNA lab tests to hone in on pollution types, including finding illicit sanitary sewer-to-stormwater conveyance connections and failing septic systems.*

JAMES PACKMAN *James Packman is a Senior Hydrologist at Aspect Consulting, LLC. His experience with IDDE includes: environmental compliance programs for ports, cities, and counties; identifying and tracing sources of urban stormwater pollution; and a regional evaluation of IDDE and source control data from throughout western Washington. Aspect Consulting is the lead consultant on the project presented here, which will update the IC-ID Field Manual and provide trainings on field methods for municipal stormwater staff.*

ABSTRACT. This presentation will provide a summary of work to date on a project to update the 2013 Illicit Connection and Illicit Discharge (IC/ID) Field Screening and Source Tracing Guidance Manual published by King County and to provide trainings on it to municipal staff throughout western Washington. The project, which is funded by municipal stormwater permittees via Ecology's Stormwater Action Monitoring (SAM) program, will provide timely updated information on new technologies and field methods to support implementing the illicit discharge detection and elimination (IDDE) requirements of municipal NPDES stormwater permits. The goals of this presentation are to inform municipalities of this work in progress, to convey some of the updated IC/ID methods identified to date, and to encourage municipalities to send field staff to the trainings, which will be held at various locations in western Washington in the spring and summer of 2020.

As the lead agency for the project both in 2013 and presently, King County seeks to convey the importance and the usefulness of the IC/ID Manual for water quality protection within the framework of NPDES IDDE requirements. By publishing an updated manual and providing trainings on IC/ID field methods concurrent with the next issuance of the municipal stormwater permits in Washington, the outcomes from this project will help municipalities who are implementing new IDDE programs as well as those who have had IDDE programs in place for years. The methods can also be used for attaining objectives under other elements of the NPDES permits, including total maximum daily load (TMDL) evaluations, source control business inspections, education and outreach efforts, and pollution identification and correction (PIC).

**Available at https://www.ezview.wa.gov/Portals/_1962/Documents/SAM/LakewoodD7.7-IDDEfinalreport.pdf; Fact sheet at https://www.ezview.wa.gov/Portals/_1962/Documents/SAM/FS%23005_Illicit_discharge_detection.pdf*

LEARNING OBJECTIVES. This presentation will benefit Phase I and II NPDES municipal stormwater permittees from both E. and W. Washington by providing updates on IDDE technologies and field methods, and announcing upcoming trainings in year 2020 to be held in W. Washington, open to municipal staff from both Eastern and Western Washington.

EMERALD AB
10:25 am

Municipal IDDE Program Update to Integrate Bacteria TMDL Screening

Julie Brandt, Parametrix; Kristin Terpstra, City of Bothell

JULIE BRANDT *Julie is a senior surface water engineer specializing in regulatory compliance support; watershed planning; hydrologic and hydraulic modeling; NPDES permitting; Low Impact Design (LID)/Green Stormwater Infrastructure (GSI); NEPA/SEPA environmental assessments; and municipal, industrial, and construction stormwater management. She also supports wetland restoration, fish passage analysis, and hazardous material spill control management. Julie has a certificate in Low Impact Development from WA Ecology, is a Certified Erosion and Sediment Control Lead (CESCL), and a licensed PE in Washington and Oregon. Prior to coming to Parametrix, she was a federal enforcement agent for the US. EPA.*

KRISTIN TERPSTRA *Kristin Terpstra, PE is a Senior Surface Water Engineer with over 18 years of stormwater experience in both the private and public sectors. At the City of Bothell, she works to actively improve stormwater management and reduce its impacts on residents through refined development standards, infrastructure improvements, technical assistance, and short and long-range planning. Kristin led the City's efforts in developing Bothell's Illicit Discharge Detection and Elimination Program and was a key participant in the implementation of asset management software across the City.*

ABSTRACT. The City of Bothell recently overhauled its NPDES Illicit Discharge Detection and Elimination (IDDE) program to integrate bacteria screening based on the North Creek total maximum daily load (TMDL). As a result of this project, the City has learned that while bacteria are upsettingly difficult to trace, there are several straight-forward, cost-effective approaches that can make the job easier for most situations. In the remaining cases, the effort will always require creativity, improvisation, and a toolbox of lesser-used techniques to trace the bacteria source; however, it is not always worth the time and money to use every screening approach for every possible source. More is not better.

The effort setup a 5-year roadmap to integrate the separate Phase II Municipal Stormwater NPDES Permit IDDE program with the TMDL bacteria screening based on the following goals, which will be discussed in detail during the presentation:

- NPDES Requirements: Identified and evaluated relevant IDDE & bacterial screening requirements of the NPDES Phase II Municipal Stormwater Permit, discuss City-specific needs and goals, reviewed current screening practices and information, and identified program gaps to develop a prioritized compliance response.
- Compared Other Jurisdictions: Interviewed and collected information from other jurisdictions regarding their current and past efforts to address bacteria TMDLs in their own drainage basins and identified tested approaches that can be adapted in an effective, practical, and affordable way for Bothell's use in the long-term.
- Key Stakeholders: Obtained feedback from cross-division managers and City road and maintenance crews to identify key elements that will support successful program implementation and to avoid ideas that would be impractical for field work or would not achieve permit compliance.
- Future Long-Term Strategy: Ranked the recommended action items for infrastructure, environmental impact, cost, and current staff abilities and needs to develop annual screening targets, bacteria tracing techniques, staff training curriculum, and future mapping needs.
- Updated IDDE Manual: Effectively communicated the recommended IDDE and bacteria screening strategy in written format accessible to a broad spectrum of City staff including surface water group members, field crews, and City Council members.
- Ecology Report: Documented the high-level IDDE and bacteria screening strategy for Ecology.

LEARNING OBJECTIVES. After building on the work of neighboring jurisdictions and vetting multiple bacteria screening techniques, the City is sharing this information to help other municipalities quickly select approaches that are right for their communities. This presentation will be relevant to any Eastern or Western Washington municipal NPDES permittee that has humans or animals (the most common sources of bacteria) present in their jurisdiction, with special relevance to those with a TMDL water body.

EMERALD AB
11:10 am

Utilizing Asset Management Software for IDDE Tracking & Reporting

Melissa Ivancevich, City of Shoreline

MELISSA IVANCEVICH *Melissa Ivancevich has a Master's degree in Environmental Management and has spent the last 11 years working in the environmental field in both the private and public sectors. Melissa came to the City of Shoreline in 2015 as the Surface Water Quality Specialist, and is responsible for implementing the City's IDDE program, private storm drainage inspection program, water quality monitoring program, and educates property owners on these issues. Melissa also serves as the Chair of the Stormwater Work Group's Source ID Subgroup.*

ABSTRACT. The City of Shoreline (City), Washington, is using asset management software (Cityworks) to manage Illicit Discharge Detection & Elimination (IDDE) tracking and reporting to not only exceed the 2013-2018 NPDES permit requirement, but to also meet expectations for transparency and interdepartmental coordination.

In 2013, the Department of Ecology (Ecology) developed an IDDE tracking form; however, the tracking form was not available when the permit was issued in 2012 with a legislative-mandated one-year delay. Therefore, the 2013-2018 NPDES permit does not require the use of Ecology's 2013 IDDE tracking form. In 2013, the City took a proactive approach to IDDE tracking and began utilizing Cityworks to voluntarily implement Ecology's form. The City uses Cityworks to track and report illicit discharge notifications, investigations, and illicit connection removal. Cityworks manages the process in one application and uses a mobile-friendly inspection form, thereby streamlining program administration.

This presentation is aimed at sharing the City of Shoreline's experience in utilizing Cityworks over the last five years to track and report IDDE, including saving the City time and resources, and facilitating interdepartmental communication and coordination. The goal of this presentation is for Permittees, Regulators, and Consultants to learn from the City of Shoreline's experiences in light of the upcoming 2019 NPDES Permit and learn how IDDE data can be utilized to inform other sections of the Permit.

LEARNING OBJECTIVES. This presentation is aimed at sharing the City of Shoreline's experience in utilizing Cityworks over the last five years to track and report IDDE, including saving the City time and resources, and facilitating interdepartmental communication and coordination. The goal of this presentation is for Permittees, Regulators, and Consultants to learn from the City of Shoreline's experiences in light of the upcoming 2019 NPDES Permit and learn how IDDE data can be utilized to inform other sections of the Permit.

11:40 am

EMERALD BALLROOM

Lunch

12:40 - 4:30 pm

Afternoon Breakout Sessions

TRACK 1: EDUCATION & OUTREACH AND SOURCE CONTROL

CRYSTAL A
12:40 pm

Sharp Avenue Pervious Pavement and Stormwater Infiltration Treatment Analysis

Eric Lester, City of Spokane

ERIC LESTER *Eric Lester is a registered civil engineer with 25 years experience in municipal and state highway design and construction projects. The last 4 years Mr. Lester has worked in the City of Spokane's Integrated Capital Management department.*

ABSTRACT. The Sharp Avenue street improvement project utilized two different types of permeable pavements (porous asphalt and pervious concrete) are to be constructed on Sharp Avenue. A liner and underdrain has been installed for collecting treated stormwater runoff. The underdrains will connect to a sampling monitoring station for effluent sample collection and subsequent water quality analysis.

The goal of this study is to assess the effectiveness of permeable pavements with respect to durability, infiltration rates, and water quality. The City proposes to sample the influent and effluent stormwater concentrations. Effluent sample concentrations will be measured after infiltration through the permeable pavement and sub-base. Furthermore, the City proposes to monitor durability and infiltration rates of the permeable pavements.

LEARNING OBJECTIVES. Stormwater pavement runoff will be collected and treated via controlled soil infiltration process. Samples of treated effluent will be collected and analyzed against control samples to verify treatment efficacy. If tests confirm successful results the City of Spokane will consider utilization of infiltration treatment on future projects that have favorable in-situ conditions that may exploited. Post construction test analysis will be incorporated into a project test report that will be shared with Spokane's Eastern Washington municipal neighbors and with the Department of Ecology Water Quality for assessment.

