Monday, September 12
Session 01A: 1 Water Reuse
10:30AM – 11:10AM

Sustainably Protecting Local Water Supplies By Recharging Aquifers With MBR Effluent

Hiro Kuge[1], Amber Mummert[2], Allan Maas[3], Larry Morris[1], Yasushi Terao[1]
[1]Kubota Membrane USA Corporation, United States of America; [2]Ilani Resort; [3]Parametrix;
hiroo.kuge@kubota.com

As water supplies dry-up around the country, potable reuse has become a sustainable option to replenish water supplies. In Washington state the Cowlitz Water Reclamation Plant (WRP) is utilizing membrane bioreactor (MBR) and UV treatment technologies to reclaim treated wastewater for recharging local aquifers.

To comply with standards for recharging aquifers, the effluent must meet primary and secondary safe drinking water MCL's and Class A reclaimed water standards. This requires < 2.2 MPN/100 mL of total coliforms, an average 2.0 NTU for turbidity and < 10 mg/L total nitrogen.

Cowlitz WRP is located on the Ilani Resort site in Ridgefield, WA. The plant was commissioned in 2017 with an MMF of 195,000 gpd, expandable to 390,000 gpd. Wastewater is collected from the Cowlitz Casino and subjected to a screening process followed by MBR treatment. Flat sheet submerged membrane units separate the mixed liquor and bacteria from effluent, as well as provide most of the oxygen required for nitrification with scouring air. Prior to injection into the aquifers, the MBR effluent passes through UV.

The WRP has been operating for five years and the total plant effluent is achieving the Class A standards; total coliforms are < 1 MPN/100 mL and turbidity ranges from 0.05 to 0.15 NTU. Ammonia in the effluent falls below detection (less than 0.01 mg/L) and total nitrogen is < 5 mg/L.

Vadose zone injection is accomplished by pumping the disinfected effluent to 120-foot-deep injection wells where the water then percolates into the underlying water table replenishing the aquifer. This vadose (unsaturated soil) zone ranges from ground elevation to the top of the aquifer below. The wells operate under "Authorization by Rule" allowed by the federal Underground Injection Control Program.

It is possible to replenish local water supplies through sustainable reuse practices. At the Cowlitz WRP, wastewater is thoroughly treated to Class A reclaimed water standards with MBR and UV disinfection. The resulting treated wastewater is injected into vadose zone wells that recharge the aquifer and add to the local water supply. This presentation will be useful for municipalities exploring potable reuse applications.

Hiro Kuge

Hiro Kuge is Technology Manager of Kubota Membrane USA and is in charge of Membrane Bioreactor (MBR) design, technical service, and regional sales. He has been working with municipal and industrial wastewater treatment design, system integration, project management, construction, commissioning, operation and troubleshooting for over 18 years. He has designed, commissioned, and serviced multiple MBR plants in North America in the past 12 years.

Monday, September 12
Session 01A: 2 Water Reuse
11:15AM – 11:55AM

Predicting Drainage in North Idaho Forest Water Reclamation Facilities

Madeline Clark, Mark Coleman, Robert Heinse, Erin Brooks, Eureka Joshi
University of Idaho, United States of America; clar7370@vandals.uidaho.edu

Wastewater is an unavoidable byproduct of populated communities. In northern Idaho, treatment facilities generate wastewater and are permitted by the Idaho Department of Environmental Quality (IDEQ) to apply it to areas of forest. Forests in the Inland Northwest experience annual seasonal droughts, and applying reclaimed wastewater is a way to replenish some of that soil water. Wastewater contains constituents such as nitrogen and phosphorous, two nutrients that are known to increase plant productivity. However, if nutrients are leached into groundwater sources, these constituents may reach nearby lakes and cause harmful algal blooms. One of the intentions of this land application is to avoid any runoff or drainage. To ensure this, the IDEQ has developed a hydraulic loading calculation. This calculation includes an estimation of the crop evapotranspiration rate. To estimate evapotranspiration for forests, IDEQ recommends a crop coefficient of 0.7 be applied to the reference crop evapotranspiration rate. It is important to assess whether this recommended value does avoid drainage during the irrigation season. In addition to collecting actual drainage with drain gauges, the potential drainage occurring in irrigated forests was quantified by estimated evapotranspiration rates for local trees using hydrological models (Hydrus-1D and WEPP). The Nash-Sutcliffe model efficiency coefficient (NSE) was used to assess the predictive capability of these models with observed drainage data. Results show that with calibrated input parameters, Hydrus-1D and WEPP are successful at predicting drainage acquired by drain gauges. While WEPP is more user-friendly, both models require site-specific soil data in order to accurately predict drainage. According to the models, the estimated crop coefficient recommended by IDEQ does not result in drainage during the irrigation season in this forest system, drainage only begins following the treatment season and the start of wet-season precipitation. According to the model with a crop coefficient of 0.7, at some locations irrigation could be increased by up to 140% before potential drainage occurs. This presentation evaluates wastewater byproducts from the treatment plant operation and reuse of these materials in applications that can benefit the environment.

Madeline Clark
Madeline Clark, M.S. in Environmental Science at University of Idaho, B.S. in Conservation Biology and Ecology at Montana State University

Monday, September 12
Session 02A: 1 Social Equity
10:30AM – 11:10AM

Advancing Equity Within Different Organizational Cultures

Nicki Pozos, Jessie Maran
The Formation Lab; nicki@theformationlab.com

Social equity and justice seem to be everywhere these days, but that focus does not always improve

outcomes for the underrepresented or disadvantaged. In some organizations, the intention is there, but the actions are unclear. While in other places, equity may face internal opposition. This presentation focuses on different value systems seen in our industry (based on a system called Spiral Dynamics), with a discussion of the challenges to and opportunities for advancing equity within each value system. Understanding and working effectively within different value systems can help organizations advance equity without alienating staff. This understanding can also help individuals who don't match the dominant value system of their organization make greater progress in creating change. The point is not that one value system is better than another—we can learn to respect and work effectively with all of the value systems present in our organizations.

Nicki Pozos

Nicki Pozos, PhD, PE brings 20 years of experience developing infrastructure projects in the Pacific Northwest. Nicki brings a diverse background, encompassing a PhD in Civil Engineering, former work as a life coach, and current work helping leaders evolve their relationships with their staff, themselves, and their communities. She has worked extensively with public works departments, leading elected officials through decision processes, overseeing rate and system development charge studies, and leading preliminary design of a billion-dollar infrastructure project. Nicki is a recognized leader in promoting diversity within the water industry. She has presented on diversity and bias at numerous local and regional conferences, ranging from operator trainings to keynote presentations. Nicki is Board on the Board of Leading Water Forward, an organization dedicated to creating a more equitable future.

Monday, September 12
Session 02A: 2 Social Equity
11:15AM – 11:55AM

Getting Specific on Equity in a Project Plan and Aligning a Team: Why Common Language isn't Enough

Brent Robinson[1], Brenda Gardner[2], Sam Keller[2]
[1]Murraysmith; [2]Seattle Public Utilities; Brent.Robinson@murraysmith.us, brenda.gardner@seattle.gov, Samantha.Keller@seattle.gov

Seattle Public Utilities (SPU) has invested considerable time and resources in its staff to build capacity for racial equity, both as a value that is commonly shared, as well as a lens through which projects and programs can be shaped to better center the communities SPU serves. While many at SPU have embraced holding equity as a common value, understanding specifically how each project and program should proceed and eventually make decisions guided by equity is still a growing practice. The Longfellow Starts Here project is a combined sewer overflow reduction project that seeks to shape what an equitable planning approach could look like, especially one that is still heavily constrained by regulatory forces. While developing the planning approach, the project team struggled to align various staff groups and management on the approach specifics, even though everyone involved was aligned on the value of racial equity and the need to be community centered. This presentation will illustrate the approach the project team used to elevate and clarify the misaligned expectations and the framework used to guide hard conversations to align on a "north star" to better ground approach definition.

Brent Robinson

Brent Robinson is a professional engineer at Murraysmith with 11 years of experience in engineering analysis and planning in both the private and public sectors.

Brenda Gardner
Brenda Gardner is a professional engineer at Seattle Public Utilities with 15 years of experience in design, analysis, and planning.

Sam Keller
Sam Keller is a Senior Community Partnerships Planner at Seattle Public Utilities with 10 years of experience in community organizing and racial equity work.

Monday, September 12
Session 03A: 1 Treatment - Phosphorous
10:30AM – 11:10AM

Online Phosphorus Stability Analyzer: Quantifying the Risk of BPR Upset

Adrienne Menniti, Skylar Watnick, Peter Schauer

Clean Water Services, United States of America; mennitia@cleanwaterservices.org

Biological phosphorus removal (BPR) has been a cornerstone of the Clean Water Services (CWS) effluent phosphorus permit compliance strategy for decades. To reliably meet a stringent effluent phosphorus permit with limited chemical use, it is useful to have an early warning metric for detection of upsets in the secondary effluent. We have demonstrated the effectiveness of an online orthophosphate (OP) analyzer coined the 'Stability Analyzer' to better understand BPR Stability. The analyzer has been operating on aeration basin one (AB1) at the Durham Water Resource Recovery Facility since 2017.

The location of the stability analyzer was determined by repeated aeration basin orthophosphate profiling. We call its location at about 50% through the aerobic zone the stability point because generally phosphorus uptake is complete by this point during stable operation. Therefore, the stability analyzer reads zero during stable operation and becomes non-zero during unstable operation. We observe two types of conditions where the Stability Analyzer offers early warning of upset events:

1. The daily average Stability Analyzer OP concentration has read zero for at least three days followed by an increase into non-zero daily average territory. This was found to have a 50% risk of upset 2-6 days in the future.
2. The daily average Stability Analyzer OP concentration is already non-zero and the daily average concentration increases the next day. This was found to have a 77% risk of upset within the next 3 days.

A new aeration basin (AB5) recently came online at the Durham facility. AB5 is configured differently and has larger anoxic and anaerobic volumes. CWS repeated the profiling procedure for AB5 during its first summer of operation (2021) to determine the stability point. An online OP analyzer was installed at the AB5 stability point in February 2022.

The Stability Analyzer has proven useful in predicting BPR stability. The purpose of this paper is to review the profiling procedure used to locate the stability point, quantify the risk of an upset event using several years of historical stability analyzer data and summarize how the stability analyzer is used for routine process decision making.

Adrienne **Menniti**

Adrienne Menniti, PhD, PE is a Principal Process Engineer at Clean Water Services. Adrienne received her bachelor's degree in Civil and Environmental Engineering from the University of Cincinnati and her master's and doctoral degrees from the University of Illinois at Urbana-Champaign. Dr. Menniti has extensive experience in planning, design, optimization and troubleshooting of wastewater treatment processes.

Monday, September 12
Session 03A: 2 Treatment - Phosphorous
11:15AM – 11:55AM

Toward Reducing Nonpoint Phosphorus Discharges: A Novel, Commodity-driven Process for Recovering Phosphorus from Dairy Manure

Cody Peters, Erik R. Coats
University of Idaho, United States of America; pete1389@vandals.uidaho.edu, ecoats@uidaho.edu

Excess phosphorus discharged to the water environment is increasingly scrutinized to prevent/minimize eutrophication and enhance overall water quality. To improve water quality, phosphorus waste load allocations (WLAs) into a given water body are regulated through the Total Maximum Daily Load (TMDL) process. Water resource recovery facilities (WRRFs) are acutely impacted by TMDLs and phosphorus WLAs; indeed, WRRFs in the Pacific NW are facing significant investments to either remove phosphorus in compliance with imposed WLAs or to divert reclaimed water away from impacted water bodies. However, WRRFs are often not the dominant source of phosphorus in surface water; nonpoint sources often are a bigger source. In Idaho, and to a lesser degree Washington and Oregon, dairy manure land application can be a significant source of environmental phosphorus – although commensurate treatment expectations do not align with those imposed on municipal WRRFs. Recognizing that financial incentives (i.e., revenue generation) will likely be more influential in achieving dairy manure treatment, research at the University of Idaho has focused on advancing a technology to capture manure carbon as a bioplastic (i.e., polyhydroxyalkanoate, PHA). Recently the research team has discovered that the PHA technology also removes nearly all phosphorus present in the influent wastewater. Of particular interest, preliminary data indicates that P is bacterially stored in a similar manner to that observed in enhanced biological phosphorus removal (EBPR) – yet the PHA reactors are operated fully aerobic, not consistent with EBPR theory. Ongoing research is establishing i) speciation/form of sequestered P, ii) the presence of phosphorus accumulating organisms in this atypical EBPR process configuration, and iii) the mechanism for excess P removal. Results from these investigations will be presented and discussed. This work will not only be potentially impactful to management of animal waste in the PNW region, but fundamentally may shed new light on the EBPR process. We believe the work well aligns with this year's motto of "Be Like Water: Adapting with Purpose," and will fit nicely into the "Treatment Innovation and the Future" category of this year's conference.

Cody Peters

Cody Peters is a graduate student working in Dr. Erik R. Coats' environmental engineering research group at the University of Idaho. Dr. Coats' research focuses on developing new knowledge and new process configurations for achieving improved biological nutrient removal from municipal and industrial wastewaters.

Erik **Coats**

Dr. Erik R. Coats is a Professor of Environmental Engineering at the University of Idaho; Dr. Coats also regularly consults with Mountain Waterworks on wastewater projects.

Monday, September 12
Session 04A: 1 Facility Operations & Maintenance
10:30AM – 11:10AM

Why My Brand-New Equipment Shakes, Rattles, and Rolls

John Koch
HDR, Inc., United States of America; John.koch@hdrinc.com

Condition assessments have brought to the forefront many long term and ongoing issues with mechanical equipment. Finite element (FEA), modal, and vibration analyses has been employed during Level 3 and 4 stages of condition assessment to determine natural frequencies of the equipment, vibration frequencies, and amplitudes as well as how to increase equipment natural frequency to reduce vibration. Many vibration issues encountered during condition assessments can be attributed to equipment installation and anchoring.

There are many ”best practices” when it comes to mass and size of concrete equipment foundations that range from 3 to 5 times the mass of the equipment. With the sophistication and the ability to run FEA on desktop computers, the size and mass of concrete equipment pads can be determined. All of these design tools and best practices are for naught if the equipment is not properly secured and fastened to of the concrete. Sleeve manufacturers, individual/corporate standard details, textbooks, codes, You-tube videos, old gray-haired engineers, and contractors can provide examples of “how-to” anchor rotating equipment to concrete foundations. Many of these details are not applicable in today’s construction environment.

Equipment is not as “stout” as it was 40 to 50 years ago which means its stiffen and mass is less. The reduction in materials allows equipment manufacturers to thrive in this very competitive world. Older name-brand manufacturers have been taken over by big corporations where profit is often a top priority ahead of quality, reliability, and longevity. This overall philosophy has resulted in equipment that is more susceptible and prone to vibration.

API, PIP, and ANSI/HI have standard details that the industry should be following but trying to convince more seasoned engineers and contractors can be troublesome if not downright impossible. This presentation will examine photographs, details, and the results of using the “old” standards as well as what the current standards of installation should be for rotating equipment.

John **Koch**

John (PE, BCEE) serves as HDR's technical design and startup specialist for wastewater pumping, wastewater advanced treatment, and water treatment facilities. He brings more than 45 years of experience, specializing in the design of large capacity sewage pumping stations and is HDR's primary technical expert for resolving mechanical, controls, and hydraulic issues with pumping facilities. John also serves as primary commissioning and startup lead for HDR's membrane water and wastewater treatment facilities.

Monday, September 12
Session 04A: 2 Facility Operations & Maintenance
11:15AM – 11:55AM

Focus on Affordability: A Creative Approach to Increasing Hydraulic Capacity

Gregory Humm[1], Jue Zhao[2], Steve Celeste[2], Troy Thomson[2], Maria Claudia Reed[1]
[1]Brown and Caldwell, United States of America; [2]City of Salem, Oregon; ghumm@brwncald.com, jzhao@cityofsalem.net, mreed@brwncald.com

The City of Salem (City) and Brown and Caldwell (BC) are working collaboratively to achieve affordable hydraulic capacity increases at the City's Willow Lake Water Pollution Control Facility (WPCF). The joint efforts are on track to increase capacity by 32 million gallons per day (mgd) by identifying and resolving hydraulic bottlenecks.

BC used two modeling software platforms, Visual Hydraulics (VH) and InfoWorks, to estimate the peak hydraulic capacity of each segment of the WPCF and to identify hydraulic bottlenecks.

The models identified three flow bottlenecks. In the "north" plant, the VH Model confirmed that removal of existing weir plates originally intended to provide adequate submergence on the trickling filter pumps could be removed to increase trickling filter effluent flow to the south plant by 10 mgd without any cost. Increased flow conveyance to the secondary treatment process in the south plant reduces the need to put wet weather facilities into operation. The increased flow conveyance was confirmed through full scale testing by plant operations.

Further analyses of the north plant using the InfoWorks model concluded that an increase of 12 mgd could be achieved through the north plant by making physical improvements to eliminate bottlenecks. The benefit here is similar, a higher level of treatment of wet weather flow is achieved while simultaneously postponing the need to place wet weather facilities in operation. Those improvements were integrated into the design of a clarifier upgrade project at a cost of approximately $500,000.

The "south" plant hydraulic bottleneck was due to insufficient primary effluent conveyance capacity and constrictions created by Parshall flumes. By replacing the flumes with magnetic flow meters and adding a parallel conveyance pipeline, the bottlenecks were cleared, gaining 15 mgd of capacity. These improvements, estimated to cost $1,800,000, are currently under design.

In total, the City will invest approximately $2.3 million to eliminate the three major bottlenecks and increase plant capacity at a cost of less than $100,000 per mgd. Achieving an equivalent capacity increase by constructing additional unit processes would easily cost 10 to 15 times more than this amount.

Gregory Humm
Greg Humm served as project manager on the project. Greg focuses on wastewater treatment plant design projects and has completed a variety of different project throughout his 42-year career.

Jue Zhao
Jue Zhao is Wastewater Treatment Division Manager for the City of Salem. She oversees the City of Salem's wastewater treatment plants which serving a population of 200,000 residents.

Maria Claudia Reed

Maria Claudia Reed has supported numerous wastewater projects in her tenure at Brown and Caldwell. Her technical expertise includes hydraulic modeling and process mechanical design.

Monday, September 12
Session 05A: 1 Collection Systems - Pumping
10:30AM – 11:10AM

Pumping to Greater Heights: BES' Collaborative and 3DBIM-Driven Pump Station Upgrades

Jen Murphy[1], Huong Nguyen[2], Robert Bacon[2], John Welch II[2], Stan Orr[3]

[1]Parametrix, Inc, United States of America; [2]City of Portland, Bureau of Environmental Services (BES); [3]Stettler Supply & Construction; JMURPHY@PARAMETRIX.COM, Huong.Nguyen@portlandoregon.gov, robert.bacon@portlandoregon.gov, john.welch@portlandoregon.gov, StanO@stettlersupply.com

In 2017 the City of Portland, Bureau of Environmental Services (BES) embarked on a project to upgrade and replace the Broadway and 94th pump station. The age of the existing facilities was approaching 40 years, it was not seismically resilient, and it was located at the end of a local drainage pathway leading to sediment inundation. BES engaged the Parametrix team to address these facility challenges. Additionally, BES used this project to pilot project delivery via three-dimensional Building Information Modeling (3D BIM) software. This was the first time 3D BIM was used to design and construct a BES facilities project and this delivery approach is now BES' standard for these project types. The benefits of this 3D design is valuable for Wastewater Treatment Plant Operators as they assess plant impacts of new equipment and layouts.

Throughout design, the City-Consultant team navigated the challenges of implementing a new delivery method, which required modifying existing City standards and delivery models. The team was able to heavily leverage the 3D BIM model to communicate design alternatives, proposed details, and achieve rapid consensus of stakeholders within the organization. In addition, the design team collaborated with Operation and Maintenance staff, Construction Management staff, the Contractor, which enabled the City to complete the project with low change orders (approximately 2%) and high satisfaction of O&M staff. The new pump station meets O&M level of services and has improved seismic resiliency. This technical and delivery success reflects the cohesive team built throughout project delivery.

This presentation will discuss the specific challenges and associated solutions relating to station design requirements and the delivery method pilot. The speakers include the Consultant Project Manager, City Engineering Project Manager, City Construction Manager, City Operations and Maintenance Manager, and the Contractor Superintendent. This team will present their multiple perspectives and specific strategies used to build a truly dynamic and cohesive team that successfully collaborated to deliver this project.

Jen Murphy

Jen Murphy is a Sr Project Manager and NW Water Market Lead at Parametrix. She has over 16 years of experience partnering with clients to deliver pump station and treatment upgrades at facilities with capacities up to 800 MGD. She is passionate about providing creative client centric solutions, innovation within the water industry, and empathy led storytelling.

Huong Nguyen

Huong Nguyen is a Senior Engineering Associate within the Treatment and Pumping System Division within the Bureau of Environmental Service at the City of Portland. Huong has over 14 years of experience in wastewater engineering and serves as a Project and Design Manager on Pump Station and Treatment Plant Rehabilitation and Upgrade projects. She is passionate about meeting operations needs and serving as a responsible steward of public funds.

Robert Bacon (*from LinkedIn*)

My current position is with Milestone System Inc. as a Solutions Engineer. In this position I collaborate on a national and global level with Milestone partners and end users to design and bring together solutions to meet physical security needs.

I have worked in the security vertical for over 17 years. I have strong IT and electronics systems background.

My personal development experience has ranged from low voltage technician (fire alarm, intrusion, CCTV and access control), programmer, project manager, operations manager, and systems engineer.

John Welch II (*from LinkedIn*)

Experienced with stormwater and wastewater design, AutoCAD, surveying, land development regulations, permitting and project management

Ability to quickly learn new software programs and technical equipment

8 years of experience creating budgets, communicating goals, and recording decisions

Experienced at creating meeting agendas, minutes and technical memos

Stan Orr

Monday, September 12
Session 05A: 2 Collection Systems - Pumping
11:15AM – 11:55AM

Challenges of Installing a Wastewater Pump Station over an Artesian Aquifer

Erik Waligorski[1], Tyler Whitehouse[1], Ken Miller[2], Fei Tang[2], Rick Powell[3]
[1]Carollo Engineers, Seattle, WA; [2]Lakehaven Water & Sewer District, Federal Way, WA; [3]Robinson Noble, Inc, Tacoma, WA; ewaligorski@carollo.com

Lakehaven Water and Sewer District (District), located between Seattle and Tacoma, needed to design and construct a new 9.3 million gallons per day (mgd) submersible pump station (PS 33B) located on a constrained site surrounded by wetlands, a stream, and challenging subsurface conditions. This presentation highlights the unique design and construction elements, including lessons learned, of installing a large collection system pump station on a small site with unsuitable materials, pressurized aquifers, and adjacent stream and wetlands. This information can be applied to design of pump stations within the collections system, or pumping facilities located within a Wastewater Treatment Plant environment where high groundwater is present and can impact the design and operation of the facility.