CRYSTAL A
1:25 pm

Creative Integration of Diverse Organizations to Manage Stormwater

Blair Scott and Darren Greve, King County; Marcia Davis, City of Spokane; Brandy Reed, King Conservation District

BLAIR SCOTT *For the past 10 years Blair has worked in the stormwater management field, both in the Seattle area and in Brisbane Australia. Blair is currently working for King County on surface water quality policy and the implementation of the NPDES Municipal Stormwater permit. He is passionate about taking a collaborative, multidisciplinary approach to surface water quality.*

DARREN GREVE *Mr. Greve is a strategic policy advisor for King County's Department of Natural Resources working on a range of programs and policies for land conservation and acquisition. Prior to this current role Darren developed King County's Transfer of Development Rights (TDR) and Mitigation Credit Programs from 2007 - 2015 and brings a valuable national perspective on market-based solutions for land conservation and restoration. Darren expanded the market in development right trading to achieve over $24 million in trades and 55,000 acres of permanent forest and farm land protection in the Pacific Northwest, and oversaw $9 million worth of wetland/aquatic mitigation credit sales to the private and public sectors. Darren holds an M.A. in Environmental Economics & Policy (2005) from the Bren School at UC Santa Barbara and a B.S. in Chemistry from the Colorado College (1997). He is a 2007 Kinship Conservation Fellow where he focused on market-based solutions to the Puget Sound Region's environmental challenges.*

ABSTRACT. Managing stormwater in Western Washington is challenging and expensive, yet critical for the health of our water bodies, wildlife, and human population. Pressures from population growth, urban development, and climate change further threaten to cause larger and more challenges, which complicates the management of stormwater. Federal, State, and local laws and regulations provide a foundational framework for coordinating management of water quality and quantity in the region. However, permit compliance can be considered "the minimum effort" needed to manage stormwater effectively and this compliance can also be very costly. Therefore, creative ways to manage stormwater can be found when utilizing the funding and frameworks of other agency efforts and initiatives whose original goals were not directly to improve water quality. For example, many agencies are looking to plant more trees, preserve open space, reduce urban heat island impacts, and model for future weather conditions. These goals, perhaps inadvertently, can also support and align with stormwater management goals. Government agencies, universities, and other organizations may also have separate funding sources to cover the costs of these objectives. Stormwater managers would benefit from breaking out the confines of permit compliance, and reaching across to other sectors to help assist with stormwater management best practices, find funding, and increase the intersection across diverse organizations that aim to improve the stormwater resilience of the region. This panel will discuss several initiatives in the Puget Sound region and how they are working together to manage stormwater more effectively. These initiatives include; King County's 1M Trees and Land Conservation Initiatives, the Institute for Sustainable Solution's work on reducing urban heat islands and relevant greening efforts, and the King Conservation District's Urban Tree Canopy and Stormwater Analysis project (bringing foresters and stormwater managers together). This panel will also touch on a modeling study conducted by King County aimed at determining if the region will need to size stormwater facilities larger under various climate change emissions scenarios. We will have each panelist address the following questions; (1) what existing organizations can help to advance crossing institutional boundaries to address stormwater management; and (2) what practice and research needs are priority for advancing cross-sectoral integration for managing stormwater?

LEARNING OBJECTIVES. This panel discussion will benefit permittees by challenging them to think outside of permit requirements for stormwater management and ways to fund water quality improvements. They will walk away with tools regarding, how to reach across disciplines to work on common goals and share funding that could ultimately lead to more successful and collaborative outcomes. The presentation will identify the challenges in funding permit compliance and some lessons learned on how to work across agencies to more creatively address stormwater management issues, which leads to more efficient permit compliance.

CRYSTAL A
2:25 pm

Tips and Tricks for Developing an Engaging Source Control Program

Danielle Driscoll and Kerry Neil, Snohomish County Public Works, Surface Water Management Division

DANIELLE DRISCOLL *Dani Driscoll has been a Planner with Snohomish County for the past year conducting business inspections, collaborating regionally through STORM, and assisting with public outreach. For the past eleven years, she has worked professionally in a variety of fields including: environmental education, resources management, water quality monitoring, marine species monitoring, public outreach, and organizational development.*

KERRY NEIL *Kerry is a Pollution Prevention Specialist with the Snohomish County Public Work, Surface Water Management Division.*

ABSTRACT. Snohomish County implements a Source Control Business Inspection Program that focuses on working with commercial and industrial businesses to control pollutants at the source while utilizing an education and outreach approach. County Pollution Prevention Specialists inspect businesses performing activities that could potentially pollute surface waters and the County's MS4. On-site business inspections are designed to reduce or prevent pollutants from entering the MS4 and ensure businesses implement Best Management Practices (BMP) pertinent to their site. While providing BMP technical assistance, the County is successfully protecting water quality and maintaining relationships with the business community.

Permittees will learn the basics of a Source Control Program including: authority to require BMPs at businesses, lessons learned while developing the business inventory list, process of conducting a business inspection to observe BMP usage and ensure BMP effectiveness, different BMPs for a variety of pollutants and business sectors, critical information to track, elements of a database structure, communication techniques, and progressive code enforcement strategies.

Over the years, Snohomish County has developed creative and practical strategies for implementing a Source Control Program all while successfully meeting and exceeding permit requirements. The County has navigated issues related to accessing private property, establishing outside agency partnerships (e.g. Conservation Districts, Health Districts) and working with agricultural and livestock operations.

Phase II Permittees preparing for the new permit requirements will benefit from learning how Snohomish County developed and implemented its business inspection program in a service area with both urban and rural businesses working with a variety of pollutants.

The County continues to develop and implement Source Control Program enhancements. Our future work includes facilitating more creative partnerships, promoting regional stormwater campaigns, fostering more collaboration with Phase II permittees in Snohomish County, and using social marketing techniques to develop pollutant targeted educational handouts for businesses.

CRYSTAL A
3:10 pm

Using Lean/Kaizen to Make Source Control Inspections More Effective

Kevin Buckley, Seattle Public Utilities; Jessica Branom-Zwick, Cascadia Consulting Group

KEVIN BUCKLEY *Mr. Buckley is a strategic advisor focusing on stormwater and wastewater regulatory compliance for Seattle Public Utilities.*

JESSICA BRANOM-ZWICK *Jessica Branom-Zwick leads Cascadia Consulting Group's evaluation practice, working with clients to measure and improve behavior change programs and community-based social marketing campaigns on topics such as stormwater, pollution prevention, and recycling.*

ABSTRACT. Learn how the source control business inspection team at Seattle Public Utilities (SPU) reduced median time to compliance by one-third. The presentation will share SPU's process, techniques, implementation, and lessons learned regarding a Lean process that improved the effectiveness of the program. Lean (also known by its Japanese name, Kaizen) is a business and process improvement approach that focuses on continuously improving efficiency to minimize unnecessary steps while delivering value for customers and the environment. In January 2016, SPU's source control program began a Lean transformation to bring businesses into compliance more quickly and efficiently. The business inspection team conducted a one-week Lean event, facilitated by OfficeRocket, a consulting organization, to collaboratively identify goals for the Lean transformation, barriers to efficiency, opportunities for improvement, and a plan to implement improvements. Over the next two years, the team worked together to implement improvements and identify further opportunities. In 2018, SPU commissioned an independent program evaluation from Cascadia Consulting Group, which found that the changes SPU made to the business inspection program resulting from the Lean effort substantially improved the effectiveness of the program.

LEARNING OBJECTIVES.

- How will this benefit permittees in Eastern and/or Western Washington? Phase I and II communities can learn how to implement tools to improve the efficiency and effectiveness of their source control inspection programs. SPU has already investigated, piloted, and implemented these tools-and an independent evaluation has shown them to work. Specific benefits are that customer service has been improved and businesses are coming into compliance with source control requirements quicker than before the Lean process was implemented.
- What tools will permittees take away from this presentation? - A better understanding of the Lean process and how it can be used to improve the effectiveness of their source control programs. It is hoped that by attending this presentation permittees will understand how to structure their source control inspection program so that entities pathway to compliance is quick and that entities stay in compliance longer. They will also take away lessons learned and specific improvements that SPU made to its program to speed up time to compliance.
- Does this presentation identify specific challenges and/or lessors learned? Yes, the presentation will present lessons learned around what level of effort is needed to sustain the Lean process once implemented.
- How will this presentation improve efficiency of municipal permit compliance? The focus or this project was to evaluate the effectiveness of Seattle Public Utilities business inspection program for compliance with S5.C.7. The entire project is focused on improving the efficiency and effectiveness of source control inspections, which are required by both Phase I and II communities. This project was not selected to be completed as part of the SAM program so there is no fact sheet available to permittees and interested parties on this effectiveness evaluation. Presenting at MUNICON is the perfect venue to provide this valuable information to permittees.

CRYSTAL A
3:55 pm

Common Source Control Problems and Innovative Routes to Compliance

Alison Schweitzer, King County

ALISON SCHWEITZER *Alison Schweitzer has five years of hands-on stormwater compliance and management experience, working with the industrial, construction, and municipal stormwater general permits in Washington State. Currently Alison is a Stormwater Pollution Prevention Inspector at King County. In this role she inspects commercial and multifamily residential properties within unincorporated King County, providing technical assistance and education to businesses and property owners to identify and mitigate potential pollution discharges. Alison has inspected a variety of businesses, ranging from restaurants to auto wrecking yards to dentist offices to equestrian facilities and more. She has seen the good, the bad, and the ugly.*

ABSTRACT. This presentation will review common problems observed during source control inspections, innovative solutions businesses have implemented to achieve compliance, and lessons learned from these inspections. This topic is relevant to all Permittees because it is anticipated that all Permittees will be required to perform these inspections during the next municipal stormwater permit cycle.

Source control inspections are performed at commercial, industrial and multifamily properties in order to identify stormwater compliance issues. Sites with problems are required to implement corrective actions but instead of specifying a specific pathway to compliance, it can be much more effective to allow businesses to choose their own innovative routes to compliance. By giving businesses flexibility, they will come up with creative solutions that they are more vested in and will create a deeper connection to stormwater management that will persevere long after the inspection. Source control inspections are similar across Washington, but solutions to compliance can vary depending on climate, topography, and stormwater infrastructure. Therefore, instead of providing a prescribed solution, source control inspectors must help businesses first understand the "why" behind the regulations and then provide businesses flexibility to create their own innovative route to compliance.

Source control inspections are a valuable component of a Permittee's stormwater program and, when used effectively, can not only help to reduce the sources of stormwater pollution, but can also identify illicit discharges, strengthen relationships with the community, and educate the public about stormwater management. It is important to educate people about source control, but education alone doesn't effect change. These inspections allow jurisdictions to help businesses and property owners make the connection of how their actions impact stormwater pollution and thus their surface waters, which they aesthetically enjoy, recreate in, and eat food from.

LEARNING OBJECTIVES. This presentation will benefit Eastern and Western Washington because it is anticipated that all Permittees will be required to perform source inspections during the next municipal stormwater permit cycle. Permittees will take away strategies to improve or help build their source control program to streamline compliance. This presentation identifies lessons learned to help businesses achieve and maintain compliance by allowing businesses to be creative in their route to compliance. By providing this flexibility, businesses are more likely to be vested in their solution and maintain compliance. This presentation also highlights the importance of educating businesses on why these stormwater regulations matter, connecting their actions to surface water quality.

TRACK 2: RESEARCH AND GREEN STORMWATER INFRASTRUCTURE

CRYSTAL B
12:40 pm

Infiltration Feasibility Assessment To Successful Infiltration Design and Performance

Jennifer Saltonstall, Associated Earth Sciences, Inc.; Curtis Koger, L.E.G., L.Hg.

JENNIFER SALTONSTALL *Jenny specializes in onsite stormwater management through infiltration and has managed hundreds of infiltration facility design projects from design through construction. She routinely conducts infiltration feasibility and design studies ranging from watershed-scale assessments to single-family residential projects involving field exploration, testing, ground water modeling, and geologic hazard impact assessments for shallow infiltration systems and Underground Injection Control (UIC) wells. She worked collaboratively with University of Washington evaluating the relationship between field based flow tests and grain size distribution in consolidated and unconsolidated sands, and computing hydraulic conductivity from borehole infiltration tests for application in deep UIC well systems.*

CURTIS KOGER *Curtis has extensive experience in infiltration facility testing, analysis, design and long term performance monitoring. He has completed hundreds of projects requiring field exploration, identification and correlation of geologic units, determination of soil permeability and infiltration rates, documentation of groundwater levels and flow direction, characterization of geologic stratification, groundwater modeling including mounding analyses, slope stability impact characterization, and developed innovative designs for both shallow and deep infiltration systems. He was on the Advisory Committee for the 2005 LID Guidance Manual for Puget Sound, and selected in 2009 to serve on Ecology's Technical Advisory Committee for the development of LID Standards.*

ABSTRACT. We present key findings for successful subsurface geologic characterization and estimating design infiltration rates for a range of project types. We review infiltration feasibility assessment fundamentals and design concepts, the pilot infiltration test (PIT) procedure and grain size correlation method, discuss the geology of Puget Sound, and describe how water moves through the subsurface in different hydrogeologic settings. The work is based on over 20 years of infiltration studies as part of land use application and retrofit projects, and recent work conducted as part of the Bioretention Hydrologic Performance Study (funded by Stormwater Action Monitoring). The presentation will provide guidance for municipal permit reviewers on what is contained in a geotechnical report and provide design professionals with key 'lessons learned' to improve infiltration design.

LEARNING OBJECTIVES. Practical discussion of what goes into subsurface characterization and estimating design infiltration rates. Key portions of geotechnical and drainage/stormwater reports will be highlighted, to help reviewer identify mis-matches in subsurface characterization and proposed infiltration design. Specific examples will be provided.

CRYSTAL B
1:25 pm

Enhancing the Functionality of Pervious Concrete Pavements

Mohammadsoroush Tafazzoli, Washington State University

MOHAMMADSOROUSH TAFAZZOLI *Dr. Mohammadsoroush (Tommy) Tafazzoli is an assistant professor at Washington State University. Tommy has his bachelor degree in Civil Engineering, his master's in Transportation Engineering and his presentation popularity in Construction Management. Tommy has both of the most distinguished sustainable construction credentials in the United States which are LEED AP (Leadership in Energy and Environmental Design Accredited Professional) as well as the ENV SP (Envision? Sustainability Professional). He is committed to contributing to the essential paradigm-shift in the construction education, which considers the impacts of all decisions and actions for the whole life-cycle of the projects.*

ABSTRACT. Stormwater runoffs in urban areas are the primary cause of multiple environmental issues such as pollution of water bodies, reduction of groundwater recharge, and increase in the rivers' water temperature. Each of these impacts has a wide range of environmental ripple effects. Runoffs can be effectively controlled by applying the best management practices. Pervious concrete pavements are one of the most effective tools for implementing these practices in urban stormwater management. Numerous environmental benefits of these pavements have caused them to be widely replaced with the conventional concrete. However, considering the relatively short history of these pavements,

there are still common issues in their application. Additionally, further enhancement of pavement technology depends on resolving certain limitations through further research. This paper discusses the major common issues in design, construction, and maintenance of these pavements that can lower the permeability in the surface, lead to functional deterioration, decrease service life, and reduce the efficiency of pervious pavements as a system in collecting runoffs. Recommended policies to resolve each of the issues are provided. The paper also discusses different existing limitations such as low compression strength and resistance against freeze-thaw and suggests potentials for further research to enhance the permeability and durability of the pervious concrete pavements.

LEARNING OBJECTIVES. This presentation discusses how to improve the functionality of pervious concrete pavements through design and maintenance and is expected to contribute to extending the knowledge about one of the most effective BMPs in controlling stormwater runoffs. The study also clarifies the significance of making enhancements in pervious concrete pavements technology to extend its service life.

The permittees will learn more about the impact of sedimentation of particles in the voids, clogging of the sublayer, and repeated iterations of water freeze and melt in the course of time on decreasing the permeability and infiltration/exfiltration rate of the pavement. The challenge of frost for the Washington area will be specifically explained.

The recommended research to enhance the functionality of pervious concrete pavements are listed in the following:

1. The need for practical documented feedback data on the long-term performance of existing pavements in different types of design and various climatic regions to create a database for making comparisons and identifying the successful practices.
2. A comprehensive study to find out the impacts of making changes in different design elements on sedimentation rate in the course of time.
3. Developing more accurate and comprehensive guidelines and standards in the design, construction, inspection, and maintenance of pervious concrete pavements

CRYSTAL B
2:25 pm

Development of a New BMP: Sand Filter Sidewalk Vaults

Aimee Navickis-Brasch and Taylor Hoffman-Ballard, Osborn Consulting; Jake Saxon, Spokane County

AIMEE NAVICKIS-BRASCH *See page 6.*

ABSTRACT. Constructing best management practices (BMPs) at sites with space constraints creates a challenge for jurisdictions, particularly for retrofit or redevelopment projects that are located in established urban areas. A viable solution is to develop BMPs that can fit into these built areas, such as the sand filter sidewalk vault BMP. This BMP receives runoff from roadways through a curb inlet that discharges to a vault, installed under the sidewalk. Stormwater is treated as it infiltrates through the sand media and then treated stormwater discharges to a storm drain network or drywell. The goal of this presentation is to provide an overview of the BMP development process. The specific objectives of this paper include: 1) provide an overview of the new Sand Filter Sidewalk Vault BMP as well as background information on what motivated Spokane County to develop this new BMP; 2) summarize the results from column testing sand media including how the results were used to develop the new BMP design and maintenance guidance; and 3) provide an overview of the field monitoring portion of the study which focuses on demonstrating the treatment performance of the new BMP for removing TSS, dissolved metals, and oils.

LEARNING OBJECTIVES.

- Provides permittees from both EWA and WWA an overview of the process for developing new BMPs as well as how an idea from the county was developed through research.
- Test-site is located in EWA and field results will include consideration for cold climates
- Presentation will include lessons learned for field monitoring and effectiveness studies
- This study is being conducted in compliance with the Monitoring section of the NPDES MS4 permit

CRYSTAL B
3:10 pm

Plant Selection for Stormwater Management

Brandy Reynecke, Washington State Department of Ecology

BRANDY REYNECKE *Brandy is Ecology's Eastern Region municipal grants and loans project manager and the Water Quality Program's stormwater vegetation specialist. I have a BS in botany and an MS in plant ecology.*

ABSTRACT. Throughout Washington, stormwater managers implement Low Impact Development (LID) or Green Infrastructure (GI) practices to manage stormwater quality and quantity. These practices usually require the inclusion or preservation of plants, and provide a broad range of environmental, health, and economic benefits beyond stormwater management. Often, stormwater managers have trouble with plant survival and maintenance, especially in arid and semi-arid environments. Proper plant selection and installation are critical to the success of an LID or GI project, and will ultimately save money and prevent frustration. In this presentation, I will introduce basic plant ecology principals, plant terminology, and discuss some common stormwater vegetation misconceptions. I will present a couple of arid/semi-arid environment case studies that demonstrate some of the "do's' and 'don'ts" of including vegetation in stormwater projects. I will also share a plant selection tool used in California and invite the audience to discuss the idea of developing a similar tool for Washington.

LEARNING OBJECTIVES. Municipalities often include LID practices in their stormwater management plans and projects. This presentation will discuss basic plant ecology principals and terminology, examine a couple of case studies, and discuss the use of a plant selection aid.

CRYSTAL B
3:55 pm

Assessment Protocol for Determining Rain Garden and Bioretention Facility Effectiveness

Robert Simmons, Washington State University

ROBERT SIMMONS *Bob Simmons is WSU Extension's Olympic Region Water Resources Regional Specialist. He has over 26 years of experience in providing community based water resource stewardship programs focusing on water quality in the Puget Sound region. Since 2005 he has focused much of his efforts on stormwater management at the site scale. He has developed and provided a wide range of outreach programs, including workshops, factsheets, websites, videos, newspaper articles, and radio programs. He has served as the chairperson of the Washington Governor's Council on Environmental Education and currently serves as WSU Extension's State Water Resources Program Leader.*

ABSTRACT. Rain gardens and bioretention facilities are considered to be effective tools in the Low Impact Development (LID) toolbox and are being implemented at an accelerating rate. Project partners, WSU Extension, Stewardship Partners and the City of Puyallup have developed a rain garden and bioretention assessment protocol that builds our region's capacity to monitor basic functions of rain gardens and bioretention facilities and assess factors influencing their success and failure at a regional scale. The protocol was developed to allow ease of implementation, repeatability across large geographic scales and multiple implementers, and provide data of scientific and adaptive management value. The key questions that this project answers are:

- What attributes of rain garden/bioretention functionality measured by volunteers and staff through visual observations and simple field or lab tests correlate best predict functional success of the system?
- What design, construction, and maintenance actions identifiable by volunteers and staff have the greatest correlation with functional success of a rain garden/bioretention facility?

Through an extensive literature search and two rounds of pilot studies in 4 Puget Sound counties, our team of academics, permittees, and on-the-ground experts with extensive experience in measuring rain garden/bioretention function have developed effectiveness metrics as a framework for the evaluation of rain garden/bioretention effectiveness. This framework also provides insight into how installation methods and maintenance practices predict functional success of bioretention/rain garden success. The targeted effectiveness metrics include soil characteristics, infiltration capacity, bypass/overflow frequency, plant viability, public acceptance, maintenance issues, and whether or not the installation is still collecting runoff.

This presentation will provide an overview of the metrics, data methodology, challenges and successes, how jurisdictions can access and adapt the protocol for their use, protocol limitations, and an overview of the results using the protocol on 41 sites in the Puget Sound region.

This replicable, streamlined monitoring protocol will enable NPDES permittees to monitor progress consistently, economically and effectively. It will also be a useful tool to compare and share data between municipalities allowing for region-wide evaluation of progress as well as foster collaborative approaches to shared obstacles.

LEARNING OBJECTIVES. This presentation will provide an overview of a useful tool that enables permittees to assess the functional success of rain garden and bioretention facilities. The participants will learn how to access the protocol, protocol limitations, and long term utility of the data for asset management, facility design, and investment. It will enable permittees to validate the effectiveness of installed facilities.

TRACK 3: STORMWATER PLANNING AND RETROFITS

CRYSTAL C
12:40 pm

Port Townsend Stormwater Management Plan

Paul Fendt, Parametrix; Samantha Harper, City of Port Townsend

PAUL FENDT *Paul has more than 30 years of water resources planning experience managing complex restoration, stormwater, hydraulics, and surface water projects. His expertise includes natural resource mitigation design, stream and river restoration, fish passage design, stormwater quality compliance and permitting, hydrologic and hydraulic modeling, and floodplain management. Paul specializes in leading diverse teams of scientists, engineers, planners, permitters, and designers to develop comprehensive solutions for urban water resource projects.*

ABSTRACT. The City of Port Townsend developed a comprehensive stormwater management plan to address management of their existing system and plot a course for the future of the system. The City has a legacy of lots and road rights-of-way that were platted and developed over 100 years ago, with a mismatched drainage system, steep slopes, and discontinuous areas of good, infiltrating soils. The plan is developing four key elements in a coordinated plan: 1) a plan to define and connect the discontinuous drainage system with physical improvements and protections of natural system elements; 2) defined design and detail improvements for the predominant roadside ditch drainage system; 3) capital projects to resolve existing drainage problems; and 4) an approach and guidance for single lot developers to address site infiltration, where feasible, and connect to the newly defined drainage network.