The project site for the new pump station is approximately 95-foot wide by 100-foot long located along a busy residential roadway and is bordered by Hylebos Creek to the east and wetlands to the west. Nine geotechnical borings were performed at the site and identified three different pressurized aquifers within 40 feet of existing grade, including a lower artesian aquifer encountered at 37 feet below grade that creates a water head extending 19 feet above ground surface if punctured. The subsurface soils from 0 to 30 feet depth included a slightly pressurized middle aquifer followed by an upper aquifer with groundwater at grade. It was also determined that the top seven feet of soil at the project site were unsuitable and would need to be removed and replaced.

The most critical design challenge was maintaining global stability of the site by ensuring that the lower aquifer would be protected and not punctured during all phases of construction of the new improvements. Design requirements implemented to protect the lower aquifer included:

- Limiting open excavation volumes during removal and replacement of unsuitable soils.
- Adding temporary fill to the site extending two feet above proposed grade during installation of the wet well.
- Installing the wet well via a 28-step sink-in-place caisson method that included dewatering two separate aquifers, maintaining high water levels inside the caisson, and diver assistance.

The installation of the 21-foot deep rectangular sink-in-place caisson took approximately eight weeks to accomplish with multiple challenges encountered during construction, including slowed caisson sinking due to sloughed material, maintaining water levels in the caisson to prevent aquifer blowout, and swelled water stops requiring diver intervention.

Erik Waligorski

Erik Waligorski is a Principal Infrastructure Engineer with Carollo in their Seattle office. He has over 25 years of experience in the design and construction of water and wastewater conveyance facilities.

Monday, September 12
Session 06A: 1 Stormwater - Design
10:30AM – 11:10AM

Stormwater Parks: A New Model for Regional Retrofits

Paul Fendt, Seth Sokol
Parametrix, Inc., United States of America; PFendt@parametrix.com, ssokol@parametrix.com

Stormwater retrofits can protect impaired receiving waters from pollution from outdated legacy development while helping manage planned growth. However, too often these facilities are fenced-in "stormwater prisons" that fail to deliver a full range of public benefit. An emerging new concept explores the joint need for both public open spaces and stormwater retrofits that create new public spaces with multiple uses: stormwater parks.

The speakers will first talk through the planning and design of a stormwater park. This process starts with a needs assessment that identifies open space deficiencies and subbasins within the watershed that are most likely to benefit from stormwater management actions beyond current development requirements. After defining the multi-purpose project objectives and engaging stakeholders, the team develops stormwater park concepts, conducts preliminary engineering, seeks funds, acquires land, and completes

design of the facility. At this point, the speakers will present several case studies and share lessons learned on recent stormwater parks such as the one soon to go into construction in the City of Marysville and several in Kitsap County. Finally, once the park has been built it is critical that the benefits of the facilities are distributed equitably by deciding who can buy in to the provided capacity and ensuring that public resources aren't unfairly benefiting private development.

Throughout the presentation, the speakers will identify three key ideas for successfully planning and implementing stormwater parks: how space-making has evolved the stormwater facility from utility to broader purposes like providing desirable public spaces and educational opportunities; why the newest generation of proprietary filtration media has transformed the scale of what is possible in a given footprint; and what characteristics make a site optimal for such a facility.

Paul Fendt

Paul Fendt, P.E. of Parametrix. Paul is a civil engineer in the Puget Sound region who specializes in stormwater planning and engineering for large-scale watershed, stormwater, and surface water projects. His experience includes GSI planning and design; storm and surface water management planning; stormwater quality compliance; flood control and flood studies; stormwater permitting; water quality studies; and hydrologic and hydraulic modeling.

Seth Sokol

eth Sokol, P.E. of Parametrix. Seth is passionate about water resources and problem solving, so he is always looking for ways to combine those in his career. Based in Portland, Oregon, he has been involved in stormwater parks from the vendor side at Contech Engineered Solutions and as an engineer at Parametrix. His core skills are in stormwater treatment, collection, conveyance, and flow control. He also has experience in fish passage design, riverine and flood modeling, wastewater conveyance, and industrial stormwater treatment.

Monday, September 12
Session 06A: 2 Stormwater - Design
11:15AM – 11:55AM

Designing with Maintenance in Mind

Robin Kirschbaum
Robin Kirschbaum, Inc., United States of America; Robin@robinkirschbaum.com

The Washington State Department of Ecology requires all projects across the State to plan for and perform appropriate preventive maintenance and performance checks at regular intervals to ensure that stormwater facilities are adequately maintained and properly operated. However, the majority of project planning and implementation effort is often focused on the initial design and construction of the facilities, with less attention to optimizing the life cycle cost and feasibility of maintaining the facilities over the long-term.

The asset owner (i.e., private property owner or public asset manager) is typically not involved during the design and construction phases; but they inherit the consequence of decisions made by others. If factors such as access and ease of maintenance for each and every design component are not sufficiently

assessed, the useful life of the facility may be less than expected, the intended benefits of the project may not be delivered, and the total life cycle project costs may be unreasonable.

This presentation will review three case studies, including the Seattle Public Utilities (SPU) Ballard Natural Drainage System Phase II, the SPU Capitol Hill Water Quality Project Retrofit, and the Kitsap County Suquamish Regional Stormwater Treatment Facility. These projects represent a wide range of contributing drainage areas, from 8 to 435 acres, and a broad mix of site settings, including ultra urban, residential, and rural/commercial. Each case study includes specific examples of how designs evolved based on available monitoring data and feedback from maintenance crews and community members. Lessons learned from these case studies are presented regarding how to design for successful long-term maintenance and operation.

Robin **Kirschbaum**

Robin is a civil engineer with expertise in project management, asset management, operation and maintenance, stormwater retrofits, and Green Stormwater Infrastructure (GSI) design. She brings over 20 years of consulting engineering experience and a deep passion for developing sustainable solutions for water infrastructure and the environment.

Monday, September 12
Session 07A: 1 Treatment - Biosolids
10:30AM – 11:10AM

Design of Pocatello's Biosolids Reuse and Recovery

Colter Hollingshead[1], Skyler Allen[2], Jared Richens[1]
[1]Keller Associates, Inc., United States of America; [2]City of Pocatello;
chollingshead@kellerassociates.com, sallen@pocatello.us

The City of Pocatello has one of the largest liquid biosolids handling and land application practices in the Pacific Northwest. The City's primary and secondary biosolids are treated in mesophilic anaerobic digesters and then held onsite in a sludge holding lagoon prior to seasonal liquid land application on farm fields. This type of operation requires a significant amount of effort, and the City is beyond their biosolids storage capacity. To improve the overall handling capacity and reduce operator effort, the City is now modifying its sludge handling process to incorporate mechanical dewatering. The City is implementing dewatering in a phased approach to balance project costs with the available capital budget, which will limit the financial impact on the community.

The transition to mechanical dewatering will provide substantial benefits to the overall capacity of the biosolids handling. One of the primary benefits of mechanical dewatering is that it will optimize the use of space at the treatment facility by eliminating the need for the large sludge storage lagoon. Also, because the liquid solids have historically been an important soil amendment on the existing fields, dewatered solids will still be land applied according to agronomic schedules, just in fewer loads. Additionally, the City is considering composting as a potential new commodity. Having a dewatering system will provide flexibility to allow composting to be tested since composting requires dewatered biosolids as raw material.

However, the transition to a mechanical dewatering system also provides some challenges to ongoing operations at the facility. Mechanical dewatering can negatively impact liquid stream treatment capacity due to increased nutrient recycling from the pressate stream, which is particularly difficult for the City, as

their treatment has incorporated enhanced biological nutrient removal. With the additional nutrient recycle, there is also an increased potential for struvite formation. Each of these challenges will be discussed along with the creative solutions being incorporated into the design.

Colter Hollingshead
Colter is the project manager for Pocatello's biosolids improvement project. He has bachelor's and master's degrees in Civil and Environmental Engineering from Utah State University and is a licensed professional engineer in Wyoming, Utah, and Idaho.

Skyler Allen
Mr. Allen is a registered Idaho Civil Engineer with the City of Pocatello, overseeing projects and improvements to the City's major infrastructure components, including the Water Pollution Control Facility.

Monday, September 12
Session 07A: 2 Treatment - Biosolids
11:15AM – 11:55AM

Is a Thermal Hydrolysis Process (THP) the Right Solution for Your Facility?

Majid Neyestani, Cameron Clark
Carollo Engineers; mneyestani@carollo.com, cclark@carollo.com

Thermal Hydrolysis is a thermal conditioning treatment process used to enhance anaerobic digestion. A growing number of facilities are considering THP when evaluating solids stabilization technologies. THP is often viewed as a complex process. A typical THP system consists of solids screening, pre-THP dewatering, pre-THP dewatered cake storage, cake transfer pumps, THP reactors, steam boilers, and a solids cooling system.

The purpose of this paper is to illustrate how the key advantages and disadvantages of various technologies can be used to facilitate decision-making when evaluating solids stabilization technologies. This paper reviews the THP process in detail and summarizes the evaluation of three representative plants in which THP plus anaerobic digestion was compared to mesophilic anaerobic digestion only. The representative plants were evaluated using economic, environmental, social, and technical criteria. The results of this analysis show the following drivers for THP:

- Producing Class A biosolids
- Increasing volatile solids reduction
- Producing more digester gas
- Improving dewaterability of biosolids
- Increasing the capacity of existing digesters or reducing the required volume of new digesters
- Increasing community acceptance due to enhanced aesthetics and local product use
- Reducing truck traffic
- Reducing digester foaming concerns

Conversely, the drawbacks of THP include the following:

- Many utilities have safety and staffing concerns about the need for steam boilers and certified steam boiler operators.

- Potable water must be used for post-THP dilution to maintain Class A biosolids classification which could be problematic for utilities in water scarce regions.
- Some facilities find that soil blending or other post-processing steps are necessary to produce a more valuable and acceptable biosolids product. Biosolids post-processing adds cost and infrastructure required to generate a desirable biosolids product.
- Polymer consumption by Pre-THP dewatering can increase O&M costs considerably.

Because needs and priorities may vary significantly among facilities, a holistic analysis is required to understand tradeoffs of a THP process.

Majid Neyestani

Dr. Neyestani has more than 10 years of experience in research, planning, design and operation of wastewater treatment systems. His experience encompasses treatment capacity analysis and optimization of both liquid and solids stream processing including primary and secondary treatment, disinfection, and solids thickening and dewatering.

Cameron Clark

Mr. Clark is an environmental engineer with more than 20 years of experience in wastewater treatment plant evaluation, design, research, and operation. He specializes in wastewater solids treatment, particularly high-performance anaerobic digestion and biogas utilization. He is also experienced in energy and mass balances, greenhouse gas evaluations, and sidestream nutrient recovery technologies.

Monday, September 12
Session 08A: 1 Innovative Stakeholder Involvement
10:30AM – 11:10AM

The City as a Stakeholder in Holistic Approach to Distributive Infrastructure Management

Mark Reiner, Shannon McElvaney
Jacobs, United States of America; Mark.Reiner@jacobs.com

On February 9th, 2022, a massive 42-inch diameter, 100-year-old water transmission main burst and resulted in catastrophic flooding in Philadelphia. Deferred maintenance is a hazard. After every major infrastructure failure, there is a window of opportunity to create discourse of the benefits resulting from a proactive cross-sector (water, energy, communications, etc.) analysis of a city's remaining risks and vulnerabilities. The ongoing barrier to effective bottom-up infrastructure planning by municipal senior staff is the lack of informed insights and information to be better informed advocates for improved maintenance and management of their infrastructure assets. Becoming effective stakeholders in utility management and CapEx prioritization with all utility providers requires a common language and KPIs.

The baseline of our Business as Usual is clear. At the national level, the – "US needs a new approach to invest in resilient infrastructure and communities." (Brookings Institute, Dec. 20, 2018). On a household financial level in the United States – each household will have an average loss of $3,300 per year due to deteriorating infrastructure through 2039 (2021 ASCE Failure to Act). And, even at the water utility level, consider that the current paradigm has resulted in our water mains having an average life span of only 47 years – approximately only 60% of intended service life (material dependent). The path to the resilient city is not built on an infrastructure paradigm that fosters deferred maintenance and hurried construction.

Rather, the city as a stakeholder needs information relevant for understanding existing vulnerabilities and the ability to communicate to the public.

This presentation will discuss Jacobs' Kaleidoscope predictive analytics app and the Geodesign methodology that helps cities to assess vulnerabilities and threats across six key sectors of fixed horizontal infrastructure. Its cross-sectoral, approach provides a valuable, big picture view of infrastructure vulnerability that is complementary to traditional single sector asset management. And provides an aging infrastructure baseline for the outcomes of a city's Hazard Mitigation Plan. Kaleidoscope uses the power of spatial analytics to identify exactly where infrastructure is most vulnerable so leaders can make informed, objective decisions on where to spend their limited budgets.

Mark **Reiner**

Mark has 25 years of experience as a professional engineer and geologist, with an emphasis on developing resilient infrastructure paradigms to protect against acute and chronic hazards for the developed and developing nation contexts. The common denominator of his work has been to focus on the connection of reliable access to basic infrastructure services as foundational to viable communities. Mark's career spans design and construction management of dams along the Colorado Front Range to the infrastructure sustainability assessment of Kigali, Rwanda. Mark has authored 16 vetted publications on infrastructure resilience ranging from civil engineering journals, book chapters, and co-authoring a report for the United Nations International Resource Panel.

Monday, September 12
Session 08A: 2 Innovative Stakeholder Involvement
11:15AM – 11:55AM

Promising Research on Eliminating PFAS and PFOA using Pyrolysis Process

Valentino Villa, Garrett Benisch, Elizabeth Bridges
Bioforcetech Corporation, United States of America; v.villa@bioforcetech.com

Recent testing by the EPA that confirms the Bioforcetech system's ability to destroy or reduce PFAS, PFOA, and other CEC's to non-detectable levels from biosolids in our OurCarbon product. The research team published an article on February 14th, 2022 in the Journal of the Air and Waste Management Association outlining the process and the results. A summary of the project will be presented as explained below.

In 2019, Bioforcetech initiated testing of our process to determine our ability to eliminate CEC's from biosolids. To do this, Bioforcetech isolated a single large batch of biosolids and tested samples of this batch for PFAS, PFOA, and PFOS at each step of our drying and pyrolysis process. An initial sample was taken of digested biosolids at 17% solids content, a second sample was taken of 91% solids content after the batch was dried in our patented BioDryer, and a third sample was taken after the batch was carbonized in our P-FIVE pyrolysis machine. The analysis of these samples, conducted by Vista Analytical Laboratory, showed the reduction of 38 PFAS, PFOA, and PFOS compounds from a significant presence in both of the biosolids samples to below detectable levels after pyrolysis.

In June 2020, Bioforcetech was approached by the EPA requesting to test the potential destruction of PFAS with their process. To test the system, the EPA designed a series of tests on the feedstock, the biochar produced, and the system's scrubber water and exhaust gas. The resulting biochar was sent to

Test America, Vista Analytical Laboratories, and the EPA Laboratories for multiple samples analysis. The results on the biosolids and Biochar confirmed that the Bioforcetech system reduces PFAS from Biosolids to non-detectable levels. It has also been demonstrated that the PFAS do not end up in the scrubber water. The flue gas was analyzed by Montrose Air Quality Services with an experimental method, which utilized 3 parallel FDIR. The results from these analyses have been peer reviewed by the EPA and do not show any PFAS in the analyzed exhaust gas, indicating that all PFAS compounds could be destroyed in the system's combustion chamber.

Valentino Villa

Valentino Villa is the Co-Founder and Chief Operating Officer at Bioforcetech Corporation. He earned the status of "Perito Industriale Capotecnico per l'Elletronica e le Telecomunicazioni," an Italian professional designation for an industrial expert in the field of engineering that is recognized as an industrial engineer outside of italy. Since Co-founding Bioforcetech, Valentino and his team have been rethinking every step of biosolids management to prepare for a carbon free future. Valentino believes that Bioforcetech's biochar, OurCarbon™, is a resource, which is why he and his team are investing in research and development to expand the applications for biochar far beyond soil amendment. Valentino lives in California with his wife and 4 year old son, Leonardo.

Monday, September 12
Session 01B: 1 Utility & Asset Management
1:15PM – 1:55PM

The Evolved Water Professional: Leveraging Integrated Data to Address Megatrends

Guy Carpenter[1], Pablo Calabuig[2]
[1]Murraysmith; [2]GoAigua Inc.; Guy.Carpenter@murraysmith.us, pablo.calabuig@go-aigua.com

The water industry is collectively tossing and turning at night thinking about aging infrastructure, a maturing workforce without sufficient renewal, water scarcity, climate change, consumer activism, and funding gaps. Meanwhile, we use a variety of software tools and sources of data like meters and monitors to generate and collect data. On their own, the data sets are useful for a particular effort; however, through the power of machine learning, artificial intelligence, and digital twins, these disparate sources of data can be integrated in a way that produces insights not otherwise possible to help us more efficiently operate our utilities, maximize the capacity of existing assets, and right size new assets. Further, this sort of data integration and automated analysis can help us shore up operator training and responsiveness, develop strategies for addressing water scarcity and responding to climate variability, and anticipate asset failure so that repairs can be made before catastrophe ensues. All these outcomes help address the increasing scrutiny of rate payers regarding how their utilities are managed.

This presentation will provide an overview of the major trends the water industry is grappling with, and how SCADA systems, smart metering, GIS, CIS system, work order management, and other sources of data can be integrated to effectively respond to them. Engineers, operators, utility managers, compliance professionals, and laboratory staff will soon need to adapt to smart water systems that will fundamentally transform how we ensure high quality utility services. Mini-case studies will be highlighted to demonstrate the effectiveness of data integration, digital twins, and analytics in addressing today's water megatrends. It is the authors' intent to provide an overview of why smart water and digital twin technologies are appropriate for addressing today's water challenges.

Guy Carpenter

Guy is a chemist and registered professional civil engineer with 10 years of utility operations experience and 22 years of consulting engineer experience. He has been instrumental in normalizing water recycling and ushering in the era of potable reuse, and implemented a strategy to adopt smart water solutions as a service offering for a national engineering consulting firm. Guy is currently the Water Technical Services Leader for Murraysmith/CONSOR Engineers.

Pablo Calabuig

Pablo is a Civil and Environmental Engineer and started his career in water operations for the water utility of Valencia (Spain), where he is from. After studying his MBA, he worked for McKinsey & Company for nearly 7 years helping large multinationals in Europe, Latin America and the US navigate their digital transformation. In 2019 he started the North America operations at GoAigua, the smart water platform that was born out of the utility where he started his career. In just 3 years his team in NA is already helping major cities like Mexico City, City of Houston, City of Long Beach or the City of Toronto.

Monday, September 12
Session 01B: 2 Utility & Asset Management
2:00PM – 2:40PM

Selection and Development of a New Data Management Tool

Steven Rice
Clackamas WES, United States of America; SRice@clackamas.us

Clackamas Water Environment Services (WES) operates five water resource recovery facilities and eighteen pump stations in Clackamas County, OR, producing clean water for a service population of around 200,000 people. In 2021, WES completed the selection process for a new data management tool to improve manual field collection of data, increase access to various types of data, and streamline processes and regulatory reporting.

After a broad search of commercially available solutions, WES narrowed the selection process to four applications. Vendor demonstrations, user interviews, and demo systems were evaluated to determine the ability of each software to meet functional requirements developed by a cross-section of WES stakeholders that included operators, asset management staff, engineers, and IT staff. Following a competitive value-based procurement process, the group of stakeholders reached a consensus to move forward with procurement of eRIS. WES is the first utility in the Pacific Northwest to implement the software, which is a relatively new application in the data management field.

Near the end of 2021, the software was deployed as a virtual appliance within the County's server environment. The software's functionality is delivered through direct connection to source data, so no data migration, duplication, or storage was required during deployment. The system was initially integrated with WES' two primary sources of operational data: SCADA historian and the laboratory's information management system. A new database was setup to store manually collected field data that is entered through the tool's user interface. The system was later integrated with additional data sources including cloud-based collection system flow monitoring data and field precipitation data.

The implementation phase of the project is ongoing and has included development of the custom field data entry forms, reports, and dashboard screens with key performance indicators for each of WES' five water resource recovery facilities. Ahead for WES is continued development of the system tools and rollout to a broader operational user base at the treatment facilities. Long-term goals include expanding the system's capabilities to serve additional programs within WES, such as the biosolids management, watershed protection, industrial pretreatment, and field operations groups.

Steven Rice
Steven Rice has fourteen years of experience in the wastewater field. He is currently a Senior Civil Engineer with Clackamas WES within the Planning and Capital Division. Prior to joining WES in 2020, Steven worked as a water/wastewater Project Manager and Design Engineer for a private consulting firm.

Monday, September 12
Session 02B: 1 Collection Systems - Pumping
1:15PM – 1:55PM

Can Companies Compute Cost Conscious CFD?

Brandon Moss, Jacob Stolle, Jen Murphy
Parametrix, Inc.; bmoss@parametrix.com, jstolle@parametrix.com

Computational fluid dynamics (CFD) is rapidly becoming an important tool for designing, optimizing, and visualizing water infrastructure. Over the last few decades, commercial CFD software has entered the market with ever-increasing usability and workflows. However, the civil engineering field has yet to broadly adopt the software; it is often perceived as overly complicated and expensive. This presentation will show how CFD can be used cost-effectively to aid in design of a pump station retrofit. CFD analysis can be critical to determining layouts of wet wells in offsite facilities as well as influent pump stations within a Wastewater Treatment Plant environment.

The Sandy Pump Station, part of the Sandy Drainage Improvement Company, provides flood protection to homes, businesses, and public land to the northeast of Portland, OR. When the station was originally built in the early 1940s, the wet well included components to prevent vortices that create cavitation during pump operation. Condition assessments revealed that the anti-cavitation platform was partially rotted and in poor condition. Some anti-cavitation baffles had failed and been removed, and the remaining baffles were significantly deteriorated. Higher-capacity pumps had also replaced the original pumps.