Phase 2 NPDES communities will be tasked with preparing similar plans in the next permit. As each watershed and community is different, seeing and understanding different approaches will assist the Phase II municipalities with scoping their plans.

The plan features several innovative approaches: basin-specific land use evaluations to develop protection strategies; basin impact threshold evaluations to consider different land use thresholds; and measures to address legacy platted lots that are now being constructed.

One challenge in the plan was evaluating potential impacts to existing receiving waters, which are sparse or non-existent in this western Washington community due to the Olympic Mountain rain shadow effect. Annual rainfall (about 17 inches) is half of the total just 20 miles away to the south. The rainfall and runoff rates are more like Spokane, WA than the westside communities of the Cascades, therefore some of the findings are applicable across the state.

LEARNING OBJECTIVES.

- How will this benefit permittees in Eastern and/or Western Washington? Basin planning is a key requirement in the new permit. Approaches and methods to select, evaluate, select, and plan for future development will assist the municipal permit holders.
- What tools will permittees take away from this presentation? Methods for evaluating the "maximum extent practicable" infiltration on individual lots.
- Does this presentation identify specific challenges and/or lessors learned? Yes. Basin planning with poorly defined, indistinct, or artificial drainage patterns is a unique challenge in developing communities.
- How will this presentation improve efficiency of municipal permit compliance? Permit-holders will understand the "state of the practice" and reduce expectations and concerns about compliance.

CRYSTAL C
1:25 pm

Bonney Lake Watershed Protection and Land Use Planning

Paul Fendt, Parametrix; Jason Sullivan, City of Bonney Lake

PAUL FENDT *Paul has more than 30 years of water resources planning experience managing complex restoration, stormwater, hydraulics, and surface water projects. His expertise includes natural resource mitigation design, stream and river restoration, fish passage design, stormwater quality compliance and permitting, hydrologic and hydraulic modeling, and floodplain management. Paul specializes in leading diverse teams of scientists, engineers, planners, permitters, and designers to develop comprehensive solutions for urban water resource projects.*

JASON SULLIVAN *Jason is a Planning and Building Supervisor for the City of Bonney Lake.*

ABSTRACT. The City of Bonney Lake, located in a rapidly growing part of Pierce County in the Puyallup River basin, prepared an integrated approach to watershed protection and land use planning. The purpose of the plan is to protect Fennel Creek and other receiving waters in the City. The objectives of the plan includes:

- Land use plans and development regulations that are compatible with watershed protection targets established in this analysis
- Regional and sub-regional stormwater control facilities
- Retrofitting and neighborhood redevelopment plans identified as indicated by the needs and prioritization process
- Basin-specific stormwater development standards, including infill, redevelopment, new site development, and water quality retrofits
- LID feasibility assessments
- Solutions to existing flooding problems

This effort provides a unique opportunity for the City to apply this approach to land use and comprehensive planning for its water resources. Much of the City is in the Fennel Creek basin; therefore, the City has nearly complete control over development, redevelopment, and land use decisions.

The City also prepared plans to develop, infill, and redevelop "Centers" where land use and infrastructure planning are identified and shaped in a planning process conducted in parallel with the watershed plan.

The Watershed Protection Plan features several innovative approaches: basin-specific water resource protection standards; regional stormwater facilities for new development and redevelopment; and developing a suite of measures to minimize impacts and correct existing problems. Current land use planning efforts include updating the City's Critical Area Regulations, Landscaping Code, and Zoning Code updates informed by the Watershed Protection Plan.

One challenge in the plan was finding and prioritizing basin stormwater retrofitting. The highest priority basins are fully built out with available vacant land, and the plan findings show that the basin is in a protection mode, not a restoration mode, which reduces the motivation to implement substantial capital projects to address retrofitting.

Phase 2 NPDES communities will be tasked with preparing similar plans in the next permit. As each watershed and community is different, seeing and understanding different approaches will assist the Phase II municipalities with scoping their plans. The process for adoption as an Ecology-approved basin plan with area-specific control standards is underway.

LEARNING OBJECTIVES. Briefly describe the expected outcomes and learning objectives of your presentation including:

- How will this benefit permittees in Eastern and/or Western Washington? This plan closely follows emerging guidance for the permit basin planning requirement and can provide an approach and template for Phase II communities.
- What tools will permittees take away from this presentation? Approaches for assessing watershed characteristics via hydrology.
- Does this presentation identify specific challenges and/or lessors learned? Yes, such as unique basin characteristics and development pressure.
- How will this presentation improve efficiency of municipal permit compliance?Provides an approach and template for the watershed planning requirement

CRYSTAL C
2:25 pm

Swale on Yale: P3 Regional Impact

David Schwartz, KPFF Consulting Engineers

DAVID SCHWARTZ *David E. Schwartz, PE, LEED AP, has 36 years of experience in civil engineering and is a principal with KPFF. Sustainable development and creative treatment and use of storm water are a corner stone of David's practice. He starts with conceptual design and coordination with other disciplines and carries through to working with the contractor for proper installation. He is LEED accredited and founded the KPFF Seattle's sustainable design group. A significant portion of David's experience includes urban infill projects. He is active with the Engineers Without Borders program and started the KPFF internal LEED® group.*

ABSTRACT. The objective of this project is to provide water quality enhancement for a, roughly 450 acre, portion of urban runoff from the Capitol Hill area of Seattle. Prior to the construction of the swales the runoff was discharged directly to Lake Union untreated. Stormwater runoff from the streets of upper Capitol Hill, which is a densely developed urban area, transports silts, oils, heavy metals and other pollutants from the streets to the stormwater collection system and into Lake Union. This project has significantly improved the water quality and removed a large portion of the pollutants, improving the long term environmental health of the Lake. Another significant part of the project was the City of Seattle entering into a public/private partnership providing sufficient space along the frontage to make the project a success. This project is half complete with the second half under construction, when completed, the swales will treat approximately 500 million gallons of stormwater runoff annually.

APPROACH. The project approach diverted low flows out of the current storm drainage system into the treatment system that includes a swirl separator and the swales. The project starts with a flow diversion structure which backs stormwater up using a weir to divert water towards the treatment system. Higher flows during storm events will overflow the weir and continue down the existing piped conveyance system. The diverted lower flows pass through a swirl separator to remove large sediments and floatables prior to continuing toward the swales.

Flow splitting devises are used to divide the flows from the swirl separator into the 4 individual swales. Each of the flow splitting structures has an emergency overflow to prevent excessive amounts of water flowing into the swale and to provide for maintenance of the swales. The maximum flow that the swales are intended to treat is 7.23 cubic feet per second or roughly 3240 gallons per minute during the peak flows. The different swales vary in width and length according to the space available on each block. The flow splitters are designed to divide the water so that each swale has a minimum residence time of nine minutes in a flow through condition.

SUMMARY OF METHODOLOGIES & FUNDING. As noted in the previous sections the project was developed as a public/private partnership between the City of Seattle Public Utilities (SPU) department and the private developer Vulcan Inc. This partnership was critical to the success of the overall project.

The total cost of this project is approximately $10 million. SPU received a $1 million stormwater grant from the Washington State Department of Ecology's FY2011 Stormwater Retrofit and LID Competitive Grant Program and a $1.8 million loan from the Washington State Water Pollution Control Revolving Fund Loan Program.

SPU worked with City Developers., in developing and funding the Capitol Hill Water Quality project. Vulcan Inc. provided technical and professional support and is funding $1.3 million of the overall costs, as well as dedicated a 1-foot wide sidewalk easement on private property to the City along each frontage of their development to the City so that sufficient space was available to construct the swales and still provide pedestrian walkways in the right of way. The terms of the partnership between the City of Seattle and Vulcan Inc. were spelled out in a Memorandum of Agreement that each party signed. The remaining funding was raised through issuance of bonds that were federally secured.

LEARNING OBJECTIVES. This project can act as a starting point for other Cities and Counties to provide regional facilities of this type for water quality enhancement. This is also a good example of the private public partnership that can aid jurisdictions in accomplishing similar projects.

- Does this presentation identify specific challenges and/or lessors learned? Yes
- How will this presentation improve efficiency of municipal permit compliance? The ability to provide high level water quality enhancement for large systems that are currently untreated gives agencies a different tool to meet discharge goals for water quality.

CRYSTAL C
3:10 pm

Our Green Duwamish Watershed Stormwater Strategy

Todd Hunsdorfer, King County; Carly Greyell

TODD HUNSDORFER *For nearly a decade Todd has worked on a variety of programs focused on improving stormwater quality. He has extensive experience managing stormwater education and outreach programs, administering infrastructure operations and maintenance programs, TMDL implementation, and commercial and construction code compliance programs. At King County he implements water quality grants, and a variety of other programs related to water quality.*

CARLY GREYELL *Carly Greyell has a degree in Environmental Toxicology from Western Washington University and has worked in King County's Water and Land Resources Division since 2013. During this time, she has worked on projects addressing pathways of priority pollutants to the Lower Duwamish Waterway, literature reviews about bioretention performance, studies on stormwater treatment effectiveness, and strategic planning efforts related to stormwater management and water quality improvements.*

ABSTRACT. In September 2014, King County, in partnership with the City of Seattle, launched the Our Green/Duwamish initiative to develop strategies to strengthen communities and improve air, land, and water conditions in the Green/Duwamish Watershed. With over 40 representatives from environmental groups, community-based organizations, business leaders, urban planners, public health organizations, regulatory agencies, tribes, and elected officials, this initiative intended to increase coordination of current work in the watershed at the local, state, and federal levels to better manage habitat restoration, salmon recovery, flood control, stormwater management, public health, social equity, environmental cleanups, economic development, open space preservation, water quality and more.

The outcome from this phase was a Preliminary Background Report that identified regional comprehensive stormwater management as a key to improving the health of the watershed. In 2016, a collective of stormwater experts in the watershed convened to develop a strategy for the regional management of stormwater.

This watershed based stormwater management effort has now entered the implementation phase. King County is facilitating a group of stakeholders discussing the functional processes needed to make decisions, define participation, and assess priorities for stormwater management in the watershed.

This presentation seeks to share the methods used for developing this collaborative body, discuss several of the goals and objectives identified by the stakeholder group, and highlight a mapping tool that can be used for implementing the watershed-wide stormwater management strategy, as well as assisting with Phase II NPDES permit compliance. This mapping tool is completely scalable, capable of being used to inform decision making, and measure progress at a regional or local level.

Regulatory requirements have been evolving over the last two NPDES permit cycles to include more elements focused on watershed based planning. This presentation is designed to share how Our Green Duwamish is facilitating partnerships, exploring innovative approaches to stormwater management, and enabling coordination across the landscape.

LEARNING OBJECTIVES. This presentation seeks to share the methods used for developing this collaborative body, discuss several of the goals and objectives identified by the stakeholder group, and highlight a mapping tool that can be used for implementing the watershed-wide stormwater management strategy, as well as assisting with Phase II NPDES permit compliance. This mapping tool is completely scalable, capable of being used to inform decision making, and measure progress at a regional or local level.

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BREAKOUT SESSIONS

CRYSTAL C
3:55 pm

Kitsap County Stormwater Management Action Plan

Brian Ward, HDR; Angela Gallardo, Kitsap County

BRIAN WARD *Brian has nearly 30 years of experience with stormwater planning, design, permitting, modeling, hydraulic engineering. Brian manages HDR's western Washington stormwater group where he and his team have planned for and designed Green Stormwater Infrastructure projects, prepared municipal stormwater comprehensive plans, and have provided full-service design to agencies throughout Western Washington.*

ABSTRACT. The Kitsap County Public Works Stormwater Division is charged with administering the County's Western Washington Phase II Municipal Stormwater Permit. The intent of the Permit is to require stormwater management agencies to implement various stormwater Best Management Practices throughout their jurisdiction to improve water quality conditions in receiving waters. The 2019 Permit has expanded requirements in Section S5, Special Conditions for Stormwater Management Program for Cities, Towns, and Counties, that include provisions requiring comprehensive stormwater planning.

We will develop a Stormwater Management Action Plan (SMAP) in accordance with Ecology's draft Stormwater Management Action Planning Guidance which guides permittees on selecting the highest priority drainage basin for implementing management action plans for improving water quality conditions in receiving waters (details about the SMAP process are described below).

Developing the SMAP (Track 2) is a three-step process that provides the framework for collectively addressing impacts to receiving waters.

Step 1: Conduct a Receiving Water Assessment (RWA) that determines the influence and relative contribution of the Permittee's jurisdictional area on the receiving water. For Phase II counties, like Kitsap County, the Urbanized Areas and designated Urban Growth Areas are required to be included in this step. The outcome of RWA is a list of stormwater basins to be prioritized in Step 2.

Step 2: Basin Prioritization. Basins identified in step 1 will be prioritized based on the water quality conditions in the respective receiving waters. Receiving waters conditions will be assessed by identifying the beneficial uses and desired water quality conditions in each and the highest priority will be given to basins with:

- Low to moderate levels of impairment,
- Where municipalities can exert a greater influence on land management decisions and project implementation decisions.
- Where regional rehabilitation efforts are also focused and
- Where stormwater is directly discharged to Puget Sound convergence zones.

The result is a Watershed Inventory that organizes data into a common format for further analysis.

Step 3: Develop a SMAP for the highest priority basin. The action plan will be based on protection and restoration goals, along with a list of retrofit facilities to be implemented in both the short-term (< 6 years) and the long-term (7-20 years) periods. Strategically, SMAP addresses existing problems, and lays out a plan to meet future population and density targets while protecting resources.

The draft 2019 NPDES permit expands the role of comprehensive stormwater planning as a tool for protecting and restoring receiving waters. To position the County for meeting the new planning requirements, an evaluation of County policies, codes, and intra-agency coordination opportunities to identify how stormwater management needs and the need to protect and restore receiving waters is included in the County's overall planning processes.

LEARNING OBJECTIVES. The presentation will highlight an approach for completing the new permit condition for comprehensive planning including the preparation of a Stormwater Management Action Plan. Tools that will be highlighted are methods for including past planning efforts in the SMAP and criteria for conducting receiving water assessments. Attendees will be introduced to the project approach and issues/problems encountered and resolutions developed.

EMERALD AB
12:40 pm

Implementing a Surface Water Infrastructure Inspection and Asset Management Program

Theresa Thurlow, City of Federal Way

THERESA THURLOW *Theresa Thurlow, P.E., is the Surface Water Manager for City of Federal Way and has over twenty years of experience in public works and environmental management. She has been working in recent years growing the City of Federal Way's stormwater asset management program to streamline CCTV of the City's drainage infrastructure, incorporate risk assessment for prioritization of pipe repairs and maintenance scheduling, and integrate mobile technology into infrastructure inspections.*

The original abstract was submitted with the City of SeaTac's asset management program as the case study. With the change in presenter, the case study will be primarily City of Federal Way with highlights of other regional asset management programs and their challenges.

ABSTRACT. The City of SeaTac, Washington was incorporated in 1990. When it incorporated, the City inherited the public surface water infrastructure that was operated and maintained by King County. The City continued developing commercial and residential infrastructure increasing connections to the existing surface water system. The City did not have an accurate assessment of the surface water infrastructure to guide and schedule repair and replacement of this utility and was taking a reactive stance - waiting for surface water system failure. This exposed the City to inherent risks such as property damage, flooding, erosion, and personal injuries. Surface water program changes were necessary to address these needs.

In 2013, the City revised its Surface Water Plan and adopted a proactive approach to managing their assets. The City developed an asset management program and integrated it into Utility work practices with the goal of conducting an inventory of its surface water system. The goal of the asset management program was to evaluate rank and schedule needed surface water system repairs and replacement, prior to asset failure minimizing the risk of property damage, flooding and personal injuries resulting from failures.

The City's goals for the asset management program were to:

1. Conduct an inventory of at least 12 percent of the City's surface water system each year, beginning in 2016, using video inspection equipment.
2. Adopt and maintain an asset management program to provide cost effective level of service to City residents and property owners.
3. Preemptively identify segments of the system that need maintenance and take action before asset deterioration causes flooding, erosion, and sedimentation.

It's now 2019 and the plan has been in place for several years. Has the City achieved its goals? This presentation will provide an overview of the Surface Water asset management program and address:

- How the assets are inspected, ranked and assigned for repair or replacement.
- The risks and liabilities of the asset management program.
- Successes of the program.
- Lessons Learned.

LEARNING OBJECTIVES. This presentation will be of interest for those contemplating an inspection program to improve their understanding of the surface water infrastructure network.

The presentation will describe the cameras, software, and other equipment necessary to implement an inspection program.

The presentation addresses how the City overcame challenges of scheduling, traffic control, cleaning and creating work orders for repair and maintenance.

Permittees will gain a better understanding of how to find buried, hidden and disruptive elements of their surface water infrastructure that may affect their compliance with the permit.

EMERALD AB
1:25 pm

Roadside Ditch Inventory, Inspection, and Maintenance Recommendations

Rebecca Dugopolski, Herrera; Doug Navetski, King County

REBECCA DUGOPOLSKI *Rebecca Dugopolski, PE, is an associate engineer with Herrera Environmental Consultants in Seattle, Washington with over 13 years of experience in stormwater monitoring, design, and NPDES permit compliance. She received her Bachelor's degree in Environmental Engineering from Michigan Technological University and her Master's degree in Civil and Environmental Engineering from the University of Washington. Ms. Dugopolski has worked with numerous Phase I and Phase II jurisdictions in Eastern and Western Washington to develop checklists, tools, and training to help permittees meet their NPDES permit requirements.*

DOUG NAVETSKI *Doug Navetski has over 35 years of experience working in environmental programs in the Pacific Northwest and throughout the western and southern United States. As a consultant he conducted oceanographic and ecological studies in marine, estuarine, and freshwater ecosystems throughout the western US. He has been at King County for the last 20 years and is the Managing Supervisor of the Water Quality Compliance Unit in King County's Stormwater Services Section and Municipal Permit Coordinator for King County. He is responsible for the implementation and coordination of stormwater management programs that are required by the Phase I Municipal NPDES permit. These programs include business inspections; code enforcement; public education and outreach; operations and maintenance for both the stormwater system and county-owned properties; and response programs for spills, illicit connections, and illegal dumping. Several other of his programs the Vashon Island Pollution Identification and Correction program (PIC program) and three bacteria pollution reduction programs known as TMDLs. He is also managing King County's stormwater management efforts on the lower Duwamish Superfund Cleanup.*

ABSTRACT. Roadside ditch maintenance is often an overlooked and underfunded aspect of a stormwater management program. King County was awarded a National Estuary Program grant from the Washington State Department of Ecology to evaluate roadside ditches and correlate their condition with appropriate maintenance and/or retrofit strategies. The overall project goal is to maximize the potential of roadside ditches to help manage the flow and quality of stormwater.

The first step in the project was to conduct a literature review to identify ditch maintenance practices, the impact of these practices on flow control and water quality, and prioritization strategies for adopting these practices. A total of 39 local and national ditch maintenance resources were reviewed. Most of the resources reviewed did not link ditch classification and/or condition with specific maintenance and remediation needs. Limited information was found in the literature review on prioritizing ditches for maintenance. Due to the limited information found in the literature review, the project team relied on the County Roads crews and the regional road maintenance group (ROADMAP) to provide input throughout the development of project deliverables.

A desktop assessment and field evaluation of 21 ditches in King County was also conducted. The information gathered from the desktop assessment and field evaluation, along with the literature review, was used to develop content for a ditch maintenance matrix, a ditch maintenance field guide, and a set of fact sheets.

The ditch maintenance matrix is a set of four tables that focuses on routine and corrective maintenance activities in standard ditch systems and ditch systems that have natural flow. The ditch maintenance matrix includes considerations and adjustments for different ditch surface types, flow conditions, steep slopes, and natural flow conditions.

The Field Guide for Roadside Ditch Maintenance is intended to be used by field staff and provides a user-friendly set of recommendations for each of the routine and corrective maintenance activities identified as part of this project. The Field Guide can be used as a stand-alone document or can be integrated into an existing standard operating procedure (SOP) or operations and maintenance (O&M) manual.

The fact sheets cover topics that are of interest to office-based staff and/or field crews:

- Ditch mapping recommendations
- Prioritizing ditches for inspection and maintenance
- Permit requirements for ditch maintenance
- Ditch source control strategies
- Ditch retrofit strategies
- Considerations for field evaluation of roadside ditches
- Ditch cleaning strategies
- Adjusting ditch maintenance activities when natural flow is present

Although the project focused on Western Washington, this topic and the project deliverables may also be of interest to the Eastern Washington permittees. The project deliverables are provided for guidance on ditch inventories, inspections, and maintenance, but can be modified by jurisdictions prior to implementation as needed.

LEARNING OBJECTIVES. The presentation is intended to introduce attendees to guidance on roadside ditch inventories, inspections, and maintenance that was developed by King County and vetted by the ROADMAP regional road maintenance group. Attendees (Phase I and Phase II permittees from Western and Eastern Washington, secondary permittees, and WSDOT staff) can incorporate guidance and recommendations from the project deliverables into their own inventory, inspection, and maintenance programs. The project deliverables are intended to support a wide range of permittees and can improve the efficiency of municipal permit compliance.

EMERALD AB
2:25 pm

Programmatic Approaches to Ensuring Long-term Performance of Post-Construction Stormwater Controls

Jeremiah Lehman, CONTECH

JEREMIAH LEHMAN *Jeremiah Lehman, PE, is the NW Regional Regulatory Manager for CONTECH Engineered Solutions, LLC. He holds an MS in Environmental Engineering from Tulane University and has spent 15 years in the stormwater industry. With experience in system design, regulatory development, field and lab testing, Jeremiah has been fortunate enough to work on projects and programs throughout the US, Italy, New Zealand, and China.*

ABSTRACT. If stormwater treatment systems are working, they will need periodic maintenance. Many municipal stormwater programs are focused on review and approval of new stormwater control measures (SCMs) but lack the resources required to ensure adequate ongoing inspection and maintenance. Although most permittees require submittal of an inspection and maintenance plan for post-construction stormwater management systems as part of the plan review and approval process, these plans tend to get buried in a mountain of project-related paperwork. Without clear communication and enforcement of operation and maintenance (O&M) responsibilities, SCMs are likely to provide only a small fraction of their intended benefits over the life of an installation. This performance gap is especially wide where ownership of properties changes hands shortly after the development is complete. This presentation highlights best practices from stormwater programs around the country that ensure that SCMs are properly constructed and adequately maintained.