In 2021, Parametrix began work to design wet well modifications that would reinstate components to minimize cavitation during pump operation. The design team used FLOW-3D CFD software to assess multiple design elements and configurations. The modeling consisted of larger scale simulations of the pump station and upstream channel to determine station influent flow characteristics and set appropriate model resolution. The modeling then focused on the pump station itself, using large eddy simulations (LES) turbulence model on numerous configurations to iterate design elements. Recent academic studies have shown LES turbulence models consistently identify flow patterns and vortex structures. Model

results were evaluated against Hydraulic Institute standards for scale modeling such as swirl angle and turbulent kinetic energy to compare improvements provided by proposed components.

Instead of providing limited design alternatives based on Hydraulic Institute standards and best industry practices, using CFD software allowed quantitative evaluation of alternatives and configurations by comparing resulting model data. Furthermore, the CFD modeling provided an alternative to more costly scale modeling and provided a level of risk reduction and confidence that the proposed design would result in better flow characteristics for continued pump operation.

Brandon Moss

Brandon Moss is a professional engineer at Parametrix within the Pacific Northwest water markets. He provides hydraulic, mechanical, and civil engineering design, modeling, simulation, and field assessment support to local agency, industrial, and tribal clients. His work supports water and wastewater projects including rehabilitation and replacements of force mains and pump stations, treatment processes and hydraulic designs, and reclamation plant upgrades.

Jacob Stolle

Jacob Stolle is an engineer in training at Parametrix within the Pacific Northwest water markets. He provides support for mechanical engineering design, modeling, simulations, and field assessment support to local agencies and industrial clients. His work includes pump stations, treatment processes, and facility redesigns for both water and wastewater systems.

Monday, September 12
Session 02B: 2 Collection Systems - Pumping
2:00PM – 2:40PM

Adding Another Level of Redundancy to Influent Pumps at Vancouver Westside Wastewater Treatment Facility

Frank Dick[1], Brad Eagleson[2], Matt Noesen[2]
[1]City of Vancouver, WA; [2]Jacobs Engineering, United States of America; Frank.Dick@cityofvancouver.us, brad.eagleson@jacobs.com

Problem Statement: Aging infrastructure and community expectations for more resilient utilities prompted plant staff at Vancouver's Westside Wastewater Treatment Plant to identify a vulnerability. The loss of both utility and emergency generator power caused loss of influent pumping, which resulted in raw sewage diversion to the Columbia River. The plant's influent wet well and backup surge tank provide only a few minutes storage time before diverting influent flow to the Columbia River.

Approach:

The City evaluated the following options to address this issue:

3. Replace aging electrical distribution infrastructure and standby generator transfer controls.
4. Install backup standby diesel pumps near the surge tank capable of transferring influent flow near though upstream processes.

The second option was selected to bridge near-term redundancy concerns and a turn-key project with Jacobs Engineering was constructed.

Unique features of the project:

- Selection of two large diesel driven standby pumps capable of operating without plant power.
- Computational fluid dynamics (CFD) modeling to guide engineering design to ensure vortices would not hamper pump performance within a surge tank not designed to Hydraulic Institute (HI) standards.
- Project footprint and existing underground utilities provided challenges for design engineers and contractors to install the pumps and connecting pipes.
- Limited response time required close coordination with the vendor to ensure pumps could prime and pump within the necessary timeframe.

Results:

- The project provides for a completely independent powered influent pumping system to serve in both unplanned and planned events.
- The CFD analysis identified the need for a complex vortex breaker to improve pump performance. Installation of an early warning level sensor at the influent wet well provided additional reaction time for the pumps.
- The system was installed and commissioned in less than 12 months and has performed as designed during several start-up tests.
- The backup pumps are tied into the influent pump discharge header, which allows isolation of the existing influent pump station for maintenance.

Conclusions:

Diesel backup pumps proved to be an innovative, cost effective way of bridging the gap between aging infrastructure and reliability and can be installed with little or no disruption to plant operations.

Frank **Dick**

Frank oversees sewer and wastewater engineering functions including capital projects, wastewater system planning, interface with the City's contract operator for wastewater (Jacobs), and the city's fully delegated pretreatment program. He has worked in these functions in Vancouver for 11 years. He has developed energy management programs for both of Vancouver's wastewater and water utilities.

Brad Eagleson

Brad Eagleson has a bachelor's degree in chemical engineering and a master's degree in environmental engineering and has 7 years of experience in the semiconductor industry and 3 years of experience in the water and wastewater industry. He has experience with process mechanical, waste, and chemical systems, and is familiar with many of the governing codes including IBC, IFC, CGA and NFPA (820, 55, 70) with a focus in hazardous chemicals. He has experience with both gravity and pressurized hydraulics and has been involved in the design and SDC of several large waste water facilities with advanced tertiary treatment as well as semiconductor greenfield and brownfield projects both domestically and internationally. Brad spent 2 years living in Paraguay as a Peace Corps volunteer, and enjoys biking, running, and spending time with his 3-year-old son.

Monday, September 12
Session 03B: 1 Innovative Stakeholder Involvement
1:15PM – 1:55PM

Yikes! More Clogged Pipes? Using Social Marketing to Improve System Outcomes

Rachel Garrett[1], Lynn Knapp[2]
[1]Brown and Caldwell, United States of America; [2]Cascadia Consulting Group, United States of America;
rgarrett@brwncald.com

Utilities are overwhelmed with competing needs, from system maintenance to capital projects. To compound the issue, system users often contribute to existing problems through detrimental behaviors such as rinsing FOG down drains and flushing wipes and trash. How can utilities not only increase awareness around problematic behaviors, but motivate behavior change?

In this session, Rachel Garrett of Brown and Caldwell and Lynn Knapp of Cascadia Consulting Group will explore how applying a Community-Based Social Marketing (CBSM) framework can help motivate behavior change. CBSM can be a useful tool in many scenarios that utilities commonly face. Here are a few examples of situations your utility may face that lend themselves well to a CBSM approach:

- People are flushing more wipes than ever, especially since the pandemic began. Utilities are spending more to maintain equipment due to clogs.
- FOG is clogging pipes in residential areas, contributing to “fatburgs”. Despite sharing outreach materials with customers, the problem seems to be increasing.
- Businesses are not installing or maintaining grease interceptors. Enforcement crews issue fines and provide handouts, but in many cases, this does not increase compliance.
- Potential stormwater challenges can also be addressed with a CBSM approach. To name a few: storm drains clogged with leaves, pet waste troubles, need for more green stormwater projects on private property, and businesses out of compliance with code-mandated stormwater BMPs.

In this session, we will define the practice of CBSM, where it originated, and its key elements. We’ll describe when to apply the CBSM approach, and how it differs from more widely used communications or public outreach tools.

We’ll share lessons learned from Seattle Public Utilities’ “What to Flush” student engagement campaign in 2018-2022, including choosing where to focus, conducting audience research, identifying values and behaviors of different audiences, changing course in response to audience feedback, and evaluating outcomes.

Finally, we’ll talk about the best way to learn more and access tools and resources, including national and regional communities of practice and trainings.

Rachel Garrett
Rachel Garrett is a Strategic Communications Specialist for Brown and Caldwell, who recently spent 8 years working for Seattle Public Utilities managing wastewater and stormwater-focused community engagement programs and communications. She has a BA in Spanish and an MA in Environmental Policy with a focus in Water Resource Management.

Lynn **Knapp**

Lynn Knapp is a Senior Associate at Cascadia Consulting Group, managing sustainability and behavior change projects for clients such as Seattle Public Utilities. She has a BS in Environmental Science and minor in Sociology from Huxley College of the Environment at Western Washington University.

Monday, September 12
Session 03B: 2 Innovative Stakeholder Involvement
2:00PM – 2:40PM

Building Support for a Clean Water Future

Shelly Parini-Runge[1], Haili Matsukawa[2]

[1]Clackamas Water Environment Services, United States of America; [2]Water System Consulting, Inc., United States of America; sparini@clackamas.us, hmatsukawa@wsc-inc.com

Clackamas Water Environment Services (WES) provides clean water services to more than 200,000 people within Clackamas County. WES serves seven cities, plus urban and rural unincorporated areas. After the recent consolidation of sewer and surface water districts, we created a new brand to unify our services around our shared mission to protect public health and the environment, and the region's economic vitality.

The regionalized story is complex, so in 2021 WES partnered with WSC to plan and deliver a robust community engagement and discovery process called the Clean Water Exchange. The three-component research approach included: Stakeholder Interviews, Virtual Focus Groups, and a Survey & Engagement Webpage.

Participants in the Exchange ranged from stakeholders vested in WES' future, programs, and services to ratepayers with less existing familiarity with us and our services. To steer the process WES developed the following goals:

- Strengthen customer and stakeholder understanding,
- Create new clean water partnerships and advocates, and
- Build trust through enhanced connections.

The data showed us there is deep appreciation for the work WES does to keep our waterways clean, but the district story is hard to understand. Moving forward WES needs to find creative and more inclusive ways to connect to its customers, stakeholders and service area communities to its work. Engendering understanding and support from stakeholders will be critical to WES' long-term financial viability and its ability to sustain a high level of customer satisfaction.

The data also showed growing awareness for the clean water challenges ahead, such as climate change, affordability and equity, and a general sense that we can all work more closely together to address the complex issues.

In response four strategic initiatives were designed:

5. Ensure educational materials are accessible for diverse audiences.
6. Establish partnerships that leverage the strength of the community and shared goals.
7. Invest in communication initiatives that support safe, reliable, and affordable services.
8. Cultivate a generation of diverse watershed leaders.

These strategic initiatives were used to develop a **2022-2025 Communications and Engagement Roadmap** which will help WES chart a course for continuous improvement with its customers and stakeholders.

Shelly Parini-Runge

Shelly Parini-Runge is a passionate community builder, her career strengths include strategic communications, designing results-driven community engagement initiatives and raising support for critical public infrastructure projects. Her inclusive style provides a practical way to facilitate community-centered conversations that build trust and illuminate the roles that dialogue, social-networks, and leadership play, in creating and navigating sustainable change.

Shelly holds a Bachelor of Arts in Theater and Communications from Arizona State University and a Master of Arts in Organizational Communications from Marylhurst University. Shelly also serves on the Oregon ACWA Education Committee as Vice Chair and recently the WateReuse Pacific Northwest Board of Trustees. She has worked in the public sector in a variety of management roles for more than two decades.

Haili Matsukawa

Haili Matsukawa is an accomplished communications professional with Water Systems Consulting, Inc. (WSC), specializing in strategic planning, community outreach, stakeholder coordination for water agencies.

With years of experience working as a public servant, Haili brings a strong understanding of the emerging challenges and opportunities facing local government and public utilities. Haili is a thoughtful facilitator with a passion for community-driven solutions.

She holds a Bachelor of Science in Environmental Science and a Master of Public Policy and Administration. With years of experience working as a public servant, Haili brings a strong understanding of the emerging challenges and opportunities facing local government and public utilities.

Monday, September 12

Session 04B: 1 Facility Operations & Maintenance

1:15PM – 1:55PM

Flow Predictive Models Using Natural Intelligence and Human Learning

Chris Maher

Clean Water Services, United States of America; maherc@cleanwaterservices.org

The Water Environment Federation (WEF) and The Water Research Foundation (WRF) sponsor the Intelligent Water Systems (IWS) Challenge through the Leaders Innovation Forum for Technology (LIFT) program. The stated intent is to provide an “opportunity to showcase … innovation, with a focus on leveraging data using the best available tools to help utilities better understand the dynamics of complex systems and make better decisions”. In 2021 Clean Water Services (CWS) entered a project entitled “Intelligent Influent Flow Management”. The challenge was to “find, acquire, and leverage data to inform the operation of the Influent Pump Station (IPS) to maximize process and system efficiency, and inform risk knowledge when operating in a flow equalization (FEQ) mode.” The team placed third.

One piece of the challenge solution was to develop a prediction of influent flow. The Northwest River Forecast Center (NWRFC) issues a ten-day forecast for flow and gauge height for the receiving stream for the Rock Creek AWWTF, the Tualatin River. The team sought to leverage this forecast into a predictive model for IPS flow. Three years of daily river flow, gauge height, and IPS flow were used in calculating a multiple linear regression (MLR) model in Excel, verified with 2 years of data. The Solver function was used to find coefficients that would minimize the root mean square error (RMSE). The final model has an RMSE of 2.68. Finding the principal dependency of IPS flow on gauge height a simple logarithmic data fit between flow and gauge height was calculated with the same method for minimizing RMSE. This model returned an RMSE of 2.91, but proved to be slightly better at predicting the highest flows.

The Rock Creek AWWTF is subject to ammonia toxicity limits dependent on the daily and monthly average receiving stream flow. A monthly average river flow prediction was developed using actual, forecast, and 30 day running average data. This informs operations to better control nitrification rates for efficient compliance.

Both models are automated in Power BI, however, this project highlights a widely applicable, accessible flow prediction model, done with existing tools, and leveraging available data.

Chris Maher
Chris Maher was a Class A operator at the Upper Blue Sanitation District in Breckenridge, CO for 13 years where he earned his MS degree in Environmental Engineering through the Illinois Institute of Technology. He has been with Clean Water Services for 6 years where he is now a Senior Operations Analyst and a Grade IV certified operator.

Monday, September 12
Session 04B: 2 Facility Operations & Maintenance
2:00PM – 2:40PM

How Can You Manage Your Peak Wet Weather Flows with Treatment?

John Dyson
Aqua-Aerobic Systems, Inc., United States of America; Jdyson@aqua-aerobic.com

As our climate changes, we are experiencing more intense wet weather events resulting in an increase frequency in peak flow conditions in our collection networks and treatment facilities. These wet weather events are resulting in much higher instantaneous peak flow conditions and events are lasting for longer durations. These conditions are putting more stress on our treatment facilities to handle a larger range of operating conditions. Our industry has focused for decades on separating combined sewer systems (CSS), repairing sanitary sewer systems (SSS) or building storage to contain the excess volume during events. This work has made some major dents in reducing the discharge of untreated wastewater, but we continue to have untreated wastewater discharges because of climate change and the never ending collection networks repairs needed.

Generally, the first solution has been to build storage for the peak wet weather flow events and feed the stored volumes back to the treatment plant. This solutions works in some cases but not in all cases because the volumes to be stored can be very large volumes and not practical for all events.

How can we solve the issue of reducing or eliminate the discharge of untreated wastewater during peak wet weather flow events? The solution is the use of a combination of technologies to manage and control these peak wet weather flows and treat these volumes of wastewater.

This paper will cover the use of EHRT technologies with a focus on pile cloth media filtration (PCMF) to treat peak wet weather flow: This paper will cover the following items when using EHRT:

- Use of PCMF for treatment
- Application of PCMF within a treatment facility or remote sites

In summary, we have debated for decades about how to handle peak wet weather flows and legal issues regarding whether treatment of peak weather flows by auxiliary EHRT technologies is acceptable. While we have spent years debating how it should be done, millions, if not billions of gallons of untreated effluent have continued to flow into our waterways. Many EHRT technologies produce effluents close to or better than secondary treatment standards without biological.

John **Dyson**

John holds a B.S. degree in Chemistry from Longwood College. He has experience working with many treatment technologies including clarifiers, filters, headwork equipment, disinfection processes, biological processes and membrane processes in both the water and wastewater segments of the industry. Over the 25+ years, worked on many projects varying in size from 0.1 MGD to 600+ MGD with multiple technologies. John experience with the many technologies gives him a unique ability to evaluate and determine the best solutions for clients. In addition, he has been involve in the introduction of several new technologies through his career.

Monday, September 12
Session 05B: 1 Regulatory Challenges
1:15PM – 1:55PM

Feasibility and Cost of Compliance with Washington Human Health Criteria Water Quality Criteria (HHWQC)

David Clark[1], Michael Falk[1], James Tupper[2]
[1]HDR, United States of America; [2]Tupper Mack Wells PLLC; dclark@hdrinc.com

Human Health Criteria Water Quality Criteria (HHWQC) for toxics in Washington have been a controversial, variable, unpredictable, and subject to litigation highlighted by the differences between the Department of Ecology and EPA. At the heart of the matter are new water quality standards driven by human health risk assessment and increased fish consumption rates (FCR). The resulting standards for nearly 100 toxics are extremely low concentrations. Compliance for wastewater discharges to surface waters for notable constituents such as Polychlorinated Biphenyls (PCBs), Arsenic, Mercury, and Benzo (a) Pyrene will be extremely expensive and perhaps technically infeasible.

This study has analyzed the technical feasibility of compliance with new water quality standards driven by human health to assess treatment processes and costs of compliance. Wastewater treatment targeted water quality standards for Total PCBs (0.000007 ug/L), Inorganic Arsenic (0.018 ug/L), Methyl Mercury (0.03 mg/kg fish tissue), and Benzo (a) pyrene (0.000016 ug/L). Elaborate treatment process trains comprised of microfiltration, reverse osmosis, carbon absorption, and advanced oxidation processes have

been considered. The environmental impacts of employing these treatment processes include excessive energy consumption, chemical use, greenhouse gas emissions, reject brine disposal, and spent carbon regeneration have also been assessed.

Disagreements about Washington HHWQC have extended over a period of several years and two federal administrations. On August 1, 2016 Washington Ecology proposed state Water Quality Standards for Protecting Human Health following EPA's proposed 2015 rulemaking for Washington. However, on November 15, 2016, as ordered by federal judge Barbara Rothstein, EPA decided on Human Health Criteria for Washington based on EPA's 2015 proposed criteria, rather than what Washington Ecology had proposed.

In response to a February 21, 2017 petition, EPA reconsidered its previous Partial Approval/Partial Disapproval of Washington's Human Health Water Quality Criteria and approved certain human health criteria that the Agency previously disapproved on November 15, 2016 from an August 1, 2016 Washington standards submission. On April 16, 2020, EPA finalized a rule to withdraw federal water quality standards for certain human health criteria as the final step resulting from the Agency's May 10, 2019 approval of Washington's human health criteria.

David Clark

David Clark is Senior Vice President and serves as HDR Engineering, Inc.'s Market Sector Director for Wastewater. He has more than 40 years of consulting experience and currently leads strategic efforts in understanding wastewater regulatory issues as they affect wastewater utilities. Mr. Clark was the regulatory liaison for the Water Research Foundation (WRF) Nutrient Challenge research program and the lead author on regulatory issues. He is currently the Principal Investigator for the WRF Holistic Approach to Improved Nutrient Management research project (WRF4974).

Monday, September 12
Session 05B: 2 Regulatory Challenges
2:00PM – 2:40PM

Occurrence of Per- and Polyfluoroalkyl Substances in U.S. Water Resource Recovery Facilities

Jennifer Hooper[1], Charles Schaefer[1], Laurel Strom[1], Ibrahim Abusallout[1], Jennifer Guelfo[2], Gaya RamMohan[3], Eric Dickenson[4], Detlef Knappe[5]

[1]CDM Smith, United States of America; [2]Texas Tech University; [3]Gwinnett County Department of Water Resources; [4]Southern Nevada Water Authority; [5]North Carolina State University; stroml@cdmsmith.com

The presence of per- and polyfluoroalkyl substances (PFAS) in water resource recovery facilities (WRRFs) has been widely reported. However, comprehensive quantitative data on specific PFAS compounds, their fate and phase partitioning through WRRF treatment processes, and the factors that control PFAS distribution in finished biosolids, remain poorly understood. The goal of this research is to increase understanding on the occurrence, fate, and mass distribution of PFAS in WRRFs and determine the implications of these results for utilities. For this study, 34 utility partners representing 38 facilities participated spanning most US geographies and climates. In the first phase, these facilities collected 24-hour flow-weighted composite samples from WRRF influent and effluent, in addition to a single-point biosolid grab sample. For the second phase, 14 facilities continued to sample their influent and effluent monthly and their biosolids quarterly for 12 months. Finally, a detailed mass balance investigation was

conducted at 9 WRRFs to characterize PFAS partitioning through various treatment processes. Aqueous, solids, colloidal and volatile PFAS samples were collected and analyzed for 40 target PFAS compounds, total oxidizable precursors, and/or extractable organic fluorine.

Results have been compiled from the first phase to assess overall PFAS occurrence in influent, effluent, biosolids, and mass loading. Results have also been compiled from the second phase to perform a temporal variability assessment. The detailed mass balance sampling has been conducted and data analysis is currently underway.

Initial results from this study showed that target PFAS were detected in the influent, effluent and biosolids at all the 38 WRRFs sampled within a relatively narrow range of 98±28 ng/L, 80±24 ng/L, and 160,000±46,000 ng/kg, respectively. Among WRRF treatment schemes, a decrease of PFAS precursors and increase in short chain perfluorocarboxylic acids (PFCAs) from influent to effluent suggests that perfluoroalkyl acid (PFAA) precursor transformation may be occurring. However further investigation is needed to characterize the extent of transformation and the implications for treatment. The results from this study provide a benchmark for comparison of PFAS occurrence in US WRRFs and ultimately may be used as the basis to develop appropriate methods and tools to decrease PFAS release to the environment.

Laurel Strom

Ms. Strom is an environmental engineer with 5 years of experience in water and wastewater engineering with CDM Smith. She obtained a bachelor's degree in Civil Engineering from Washington State University and a master's degree in Environmental Engineering from Virginia Tech. Her time working for a large drinking water utility and studying opportunistic pathogens in drinking water in graduate school provided her a breadth of understanding of current and ongoing water quality issues, particularly as they pertain to aging infrastructure. She has worked on numerous drinking water projects with CDM Smith including the design of two greenfield drinking water treatment plants and is currently serving as the chemical design lead for a large California drinking water project. She has participated in numerous Water Research Foundation projects and proposals related to PFAS and water/wastewater quality, including sampling coordination, data analysis, and reporting of this WRF 5031 project.

Monday, September 12
Session 06B: 1 Treatment Phosphorous
1:15PM – 1:55PM

The Impact of Anaerobic Mass Fraction on EBPR Performance and Robustness

Austin Carnes
City of Boise, United States of America; acarnes@cityofboise.org

On March 3rd, 2021, the West Boise Water Renewal Facility (WRF) suffered a prolonged power outage during which primary effluent was fed to the activated sludge process, but no aeration occurred. Prior to the power outage, the facility had been experiencing unstable enhanced biological phosphorus removal (EBPR), with daily average effluent dissolved reactive phosphorus (DRP) of 1.5 mg/L over the previous two weeks. Immediately after the power outage, EBPR stabilized, with no daily average effluent DRP value exceeding 1 mg/L for 45 days, and DRP for that 45-day period averaging 0.21 mg/L.

It was hypothesized that the increased anaerobic volume during the power outage boosted EBPR performance. A survey of the literature revealed key discussions around the relationship between anaerobic mass fraction and EBPR performance. First, an increase in anaerobic mass fraction can promote Accumulibacter PAOs to switch from the TCA-cycle to glycolysis for anaerobic reducing power which increases polyhydroxybutyrate (PHB) storage polymer production per VFA by roughly 1.5 times on a mass per mass basis. Second, increased anaerobic mass fraction can lead to a highly negative ORP (<-300mV) which favors the metabolisms of bacteria in the genus Tetrasphaera which are putative PAOs themselves, but can also ferment complex carbon molecules into VFA which can be utilized by Accumulibacter PAOs.

Based on this, the West Boise WRF's Modified Westbank process was altered by discontinuing mixed liquor recycle in the Modified Ludzack-Ettinger portion of the process, making the second anoxic reactor anaerobic and increasing total anaerobic mass fraction from 11.8% to 28.5%. This resulted in plant effluent DRP of 0.048 mg/L during the period from October through December 2021. Plant effluent DRP was 0.927 mg/L during the previous October through December under otherwise similar operating conditions.

In addition to better phosphorus removal performance, increased anaerobic mass fraction resulted in a generally more robust process. A two-day interruption to the supplemental VFA supply was withstood whereas it would have led to an immediate upset under conventional operation. The process also tolerated increased return activated sludge nitrate mass loading which has historically been an inhibitor of EBPR at the West Boise WRF.

Austin **Carnes**
Austin has been in the wastewater profession for seven years with the City of Boise, first as an Operator and then as a Wastewater Process Analyst. He provides direction on process control for two advanced Water Renewal Facilities and a chemical Phosphorus Removal Facility. Austin is the City's primary wastewater modeler and administers its Water Information Management System.

His primary research focus in recent years has been optimization of EBPR at the West Boise Water Renewal Facility which suffers from a poor carbon to phosphorus ratio. Austin holds a Bachelor of Science in Environmental Science from Portland State University and is pursuing a Master of Science in Science in Environmental Science through the University of Arizona.

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Monday, September 12
Session 06B: 2 Treatment Phosphorous
2:00PM – 2:40PM

Achieving Low Level Effluent Phosphorous - Lessons Learned from Early Adopters

Jennifer Strehler, Laurel Strom
CDM Smith, United States of America; strehlerjl@cdmsmith.com

Beginning in the 1990's the US Environmental Protection Agency and state regulators began issuing NPDES permits with low-level total phosphorus (TP) limits to publicly owned treatment works (POTWs) to mitigate eutrophic conditions in sensitive watersheds. One of the first facilities to receive such a permit was the Charles River Pollution Control District (CRPCD), in Medway, Massachusetts. CRPCD received a seasonal monthly limit of 0.2 mg/L TP in 1996 and implemented provisions for chemical addition and the

then novel cloth disk filtration technology. Shortly thereafter, in the early 2000's, facilities discharging to the Sudbury, Assabet and Concord Rivers received seasonal limits of 0.2 mg/L and 0.1 mg/L. At the time, phosphorus removal to 0.1 mg/L was beyond the known limit of technology, and so existing technologies were pushed to their limit and new technologies were spawned to achieve these limits. Tertiary treatment technologies included cloth filtration (AquaDiamond®, AquaDisk®), ballasted flocculation (Actiflo®, CoMag®, BioMag®), upflow sand filtration (Dynasand®, BluePRO®), and dissolved air flotation (AquaDAF®), many of which were employed with or without biological phosphorus removal. As of today, there are 70 wastewater treatment plants in Massachusetts alone which have been operating to meet low phosphorus limits for a decade or longer.

The trend toward more stringent permit limits on phosphorous has expanded nationally. This presentation focuses on lessons learned from the early adopters - in the planning, design, construction, and operation of add-on technologies implemented to achieve the low-level total phosphorus (TP) limits (i.e. TP of 0.1 – 0.2 mg/L). The long-term performance and operation and maintenance of various systems, based on 10 to 20 years of experience, are shared that will help communities who are now just entering the world of low-level phosphorus removal.

Jennifer Strehler
Jennifer Strehler has over 30 years of engineering experience in planning, designing, executing, and managing complex projects. She is a Project Technical Leader and Water Reclamation Discipline Leader for CDM Smith. Her expertise is treatment plant design, however she also has experience with operations management and construction management and has an inside understanding of local government from former leadership positions as Director of Public Works and City Engineer.

Monday, September 12
Session 07B: 1 Treatment
1:15PM – 1:55PM

PowerBI and Piloting: Monitoring Micro-Aeration for H2S Control at Chambers Creek

Karina Woodland[1], Vicky Hollingsworth[1], Peter Zemke[1], Chris Muller[1], Karla Guevarra[2], Amanda Summers[2], Parisa Shahbaz[2]
[1]Brown and Caldwell; [2]Pierce County; kwoodland@brwncald.com

The hydrogen sulfide (H_2S) gas generated during anaerobic digestion produces corrosive condensates in the biogas stream that damage conveyance and handling equipment, resulting in increased operation and maintenance labor and costs. While in-situ chemical treatment and biogas cleaning technologies can mitigate high H_2S concentrations, they are often accompanied by high operational costs, chemical handling considerations, and additional equipment. Micro-aeration is an alternative H_2S treatment option that involves injecting a small amount of air into an anaerobic digester to oxidize the H_2S. Micro-aeration has been thoroughly investigated in laboratory and research settings and is sucessfully used at full scale at several treatment facilities in Europe. However, it is less common in the United States with only a handful of full-scale pilots.

This presentation details the micro-aeration piloting effort at the Chambers Creek Regional Wastewater Treatment Plant located in Pierce County, Washington, which experiences high biogas H_2S concentrations, often exceeding 2200 ppm. A pilot started in August 2021 on a full-scale submerged fixed cover digester to evaluate the ability of micro-aeration to reduce the H_2S concentration in the biogas. A redundant digester was monitored under similar conditions but without micro-aeration to serve as a control. PowerBI data dashboards were created to monitor the pilot data and easily communicate results with stakeholders. These dashboards allow for near real-time monitoring to check the health of the anaerobic digester during micro-aeration. Key data was summarized in a clear and effective manner, which allowed the team to better leverage pilot data to execute process changes and explain the results of the pilot. This presentation will describe the setup, operating parameters, conclusions, and lessons learned from the pilot. Particular focus will be provided to how data communication and can improve piloting outcomes.

Karina Woodland
Karina Woodland (EIT) is a Senior Staff Environmental Engineer based out of the Seattle Brown and Caldwell office. She works on a variety of water and wastewater design projects as a process design and process mechanical engineer. She has a special interest in data analytics and enjoys incorporating advanced analytics processes in new and different ways to projects, particularly piloting projects.

Monday, September 12
Session 07B: 2 Treatment
2:00PM – 2:40PM

Full-Scale implementation of Membrane Aerated Biofilm Reactor (MABR) for process intensification of WWTP upgrades

Amit Kaldate, Jeff Peeters, Matthew Reeve, Daniel Coutts
Suez WTS; amit.kaldate@suez.com

Membrane Aerated Biofilm Reactor (MABR) technology is an attached-growth process in which autotrophic and heterotrophic biofilm growth occurs onto a dense gas-permeable membrane delivering oxygen by molecular diffusion. The advantages of the so-called counter-diffusion mechanism occurring in MABR result in a strong potential for process intensification, i.e. the increase of treatment capacity and/or achieving more challenging nitrogenremoval treatment goals within an existing biological process volume. Preferential growth of nitrifiers versus heterotrophs in a counter-diffusional biofilm is a key differentiator of MABR. MABR provides higher nitrification rates and oxygen transfer efficiencies as compared to conventional activated sludge and other biofilm technologies such as IFAS/MBBR. MABR zone can be operated as anoxic reactor, achieving simultaneous nitrification-denitrification. Since its early applications at pilot- and demonstration-scale, MABR has proved capable of providing process resilience and improved process performance, even under challenging conditions (e.g. low temperature, peak and variable loads, etc.).

The paper describes four full-scale MABR case-studies by focusing on (i) design challenges faced, (ii) the key-performances demonstrated at the existing WWTPs and (ii) the drivers which led to the selection of the technology against other options. Although each project has its own specificities, the full-scale

installations confirm the value of MABR technology when upgrading and retrofitting existing plants. The key factors that make MABR preferred over other approaches include efficient process intensification within existing infrastructure and the associated benefits of fast implementation, no new civil construction and more competitive CAPEX and OPEX. In addition, the beneficial effects of counter-diffusion and bubble-less oxygen transfer have resulted in improved nitrification stability, enhanced operational flexibility (e.g. enabling bio-P removal and simultaneous nitrification denitrification) and lower OPEX mostly due to high energy efficiency.

Amit Kaldate

Amit Kaldate is Domain Leader at Suez with 20 years of experience in design, commercialization and growth of technologies. He received his Ph.D. from University of Illinois, Urbana-Champaign. As a professional member, he has been an active participant in committees (WEFTEC Program Committee, WEF Innovations in Process Engineering Steering Committee, WRF Energy Advisory Committee) and task forces (e.g. WEF MOP8, MOP31, Utility of the Future, WRF LIFT).

Monday, September 12
Session 08B: 1 Workforce Development
1:15PM – 1:55PM

Neurodiversity in the Workplace: Applying Universal Design to Cultural Difference

Callan Wood. PE[1,2], Carlyle King[2,3], Carolyn Golden. PsyD[3,4]

[1]Idaho DEQ; [2]Autism Society of Treasure Valley; [3]Boise State University; [4]Northwest Neurobehavioral Health, LLC; darren.wood@deq.idaho.gov

People with autism and disabilities face a staggering unemployment rate, even when they are fully qualified and may have a lot to bring to table. These individuals may face difficulty in the hiring process itself, due to communications issues, which can continue to be an issue in the workplace. Employers also often see accommodations as a waste of resources. After conducting a literature review and consulting with Co-Authors Carlyle King, fellow Autism Society of Treasure Valley board member and winner of the Commitment to Community Award for his advocacy work, and psychologist Carolyn Golden, several conclusions were made. People tend to assume that applying universal design, providing the design that is usable to the greatest extent possible by the greatest number of people, will necessarily result in a design that is over budget. But when you involve the disabled community in the process, an interesting thing happens. We are used to having to think outside of the box in order to come up with solutions that work for us, and in finding a way to avoid our obstacles, we often come up with a solution that nobody else did but is easier and more efficient for everyone involved. Furthermore, we found that the concept of universal design has never been applied to cultural differences before. For Autistics, certain things like mannerisms, slang, figures of speech, sarcasm, metaphors, allegory, etc. are difficult to understand. It's as if we're walking around with perpetual cultural shock. Often times when we ask clarifying questions, people think we're playing dumb, are dumb, or are being argumentative. Applying universal design to this issue, the apparent solution is then to treat everyone as if they are a possible foreigner or immigrant, and to keep things a clear as possible and not assume a certain level of understanding. And when someone questions you, always assume the best intentions.

Callan Wood
Callan attended Colorado State University and has a master's degree and PE in water resources engineering. Callan has spent the last five years working on water reuse permitting and inspections for Idaho Department of Environmental Quality. As a neurodiverse individual, Callan has first hand experience with the challenges that brings to the workplace.

Monday, September 12
Session 08B: 2 Workforce Development
2:00PM – 2:40PM

Implementation of a Community Benefits Agreement Brings Subcontracting and Workforce Diversity on the City of Portland's Secondary Treatment Expansion Program

Muriel Gueissaz-Teufel[1], Andre Baugh[2], Bill Mariucci[3]
[1]City of Portland, Bureau of Environmental Services; [2]Group AGB, LTD; [3]Kiewit Infrastructure West Co.;
Muriel.gueissaz-teufel@portlandoregon.gov, andre@GROUPAGB.COM, bill.mariucci@kiewit.com

People of color, women and disadvantaged businesses continue to face significant barriers to employment and opportunities in the construction industry and beyond. Public agencies hold tremendous economic power in issuing contracts; low-bid, good faith efforts have had limited success in meeting diversity goals. In a trend that is likely to continue, a backlog of capital improvement on public works is leading to the implementation of large projects of increasing complexity, lending to the selection of alternative delivery methods for risks, cost, and schedule management. With this trend also comes the opportunity to truly achieve diversity and inclusion goals on large construction projects and leverage an agency's purchasing power and distribution of wealth in its own community.

This presentation will discuss the City of Portland's Bureau of Environmental Services (BES) experience implementing a Community Benefits Agreement (CBA) on its $475M Secondary Treatment Expansion Program (STEP) at the Columbia Boulevard Wastewater Treatment Plant, delivered under a Construction Manager/General Contractor (CM/GC) delivery method managed by the BES' Project Management Office. Successful implementation of a Community Benefits Agreement starts early in the life of a project; the presentation will provide lessons learned and best practices from the early stages of the project through construction so that other public agencies and contractors have a better understanding of the activities entailed and outcomes that can be expected.

Muriel Gueissaz-Teufel
Muriel has more than 23 years of experience in the PNW working in various capacities on wastewater capital projects implementation, including planning, design, and construction. An advocate of process improvements, she has worked to implement the first design build project at the treatment plant and is now managing the CM/GC delivery of the Secondary Treatment Expansion Program for BES, a major investment in the Columbia Boulevard Wastewater Treatment Plant. Muriel has a Bachelor and Master's degree in Chemical Engineering, and is a Board Certified Environmental Engineer. Muriel works out of BES' new Project Management Office. She loves the work she does, and mostly, the people she works with.

Andre **Baugh**

For most of his life, an Oregon resident, a University of Oregon alum, and a 29-year Portland, Oregon resident. In 2000, Andre' founded Group AGB, Ltd., a Diversity, Inclusion, and Equity management consulting firm, which has worked on significant infrastructure and building projects in the Portland METRO area over the last 22 years. Andre's consulting career started with Light Rail and continues today, working as the Diversity Manager on the City of Portland Columbia Wast Water Treatment Project, City of Portland Bullrun New Water Facility, and Interstate Bridge Projects. André Baugh has a proven record of accomplishment in meeting and exceeding contracting and diversity goals set by agencies and owners through developing effective outreach, diversity initiatives, and policies, providing excellent technical and business assistance to women and minority firms. Group AGB, capabilities include Social Equity and inclusion policy development and management, Community Benefits Agreement / Project Labor Agreements, incorporating best practices, communities of concern engagement and outreach, and Federal, state, and local compliance monitoring and reporting results.

Andre was a member of the Portland Planning Commission and subsequent Portland Planning and Sustainability Commission from 2008 through April 2019. During his service, he served as Chair and vice-chair for six years. Andre has also, served on local community boards and committees, including as a former founding member of the Transit Equity Advisory Committee. Andre's recognition includes the 2014 Spirit of Portland Mayors Award and DJC 2017 Professional Service Company of the Year.

Bill **Mariucci**

Bill Mariucci is an Area Manager with Kiewit Infrastructure West based in Portland, OR. He has over 40 years of construction experience with Kiewit including major infrastructure civil, tunneling, airport, and plant projects. Bill has been directly involved in the management of design-build, progressive design-build, and alternate contract delivery models throughout his career. Most recently, Bill was involved in the early stages of the City of Portland's Columbia Boulevard WTP – Secondary Treatment Expansion Project where he worked with the City and Group AGB to implement the current Community Benefits Agreement. Currently, Bill is the Operations Manager on Kiewit's portion of the VTA/BART Silicon Valley Phase Two Extension Project, Contract Package 2 – Tunnel and Trackwork in San Jose, CA.

Monday, September 12
Session 01C: 1 Planning
3:00PM – 3:40PM

City of Spokane System-Wide Wastewater and Stormwater Risk Assessment

Marcia Davis[1], Santtu Winter[2]
[1]City of Spokane; [2]Jacobs; mdavis@spokanecity.org, santtu.winter@jacobs.com

The City of Spokane recently completed a system-wide risk assessment of their wastewater collection, wastewater treatment, and stormwater systems. The purpose of this assessment was to identify and prioritize risks facing these systems, with a focus on identifying mitigation actions that the City should implement.

The risk assessment used the classic risk framework: a risk register was populated with risks identified during workshops, the risks were evaluated for their consequences and likelihood, and mitigation actions were identified. The resulting risk register was then analyzed to identify key risks and mitigation actions that the City should advance.

This risk assessment was unique because of its comprehensive and system-wide nature. Often times risk assessments are focused on specific programs or projects, whereas this risk assessment evaluated the entirety of the City's wastewater and stormwater systems. This comprehensive approach resulted in several important benefits:

- Allows for systems-level comparison of risk profiles – for example, the risk assessment clearly showed the risk reduction in the City's wastewater treatment and combined sewer system due to the massive investment in capital facilities over the past several decades. The higher-risk systems are those that have had less investment – stormwater and the separate sewer system.
- Enabled cross-discipline collaboration around risk identification, evaluation, and mitigation by bringing planning, engineering, management, and operations and maintenance staff together.
- Focus on mitigation actions identified cost-effective non-capital projects, programs, policies, and initiatives that the City can implement to reduce risk.
- Serves as a key steppingstone for the eventual development of an integrated utility master plan that prioritizes efforts across very different systems.
- Some mitigation actions that were identified were applicable to multiple risks – for example, completing calibration of the City's sewer model was a key mitigation action for many of the wastewater collection system risks. This helps identify the highest value mitigation actions.

This comprehensive risk assessment sets the City of Spokane up for more detailed planning efforts, while also identifying near-term actions that should be implemented. The effort was completed very efficiently, and resulted in an actionable and high-value plan that could easily be replciated in other municipalities.

Marcia Davis

As the principal engineer of the City of Spokane's Integrated Capital Management Department, Marcia is responsible for capital project scoping, funding, and programming. For the past 2 decades, she has designed and programmed water, sewer, stormwater, and transportation capital projects. Marcia has worked on the City's capital improvement programs since 2005. Marcia is responsible for the managing programming, scoping, and funding of water, sewer, and stormwater projects. Currently she is working on the 20-year capital facility plans for water, sewer, and stormwater.

Santtu Winter

Santtu Winter is a project manager with Jacobs in Seattle, Washington. He has 14 years of experience helping municipalities understand their wet weather problems and developing creative solutions to address these challenges.

Monday, September 12
Session 01C: 2 Planning
3:45PM –4:25PM

Getting to the POINT of Nutrient Limits: An Interactive Planning Tool

Katerina Messologitis, Sanaz Inmen, Art Umble, Mehran Andalib
Stantec Consulting, United States of America; katerina.messologitis@stantec.com,

Across the globe today, over 400 water bodies are at risk of severe environmental degradation and economic loss from nutrient pollution (i.e. eutrophication and hypoxia). In an effort to improve the health of impaired water bodies, water quality limits on effluent nitrogen and phosphorus discharge are becoming more common throughout the Western US and in the Pacific Northwest. Complying with these limits can be very challenging for existing facilities, especially given limited timeframes for compliance. Having a straightforward tool to assess the scale of improvement needed and the benefit of different process technologies can help public agencies understand potential nutrient removal options and communicate information to decision-makers.

Stantec developed an interactive tool called Process Optimization and Identification for Nutrient Treatment (POINT) to rapidly compare alternatives for a given facility to implement various nutrient removal technologies and illustrate the gap between current operation and the required level of performance. POINT was developed using more than 250 GPS-X process model simulations to evaluate performance under various influent characteristics, solids retention time, and COD/N Ratios. POINT can show both the potential and the limitations of nutrient removal technology. The tool offers valuable information through:

- Powerful visualization backed by extensive biological process analysis
- Illustration of the gap between existing treatment capabilities and potential future limits
- Clear indication of performance of different treatment processes
- Simple graphical representation to communicate complex process considerations

This presentation will describe the process used to develop the POINT tool, review the data that provides the foundation for process model simulations, show how the simulation results are used to generate heat map visualizations for different treatment scenarios, and provide a demonstration of the POINT tool.

Katerina Messologitis
Katerina is a water & wastewater process engineer with 5 years of experience in planning, piloting, design, and plant operation. Katerina is an avid user of BioWin and GPS-X process modelling software to support clients in evaluating treatment performance and process capacity, as well as evaluating process optimization scenarios. Katerina used her process modelling software experience and process knowledge to aid in the development of the POINT tool.

Monday, September 12
Session 01C: 3 Planning
4:30PM –5:10PM

Tualatin River 2013-2020 Water Quality Model Development and Calibration

Bernadel Garstecki[1], Scott Wells[1], Chris Berger[1], Scott Mansell[2]
[1]Portland State University; [2]Clean Water Services; bernadel@pdx.edu, wellss@pdx.edu

Oregon's Tualatin River originates as a fast-moving stream in the forested slopes of the Coast Range after which it becomes a low velocity, meandering river through farmlands. River resources are severely stressed during the summer months due to low flows and increased agricultural and domestic water

demand. Significant flow contributions during the summer months are from Clean Water Service's wastewater treatment plants. Clean Water Services initiated the development of a water quality model to help predict and regulate changes in water quality conditions in the river as a result of their wastewater effluent. The water quality model for the Tualatin River and Hagg Lake was set up using the public domain model, CE-QUAL-W2, to simulate water quality parameters from 2013-2020 continuously. This model is a 2-dimensional (longitudinal-vertical) hydrodynamic and water quality model capable of predicting temperature and many water quality parameters. The model was calibrated to eight years of data collected during 2013-2020 along the Tualatin River and at Henry Hagg Lake. To better understand the processes occurring in the river system, two separate models were developed: (1) zero-order and first-order SOD model and (2) sediment diagenesis model. The sediment diagenesis model is fully predictive to changing organic matter flux into the sediments, however it requires much more precision in initial and boundary conditions. The zero-order and first-order model is often able to calibrate closely to field data in systems that have achieved a steady-state. Most water quality predictions were very similar between the first-order model and the sediment diagenesis model, with both models closely matching field data for most parameters. In most cases though, the first order model did better at predicting water quality variations over the 8-year simulation period. The sediment diagenesis model was not able to capture the yearly loading of particulate organic matter to the sediments. Whereas in the zero-order model, the background SOD was fixed and seemed adequate for predicting year-by-year variations in dissolved oxygen and nutrient releases. Analyzing the results from both models side-by-side allowed for a comprehensive analysis of the primary factors affecting the water quality of the Tualatin River.