To aid in the successful structuring of NPDES permit language regarding O&M, federal guidelines such as the EPA's 2010 MS4 Permit Improvement Guide are examined. These documents provide permit writers with suggested language to satisfactorily structure NPDES permits with enforceable O&M requirements, while allowing local variation for unique water quality issues and in response to local stakeholder input, whether maintenance of the SCM is performed by the permittee or the site owner/operator. Specific language is provided to structure legally binding maintenance agreements which allow the permittee to perform necessary maintenance or corrective actions neglected by the property owner/operator, and bill or recoup costs when they have not performed the necessary maintenance. Other examples provide guidance for tracking SCM installations within a jurisdiction, ideally in a format that is integrated into a GIS, as well as inspection, reporting and enforcement strategies to ensure compliance with the design intent of the initial stormwater plan.

Actual permit and ordinance examples are reviewed, demonstrating existing means by which permittees implement maintenance requirements of their SCMs and associated infrastructure. These include:

- Los Angeles Region, maintenance inspection and recording requirements that are passed on to owner/operators when the property changes hands.
- Washington State Phase I, requiring spot-checking of SCMs after a 10-year 24-hour storm or larger to identify and correct damage from extreme events.
- City of Carlsbad, California, where municipal code contains explicit details regarding the permittee's right to inspect stormwater facilities including performing tests, taking photographs and reviewing records.

Additionally, examples of successful maintenance agreements, as-built verification strategies, and local program enforcement approaches are discussed, showing elements that can be universally applied for O&M accountability, which will assist NPDES permit holders in ensuring lasting performance from their SCM infrastructure.

LEARNING OBJECTIVES. While design, sizing, and selection of post-construction stormwater control measures are common elements of NPDES permits and local stormwater manuals, the long-term performance of these systems depends on well-structured operation and maintenance requirements.

This presentation examines some of the challenges involved with tracking, inspecting, and enforcing maintenance needs on both private and public facilities, as well as providing real-life examples of successful permit language, ordinance structures, and enforcement strategies that address these challenges. Permit holders will be able to adapt and use these examples in their own jurisdictions, improving stormwater control function over the lifespan of each installation under their authority.

EMERALD AB
3:10 pm

Case Study: Compliance Success for Private Facility Inspection and Maintenance

Laura Frolich and Jody Lind, Snohomish County

LAURA FROLICH *Laura Frolich is a supervisor and program manager in the Surface Water Division at Snohomish County. She oversees a diverse team of stormwater professionals who execute NPDES program requirements including source control, operations and maintenance, and MS4 mapping. For 15 years, she has worked in the field of watershed management and water resources in California, Colorado and Washington. One of her specialties is municipal stormwater compliance for both Phase I and Phase II jurisdictions. She holds a B.S in Earth Sciences from CalPoly-San Luis Obispo and a M.P.A. in Public Administration from the University of Washington.*

JODY LIND *Jody Lind works as an Engineer Technician V - Drainage with Snohomish County Surface Water Management. Jody has spent the past 23 ½ years in public service including the last eight years focusing on NPDES operation and maintenance of stormwater facilities.*

ABSTRACT. With a population exceeding 800,000 residents, Snohomish County is the 3rd most populated county in Washington State. As a Phase I Municipal Permittee, SWM has implemented a successful, effective and efficient Operations and Maintenance program for over 20 years. The program has evolved to address challenges such as rapid increases in the number and types of facilities, digitizing work processes using an asset management database and updating codes and policies to meet regulatory requirements. The program encompasses 1,970 stormwater facilities, spread out over 6,000 square miles. Our dedicated efforts have led to outstanding compliance rates of over 90% each year for commercial entities.

SWM O&M program focuses on customer service, communication, and education. Through direct and personal interactions with the commercial property owners, we've increased awareness and established mutual respect. The inspector's visit each facility annually and work collaboratively to ensure timely and accurate maintenance. Once work is complete, inspectors validate right away, to demonstrate to the owner that their efforts are important to us. Although it can be time intensive, excellent customer service is a worthy investment because it creates a deeper understanding and appreciation for stormwater systems, which leads to better compliance outcomes.

It is our standard to provide customized resources to facility owners because we have learned the value of clear and personal communication. Tailored letters and corresponding site maps are critical communication tools because they allow the public to visualize an underground system, ensures the right components are addressed and enables a vendor to provide accurate quotes. Friendly postcards remind owners that we remain committed to their progress. In addition, our educational brochures have a detachable, prepaid response cards that encourage notification of completed work. Intentional communications are effective tools that outline expectations and generate compliance.

Online resources help the public understand their O&M responsibilities and the County's expectations of them. For example, our Drainage Facility Maintenance Guide depicts the county maintenance standards with appealing graphics and lay term explanations. Our interactive web map shows the countywide drainage inventory and NPDES required data layers. A current stormwater services vendor lists, shows the array of professionals available for hire, which supports owners in maintaining their systems.

Our presentation includes the essential components of a successful private facility inspection program and effective methods of ensuring compliance. It highlights the resources most utilized by the public, outreach materials that streamline communication, and tips on prioritization when developing or enhancing a program. Permittees will see examples of how personal communication, direct customer service, and excellent resources build better relationships with facilities owners and generate positive outcomes.

LEARNING OBJECTIVES.

- Our presentation will teach Permittees in Eastern and/or Western Washington the essential components of a successful private facility inspection program and effective methods of ensuring compliance from commercial facilities.

- Permittees will get exposure to the resources most utilized by the public, outreach materials that streamline communication, and tips on prioritization when developing or enhancing a program.
- This presentation focuses on the challenges of compliance using customer service, communication, and education which leads to facility owners gain a deeper understanding and appreciation for stormwater systems, which leads to better compliance outcomes long term.
- Permittees will see examples of how personal communication, direct customer service, and excellent resources build better relationships with commercial facilities owners and generate excellent compliance outcomes.

EMERALD AB
3:55 pm

Municipal Construction Stormwater Site Inspection Toolkit

Rebecca Dugopolski, Herrera; Amy Georgeson, City of Tumwater

REBECCA DUGOPOLSKI *See page 28.*

AMY GEORGESON *Amy Georgeson, Water Resources Specialist with the City of Tumwater, has over 17 years of experience in water resource management. She received a Bachelor of Arts and Science from The Evergreen State College with an emphasis on watershed ecology, hydrology and Central American studies. Her accomplishments include leading watershed groups to prioritize and implement water resource protection projects, managing pollution identification and correction programs and developing standardized pollution reduction procedures and policies for water quality protection. Currently, she coordinates and implements the Phase II NPDES Permit for the City of Tumwater, WA. Ms. Georgeson previously worked with Mason County Public Health as an Environmental Health Specialist and the State Department of Health – Office of Shellfish and Water Protection as a Public Health Advisor – Shoreline Survey Lead.*

ABSTRACT. What should an inspector be inspecting and tracking during a construction stormwater site inspection? Are inspectors inspecting and tracking the same items in neighboring jurisdictions? The City of Tumwater applied for and was awarded a Grant of Regional or Statewide Significance from the Washington State Department of Ecology (Ecology) to address these questions by developing a set of construction stormwater site inspection checklists. The primary goal was to assist municipal inspectors with more effectively tracking compliance with the municipal stormwater National Pollutant Discharge Elimination System permit. The City of Tumwater worked with a regional group that included the City of Lacey, City of Olympia, and Thurston County to develop the checklists.

The project team developed a total of five checklists:

- Initial Erosion and Sediment Control (ESC) Inspection
- Construction ESC Inspection
- Post-Construction ESC Inspection
- Construction of Permanent Stormwater Best Management Practices (BMPs)/Facilities Inspection
- Post-Construction of Permanent Stormwater BMPs/Facilities Inspection

The first step in the project was to conduct a survey of current construction inspection practices in Western and Eastern Washington. A total of 45 responses were received from 13 counties including 40 responses from Phase II permittees, three responses from Phase I permittees, and two unspecified responses. Currently, more than 50 percent of the survey respondents use jurisdiction-specific construction stormwater site inspection forms and 11 percent reported used Ecology's construction stormwater site inspection form. The remaining respondents (34 percent) reported using proprietary software and handwritten notes. Approximately 27% of the respondents currently track their inspections electronically and 73% of the respondents would like to track their inspections electronically in the future.

Development of the checklists involved reviewing the jurisdiction-specific checklists that were readily available online, provided as part of the survey, and provided by jurisdictions participating in the regional group. Two working group meetings were held with the City of Tumwater, City of Lacey, City of Olympia, and Thurston County representatives to review and comment on the proposed checklist content and to review the draft checklists.

A series of trainings were held in the fall of 2018 and the spring of 2019 to introduce the municipal construction stormwater inspection toolkit (checklists and fact sheets) and to highlight critical items for municipal stormwater site plan reviewers, municipal ESC inspectors, and municipal engineers to consider.

Although the checklists and training materials were developed in Western Washington with input from Western Washington permittees, this topic and the project deliverables may also be of interest to the Eastern Washington permittees. An implementation factsheet specific to Eastern Washington permittees was developed as one of the project deliverables. The checklists are provided as guidance for consistent tracking of construction stormwater site inspections, but can be modified by jurisdictions prior to implementation as needed.

LEARNING OBJECTIVES. The presentation is intended to introduce attendees to a set of construction stormwater site inspections that was developed by the City of Tumwater and vetted by a regional group including the City of Lacey, the City of Olympia, and Thurston County. Attendees (Phase I and Phase II permittees from Western and Eastern Washington, secondary permittees, and WSDOT staff) can incorporate guidance and recommendations from the project deliverables into their own inspection programs. The project deliverables are intended to support a wide range of permittees and can improve the efficiency of municipal permit compliance.

4:30 pm **Conference Concludes**

POSTERS

POSTER GALLERY

EMERALD C

While there is not a dedicated poster session at MuniCon 2019, a number of posters will be on display for the duration of the Conference detailing research, processes, statuses and/or results over a range of topics.

Effects of environmentally realistic concentrations of neonicotinoids on aquatic invertebrates

Claire Duchet, Washington State University

CLAIRE DUCHET *See page 9.*

Neonicotinoid insecticides represent nearly a quarter of the global market, and their use is increasing globally. They are widely used as systemic insecticides in agriculture, but are also used for lawn and garden care, and pest control. They are highly soluble in water and persistent in soil, and even though they are not intended for direct use in water bodies, they may enter in the aquatic compartment via spray drift, runoff or leaching, and contribute to downstream aquatic toxicity. In Washington State, imidacloprid is almost always detected in surface water in the Puget Sound area, at concentrations usually lower than 0.1 µg/L but exceeding 1 µg/L in some sampling sites.

Although insects appear to be the most sensitive group to neonicotinoids, some studies have shown toxicity of neonicotinoids on the crustaceans *Ceriodaphnia dubia* and *Daphnia magna*. However, most of the studies focus on single-insecticide exposure and very little is known concerning the impact of neonicotinoid mixtures on the environment and their combined toxicity on invertebrate community.

As a first step, we tested the effect of a mixture of imidacloprid, clothianidin and thiamethoxam, the most commonly used neonicotinoids, at concentrations measured in the environment, on *C. dubia*, at the population level and under controlled conditions. The mixture had a negative effect on the reproduction of *C. dubia*. Single nicotinoid-exposures did not affect the population growth rate (λ), but λ was lower under when *C. dubia* was exposed to the mixture and the mixture induced a 6 weeks-delay to reach the carrying capacity (K = 500,000 individuals).

Since neonicotinoid contamination is likely to induce a top-down trophic cascade in a community dominated by invertebrate predators, we then ran an outdoor mesocosm experiment to test the effect of the neonicotinoid mixture on an aquatic invertebrate community and to explore community-level effects. The community was sampled before the insecticide application and throughout the month following the treatment. Three weeks after exposure, the diversity of the active dispersers (mainly insects) decreased significantly in the mixture-treated pools in comparison to control, while passive disperser diversity (mainly zooplankton) increased. Among the insects, the Nematocera group (dipterans) were negatively affected by the treatments, chironomids being the most impacted taxa.

Municipal Permeable Pavement Monitoring

Mauro Heine, Kitsap County

Understanding how different permeable pavements age and deteriorate is fundamental to make good management decisions about where and when to put them in. The testing described here begins to explain our collection of the needed data to make those informed decisions.

In 2010 Kitsap County Roads installed three pilot applications of porous asphalt. In the following years more than a dozen other installations of permeable pavements were completed around Kitsap County by various departments. Kitsap County Public Works Stormwater Division began monitoring the infiltration rate of the permeable pavements soon after the Roads Division first installed its pilot porous asphalt in 2010. In 2011, after experimenting with different methods, settled on the American Society for Testing and Materials (ASTM) standard test method C 1701/C 1701M-09.

Over the years all sites have seen a decline in infiltration, though some more precipitous than others. Understanding why some sites have slowed down faster that others is difficult to tease out. Initial quality of installation seems to play a big part in longevity. If the surface was laid down well and had very high infiltration at the start, then they tended to last longer. Not surprisingly locations with less traffic wear tended to keep higher infiltration longer.

In the summer of 2018 three sites were intensively cleaned with a specialized vacuum-pressure wash machine. Pre and post testing were conducted at each site, and to better compare before/after results the exact locations were duplicated for post testing. Surprisingly not all individual test locations improved, but each site showed overall improvement as well as fewer canceled tests due to very slow infiltration. Overall there was a marked improvement, essentially erasing about 2 years' worth of clogging.

With a relative small data set, permeable pavers seem to have the advantage in low speed parking areas, they seem to plug slower and the permeable space is more easily replaced if plugging does occur. The ability to rejuvenate the surfaces with pressure washing and intensive vacuum seems promising, especially if it occurs more frequently and or earlier. The current preventative maintenance of increased sweeping, seems to be insufficient to keep the porous asphalt infiltrating adequately. Overall the proper initial installation seems to be the most important determining factor on longevity of permeability.

Storm water & escaped plastics

Margaret McCauley, U.S. EPA

The accumulation of waste plastic in our waters is increasingly causing concern. Storm water is one of the main pathways for escaped trash to reach Washington waters. EPA is working on a standard method for assessing escaped trash, with the intent that it could be used by any interested community yet produce results rigorous and replicable enough to align with the Clean Water Act and other regulatory work, such as tracking illegal dumping. This poster will show some of the process and data so far. It will highlight partnerships thus far and invite new ones.

Visualizing Sustainable Cities through Green Infrastructure

Sian Wu, Resource Media

As the Puget Sound region continues to experience a building and economic boom, there are ripe opportunities to integrate green infrastructure with new and existing projects as a viable way to reduce stormwater pollution into our rivers, streams and Puget Sound. However, are these images of green infrastructure inviting for all communities? What positive or negative associations do people have with this new way of planning and planting, and what value do they associate with it?

In 2017 Resource Media worked with the Bullitt Foundation to work with Washington Environmental Council to deploy image testing research around green infrastructure in King County. The research and resulting image bank is helping WEC continue its important work to advocate for funding of more green infrastructure adoption in the Puget Sound region. Together, we wanted to answer these questions and improve communications strategies for public-facing communications materials, as well as persuasive arguments with community leaders and policymakers at the state level.

On the outset of this research, we wanted to ascertain the specific values that people saw to green infrastructure, and what (if any) negative associations they had with it. We were particularly interested in viewpoints from neighborhoods that have not yet received a lot of investment in green infrastructure.

While Washington Environmental Council (WEC) members have been an ardent and passionate force advocating for environmental protections for over 50 years, this passion isn't always reflected outside their traditional member base. As is so often the case with nonprofits, messages and images aren't always resonating with the people we need to recruit the most. This session will review the process through which we set up the parameters and tests for the imagery and testing, as well as how we set up community photo shoots to ensure representation of the community that reflects the diversity of King County.

Bay-to-Downspout Stormwater Treatment: Oyster Shell Treatment Media for Stormwater

Richard Price, EA Engineering, Science, and Technology, Inc., PBC

Municipal permit tenants and businesses subject to business inspections have a myriad of unique stormwater treatment requirements, often limited by space, access for operation and management, cost constraints. The Port of Seattle has demonstrated the pollutand removal efficiency, and cost effectiveness of oyster shells as a treatment media for metals in stormwater.

The Port of Seattle has been conducting research on alternative stormwater treatment media including oyster shells for treatment of metals in stormwater. This poster will provide information on sourcing and preparing oyster shells for use as treatment media, and pre and post-treatment sample analysis results and removal efficiency. The poster will also address possible treatment system layout and design, and operation and maintenance of these systems.

Quantifying Stormwater Benefits of Individual Native Trees in Western Washington

Benjamin Leonard, Washington State University

BENJAMIN LEONARD *See page 9.*

Managing stormwater is a serious challenge in urban areas, particularly for rapidly growing urban communities in Western Washington. Urban trees in parks, natural areas, street-side, and on private lands combined with other green stormwater infrastructure provide excellent opportunities to mitigate the effects of stormwater runoff in the Puget Sound. While the runoff mitigation potential of forests and large tree stands is well-known there is still the need to quantify stormwater mitigation values associated with individual trees. There have been very few species-specific estimates of hydrologic benefits provided by common trees in the Pacific Northwest.

It is well known that tree canopy interception of rain and snow can delay stormwater runoff timing and reduce quantity. Unlike deciduous trees, evergreens provide important canopy buffering capacity during the winter months when storms bring large amounts of precipitation in the PNW. Tree crown size is also important because large trees provide the greatest capacity for interception. Different tree species can have different, and important influences on interception, and it is important to quantify these effects to improve models for canopy interception.

The purpose of this study is to develop a rigorously derived hydrologic dataset that shows how stormwater is captured by existing common native evergreen and deciduous trees, based on the physio-climatic conditions of the Pacific Northwest. Two evergreen species, Douglas fir (*Pseudotsuga menziesii*) and Western red cedar (*Thuja plicata*), and two deciduous species, bigleaf maple (*Acer macrophyllum*) and red alder (*Alnus rubra*) are currently being evaluated at two climatically diverse study areas around Olympia, WA. Each tree is instrumented with sensors that measure interception, stemflow, transpiration, and localized soil moisture. When combined, data from these sensors will provide a complete view of how much rainfall is managed by an individual tree. Data is being collected over two years to include seasonal variability that is typical of the region.

Evaluating Stormwater Bioretention Amendments for Removal of Organic and Biological Contaminants

Chelsea Mitchell, Washington State University

Current stormwater permitting regulations per the Washington Department of Ecology's Stormwater Manuals do not include performance measures for key pollutants like certain organics contaminants (Polycyclic Aromatic Hydrocarbons - PAHs) and bacteria (fecal coliforms, enterococci, total coliform). As a first step in determining Best Management Practices (BMPs) for the removal of these contaminants from stormwater runoff, a bench scale study will be conducted to assess the removal efficiencies of current use bioretention soil media (BSM; e.g., compost and sand), and several emerging BSM amendments. The following treatments will be compared in a bench scale stormwater filtration experiment: *1)* 60:40 sand-compost mixture alone (control), *2&3)* the sand-compost mixture amended with two different high temperature pyrolysis biochars, and *4)* the sand-compost mixture amended with aluminum sulfate (i.e., alum). These treatments have been chosen for their strong sorptive capacities and ability to enhance desirable hydraulic properties of BSM. Mini bioretention columns (PVC cylinders with dimensions 10 inches height by 3 inches diameter) will be dosed with stormwater that has been spiked with Escherichia coli and a PAH mixture representative of the PAH profiles observed in stormwater. Influent and effluent from the stormwater-dosed columns will be analyzed for the 16 EPA priority pollutant PAHs, E. coli, and water quality parameters (pH, DO, conductivity, and temperature). To compare the ability of each amendment to prevent toxicity to aquatic organisms, a Danio rerio (zebrafish) embryo bioassay will be conducted for influent and effluent samples from each column. The results of this bench scale study will be presented and will help inform the treatment design of a larger scale bioretention column experiment.

STORMWATER ACTION MONITORING AND EASTERN WASHINGTON EFFECTIVENESS STUDIES

EMERALD C

In addtion to the MuniCon Poster Gallery, learn more about the status of stormwater research being conducted in Washington. Study posters that will be on display include:

Developing a Rain Garden and Bioretention Assessment Protocol *(City of Puyallup; Washington State University; Washington Stormwater Center; Stewardship Partners)*

See abstract on page 21.

Sand Filter Sidewalk Vault BMP *(Spokane County)*

Constructing BMPs at sites with space constraints creates a challenge. A viable solution is to develop BMPs that can fit into these built areas, such as the proposed sand filter sidewalk vault. A sand filter sidewalk vault is a variation of the basic sand filter vault BMP that is defined the Ecology stormwater manuals. Specifically, a sand filter sidewalk vault is located in a vault that fits underneath the sidewalk. The primary differences between the proposed sand filter sidewalk vault and the basic sand filter vault are, the proposed BMP does not utilize a pretreatment cell and is designed to accept runoff from a larger contributing basin area.

The goal for this study is to evaluate the effectiveness of the proposed BMP. Specifically, the efficacy of the BMP to achieve Ecology treatment goals for total suspended solids (TSS), dissolved copper (Cu) and zinc (Zn), and oils. If these objectives can be met, the results from this study will be used to justify the development of a new BMP that is approved for 'general use' on future projects.

The goals for this study are achieved by conducting flow-through column testing of sand media and field testing the BMP. The purpose of the column testing was to define BMP design and maintenance guidance. The field testing includes installing the sand filter sidewalk vault at a test-site in Spokane, WA and using automated equipment to collect data. The data being collected includes pollutant concentrations from water quality samples (influent and effluent), the flow rate (influent, effluent, and overflow), and precipitation depth. Field testing began in the fall of 2018 and is projected to continue through the spring of 2020.