Bernadel Garstecki
Research Assistant, Department of Civil and Environmental Engineering, Portland State University
M.S. Portland State University, Civil and Environmental Engineering
B.S. Portland State University, Civil Engineering
B.A. University of Oregon, International Studies and Spanish

Monday, September 12
Session 02C: 1 Facility Operations & Maintenance
3:00PM – 3:40PM

Adapting to Rapid Growth at a Decentralized MBR Plant

Ann Dickey[1], Tyson Schlect[2]
[1]Dry Creek Sewer Company; [2]HDR; adickey@boisehunterhomes.com, tyson.schlect@hdrinc.com

Decentralized treatment facilities face unique challenges when adapting to migration changes arising from pandemic and associated trends. Rapid population changes cause disruptive flow and load requirements Small plants are difficult to operate in general, and that difficulty is amplified by current population trends.

Dry Creek Sewer Company (DCSC) owns and operates a membrane bioreactor (MBR) wastewater treatment plant that treats residential wastewater from homes in the Dry Creek Ranch development. Macro factors such as pandemic relocation and low interest rates led to record sales rates of homes in the development. For this decentralized WWTP, the flows increased from about 9,000 gallons per day in

the spring of 2019 to over 50,000 gallons per day by the spring of 2022. The sewer company showed dramatic ability to adapt and overcome design, capacity and operational challenges by implementing significant improvements much faster than envisioned.

After reassessing baseline flow projections, the bioreactor volume and UV disinfection were identified as unit processes most likely to be impacted by unexpected flow increase. Secondarily, the study identified screening, pumping, and membrane capacity as processes vulnerable to continued heightened growth.

A parallel path design project included near-term capacity expansion (fast lane) and mid-term capacity expansion (less fast lane). The UV system was quickly expanded to augment process capacity. A new bioreactor was constructed with 20 percent anoxic volume and a pre-anoxic standpipe to provide better total nitrogen removal. Since implementation of this upgrade the effluent TN has averaged about 2.9 mg/L even during cold winter temperatures (95 percent removal). The unitized improvement strategy allowed management of low flows while providing higher capacity required for additional lot/phase development.

The local controls engineer and the manufacturer controls group collaborated to develop procedures to adapt quickly to small plant specific controls issues. DCSC implemented a unique organizational structure to overcome pandemic-related hiring challenges. Multiple part-time certified operators and in-house compliance and engineering oversight staff were a critical piece of successfully adapting to the rapid growth.

Ann Dickey
Ann Dickey is the Water and Sewer Engineering Manager for the Dry Creek Ranch development, and has a long tenure in the environmental compliance industry.

Tyson Schlect
Tyson Schlect is a wastewater process engineer and project manager for HDR, father of three kids, and part-time professor of mathematics.

Monday, September 12
Session 02C: 2 Facility Operations & Maintenance
3:45PM –4:25PM

Chemical Contingencies for the Supply Chain of the Future

Chris Maher, Bruce Cordon, Heidi Blasingame, Justine Abrook, Erik Lorntson, Mike Gates, Logan Olds
Clean Water Services, United States of America; maherc@cleanwaterservices.org

Pandemic associated disruptions in manufacturing, shipping, and supply chains in general have led to delivery delays and increased costs of all goods. In a Water Resource Recovery Facility (WRRF), treatment chemicals are a critical good delivered on a regular schedule. Interruptions in these deliveries are a direct threat to permit compliance.

This presentation includes the experience of Clean Water Services (CWS) in three areas of chemical procurement.

Sodium Bisulfite Delivery Delay

In January 2022 a breakdown in shipping of sodium bisulfite resulted in the potential for CWS facilities to be unable to dechlorinate final effluent. CWS responded with operational changes, securing local supplies, and planning purchase and shipping of bulk supplies from an alternate manufacturer. This event precipitated the compliance question: In the event we cannot dechlorinate, should we continue chlorination and discharge total residual chlorine, or should we discontinue chlorination and discharge more E. coli? CWS analyzed and debated this question.

Price Increases

Over the past 12 months, CWS has experienced a 40% increase in the price of thickening and dewatering polymer. In negotiations, the supplier explained the root causes of the increases and what financial indices would be most indicative of the future market as well as being most applicable to price increase calculations. CWS purchasing staff and business analysts examined these indices and market forecasts to propose temporary price increase intervals and index averaging periods, weighing the odds that any index would trend up or down.

State of Practice in Chemical Procurement

While there has been an intense focus on reducing energy consumption in the wastewater industry in recent years, little attention has been paid to treatment chemicals. At CWS, chemical costs have outpaced energy, and are second only to labor. An effort was made to review current practice in specifications, bidding, and contracting involving a resource search into existing guidance, interviews with chemical vendors, and interviews with numerous other water and wastewater utilities in northwest Oregon. The project provides guidance in:

- Specifications
- AWWA, NSF, ANSI
- Alternative products
- Bidding
- Competition
- Format
- Contracting
- Length
- Renewals
- Adjustments
- Operations
- Other
- Consortiums

Chris Maher
Chris Maher was a Class A operator at the Upper Blue Sanitation District in Breckenridge, CO for 13 years where he earned his MS degree in Environmental Engineering through the Illinois Institute of Technology. He has been with Clean Water Services for 9 years where he is now a Senior Operations Analyst and a Grade IV certified operator.

Monday, September 12
Session 02C: 3 Facility Operations & Maintenance
4:30PM –5:10PM

Nitrogen Removal Optimization at Bellingham

Anne Conklin[1], Steve Bradshaw[2], Adam Klein[3], Susanna Leung[1], Tadd Giesbrecht[1]
[1]Carollo Engineers, Seattle, Washington; [2]City of Bellingham, Washington; [3]Brown and Caldwell, Seattle, Washington; aconklin@carollo.com

The City of Bellingham (City) provides wastewater service for over 100,000 people at the Post Point facility. As part of the Resource Recovery project, the City plans to replace the existing aging incinerators with a new anaerobic digestion process. The Washington State Department of Ecology (Ecology) recently issued a General Permit that requires treatment facilities identify strategies to optimize their process to limit their total inorganic nitrogen (TIN) discharge. Since the recycle stream from the new digestion process will effectively introduce a nitrogen load to the plant, the Resource Recovery project will include a side stream treatment process. However, this process is expected to reliably remove only 80 percent of the additional nitrogen in the digestion recycle. Therefore, additional optimization measures will need to be reviewed to comply with the General Permit.

Several optimization strategies were evaluated to help the City limit their annual effluent nitrogen load. These strategies focus on dentification during the summer months when flows are lower and wastewater temperatures are warm. The strategies evaluated include modulating the operation of pump stations within the collection system to limit peak flows at the plant and to maximize nitrogen return to the secondary process by increasing the existing RAS pumping. The viability of these alternatives was evaluated using the existing collection system model and the calibrated whole plant BioWin model. Preliminary results of these modeling efforts indicate that the City's range of nitrogen reduction strategies is anticipated to achieve compliance with the annual TIN Action Level prescribed in the General Permit through the first permit cycle.

Anne Conklin
Dr Conklin is a Principal Technologist at Carollo Engineers, and has seventeen years of experience in facility planning and wastewater treatment process modeling. She joined Carollo after earning her PhD in Civil and Environmental Engineering from the University of Washington.

Monday, September 12
Session 03C: 1 Construction & Alt Delivery
3:00PM – 3:40PM

How Progressive Design-Build Revives 100+ Year-Old Water Mains

Dennis Sanschagrin[1], Anna Pridmore[2], Joseph Willich[3]
[1]Pullman SST, Inc.; [2]Structural Technologies, LLC; [3]Brown and Caldwell; dsanschagrin@pullman-services.com, apridmore@structuraltec.com

Great Lakes Water Authority (GLWA), Detroit Metro's largest supplier of drinking water, will decommission the Northeast WTP due to overcapacity yet will still need to deliver drinking water to the residents and businesses in the service area from outlying WTPs. The service area covers a portion of northern Detroit and nearby suburbs. A series of existing 48-inch water transmission mains will be repurposed to directly provide drinking water. The challenge for GLWA: How to procure multiple projects to renew the pipelines to a AWWA Class 4 long-service life solution in an urban area while minimizing disruption.

The learning objectives of this presentation are:

9. Accelerating the procurement process with progressive design-build based on concepts
10. Structuring a dynamic design-build team to address a multi-faceted set of challenges
11. Adapting design-build to remote collaboration during procurement
12. Risk assessment and management with limited information on 100+ year old pipelines

Dennis Sanschagrin

Dennis Sanschagrin is a Senior Vice President for PULLMAN. He has over 30 years of experience in the repair and restoration of existing structures, including corrosion mitigation, structural strengthening, post tension repair and façade restoration. Dennis assists all types of commercial and municipal owners with their design-build projects around the country. He has experience teaching integrated product delivery systems and how to procure them to small groups of owners at their facilities as well as presentations for larger groups at association meetings. Dennis has a BS in Civil Engineering from the University of Maryland and an MBA from George Mason University and is a designated Design Build Professional with DBIA.

Anna Pridmore

Dr. Anna Pridmore is the Vice President of Strategic Market Development for Structural Technologies with a focus on design-build rehabilitation of civil infrastructure. She received her PhD in Structural Engineering, is a licensed professional engineer in California, and has over 18 years of interdisciplinary experience specializing in large diameter pipeline asset management and renewal using advanced composites, with over 400 projects implemented to date. Anna is a member of DBIA Water/Wastewater Committee and along with numerous other technical committees.

Monday, September 12
Session 03C: 2 Construction & Alt Delivery
3:45PM –4:25PM

Mitigating Financial & Technical Risk through Energy Savings Performance Contracting (ESPC)

Kathleen Kelleher
Ameresco, United States of America; kkelleher@ameresco.com

Deferred maintenance, open-bid contracting let downs, and being short-staffed are all concerns we hear from municipal clients. I want to present another method of procurement available to both water treatment and wastewater treatment facilities meant to protect public funds and provide the needed upgrades for facilities: Energy Savings Performance Contracting (ESPC). This form of contracting has been around for decades and used heavily in the education and municipal space; it can and has been applied

locally to our PNW WWTPs with great success to obtain needed equipment utilizing the resources of an Energy Services Company (ESCO), all under a performance guarantee.

Energy Savings Performance Contracting (ESPC) is an alternative delivery method that offers a project with guarantees. From the performance of the equipment to the overall cost of the project, this is all guaranteed through the ESPC process resulting in clients mitigating their financial and technical risk when undertaking projects. Through partnering with an ESCO, clients have an extension of their team focusing on the goals of the project together.

This presentation will review the mechanics of ESPC, how to determine if it is a good fit for your organization, and case studies of local success stories utilizing ESPC to complete projects.

Kathleen Kelleher
Kathleen has a BS from the University of Washington in Bioresource Science & Engineering and MBA from the University of Utah. She spent the first part of her career in chemical water treatment for heavy industrial processes working with process and wastewater applications. From there, she worked in water filtration for municipal and industrial clients across Western North America. Through Ameresco, Kathleen looks forward to bringing the energy and water world together to address the needs clients have and find creative solutions.

Monday, September 12
Session 03C: 3 Construction & Alt Delivery
4:30PM –5:10PM

That's a Fact: Alternative Delivery Means Alternative Value Engineering Approaches, for Real Savings and Value Added

Dick Talley[1], Muriel Gueissaz-Teufel[2], Dave Green[3], Mark Bertolero[4]
[1]Stantec Consulting Services, Inc.; [2]City of Portland Bureau of Environmental Services; [3]Jacobs Engineering, Inc.; [4]Kiewit Infrastructure West Corporation; richard.talley@stantec.com, muriel.gueissaz-teufel@portlandoregon.gov

The Bureau of Environmental Services (BES) owns and operates the Columbia Boulevard Wastewater Treatment Plant (CBWTP) and is currently making a series of significant capital upgrades to the plant through a single program referred to as the Secondary Treatment Enhancement Program (STEP). The program is delivered utilizing a Construction Management/General Contractor (CM/GC) project delivery model, where the contractor building the facilities is part of the design development process with the intent of providing constructability reviews for a best value construction project.

Large projects are required to go through a Value Engineering (VE) process, where the over-arching intent is to consider alternative design solutions to optimize the expected cost/worth ratio of projects at completion. Historically at BES, under design-bid-build deliveries, VE approaches and outcomes have more often than not led to scope cuts, which actually remove value, to the chagrin of operations and maintenance staff.

The collaborative nature the CM/GC model between the Owner, Designer, and Contractor provides a greater opportunity to realize the true intent of VE. In this model, VE is not restricted to just the design phase, where even in the CM/GC construction phase, contractors are encouraged through shared savings to draw on their special expertise to propose changes that cut costs while maintaining or enhancing quality, value, and functional performance.

The presenters will summarize lessons learned while delivering a significant capital project ($475 million) during a pandemic, social unrest, drought, fires, supply chain disruptions, material and labor shortages and overall market volatility not experienced for decades. The presenters will provide an overview of how BES utilized the CM/GC delivery model and a rigorous approach to establishing and maintaining an interactive, participatory, and contributing role in an ongoing VE culture where rolling VEs and healthy "competition" was promoted between the team members to propose value added alternatives and vet them as a team. The result of BES's VE process resulted in maintaining the forecast total budget at completion within 13% when compared to the 30% design forecast established before COVID and other disruptions surfaced.

Dick **Talley**

For 35+ years, Dick has enjoyed a career assisting agencies and private companies design, construct and operate and has delivered major capital upgrades utilizing a variety of delivery models from traditional design-bid-build and including various forms of alternative delivery including CMAR, EPC and Design-Build and hybrids thereof. Dick serves as Stantec's Vice President and Area Manager from the company's offices in Portland. Dick is a registered engineer and has fulfilled the role of designer, contractor, Owner's Representative and Program Manager for a variety of wastewater and water projects from collections and conveyance, to pumping and storage, treatment and discharge. Dick is currently serving as the Deputy Program Manager for the City of Portland Bureau of Environmental Services (BES) as they work to deliver the $475 Million Secondary Treatment Enhancement Program (STEP) at the Columbia Boulevard Wastewater Treatment Plant (CBWWTP). As the Deputy Program Manager, Dick has been very active in assisting the STEP team with the CM/GC delivery model, providing leadership and counsel on risk management, budget management, schedule management and cost control through a ongoing Value Engineering process. Dick provides a unique and engaging perspective on delivery of large capital projects in the public space using a variety of policies, procedures and tools.

Muriel **Gueissaz-Teufel**

Muriel has more than 23 years of experience in the PNW working in various capacities on wastewater capital projects implementation, including planning, design, and construction. An advocate of process improvements, she has worked to implement the first design build project at the treatment plant and is now managing the CM/GC delivery of the Secondary Treatment Expansion Program for BES, a major investment in the Columbia Boulevard Wastewater Treatment Plant. Muriel has a Bachelor and Master's degree in Chemical Engineering, and is a Board Certified Environmental Engineer. Muriel works out of BES' new Project Management Office. She loves the work she does, and mostly, the people she works with.

Monday, September 12
Session 04C: 1 IWM/Funding
3:00PM – 3:40PM

Innovative Strategy and a Case Study for Implementing Watershed Nutrient Management: The Full

Scale Program

Natalie Lenz[1], Jeff Smudde[2], Erin Houghton[2], Brent Brown[1]

[1]Jacobs; [2]NEW Water; natalie.lenz@jacobs.com, brent.brown@jacobs.com

Introduction

Wisconsin enacted legislation that allows regulated point sources to partner with stakeholders to implement watershed-wide strategies to reduce nutrient and sediment loadings to surface waters. The options include a "multi-discharger variance", water quality credit trading, and watershed adaptive management. Each of these options allow more than one implementation strategy with each having unique advantages and disadvantages. The presentation will provide a summary of the phosphorus permitting framework in Wisconsin along with a case study. The case study highlights key decision criteria for the utility selecting adaptive management and the innovative, technology-driven approach to program implementation.

Case Study

NEW Water, the brand of the Green Bay Metropolitan Sewerage District in Green Bay, Wisconsin, discharges near the Bay of Green Bay to the Lower Fox River in the Lower Fox River Basin which is impaired for phosphorus and sediment (TSS) and has an approved TMDL. Several evaluations were completed which demonstrated that a watershed approach for meeting phosphorus and TSS permit requirements would be low-cost and provide additional non-monetary benefits. The State approved NEW Water's permit application that includes adaptive management in 2020.

The adaptive management program, titled the NEW Watershed Program (Program), is anticipated to span four, five-year permit terms. The Program is partnering with several entities to install agricultural and urban conservation Best Management Practices (BMPs) to reduce phosphorus and TSS nutrient loading, with the goal to achieve TMDL reductions and water quality standards in the Action Area.

Several digital solutions were developed to address the complexity of executing and managing a large program with a diverse team. By efficiently leveraging data and utilizing tools like GIS, custom mobile applications, real-time dashboards, and automated workflows, managing a program of this size is more attainable than before. Using digital solutions has allowed personnel at all levels to effectively contribute to the overall project successes, including workload planning with key staff, collaboration in the multiple facets of BMP implementation, budget management, contracting, and monitoring progress against regulatory requirements, all in real-time.

Natalie **Lenz**

Natalie Lenz is a water resources engineer in Milwaukee, Wisconsin with Jacobs. She has 5 years of experience and assists municipal and private clients with facility master planning, phosphorus regulatory compliance, integrated watershed planning, and sustainability evaluations. Ms Lenz has also supported projects such as urban stream restoration, Monte Carlo simulation to evaluate risk, and developing custom digital solutions to process data such as real-time dashboards, automated workflows, and leveraging GIS systems to manage information. Ms Lenz has a bachelor's degree in chemistry and environmental science from the University of Wisconsin at Madison and a master's degree from Northwestern University in Chemical Engineering. She is a licensed professional engineer and certified

Envision Sustainability Professional. Ms. Lenz is a water (and snow) enthusiast and enjoys summers boating, kayaking, and swimming, and winters downhill skiing and snowshoeing.

Brent Brown

Brent Brown has over 21 years' experience as a water resources engineer with Jacobs (formerly CH2M HILL) in Milwaukee, Wisconsin. He supports municipal and private clients involving complex permitting negotiations, master planning, and working across business and technical functions to develop and implement long term technical strategies to meet permitting requirements and business goals. Mr. Brown has built a reputation for bringing diverse interests together for solving unique challenges in the fields of stormwater and watershed management, water quality credit trading and watershed adaptive management, Great Lakes water use, dry cargo shipping across the Great Lakes, and neighborhood revitalization through urban stream restoration. Mr. Brown has a bachelor's degree from the University of Wisconsin at Platteville in civil/environmental engineering and a master's degree from the University of Illinois at Urbana-Champaign in environmental engineering. During his free time, Mr. Brown is either outside biking, hiking, camping, skiing, or on the water, or is in his garage restoring vintage cars.

Monday, September 12
Session 04C: 2 IWM/Funding
3:45PM –4:25PM

Funding 101: How to Navigate the Process and Develop Strategies to Secure Funding

Shelby Smith
Brown & Caldwell, United States of America; sbsmith@brwncald.com

Securing funding is a mission-critical component of any capital project or program. In today's water market, municipalities are facing a nexus of challenges such as rising inflation, pricing and worker availability uncertainty, supply chain disruptions, and construction cost increases. These market-driven challenges coalesce with a national crisis around aging infrastructure, environmental justice, resiliency, and climate change that keep the pressure on local and state entities to act now instead of delaying project delivery. The recent Bipartisan Infrastructure Law (Infrastructure Investment and Jobs Act) passed by Congress is momentous evidence that the federal government sees the significant gap between capital needs and available funds and is taking action to help.

There is a wide variety of state and federal funding programs available to the water sector, however it can be difficult to decide which opportunity to pursue or know how to develop a compelling application that results in securing funding. This presentation will cover the overall funding process and it will focus on two specific funding programs at the state and federal level – State Revolving Fund Loan and Water Infrastructure Finance and Innovation Act (WIFIA) – providing best practices and guidance for how to develop a strategy for understanding funding eligibility requirements, preparing the funding application, and demonstrating how the capital project aligns with the funding programs' priorities.

For each funding program, case studies will be shared to tell the story of how different utilities rose to the occasion and navigated the funding process to secure critical infrastructure funding. These stories are intended to help illustrate how other interested Pacific Northwest agencies can accelerate capital infrastructure delivery, alleviate financial burden to ratepayers, support underserved communities, and deliver the essential water infrastructure needed to support a vibrant, resilient community of the future.

Shelby Smith

Shelby Smith, PE, PMP is a Senior Associate at Brown and Caldwell with diverse experience in program and project management for the municipal wastewater sector. She has supported numerous PNW municipalities with capital investment planning, design, and delivery, stakeholder engagement, alternative delivery methods analysis and procurement, public outreach, and permitting.

Monday, September 12
Session 04C: 3 IWM/Funding
4:30PM –5:10PM

Financing City Of Boise Water Renewal Facilities: A Case Study On One City's Experience With Capital Funding Strategies And Options For The Community

Scott Lester[1], Matt Millis[2], Paul Quinn[1], Martin Chaw[1]
[1]FCS GROUP; [2]City of Boise; scottl@fcsgroup.com, mmillis@cityofboise.org, paulq@fcsgroup.com, martinc@fcsgroup.com

Since 1949, the City of Boise Water Renewal Services (WRS) is responsible for renewing more than 10 billion gallons of used water (commonly known as wastewater) per year. From the shower to the kitchen sink and toilet, from homes to businesses, large industry to hospitals and schools, every drop of used water travels through some of the more than 900 miles of underground pipes to one of two water renewal facilities. In the coming years, significant capital improvements will be needed to address WRS' aging infrastructure, meet regulatory requirements, provide for capacity needs, and meet citizens' service level expectations. A financial plan was created to address these capital needs, as well as help execute on the utility's strategic plan, which includes the following elements:

- Enhance the health and use of the Boise River

- Reinvest in our existing infrastructure

- Support our local economy through industrial reuse

- Combat the pressures of climate change by adding recycled water to the aquifer for future use

- Balance affordability for our community

Using the collective work of WRS, FCS GROUP, and Brown and Caldwell as a case study, this presentation will discuss the challenges faced by the WRS, and how the utility worked in partnership with FCS GROUP to develop a customized financial solution to successfully execute the utility's strategic goals and vision. The presentation will include discussion of the financial framework used, the challenges faced when trying to implement a capital funding plan, and how the WRS used the results of the financial analysis to support stakeholder communications including a successful voter-approved ballot measure for a long-term revenue bonding strategy.

Learning Objectives

Participants will take away information and perspective on:

- Infrastructure challenges faced by the City of Boise to ensure continued delivery of quality services to the community

- Policy and financial planning considerations for capital funding strategies

- Communicating capital funding and rate impacts to elected officials and stakeholders

- The strategies and public policy framework utilized to successfully support WRS' long-term initiatives

Matt Mills
Matt Millis is the City of Boise Public Works Enterprise Revenue Manager. Full biography forthcoming.

Paul Quinn
Paul Quinn is an FCS GROUP assistant project manager with 11 years of financial research and analytical experience including cost of service and rate modeling engagements throughout the Northwest.

Martin Chaw
Martin Chaw is an FCS GROUP senior project manager with over 34 years of professional experience in state, local and regional governmental finance and policy analysis. His areas of practice include utility and general public sector management consulting, with a particular focus on budgeting, financial planning, and program evaluation. Martin has developed comprehensive rate studies and utility financial plans for cities and districts throughout the Western U.S., including agencies in Washington, Idaho, Oregon, Nevada, and Wyoming.

Monday, September 12
Session 05C: 1 Collection Systems – I&I
3:00PM – 3:40PM

Crossing the Line: I/I Impacts After Lateral Improvements on Private Property

Chris Horgan[1], **Holly Ellis**[2]
[1]J-U-B ENGINEERS, Inc., United States of America; [2]City of Sandpoint, Idaho; chorgan@jub.com, hellis@sandpointidaho.gov

How much inflow and infiltration (I/I) can be eliminated by improving sewer laterals on both sides of the property line? This presentation discusses recent results from the City of Sandpoint's attempt to answer this question based on a combination of flow monitoring and collection system improvements.

The City has long believed that I/I sources on private property, like sump pumps, roof drains, and laterals, contribute a significant amount of flow to the collection system. Despite cured-in-place pipe (CIPP) rehabilitation of almost all the oldest mainline in the collection system, peak flows at the WWTP are still 10 times higher than average flows. Reducing flow from private sources could therefore be a key component in reducing the scope of upcoming WWTP upgrades from 10 mgd to the City's goal of 6 mgd.

However, undertaking City-wide lateral improvements was an expensive proposition and, with no sense of the expected efficacy, was a difficult concept for City leaders to support. Therefore, the City's Infrastructure and Development Services Department devised a plan to provide a data-driven answer to

this question and direction for future collection system work. The City identified two micro-basins in their collection system – a demonstration basin that would receive lateral improvements and a control basin that would receive no improvements. Flow monitoring was performed pre- and post-improvements to quantify I/I reduction.

The presentation will include results from the City's approach to improving laterals in the right-of-way and on private property, the public outreach efforts used to obtain permission for lateral improvements on private property, flow monitoring results before and after lateral improvements, and challenges faced during construction.

The goal of this presentation is to provide information on the potential I/I reduction via improvements to sewer laterals and provide insight to how critical work on private property could be to a system's overall I/I reduction. Public out-reach efforts and lessons learned during construction discussion will likely be useful for other entities with similar I/I reduction objectives.

Chris Horgan
Chris is a lead project engineer and project manager for J-U-B ENGINEERS, Inc. in their Coeur d'Alene, Idaho office. He earned his B.S. and M.S. in Civil Engineering from the University of Idaho and has over 13 years of experience with water resources-related planning, funding procurement, design, and construction.

Holly Ellis
Holly is a construction manager for the City of Sandpoint, Idaho. She graduated from the University of North Carolina at Charlotte in 2016, where she earned a B.S. in Civil Engineering. She has experience in planning, design, and construction of public infrastructure projects, from both the private and public sectors.

Monday, September 12
Session 05C: 2 Collection Systems – I&I
3:45PM –4:25PM

Correcting Infiltration and Inflow in the Colfax, WA Sanitary Sewer System guided by Temperature Monitoring

Erik R. Coats[1], Simon Smith[1], Matt Hammer[2]
[1]Mountain Waterworks; [2]City of Colfax, WA; ecoats@mountainwtr.com, simonofworldthree@gmail.com

Infiltration and Inflow (I&I) in the City of Colfax, WA sanitary sewer collection system is well-documented, with I&I studies dating to the 1970s. Annually the I&I volume of wastewater flow received at the water resource recovery facility (WRRF) is 20-30 million gallons, representing 25-30% of the total annual flow, yet the source of I&I is poorly understood. Smoke testing did not reveal significant sources of inflow; conversely, analysis of precipitation-flow data indicates infiltration dominates. Identifying sources of infiltration is more challenging than inflow, ultimately requiring CCTV investigation to guide a capital improvement plan (CIP). System flow monitoring is a conventional approach to identify sewer lines for subsequent CCTV investigation. However, flow monitoring is expensive – in time and money – and thus can only be conducted in a limited manner both in time and space, particularly for small to mid-sized

cities. Cost-effective methods that can be deployed more comprehensively in the sewer system are needed to guide targeted CCTV investigations.

In May 2021 Mountain Waterworks initiated a field investigation to monitor Colfax's sewer system for I&I. Specifically, we deployed 16 temperature probes at strategic locations in the sewer system, with monthly data downloads. Temperature data was obtained in one-minute increments, providing excellent resolution for I&I interpretation. We collected data over an extended period that covered dry-, inflow-, and infiltration conditions to identify the sewer sections that contributed most I&I. Temperature data were analyzed using a simple rule-of-thumb approach coupled to a statistical-based interrogation to identify probable sources of infiltration; CCTV investigations were strategically guided from these analyses. The end result was a prioritized system-wide CIP to help the City tackle the "worst offender" areas of the sewer system and cost-effectively reduce I&I. Results from this study will be presented and discussed, along with guidance on how cities can implement their own temperature monitoring system.

Erik **Coats**
Dr. Erik R. Coats is a Professor of Environmental Engineering at the University of Idaho; Dr. Coats also regularly consults with Mountain Waterworks on wastewater projects.

Simon **Smith**
Dr. Simon Smith is an independent consultant who assists municipalities in studying sanitary sewer and storm water systems using innovative technologies to remedy I&I.

Monday, September 12
Session 05C: 3 Collection Systems – I&I
4:30PM –5:10PM

The Sewer Whisperer: "Listen Carefully, Your Sewer is Talking to You"

Brogan Quist
SmartCover Systems, United States of America; bquist@smartcoversystems.com

This presentation reviews how customers can adopt unique and patented monitoring technology, which gives them data in the field that they did not have before. The monitors mount directly on the manhole covers – thereby eliminating the need for a confined space entry - and use ultrasonic sensors to monitor water levels. The remote monitors send data to a secure customer website, as well as sending out alarms, advisories, and maintenance alerts directly to the customer.

Real-time remote water level monitoring can identify locations where a possible sewer system overflow is developing and alarm these conditions before the overflow, allowing field staff to visit the site and perform corrective actions. Locating these problems prior to an SSO actually occurring has enabled users to pinpoint the causes of these blockages.

By placing the remote monitors at sites which are cleaned multiple times a year (due to FOG, roots, etc), water levels are wirelessly transmitted in real-time to the collection system operator, and the knowledge of these water levels and the lack of problems at these sites has enabled re-deployment of staff to other problem areas. This yields both ROI in time and money within one year of utilizing the system.

Remote real-time level monitors also provide a means to detect and correlate rain events with I&I. The ability to identify, quantify and track down sources of I&I is critical to minimizing problems with overflows during significant precipitation events. This system now uses automatic tools to track WHICH locations are experiencing higher levels, based on the rain event. The system can also monitor the TOTAL dynamic range between the bottom of the pipe to the very top of the manhole.

Utilities can also utilize these monitors to provide additional information before, during, or after large Capital Improvement Projects. This application can also yield high levels of ROI, or the chance to delay, defer, or eliminate costly CIP projects.

Finally, by utilizing this same set up, agencies can now monitor H2S levels in their sewer systems as well. This new feature can assist in odor studies, dosing, and overall health of the pipe/manhole.

Brogan Quist
Brogan Quist: Brogan has a Bachelors of Science Degree from Westmont College, located in Santa Barbara, CA. Brogan has over 10 years of experience in the wastewater and technology sector. Brogan first started in the industry by installing and maintaining monitoring devices in the field, beginning in 2008. He has completed over 500 site visits, troubleshooting, and installations. Currently, Brogan works with customers in the Western/Central region of the United states to help solve their challenges by providing remote monitoring systems.

Monday, September 12
Session 06C: 1 Treatment – Nutrient Removal
3:00PM – 3:40PM

Maximum Wastewater Operation -Total Inorganic Nitrogen Tools to streamline and data for success

Austin Carnes[1], **Brandon Pechin**[2], **Adam Jennings**[3]
[1]City of Boise Water Renewal Facility; [2]City of Boise Water Renewal Facility; [3]HACH COMPANY, United States of America;
acarnes@cityofboise.org, bpechin@cityofboise.org, idahofreak@hotmail.com

To minimize RAS nitrate for the benefit of the EBPR process, the operation of anoxic/aerobic swing zones were optimized. Plant personnel began performing specific ammonia uptake rate testing and calculating nitrification capacity in pounds per day, which was translated into alarm setpoints from Hach AN-ISE probes. Swing zone aeration would be initiated if the probes indicated that basin loading was exceeding capacity and then was terminated when loading fell below capacity. This allowed for the facility to operate the swing zones in the anoxic mode for the greatest amount of time to maximize total nitrogen removal."

Connecting the operator view, maintenance and management roles for permit compliance and wastewater optimization can increase success, bolster staff knowledge and save expensive resources using technology. This talk will focus on some fresh thoughts connecting operations, compliance and technology to maximize wastewater treatment. Information and material presented by the City of Boise Wastewater Process Analyst team will show how consolodating process data and using online insturmentation can bring visibility for more successful process control and Total Inorgainc Nitrogen removal.

Learning Objectives:

- Gain perspective on NPDES compliance and operating in a traditional manner from a management view to an operators.
- Understand the impact to treatment when preventative maintenance on equipment and individual unit processes go down.
- Will cover how technology and specific data management can help with future wastewater strategic planning, staff, plant upgrades, etc.
- Connecting real world operational examples of online instrumentation, process control lab and data management for improved Total Inorganic Nitrogen removal at the City of Boise

Austin Carnes
Austin has been in the wastewater profession for seven years with the City of Boise, first as an Operator and then as a Wastewater Process Analyst. He provides direction on process control for two advanced Water Renewal Facilities and a chemical Phosphorus Removal Facility. Austin is the City's primary wastewater modeler and administers its Water Information Management System.

His primary research focus in recent years has been optimization of EBPR at the West Boise Water Renewal Facility which suffers from a poor carbon to phosphorus ratio. Austin holds a Bachelor of Science in Environmental Science from Portland State University and is pursuing a Master of Science in Science in Environmental Science through the University of Arizona.

Brandon Pechin
Brandon has been in wastewater for 10 years where he has worked through as an Operator and now holds a Wastewater Process Analyst role for the City of Boise. He brings innovation and is always working on presenting new ideas that challenge the status quo with optimization in mind. Energy and chemical savings in a regulatory driven landscape can be difficult but Brandon hopes to help keep the conversation on what's possible.

His experience in helping optimize various wastewater processes from staged aeration to fermentation carbon augmentation for EBPR systems brings a different perspective. He hopes this experience will gain treatment plants more success in nutrient removal and facility operation. In addition to his AS degree in Natural Resources he brings ground level understanding starting up the nations first nutrient offset site in Idaho.

Adam Jennings
Adam’s background and foundation is in wastewater operations and management, having previously worked as an operator, operations supervisor, and plant manager.

His professional operations licenses include: Class IV Wastewater Treatment, Class IV Collection System, and Class I Wastewater Lab Analyst.

He started in the wastewater field 17 years ago and quickly moved into operations. In operations, he supervised a team of operators during a changing regulatory landscape with new stringent nutrient limits on the horizon. Having sat in the plant manager role, and now with Hach he hopes to bring some new perspectives and foster creative thinking and plant optimization. He is a home-brew aficionado and enjoys adventuring with his kids in the mountains of Idaho.

Monday, September 12
Session 06C: 2 Treatment – Nutrient Removal
3:45PM –4:25PM

Guidelines for Optimizing Nutrient Removal Plant Performance

Bryce Figdore, JB Neethling, Dave Clark, Pat Roe
HDR, United States of America; Bryce.Figdore@hdrinc.com

The proposed sessions will present findings of Water Research Foundation (WRF) project 4973 "Guidelines for Optimizing Nutrient Removal Plant Performance." The goal of the project is to develop guidance on approaches to optimize existing plants for nutrient removal, utilize full scale examples of how it is done, and to produce a guide on how to do it.

Two PNCWA sessions are proposed to cover this material, but alternative arrangements can be considered such as only a single session focused on the Nutrient Removal Optimization Decision Guidance Tool. The first session will present the fundamentals on conventional and emerging approaches for nutrient removal optimization. The second session will present case studies and "decision tree" guides for optimization. This session will provide unique learning opportunities for attendees regarding opportunities to optimize the process and achieve some nutrient removal at existing WRRFs that currently only provides secondary treatment for BOD and TSS removal. Optimization opportunities to reduce cost and improve performance will be discussed. Finally, these sessions will also allow feedback from the audience to shape the research for the Water Research Foundation project 4973 in developing practical guidelines for optimizing WRRFs to improve nutrient removal more efficiently and more reliably.

Three key learning objectives for this session are:

13. Participants will comprehend the fundamentals of nutrient reduction and the focus areas to optimize the process (for example, while conventional thinking is to maintain a DO above 2 mg/L in biological treatment, lower DO concentrations can be used under appropriate conditions to achieve both nitrification and denitrification).
14. Participants will learn how to identify opportunities for optimizing WRRF operation to reduce operating costs and to improve process performance (these two may be mutually exclusive in some instances).
15. Participants will learn about new and emerging strategies and their development status.

Bryce Figdore
Bryce Figdore is a senior wastewater process engineer with HDR based in Bellevue, WA. He is enthusiastic about applying his expertise in biological nutrient removal to deliver innovative and robust wastewater treatment and water resource management solutions. Bryce has Bachelor's, Master's and Doctorate degrees, respectively, from Penn State, Villanova, and the University of Washington. He enjoys exploring the great Pacific Northwest while fly fishing or hiking with his family.

Monday, September 12
Session 06C: 3 Treatment – Nutrient Removal
4:30PM –5:10PM

Which Ones Do You Need? Nitrogen Removal Optimization Ideas and Case Studies

Miaomiao Zhang, Jeff Moss
Murraysmith; Miaomiao.Zhang@murraysmith.us

The Puget Sound Nutrient General Permit (PSNGP) that was issued by the Washington State Department of Ecology at the beginning of the year, categorized 58 publicly owned domestic wastewater treatment plants (WWTPs) into three types—dominant, moderate, and small Total Inorganic Nitrogen (TIN) loads. All WWTPs under these three categories are required to perform a nitrogen optimization and submit the report annually or per permit cycle. This nitrogen optimization process will provide wastewater utilities the opportunity to identify and implement reasonable strategies from the perspective of operations and maintenance, process control, and unit process improvements. With this process, utilities will be able to meet the TIN action levels or optimization goals while not imposing a significant financial burden on wastewater utilities.

This presentation will provide the audience a whole suite of nitrogen optimization ideas and a few real-world examples from Kitsap County, City of Bainbridge Island, and LOTT Clean Water Alliance. Some of the topics will include:

- Instrument/Equipment Maintenance, i.e.,

- Calibrate and repair DO, ORP, and ammonia/nitrate probes

- Calibrate and repair flow meters

- Operational changes, i.e.,

- Optimize wasting and RAS return to maintain a consistent and desired biomass inventory, thus sludge retention time

- Increase mixed liquor recycle rate

- Optimize methanol addition to promote denitrification

- Adjust dewatering operation hours to even out ammonia load from recycle stream

- Optimize the aeration cycle for simultaneous nitrification and denitrification

- Process control optimization, i.e.,

- Implement control strategies

- Flow pacing instead of manual operation

- Fine tune process control setpoints, DO, ammonia, etc.

- Process upgrade:

- Upgrade aged aeration system with blowers and diffusers with automation

- Reconfigure existing aeration basins for improved flow pattern and biological nitrogen removal

- Optimize the division of aerobic and anoxic zones in the aeration basin to balance between organics removal and TIN removal, as well as reduce filamentous bacteria

Miaomiao **Zhang**

Miaomiao is a principal engineer with over 20 years of experience performing studies, planning, designing, and overseeing construction of municipal water, wastewater, and odor control facilities. She has served on many projects as process mechanical engineer, technologist, task lead, design manager, and project manager roles which have equipped her with an array of skill sets to serve her clients all over the region and country. Miaomiao is a certified project management professional. She has worked with a number of wastewater municipalities in the Pacific Northwest on process analysis, O&M optimization and plant retrofit or upgrade to improve nitrogen removal

Monday, September 12

Session 07C: 1 Treatment – Nutrient Removal

3:00PM – 3:40PM

Fermentation or Chemical Feed? Evaluating Carbon Addition at the Meridian WRRF

Zach Dobroth[1], Clint Dolsby[2], Tyson Glock[2], Rick Kelly[1], Rick Murray[2]

[1]Brown and Caldwell; [2]City of Meridian, Idaho; zdobroth@brwncald.com, cdolsby@meridiancity.org

The City of Meridian, Idaho, is undergoing a series of upgrades to its Wastewater Resource Recovery Facility (WRRF) to meet stringent effluent nutrient limits that begin in 2027. Raw influent to the facility is carbon-limited, meaning supplemental carbon must be added to drive the WRRF's biological nutrient removal processes. Part of that carbon can be provided in fermentate from the WRRF's primary sludge fermenter (Fermenter 1), which was retrofitted from an unused digester in 2013. A second digester was designated as future Fermenter 2 but has remained mothballed.

In 2020, the City began operating a chemical feed facility capable of providing acetic acid and methanol to the WRRF's aeration basins. These chemical feeds can provide all the necessary supplemental carbon required for treatment. However, the quantity and cost of chemicals will continue to rise with increasing influent nutrient loads and lower effluent limits in the future.

What will be the most cost-effective solution? To help determine a path forward, the City tasked Brown and Caldwell with:

16. Evaluating fermenter operational data to determine the ability of Fermenter 1 to meet future carbon demands.
17. Examining fermenter performance at West Boise (full-scale) and Central Valley, Utah (pilot-scale) to find potential performance improvements that could be gained through operational or design modifications at Meridian.
18. Completing a 20-year life cycle cost analysis (LCCA) to evaluate upgrading and/or expanding the existing fermentation system in comparison to solely using external chemical addition to drive nutrient removal.

The LCCA showed the most cost-effective solution would be upgrading Fermenter 1 (including the addition of sludge heating) to optimize carbon output in the fermentate and offset chemical use. It also showed the addition of Fermenter 2 would not deliver enough value in additional carbon production to warrant the capital expense.

This presentation will summarize the fermenter evaluation and provide insights for other facilities using (or considering using) fermentation for carbon supplementation.

Zach Dobroth
Zach Dobroth, P.E. (Idaho), is a senior wastewater engineer in Brown and Caldwell's Boise office. Zach has experience designing municipal wastewater treatment facilities and with process modeling of advanced biological nutrient removal systems.

Clint Dolsby
Clint Dolsby, P.E. (Idaho), is an Assistant City Engineer for the City of Meridian. In his 18 years with the City, he has managed several expansion projects at the Meridian WRRF. He also serves as Chair of the Lower Boise Watershed Council.

Monday, September 12
Session 07C: 2 Treatment – Nutrient Removal
3:45PM –4:25PM

Upgrading Lagoon Based Treatment Systems to Meet More Stringent Limits for BOD, TSS and Nutrient Removal

Tom Birkeland
Lemna Environmental Technologies, Inc.,; tbirkeland@lemna.com

Wastewater treatment process design modeling software, which models biological, chemical, and physical treatment processes, can be used to optimize the design, performance, and reliability of lagoon-based treatment systems. Lemna Environmental Technologies (LET) employs a dynamic wastewater treatment process simulation model, to analyze the performance of existing facilities and the expected performance of proposed facilities. The modelling software is widely used in the wastewater community to investigate the impact of various changes in loadings and temperatures and allows LET to thoroughly verify process design and performance, especially with regards to BOD, TSS, and ammonia removal.

Using historical DMR data from an installation base of over 300 facilities, LET created a unique software model of its LemTec Biological Treatment Process, which utilizes a combination of aerated and settling lagoon cells for biochemical oxygen demand (BOD) and total suspended solids (TSS) removal, and the Lemna Polishing Reactor (LPR) for nitrification. By calibrating the model through the analysis of historical operating data, the model can be used as an accurate predictor of process performance. The model may be manipulated to reflect the size, configuration, loading, aeration and effluent requirements for current or future facilities and is especially useful in predicting and troubleshooting nutrient removal.

The model enables LET to consider the effects of non-steady-state factors such as peak flows, constituent loading, and ambient air and water temperatures on treatment performance, improving upon traditional

steady-state wastewater treatment process design methodology. The discussion will provide data and specific case studies demonstrating the predicted performance vs. actual data, using the calibrated model. Regional case studies will be used to demonstrate the benefits of modeling practices for lagoon design.

Tom Birkeland

Tom Birkeland is the Director of Project Development for Lemna Environmental Technologies (LET). He previously held project management positions with North American Wetland Engineering, Jacques Whitford, Stantec and Natural System Utilities, where he was responsible for 35 sustainable, decentralized water and wastewater treatment projects throughout Minnesota. He holds Class C Water and Wastewater licensees and the projects he managed received over 20 awards from the Minnesota Pollution Control Agency for operational excellence and compliance. He is a graduate of the University of Wisconsin-Madison and resides in Minnesota.