Bioretention Soil Media Thickness Study *(Spokane County)*

Current bioretention research suggests that TSS and dissolved metals removal typically occurs in the top 6″ of the bioretention soil media (BSM) mix. Additionally, studies have indicated that the BSM leaches nutrients and that the higher the content of organic matter (such as compost) the higher the concentration of nutrients leaching from the media. Because of these findings, there is an interest in reducing the BSM depth from the 18″ required by Ecology to a 12″ depth. The goal of this study is to develop a modified bioretention BMP that uses the existing 60:40 bioretention mix to a minimum depth of 12″ (rather than the current required 18″ depth) for providing treatment of TSS and dissolved Cu and Zn.

The goal of this study will be achieved by meeting the following objectives:

- Determine the pollutant removal efficiency of the 60:40 BSM mix at a depth of 18″ compared to 12″.
- Determine the change in the infiltration rate and saturated hydraulic conductivity of each cell over the duration of the study
- Determine whether the treatment performance goals were achieved for basic (TSS) and dissolved metals (Cu and Zn) by comparing study results to TAPE treatment goals

The goals for this study are achieved by conducting field testing on a dual cell bioretention area in which one cell contains an 18″ depth of BSM and the other cell contains a 12″ depth of BSM. The field testing uses automated equipment to collect data at the test site which is located at Gonzaga University in Spokane, Washington. Data collected includes precipitation, flow rate (influent and effluent), and pollutant concentrations from flow weighted composite water quality samples (influent and effluent). Field testing began in the fall of 2018 and is projected to continue through the spring of 2020. If the evaluation objectives can be met, the results from this study will be used to justify the development of a modified BMP that can be used on future projects, and subsequently lower the cost of bioretention construction.

Street Sweeping and Catch Basin Cleaning Comparison *(City of Ellensburg)*

Street sweeping and catch basin cleaning are operational best management practices (BMPs) that are known to reduce the transport of sediment to receiving water bodies. In the EWA National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System Phase II Permit (MS4 Permit), only catch basin cleaning is a required operations and maintenance (O&M) practice. The permit-required frequency of catch basin inspections (and potential cleanings) increased on December 31, 2018. Meeting these requirements creates a logistical and financial challenge for some EWA permittees due primarily to winter climate conditions which can prohibit catch basin cleaning for four or more months of the year. More frequent street sweeping may provide a solution to meeting the new permit requirements. Specifically, studies have shown that street sweeping can reduce the amount of sediment transported to catch basins during rainfall events. In theory, this could reduce the accumulation rate of sediment in catch basins and subsequently the frequency of which catch basins need to be cleaned.

The goal of this study is to investigate whether the frequency of street sweeping significantly influences sediment accumulation in catch basins (and transport from catch basins) during the dry season in a semiarid location. This goal is being achieved by conducting a two year study in the City of Ellensburg. The study area is a 1,065-feet long section of SR 97 which includes four catch basins located on each side of the road that each discharge runoff to a swale. During year one (2018), one side of the road (test site) will be swept and the catch basins were cleaned every other month starting in April and ending in October. On the other side of the road (control site), the catch basins were cleaned at the same time as the test site however the street was not swept. Year two begins in April 2019. For the second year, the test site and control site will switch to the other side of the road and the catch basin cleaning and street sweeping frequency will repeat the same as year 1. During the study the City of Ellensburg will use the equipment they typically use to street sweep and clean catch basins for data collection: a 2016 Elgin Crosswind J Regenerative Air Sweeper and a 2012 VacCon V311/1000 Combination Vactor Truck, respectively. Data is being collected from a weather station (located near the test site), the roadway, catch basins, and swale inlets including: precipitation, temperature, and wind speed; catch basin sediment depth; sediment (wet) weight, moisture content, organic content, and particle size distribution (PSD).

The results from this study will be used to recommend a combination of street sweeping and catch basin cleaning procedures for achieving NPDES MS4 Permit requirements for catch basin cleaning. If the study results indicate that more frequent street sweeping can reduce the rate of sediment accumulation in catch basins, the results will be used to recommend a condition in the next permit for O&M procedures that allow street sweeping practices to offset the frequency of required catch basins cleaning.

BMP Inspection and Maintenance Responsibilities *(Yakima County)*

One of the ways that Permitees are required to manage stormwater is to limit the amount of pollutants that discharge from the MS4s by implementing operational and structural Best Management Practices (BMPs) for publicly owned and privately-owned drainage systems. Stormwater management through the use of structural BMPs involves thoughtful application of site design principles, construction techniques and maintenance strategies to reduce the effect of altered hydrology and also prevent sediment and other pollutants from entering surface water or groundwater. Over time, the effectiveness of structural BMPs can become compromised due to lack of maintenance. Permitees are required by the permit to insure maintenance is performed so that adequate runoff treatment is provided. Difficulties can arise for Permitees when they try to identify and correct operational and maintenance problems with structural BMPs on private property.

This study will gather information from EWA Permitees and other permitted jurisdictions in similar semi-arid regions to identify ways that stormwater managers are ensuring how structural BMPs on private property are being properly inspected and maintained. The information will be gathered by an online survey and followed up by conducting interviews with survey respondents to gain additional insight on responses. This study is schedule to begin in 2019.

Elementary School Stormwater Education *(City of Kennewick)*

Under the National Pollutant Discharge Elimination System permits for municipal stormwater discharges, stormwater pollution prevention education and outreach programs are important elements of an effective stormwater management program. It is never too early to teach principles of stormwater pollution prevention and to this end the Drain Rangers program was developed in 2015 by the Pacific Education Institute, working together with formal educators, cities, and nonprofits throughout Washington to create an excellent stormwater curriculum that meets next generation standards.

In 2016, the Franklin Conservation District adapted the Drain Rangers program to Eastern Washington needs, and in 2018 they are implementing the program through several elementary schools (Grades 3-5) in the Quad-Cities (Kennewick, Pasco, Richland, West Richland) area of Eastern Washington.

This study will perform before and after testing on students in several elementary school classes to measure the effectiveness of the Drain Rangers program. The survey will test the students in areas of Action, Knowledge, and Attitude. The study results will then be presented in a final report, and will provide recommendations for potential improvements and further implementation of the Drain Rangers program in Eastern Washington.

Mobile Contractor Illicit Discharge Education *(City of Wenatchee)*

Under the National Pollutant Discharge Elimination System permits for municipal stormwater discharges, stormwater pollution prevention education and outreach programs are important elements of an effective stormwater management program. In 2010 the Dump Smart program, a stormwater education and outreach program designed for mobile contractors, was implemented in the urban area of six eastern Washington communities, including four jurisdictions in the Wenatchee Valley. The goal of the present study is to evaluate the effectiveness of the Dump Smart program. The present study involves a phone survey of carpet cleaning businesses in the Wenatchee Valley to determine if mobile businesses are carrying spill kits and disposing of wastewater in accordance with the Dump Smart program guidelines. Carpet cleaning businesses in a control area, where the program was not implemented, will receive the same phone survey. The survey responses will be used to compare the knowledge and practices of carpet cleaning businesses in communities that implemented the Dump Smart program and businesses in communities that did not implement Dump Smart. In addition, test area and control area jurisdictions covered under the Eastern Washington Phase II Municipal Stormwater Permit will be surveyed by email. The jurisdiction survey will request information about other education and outreach programs implemented in the areas and the number of confirmed illicit discharges associated with carpet cleaning businesses. The study results will be presented in a final report and will provide recommendations for the next phase of the Dump Smart program. The study results are anticipated to show whether the Dump Smart program should be more widely implemented or if modifications to the program to improve its effectiveness are needed.

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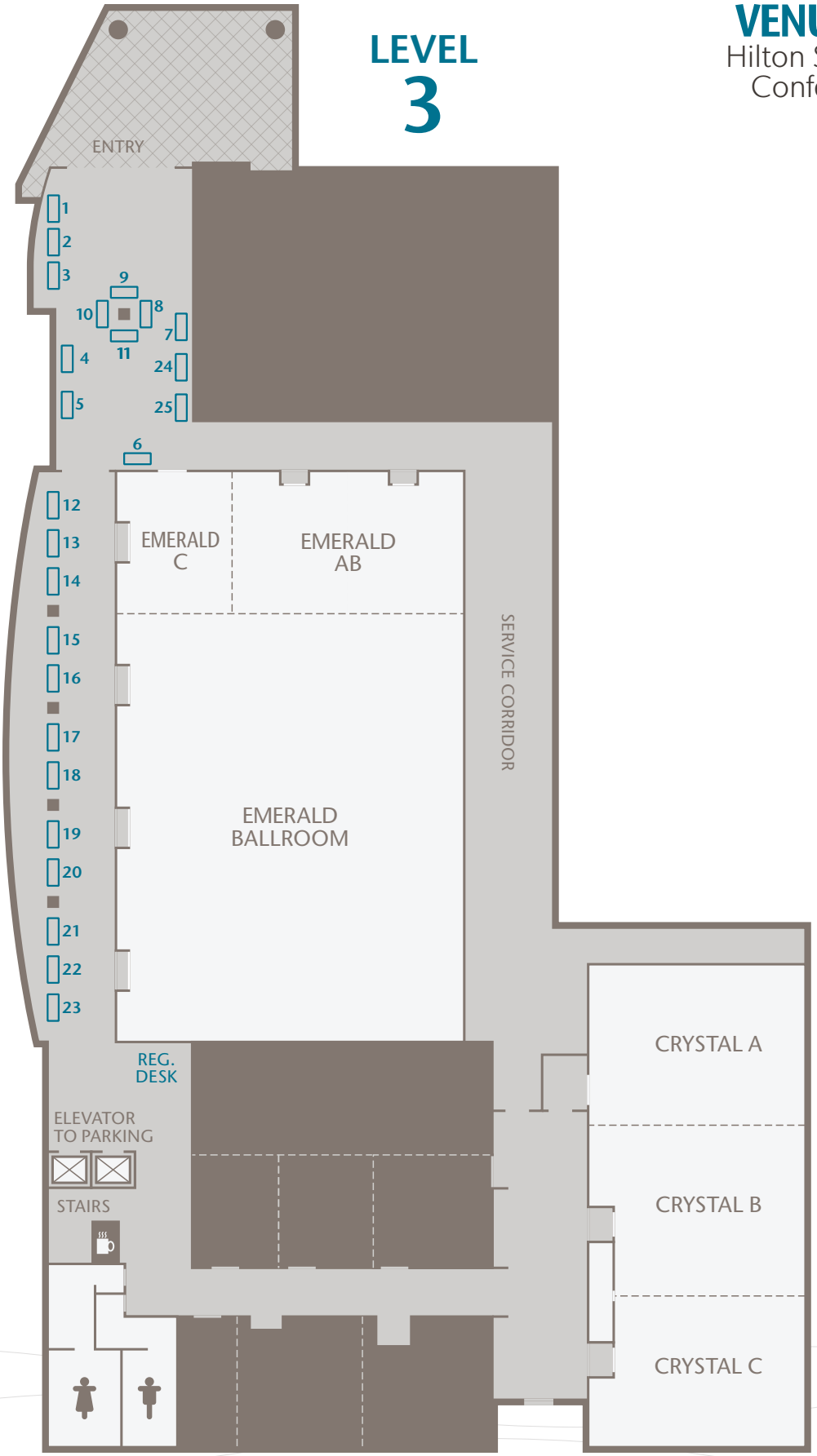

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