Monday, September 12

Session 07C: 3 Treatment – Nutrient Removal

4:30PM –5:10PM

Process Intensification Using Low Dissolved Oxygen Biological Nutrient Removal

Jose Jimenez

Brown and Caldwell, United States of America; jjimenez@brwncald.com

Current manuals of practice and historical understanding of operations assume that low DO operation creates process performance challenges. For example, low DO operation has historically been linked to poor settling sludge and lower microbial rates (e.g., low nitrification rates), which results in the design of larger volumes for treatment and undermines intensification outcomes. This traditional understanding has persisted from systems with complete mix activated sludge, but the application of metabolic selector zones and active carbon management affect biological kinetics and population selection, enabling low DO operation while maintaining good settleability and nutrient removal. Ideally, the implementation of low DO BNR results in a decrease energy demand while maintaining PAO activity, enhancing SND and maintaining good mixed liquor settling rates which are all key factors to achieve process intensification. As an alternative to new technologies for low energy BNR, many facilities have focused on developing new process control and operational approaches with their existing infrastructure to reduce energy use. Application of low DO BNR in activated sludge facilities has led to many success stories where energy has been reduced, effluent nutrient concentrations have been lowered, and capacity has increased by "simply" lowering the DO setpoints. In order to advance the understanding about low DO BNR, key research questions will be discussed in this presentation. . What setpoints represent low DO? . How are nitrification, denitrification, and phosphorus removal kinetics impacted by low DO operation? A comprehensive understanding of the ecology, and thus kinetic rates, is critical for engineering design. . What role does carbon cycling play in successful low DO BNR system? . How do we maintain good settleability in low DO BNR systems? This presentation will cover the impact of low DO operation on biological nutrient removal, settling and microbial selection in the activated sludge process. It will help accelerating and enabling successful application of low-energy BNR, which

will be a major step toward advancing wastewater facilities becoming energy positive resource recovery centers of the future.

Jose Jimenez
Jose Jimenez is a Vice President and Senior Process and Technical Specialist at Brown and Caldwell who has been involved with the functional design of numerous wastewater treatment plants across the U.S. Jose currently serves as Brown and Caldwell's Director of Technology Innovation. Jose received his PhD at the University of New Orleans and is a licensed professional engineer in multiple states, a board certified environmental engineer by the American Academy of Environmental Engineers and a WEF Fellow.

Monday, September 12
Session 08C: 1 Project Delivery
3:00PM – 3:40PM

Permitting Expectations And Strategies For Efficient Project Development

Sean Thomson, Leslie Hurley

Stantec, United States of America; sean.thomson@stantec.com, leslie.hurley@stantec.com

Permits have a direct impact on project design and construction. Without appropriate planning, the permitting process can delay construction, increase costs and generally place those involved under stress. This presentation will include a general overview for those new to the permitting process and provide effective strategies and tools which can help to streamline project development and reviews. Lessons learned from two recent case studies in Oregon; one small water utility and one very large municipal wastewater utility, will compare the right and wrong ways to go about project permitting. The presentation will also include brief introductions to permit team development and their use of SharePoint document management. From this presentation, utilities, consultants and agencies alike will see how more effective permit coordination is the key to efficient project development, lower costs and happier people.

Sean Thomson
Sean Thomson, PE has been with Stantec in Portland for 6 years where he has supported various water process design efforts for drinking water and wastewater clients in Idaho, Oregon and Washington. Sean has also been involved in pilot projects, various facility planning efforts, water system seismic risk evaluations and project permitting since starting with Stantec. Sean has also mentored four interns through Oregon's CECOP program.

Leslie Hurley
Leslie Hurley, Engineer in Training with Stantec in Bellevue has been a consultant on engineering projects ranging from commercial site drainage design to stream restoration, fish passage design for transportation projects, and water and sewer district planning projects in her 7 years of work experience. She has supported projects through permitting processes of local and federal government departments

and always seeking to better understand how to communicate and plan with design teams to be prepared for each unique process.

Monday, September 12
Session 08C: 2 Workforce Development
3:45PM –4:25PM

From Chaos to Control: Boise's New, Robust Project Delivery Model

Evan Carpenter[1], Emily O'Morrow[2], Tiffany Torres[2]
[1]City of Boise; [2]Brown and Caldwell; ecarpenter@cityofboise.org, eomorrow@brwncald.com, ttorres@brwncald.com

Boise's Water Renewal Services (WRS) must more than double its project execution rate to meet the goals of the recently completed Water Renewal Utility Plan increasing both the number and size of projects. Like many utilities, the city previously managed its Capital Improvement Plan (CIP) and prioritization based on the immediate needs of WRS and lacked a way to balance the long-terms goals of the utility with short-term facility needs. WRS recognized that a robust business process would be needed to deliver on the Utility Plan and increase efficiency and transparency (both internal and external) in project execution.

WRS built a cross-functional team of utility employees, called the Capital Projects Staff Advisory Team (CP SAT), to identify gaps in the current CIP process. This resulted in a list of 32 opportunity areas for improvement. CP Sat developed a streamlined business process to address each of the gaps identified.

Key outcomes of the project delivery business process include:

Right Solutions come from Defined Problems: City staff at all levels in the organization are encouraged to define problems. Teams then investigate the problem and understand the consequences of not fixing it before developing a solution.

Right Budget Detail at the Right Time: City teams identify projects to solve the problem and conduct an appropriately complex alternatives analysis. Teams must analyze solutions based on life-cycle cost considering risks and benefits. Once a solution project is identified project managers develop a comprehensive cost estimate to create a budget ceiling for the project.

Transparency in Delivery: Standard form project management plans document scope, schedule, and budget, including resource allocations and other interagency coordination needs. Future projects are better understood by WRS staff at all levels increasing operator buy- in. WRS Leadership can more effectively plan resources and community messaging for projects on the horizon.

By engaging city staff in the development of a standard project delivery model, WRS is moving toward greater control of capital planning and increasing transparency and efficiency in project delivery.

Evan Carpenter
Evan Carpenter is the City of Boise's Utility Planning Manager responsible for capital planning and Utility Plan implementation for Water Renewal Services, which currently holds $1B in capital projects planned in the next 20 years.

Emily **O'Morrow**

Emily O'Morrow is a project engineer and project manager with Brown and Caldwell whose career has focused on supporting utility's as they elevate their performance to deliver community expectations.

Tiffany **Torres**

Tiffany Torres is a project manager with Brown and Caldwell. She holds an MBA from Boise State University and focuses on helping clients transform their organizations and business processes to efficiently deliver.

Monday, September 12
Session 08C: 3 Workforce Development
4:30PM –5:45PM

N/A - Water for Women

Tuesday, September 13
Session 09A: 1 Treatment – Nutrient Removal
8:00AM – 8:40AM

Using Kenaf for Densification and Winter Nitrification

Eric Roundy, Marvin Fielding
Keller Associates, Inc., United States of America; eroundy@kellerassociates.com, mfielding@kellerassociates.com

The City of Rigby's Wastewater Treatment Plant received a new ammonia limit of 0.65 mg/L during the winter. With Rigby located on the eastern side of Idaho, wastewater temperatures can be extremely low in the winter, making it more challenging to remove ammonia. Expansion of the existing facility was an option; however, the City could realize significant cost savings by enhancing the current treatment. New densification technologies, such as Mobile Organic Biofilm™ (MOB), which utilizes kenaf plant material as a carrier for biofilm growth, can increase treatment capacity without the need to add basins.

The City of Rigby completed a full-scale MOB performance trial in their existing oxidation ditches, and with over a year of data, the trial demonstrated the capacity could be significantly increased. The trial primarily focused on effluent ammonia; however, total nitrogen, total phosphorus, and total suspended solids were also monitored. Additionally, process optimization such as aeration performance, solids retention time, clarifier settling, and solids dewatering was investigated. Since kenaf is commonly used as an absorbent, a toxicity test was also performed as part of the trial. This presentation will provide a summary of the results and observations from the full-scale MOB trial.

Eric **Roundy**

Eric has nearly 20 years of experience in the design and evaluation of wastewater treatment systems. He has a master's degree in environmental engineering from the University of Illinois at Urbana-Champaign, a bachelor's degree in civil engineering from the University of Nebraska – Lincoln, and a master's degree

in business administration from Mississippi State University. He is a licensed professional engineer in five states, including Idaho, Washington, and Oregon.

Marvin **Fielding**
Marvin has 20 years of experience in planning, design, and construction administration of municipal infrastructure projects. He enjoys helping communities find cost-effective solutions to their wastewater and drinking water needs. He graduated from Utah State University with a bachelor's degree in civil engineering and is a licensed professional engineer in Idaho, Wyoming, and Utah.

Tuesday, September 13
Session 09A: 2 Treatment – Nutrient Removal
8:45AM – 9:25AM

Compounding Interest: Building Your Way To Better Nutrient Removal Performance

Jeffrey Zahller[1], **Bryce Figdore**[1], **Chris Sheridan**[2], **Miaomiao Zhang**[3]
[1]HDR, United States of America; [2]Kitsap County, United States of America; [3]Murraysmith, United States of America; Jeffrey.Zahller@hdrinc.com

With the introduction of the Puget Sound Nutrient Genera Permit (PSNGP), utilities in Western Washington are looking for ways to leverage existing facilities to further reduce total nitrogen discharges. The Central Kitsap Treatment Plan (CKTP) began a process of nutrient optimization in 2020 to achieve three primary goals:

1) Find new ways to optimize operation of an existing secondary process with short-term improvements and operational changes.

2) Collect full-scale data during various operational scenarios to determine the real-world capabilities of the both the baseline and optimized plant design.

3) Determine long-term projects that could be implemented to further enhance nutrient removal as Kitsap County continues to see strong population growth.

With these goals in mind, Kitsap County began a two-fold evaluation process: (1) detailed field sampling and desktop modeling to develop a series of potential improvements (both small and large) for nutrient removal operation, and (2) implementing the most promising short-term improvements for operations staff to test at full-scale to prove the reliability and value of the improvements. The desktop modeling evaluation was conducted in 2021 and the full-scale trial work began in the first half of 2022.

This presentation will provide a summary of the key lessons learned from the initial full-scale testing process that included the following optimization options:

- Improved aeration control through most-open-valve (MOV) blower control and refurbished diffusers.

- Installation of new ammonium and nitrate probes at key locations throughout the secondary treatment train to allow for ammonia-based aeration control (ABAC).

- New control programing to allow for automation of internal mixed liquor recirculation (IMLR) in response to anoxic zone denitrification capacity.

- New control programing to automate methanol (carbon) addition in response to denitrification efficiency.

Additionally, long-term improvements were also evaluated in context of the full-scale testing results:

- Improvements to mixed liquor and return activated sludge (RAS) mixing to better distribute biomass between treatment trains and avoid solids short-circuiting.

- Development of centrate storage to equalize return rates of ammonia rich recycle streams.

- Expansion of methanol storage facilities to better support consistent, automated operation.

Jeffrey Zahller
Jeff Zahller is a professional engineer who has been working in wastewater process design for nearly 20 years. He holds a bachelor of science in chemical engineering (Montana State University) and a master of science in engineering (University of Washington). He currently serves as a professional associate with HDR engineering.

Tuesday, September 13
Session 10A: 1 Regulatory Challenges
8:00AM – 8:40AM

Developing An Alternative To A Point Source Based Approach To Regulating Nutrients In Puget Sound

Amanda McInnis, Ryan Dunne, David Austin
Jacobs; amanda.mcinnis@jacobs.com, ryan.dunne@jacobs.com

The abstract will present the work to date in developing the science to support the impairment of the Sound, the SSM and the current draft of the general permit. More importantly, it will propose complimentary pathways that include realistic timeframes and represent responsible stewardship for the utilities' rate payers.

About 5 million people in Puget Sound are served by municipalities. Those agencies are interested in responsible stewardship and protection of the Sound based on well-developed science that produces multiple measurable benefits.

Several stakeholders have considered development of alternative approaches to addressing water quality concerns in the Sound as alternatives to the current point source based approach. Some those alternative approaches include:

- Improved data collection/modeling of bays
- Integrated planning
- Adaptive Management
- Oxygenation of the deep anoxic zones

In addition, urban drainage water quality approaches and projects that more directly improve habitat are being considered.

The stakeholders will work toward development of a comprehensive menu of both natural and engineering-based options for managing nutrients across the Sound. These results will assist with making informed decisions for the best approaches to address the DO issue.

This approach, which is to use science to evaluate the health of the Sound ecosystem coupled with strategies for nutrient optimization at the municipal wastewater treatment plans, has the potential to provide a more effective roadmap for improved water quality than the general permit as it is currently proposed.

As nutrient regulation continues to move forward across the county, more and more watersheds will be facing the type of challenges that Puget Sound is facing. This work is an attempt to provide alternative pathways to improving water quality and keep a broader view of watershed management.

Amanda **Mcinnis**
Amanda McInnis is a senior Project Manager and Strategy Lead at Jacobs. She has managed wastewater and stormwater plans and projects around the Northwest for more than 25 years. She has a Bachelor's Degree from the University of Wisconsin and a Master's Degree from the University of Washington.

Ryan **Dunne**
Ryan Dunne is a Professional Associate in the Infrastructure and Advanced Facilities group at Jacobs. He received a bachelor's degree in Water Resources Engineering from Humboldt State University. His six years of experience includes Green Stormwater Infrastructure (GSI) design and conveyance system modeling to reduce combined system overflows. Ryan supported civil site design and has provided construction support over the last two years as a Field Engineer and Deputy Project Manager at the Georgetown Wet Weather Treatment Station.

Tuesday, September 13
Session 10A: 2 Regulatory Challenges
8:45AM – 9:25AM

Water Sector Federal Cybersecurity Legislation 2022

Mark McKinney
Tetra Tech, United States of America; Mark.McKinney@TetraTech.com

The U.S. energy and water sectors now account for up to 80 percent of reported cyber incidents and data breach investigations, second and third only to financial services. Attempts to compromise critical infrastructure systems and services are up more than 400% since the beginning of 2020, according to cyber security officials at the ICS-CERT, a division within Homeland Security that tracks and investigates attacks against ICS networks.

Recent cyber incidents directed at water system operators have prompted federal, state, and local authorities to re-assess current regulations governing security controls for community water systems, to address evolving threats against cyber assets that could jeopardize water safety, availability, and quality.

On 27 January, the White House issued guidance related to enhancing cybersecurity requirements for the water and wastewater sector, directing the EPA to establish a governing council to work with water sector leaders to develop plans to improve the resilience of water system operators to potential cyber and physical security threats. This 100-day initiative, coined the Water Sector Action Plan, signals a significant expansion of the President's Industrial Control Systems Cybersecurity Initiative to the Water and Wastewater Sector. Federal primacy agencies including the EPA, the Department of Homeland Security Cybersecurity and Infrastructure Security Agency (DHS-CISA), and the Water Sector Coordinating Council (WSCC) will coordinate with water systems across the U.S. to develop comprehensive security strategies and identify controls designed to improve water security resilience. A pilot program will be launched with select water utilities to evaluate effectiveness of these strategies that will form the basis for water sector security.

This session will discuss proposed legislation designed to enhance the security and resilience of the water and wastewater sector, as well as peer sectors that rely on industrial control system architectures, including energy oil and gas, maritime vessel and terminal, dams and levees, and critical building automation. Changes under review include enhancing federal oversight for water security, shortening AWIA recertification timelines, allocating more funding for system improvements, mandatory reporting of cybersecurity incidents, and implementing mandatory cybersecurity standards for water and wastewater operators similar to those required for electric utilities.

Mark McKinney

Mr. McKinney serves as the Director of Cyber and Physical Security for Tetra Tech's US infrastructure division. He is a recognized leader in technology, cybersecurity, and risk management, designing active and passive measures to prevent unauthorized access to facilities, materials, information, equipment, and personnel. His professional portfolio spans critical infrastructure operations across water/wastewater, energy, transportation, nuclear, public safety, and defense-intelligence.
Mr. McKinney advises several Congressional Committees tasked with protecting America's critical infrastructure and national security. He advises the U.S. Senate Committee on Environment and Public Works on legislative initiatives designed to strengthen cybersecurity and physical security controls protecting critical infrastructure. He is one of the original authors of the America's Water Infrastructure Act 2018 (AWIA) and is currently working with the Senate Committee to advance enhancements to AWIA and other water security legislation, including the President's Industrial Control Systems Security Initiative. He also advises two House Subcommittees, the Homeland Security Subcommittee on Cybersecurity, Infrastructure Protection and Innovation, and the Homeland Security Subcommittee on Transportation and Maritime Security, both of which support the House Homeland Security Committee.
Mr. McKinney is a Consulting Member of the U.S. Department of Homeland Security National Protection and Programs Directorate. And he is a retired U.S. Army Signals Intelligence and Force Protection Officer.
Mr. McKinney is an active member of the AWWA Cybersecurity Committee, where he continues to champion cybersecurity awareness and services for AWWA members, and the WEF Safety, Cyber and Infrastructure Security Committee.

8:00AM – 8:40AM

National Water Reuse Advocacy and Action Plan

Matt Shroll, Greg Fogel

WRA PNW President & Stantec, WRA Director of Government Affairs; matthew.shroll@stantec.com, gfogel@watereuse.org

- Introduction to the WateReuse Association Pacific Northwest (WRA PNW) recent accomplishments, future opportunities and interactions within both the Pacific Northwest Section and National WRA.
- Highlight the WRA's federal advocacy to advance water recycling across the country. The discussion will cover the recently passed *Infrastructure Investment and Jobs Act of 2021* and will include updates on implementation of the law, including the administration of federal grant and loan programs as well as the application of new *Build America, Buy America* requirements. The presentation will also include a review of the WateReuse Association's work on FY 2023 appropriations and the National Water Reuse Action Plan (WRAP).

Tuesday, September 13

Session 11A: 2 WATEREUSE

8:45AM – 9:25AM

Cheney Washington's Purple Pipe Project

Todd Ableman, Allison Esvelt

City of Cheney, Washington, Esvelt Environmental Engineering, LLC, tableman@cityofcheney.org, allison@esvelt.com

The City of Cheney, Washington will describe the community's Purple Pipe Project, a reclaimed water project to produce and distribute up to 1 million gallons per day of Class A reclaimed water for irrigation water supply to the community. Once implemented, the reclaimed water project will reduce summer peaking demand and eliminate watering restrictions associated with an existing seasonal water source deficit. The presentation will describe the planning, treatment and financing associated with the project and will showcase the water supply and resiliency benefits of reclaimed water for similar communities facing emerging water supply challenges.

Tuesday, September 13

Session 12A: 1 Stormwater

8:00AM – 8:40AM

Advances in Infiltration Testing for Stormwater Management

Scott Kindred
Kindred Hydro, Inc., United States of America; scottk@kindredhydro.com

This presentation summarizes the results of an infiltration study to develop improved methods for measuring bulk hydraulic conductivity (K_b) in the vadose zone and using that information to estimate the capacity of stormwater infiltration facilities. The methods rely on the borehole permeameter method and are suitable for sizing and design of shallow infiltration facilities such as ponds and bioretention facilities and vertical facilities such as drywells. The study includes both numerical simulations and field studies to validate and demonstrate the methods which can be implemented for multiple project situations, including wastewater treatment plant upgrades.

Shallow infiltration testing was conducted at four sites, with two test pits and three shallow test wells at each site. This testing demonstrated a high degree of variability over distances of 15 to 70 ft. These results, combined with numerical simulations, demonstrated that shallow well tests can be used to design shallow horizontal infiltration facilities by applying a correction factor to account for layering and differences in flow dynamics.

Deep infiltration testing was conducted in eight deep test wells with sandpack lengths of 15 to 30 ft and total depths ranging from 20 to 90 ft. This testing demonstrated field techniques necessary to conduct accurate deep well tests given the high flow rates and potential for air entrainment. In addition, these results provided further evidence that test wells drilled using hollow stem auger methods are prone to clogging and may not provide accurate results.

Numerical simulations were conducted to determine the effects of stratigraphic layering and groundwater mounding and to evaluate the field testing results. These simulations demonstrate that six-hour steady state tests can effectively capture the effects of perching layers and shallow groundwater for most infiltration facilities and groundwater mounding analyses are only necessary for larger infiltration facilities. The study also provides methods and correction factors for using measured bulk hydraulic conductivity estimates to size and design infiltration facilities.

The grant is funded by EPA and managed by the Dept. of Ecology. The City of Tacoma is the municipal lead.

Scott Kindred

Scott Kindred specializes in the design and implementation of stormwater infiltration. With expertise in hydrogeology, contaminant fate and transport, geotechnical engineering, and civil stormwater design, Scott provides a unique multidisciplinary perspective in addressing the range of issues associated with stormwater infiltration. Scott has developed innovative infiltration approaches to address challenging sites with relatively impermeable surface soils and is one of the leading authorities on deep infiltration drains. He has conducted hundreds of infiltration tests in both shallow excavations and deep test wells and conducted infiltration assessments for a broad range of projects, ranging from single-family residential projects to a 6,000-acre basin-wide retrofit project. Scott is the lead author for a recent paper in Hydrogeology Journal (Kindred and Reynolds, 2020) that extended the constant-head borehole permeameter method to deep wells and glacially over-consolidated soils typical of Puget Sound. He is currently working on infiltration research studies funded by EPA and Los Angeles County.

Tuesday, September 13
Session 12A: 2 Stormwater
8:45AM – 9:25AM

Sharp Avenue Permeable Pavements - A Stormwater Treatment Study

Trey George, Mark Papich
City of Spokane, United States of America; jgeorge@spokanecity.org, mpapich@spokanecity.org

The Sharp Avenue Permeable Pavements project is part of the City of Spokane's larger effort to reduce the amount of stormwater runoff and associated pollutants that discharges to the Spokane River. In addition to removing some discharges to the river, the project was designed to serve as an effectiveness study for the treatment of typical roadway pollutants, and to provide durability and maintenance information to assist with long term planning. The project consisted of installing porous asphalt and pervious concrete and associated road base along four blocks of a City arterial adjacent to Gonzaga University that include vehicle, bike and parking lanes, and full intersections. The permeable pavements capture arterial street runoff from Sharp Avenue that previously drained to the Spokane River untreated through three separate MS4 outfall pipes The project constructed multiple cross sections which varied the permeable pavements, surface slope, and placement in travel and parking lanes to evaluate the durability and maintenance implications across the seasons through the freeze and thaw cycles of Eastern Washington winter. In order to monitor the treatment effectiveness of the different permeable materials, the City installed three monitoring stations, where one collects surface runoff to provide a background, and the other two consist of underdrains, conveyance piping, manholes, and composite sampling equipment. The underdrain monitoring stations capture stormwater that has infiltrated through the permeable pavements and base materials, prior to interaction with native soils. Data and observations have been collected for almost three years, and the early data is providing analytical trends and pavement behaviors.

Trey George
James "Trey" George III is an environmental analyst in the Wastewater Management Department of the City of Spokane. He is responsible for ensuring that the city maintains compliance with the Eastern Washington Phase II Municipal Stormwater permit through implementation of the Stormwater Management Program.

Mark Papich
Mark Papich, PE, is a senior engineer in the City of Spokane's Integrated Capital Management Department and is responsible for capital project scoping, funding, and programming the City's utility projects. Mark has designed and programmed water, sewer, and stormwater capital projects, with project involvement from inception to completion of construction.

Tuesday, September 13
Session 13A: 1 Collection Systems – Condition Assessment
8:00AM – 8:40AM

Utilizing Acoustics To Enable Condition Based Maintenance In Gravity Sewer Systems

Gene Hallum
InfoSense, Inc., United States of America; ghallum@infosense.com

Effectively deploying resources to reduce sanitary sewer overflows (SSOs) is a tricky challenge. If cleaning resources are deployed to pipes that are functioning properly, then time and money are wasted. But if a blocked pipe is overlooked, SSOs may occur. For the average utility, determining where the 10-35% of pipe segments with blockages in the entire network is difficult and results in cleaning already clean pipes.

For this reason, hundreds of utilities have started using transmissive acoustics to rapidly screen small diameter gravity-sewer lines before deploying cleaning resources. The technology called the Sewer Line Rapid Assessment Tool, or SL-RAT, uses sound waves to quickly assess for blockages. The SL-RAT can provide an assessment in three minutes or less, meaning a two-person crew can inspect 10-20,000 ft/day.

This very fast and low-cost method of assessment is a powerful tool for wastewater collection system managers to gain understanding of their entire system. The quick insight helps focus resources to segments with identified need. Therefore, rapid acoustic assessment has become a helpful and economically attractive tool in helping utilities to stop cleaning clean pipe and transition to a condition-based maintenance program.

This presentation will examine numerous utilities that have effectively implemented acoustic inspections and discuss implementation strategies, cost-savings analysis and program results to demonstrate application. Furthermore, limitations of the technology will be discussed to give a comprehensive overlook of acoustic inspection technology. This presentation will be based on operator training courses performed around the country and will summarize a recently published ASTM Standard developed for acoustic pipe inspection.

Gene Hallum
Gene is the Northwest Territory Manager for InfoSense, manufacturer of the Sewer Line Rapid Assessment Tool, or SL-RAT. He has over 50 years of professional experience starting and managing several technology related companies in the fields of electronics, data collection and nutraceuticals. He studied business administration at the University of Washington (Seattle).

Tuesday, September 13
Session 13A: 2 Collection Systems – Condition Assessment
8:45AM – 9:25AM

Smart Pigging of Sewer Force Mains for Condition Assessment

Bob Jacobsen
Brown and Caldwell, United States of America; bjacobsen@brwncald.com

The City of Bellevue (COB) provides wastewater collection for Bellevue and other communities in its 37 square mile service area located between Lake Washington and Lake Sammamish in Washington. The collection system consists of approximately 525 miles of sewer mains, 36 pump stations and associated

force mains. COB retained Brown and Caldwell to design improvements to the Wilburton Pump Station and to assess the condition of the force main.

The Wilburton force main consists of approximately 1,600 linear feet of 8-inch ductile iron pipe that was installed in 1978. Brown and Caldwell subcontracted with SFE Global to provide pipeline pigging and inline condition assessment of the force main using i2iPipelines SmartFoam™, which is multi-sensor inspection tool with electromagnetic sensors embedded in the pig.

The Team performed planning, technical services and coordination, including providing equipment for pig launching and retrieval. Progressive pigging was performed to clean the force main prior to deployment of the inspection tool. The Team successfully pioneered the use of the SmartFoam™ tool in wastewater pressure pipelines, in which quality data was obtained for the entire length. The tool identifies joints, bends, fittings, and detects anomalies in metallic pipelines and identifies areas with pipe wall loss and other defects. The force main was inspected in a single day and data was analyzed and presented in a detailed report which was used to assess the condition of the pipe. The tool also captures x,y,z positional data and a record of the force main alignment can be developed.

Traditionally used in the oil and gas industry, this was the first known application of the use of the SmartFoam pig in the wastewater market. The SmartFoam pig can cost effectively inspect metal force mains that previously required complex bypassing and large installation points.

Bob Jacobsen
Bob Jacobsen is a senior project manager with Brown and Caldwell in Seattle, WA with over 20 years of experience in the wastewater industry. He has his undergraduate degree from Virginia Tech and his masters degree from Johns Hopkins University, both in civil engineering.

Tuesday, September 13
Session 14A: 1 Facility Operations & Maintenance
8:00AM – 8:40AM

Improved Filterability and Energy Savings with Mg(OH)2 Addition

Carol Nelson, Samayyah Williams
King County, United States of America; carol.nelson@kingcounty.gov

The Brightwater Treatment Plant has been operating with a full scale pilot of magnesium hydroxide [59% $Mg(OH)_2$] to supplement alkalinity demand in the aeration basins since June 2020. Activated sludge characteristics improved during the trial resulting in increased plant capacity and energy savings. Other observed benefits include reduction in chemical usage and safer handling conditions. Initial data also shows a five to ten per cent reduction in chemical costs.

Brightwater WWTP provides preliminary, primary, and secondary treatment of domestic wastewater prior to disinfection and discharge to Puget Sound. Secondary treatment includes a modified MLE process followed by Zeeweed membranes. To date, full nitrification is regularly achieved while denitrification is incomplete. Low influent alkalinity, lack of denitrification, and fluctuations in ammonia load contribute to the requirement for chemical addition. Continuous

dosing of an alkalinity source is required to ensure permit compliance for pH. Sodium hydroxide (25% NaOH) was previously used to supplement alkalinity.

Secondary treatment capacity is determined by the "filterability" of the activated sludge. Prior to the use of $Mg(OH)_2$, poor filterability resulted in reduction of plant capacity by more than 50%. During the pilot, plant capacity was either at design peak hourly flow capacity (44 MGD) or adequate for the plants influent flow (nominally 38 MGD or less). In addition to better filterability, better floc structure and reductions in foaming events were observed since continuous use in July 2020. Results for soluble COD analyses of the activated sludge were found to be well correlated with filterability prior to and during the study. Improvements in filterability also resulted in energy savings due to the reduction in scour air and backwash of the Zeeweed membranes of as much as 4,000 kWhd.

The plant plans to continue using $Mg(OH)_2$ for alkalinity addition, with continued improvements for the installation and operation of this system.

Carol **Nelson**

Carol Nelson, Process Analyst III, Brightwater WWTP (BA,MS, Group IV Operator): Carol helped with startup of the Brightwater WWTP in 2011 and has worked to optimize the treatment system with a focus on Secondary Treatment, Membranes, Odor Control, and Stormwater systems. Prior to working Brightwater, she worked as a Process Analyst at King County's South Treatment Plant for 16 years. Her primary work at South Plant focusing on Solid Stream processes, energy systems, and a variety of full scale and pilot test treatment systems.

~~Tuesday, September 13~~

~~Session 14A: 2 Facility Operations & Maintenance~~

~~8:45AM – 9:25AM~~

~~Research-Informed Operations & Maintenance Practices for Stormwater BMPs~~

~~**Aimee Navickis-Brasch, Taylor Hoffman-Ballard, Kaela Mansfield**~~

~~OCI, United States of America; aimee@evergreenstormh2o.com, taylor@evergreenstormh2o.com, kaela.mansfield@gmail.com~~

~~Ensuring the success of a stormwater best management practice (BMP) does not stop once construction is complete. Ongoing maintenance is essential to ensuring stormwater BMPs are properly functioning. However, most stormwater BMP maintenance practices are based on engineering judgement. Researching and refining approaches to maintenance practices for stormwater BMPs advances the current state of knowledge, providing jurisdictions with proven and cost-effective techniques to manage their stormwater infrastructure. Optimizing operations and maintenance for stormwater BMPs allows stormwater programs to better plan and allocate resources, saving time and money.~~

~~This presentation will explore recent research into maintenance practices for stormwater BMPs. Three case studies will be presented demonstrating how research is being used to refine maintenance practices for BMPs such as sand filters, bioinfiltration ponds, and street sweeping. The presentation will also include~~

discussion regarding how the results from these studies are being used by jurisdictions to support the MS4 permit compliance.

Aimee Navickis-Brasch

Aimee Navickis-Brasch has 28 years of experience in water resources and environmental engineering, specializing in stormwater management. She has a comprehensive understanding of both regional and national stormwater regulations and practices and is the author of several stormwater publications. Aimee specializes in applied stormwater research with the goal of developing solutions that can be applied by practitioners to meet permit requirements.

Taylor Hoffman Ballard

Taylor Hoffman-Ballard is a Project Manager at Osborn Consulting who focuses on research and effectiveness studies, compliance, planning, and operations and maintenance for stormwater management systems and technologies. She has specialized training through the University of Minnesota Erosion and Stormwater Management Certification Program for inspection and maintenance of stormwater treatment practices and has experience in informing sustainable designs that support long-term operations and maintenance.

Kaela Mansfield

Kaela Mansfield is a Project Manager at Osborn Consulting who has focused her career on stormwater GSI planning, design, and research, aligning with her interests in preserving and protecting the natural environment in urban settings. Her experience includes analyzing and designing stormwater management BMPs and conveyance for capital projects.

Tuesday, September 13
Session 15A: 1 Treatment – Industrial Pretreatment
8:00AM – 8:40AM

Effectiveness of Targeted Monitoring and Outreach Programs to Reduce PFAS in Influent

Scott Mansell, Joy Ramirez, Marney Jett, Bob Baumgartner, Kenneth Williamson
Clean Water Services, United States of America; mansells@cleanwaterservices.org

PFAS are a contaminant of increasing concern for wastewater utilities. The EPA will issue nationwide regulatory guidance on PFAS in the next few years which will affect NPDES permits of many wastewater utilities and may potentially threaten beneficial uses such as reuse and land-applied biosolids. While the EPA has provided some guidance on the potential sources of PFAS in influent to treatment plants, and many utilities around the country have begun sampling influent for PFAS in the last few years, results have been very site-specific. The dominant type of PFAS as well as the PFAS concentrations have varied widely driven primarily by the types of industries in the sewershed, often governed by a single industry even in large sewersheds.

In the next few years, wastewater utilities with industries in their sewershed will most likely be required to monitor for PFAS and work to minimize sources through source control. Several utilities in the upper Midwest have reported successful reduction of PFAS in influent and biosolids by requiring treatment of industrial effluents prior to discharge to the treatment plant. However, such treatments are expensive.

For industries with less PFAS-rich discharges, it may be possible to achieve similar reductions using product substitution, process adjustments, and other less expensive means. However, the effectiveness of these programs for PFAS reductions has yet to be demonstrated.

Over the last several years, Clean Water Services (CWS) has been conducting regular PFAS monitoring at the treatment plants, throughout the collection system, and at specific industries. These data have been used to identify the main source(s) of PFAS to each of the treatment plants. Based on the monitoring data, CWS has been conducting outreach to specific industries as well as the general industrial, commercial, and domestic sectors to help them find ways to reduce their PFAS. CWS has focused specifically on six industries identified as sources of PFAS in our sewersheds as a case study for measuring the effectiveness of outreach efforts on reducing PFAS concentrations over time. This talk will report the findings from the monitoring results and what we've learned about the effectiveness of ongoing outreach efforts.

Scott Mansell
Scott Mansell is a Principal Engineer in the Research and Innovation Dept at Clean Water Services where he's been since 2017. Scott works at the nexus between research and environmental engineering leading project on a wide variety of topics including water quality modeling, continuous sensing in the natural and engineered environments, trace organics, and emerging contaminants. Prior to working at CWS, Scott earned a PhD in Environmental Engineering from UC Berkeley in 2012 and spent five years in consulting.

Tuesday, September 13
Session 15A: 2 Treatment – Industrial Pretreatment
8:45AM – 9:25AM

Two Decade Evolution of Industrial Stormwater Treatment at Vigor Shipyards, Seattle

Johnathan Cook[1], Kate Snider[2], Scott Stainer[3]
[1]Vigor Shipyards; [2]Floyd|Snider; [3]KPFF; john.cook@vigor.net, scott.stainer@kpff.com

The Vigor Shipyard's (Vigor) Seattle facility is one of the largest private shipyards in the nation and has been operation for more than 100-years. The shipyard consists of 27-acres of upland area, 4-acres of drydocks, and 20-acres of in-water area located on Harbor Island. Surface water discharges are regulated under an individual NPDES permit by the Washington Department of Ecology. This permit regulates flows from rooftops, drydock floodwater, and light industrial areas with restrictions on production activities. Each of these area types has a different flow path to numerous points of discharge. Vigor is required to construct new collection systems for surface water discharging areas and remove stormwater from an industrial wastewater discharge to a treated NPDES discharge. This presentation focuses on facility master planning and design for stormwater infrastructure retrofits and upgrades that are being implemented to meet Vigor's changing stormwater regulatory landscape and environmental ethic.

In the early 2000s, the Vigor discharged stormwater through dozens of outfalls directly to surface waters. In 2003, due to tightening stormwater discharge limits, Vigor retrofitted the facility to discharge under an industrial pretreatment permit to King County's sanitary system. Industrial stormwater is separated from other process water and pumped to 450,000 gallon detention tanks, allowing Vigor to discharge stormwater to the county sewer.

Nearly 20-years after this retrofit, the County is requiring Vigor to discontinue discharging stormwater to their sanitary sewer system (previously up to 1 MGD combined process, drydock, and stormwater). The new treatment system and discharge includes all stormwater flow from the facility, eliminating light industrial areas.

Concurrently, a CERCLA cleanup and habitat restoration is under construction. The new system's point of discharge is adjacent to the habitat area. We will discuss the type and levels of treatment to allow this discharge near the habitat including pilot testing and mixing zone analysis. Design for these systems included retrofitting and installation of multiple pump stations, tanks, treatment system (siting, sizing and type selection), connection to City infrastructure for discharge and methods taken for validating the existing system for reuse. Construction began in May 2021 and continues through early 2023.

Johnathan Cook

Johnathan Cook, PE, is the Civil Engineering Projects Manager for Vigor. For the last four years, he has worked for Vigor managing infrastructure planning and construction projects in addition to the Southwest Yard Habitat Project and its associated infrastructure improvements. Prior to working for Vigor, he worked for San Juan County, Washington as a stormwater engineer, for the State of Utah's Division of Water Quality and Division of Radiation Control as an environmental engineer, and as a consulting civil engineer for commercial, industrial, and municipal projects. He has experience in a wide variety of projects ranging from planning to commissioning phases for complex projects with complex permitting needs.

Scott Stainer

Scott Stainer, PE, has 11 years of civil engineering experience with KPFF on a range of projects, the vast majority of which focus on waterfront environments, providing a strong background in site development within critical shoreline areas. Scott has provided civil engineering expertise on dredging and shoreline interface, as well as critical shoreline stormwater conveyance and treatment, utility design, marina design and park projects. Prior to joining KPFF, Scott had 10 years of experience working in construction providing in-field experience to aid in coordination between disciplines and constructability.

Tuesday, September 13
Session 16A: 1 Risk Assessment & Emergency Response
8:00AM – 8:40AM

Cyber-Resilience Through Manual Operations - Engineering and Operations Lessons Learned

Mel Damewood, Murphy Altunel, Andrew Ohrt
West Yost Associates, United States of America; mdamewood@westyost.com, maltunel@westyost.com

Automation is an essential part of many utilities' operations. However, our collective reliance on it has introduced new risks to our operations. As advised by recent Water ISAC and Department of Homeland Security, Cybersecurity and Infrastructure Security Agency, issued in response to increased cybersecurity risks, critical infrastructure operators need to maintain manual operation capabilities. Through West Yost's experience working with numerous utilities on the West Coast, we have observed that these capabilities are being engineered out of our systems and staff are no longer retaining the skills needed to operate manually.

This presentation will explore West Yost's observations from the field and what utilities can do to maintain or recover the ability to operate their systems manually, in the absence of automation. Broadly, this includes 1) ensuring utility staff have the skills and knowledge to operate manually, 2) the system is engineered to allow for manual operations, and 3) maintaining regulatory compliance.

In 2016, NPR noted that the U.S. Navy had realized their over-reliance on the global positioning system (GPS) system. They decided to once again teach officers how to navigate by the stars using manual methods and tools. Each organization needs to determine what their version of celestial navigation is and pursue it through better staff training and engineering practices. For many organizations in our sector, manual operations is our version of celestial navigation.

This presentation will give attendees examples of how to build and maintain staff and engineering capabilities to ensure that they can continue to serve their customers even in the instance of a loss of automation.

Mel Damewood

Mel Damewood is a Principal Engineer at West Yost based in Eugene, OR. Prior to joining West Yost, Mel was the Chief Water Operator at the Eugene Water and Electric Board where he served for 30 years.

Murphy Altunel

Murphy Altunel is a control systems engineer with West Yost based in the Portland, OR area.

Tuesday, September 13

Session 16A: 2 Risk Assessment & Emergency Response

8:45AM – 9:25AM

Monitoring Spatial and Temporal SARS-CoV-2 Burden via RT-ddPCR

Hannah Ferguson[1], Blythe Layton[1], Scott Mansell[1], Andrea George[1], Devrim Kaya[2], Matthew Geniza[3], Dana Alegre[3], Christine Kelly[2], Tyler Radniecki[2], Kenneth Williamson[1]

[1]Clean Water Services, Hillsboro, OR; [2]School of Chemical, Biological, and Environmental Engineering, Oregon State University, Corvallis, OR; [3]Center for Quantitative Life Sciences, Oregon State University, Corvallis, OR; FergusonH@CleanWaterServices.org

Clean Water Services (CWS) is a water resources management utility serving approximately 620,000 residents in Washington County, OR. In response to the SARS-CoV-2 pandemic, CWS initiated wastewater-based epidemiology (WBE) in April 2020, using reverse transcriptase droplet digital polymerase chain reaction (RT-ddPCR) to quantify SARS-CoV-2 RNA semiweekly at each of the district's four water resource recovery facilities (WRRFs). Samples were extracted and quantified in-house at CWS's molecular biology laboratory starting in December 2020, and sequenced by partners at Oregon State University (OSU). A total of 591 WRRF influent samples were analyzed from 4/1/20-3/1/22. SARS-CoV-2 RNA concentrations in influent varied spatially and temporally, with three major waves observed at each WRRF (11/20 – 2/21; 7/21 – 10/21: Delta surge; and 12/21 – 2/22: Omicron surge). These waves preceded increases in COVID-19 cases reported by the Oregon Health Authority (OHA) by 1-2 weeks, serving as a leading indicator. Spatially, SARS-CoV-2 RNA concentrations had greater peaks at the Forest Grove WRRF during the first two surges, while Hillsboro and Rock Creek WRRFs had greater peaks during

the third, or Omicron surge. This trend was mirrored in reported case data, where cases during the Omicron surge were 1.5 – 3x greater in zip codes that make up large percentages of Rock Creek and Hillsboro influent flows compared to zip codes contributing to Forest Grove influent. During the Delta and Omicron surges, the respective variant dominated SARS-CoV-2 composition, contrasting to periods of low COVID-19 burden, where variant composition was diverse. These findings demonstrate the ability of wastewater surveillance to inform our understanding of COVID-19 burden across urbanized portions of Washington County. By investing in equipment necessary for in-house SARS-CoV-2 quantification (i.e., ddPCR technology), CWS continues to have flexibility in adapting to county-specific needs identified in collaboration with county public health partners. Furthermore, outfitting the molecular biology lab provided tools necessary for various research areas such as testing for viral or bacterial pathogens (other than SARS-CoV-2) in reuse waters, monitoring microbial communities involved in key biological treatment processes at the WRRFs, assessing the benefits of habitat restoration projects on biotic communities, and tracking sources of fecal indicator microbes in stormwater.

Hannah Ferguson

Hannah Ferguson received a BS in Biology from Pacific Lutheran University before earning her MS in Biology at Ball State University where her research focused on the effect of increased nutrients on aquatic communities in Alaskan boreal peatlands. Hannah joined Clean Water Services in April 2021, where she assists in tracking viral and microbial pathogens in influent, on-boarding molecular assays, and assessing biotic use of sites within the Tualatin River watershed using environmental DNA.

Tuesday, September 13

Session 09B: 1 Treatment – Nutrient Removal

10:15AM – 10:55AM

Using IFAS at the Bend WRF to Provide an Effluent TN less than 3 mg/L

William Leaf[1], Chris Miccolis[2], George McConnell[2]

[1]Jacobs, United States of America; [2]City of Bend, OR; william.leaf@jacobs.com, cmiccolis@bendoregon.gov, gmcconnell@bendoregon.gov

The City of Bend needed an expansion of the Water Reclamation Facility (WRF) to accommodate growth within the service area, meeting both domestic and industrial demands. The Secondary Expansion project started in 2010, with selection of the integrated fixed-film activated sludge (IFAS) process to provide the basis for process capacity expansion. The key drivers for selection of the IFAS system were ability to meet the City's total nitrogen limit, increase process capacity, provide operation and maintenance resilience, and allow for ease of future expansion. In October 2020 all IFAS system unit processes were placed into service followed by performance testing in early 2021. Performance of the IFAS system has been exceptional in meeting the annual total nitrogen limit (of 10 mg-N/L), with an average effluent total nitrogen of 2.8 mg-N/L in 2021. The effluent total nitrogen value, which is among the lowest of any treatment facility in the Northwest, is achieved with just the secondary treatment process and no need for supplemental carbon.

The presentation will review the implementation of the IFAS system at Bend WRF and highlight how the system is able to achieve the low effluent total nitrogen values. Details of the IFAS system will be presented, showing both the advantages and disadvantages of the process. Key design and operational

drivers for selection of the IFAS system have been realized and will be discussed. The IFAS process has achieved the goal of meeting the total nitrogen limit, providing an increase in process capacity. Wastewater characteristics have changed in the Bend service area which have impacted the capacity of the WRF, in that the limiting unit process is no longer the IFAS system. The Bend WRF influent wastewater is considered "high strength" by industry standards, with high levels of soluble carbon, providing both benefits but also challenges for operation of the secondary treatment process. Lessons-learned throughout the startup of the IFAS system, together with findings from operation of the process over the last two years will be provided.

William Leaf
William Leaf is a Principal Technologist with Jacobs, specializing in wastewater treatment projects (planning, design, and plant optimization).

Chris Miccolis
Chris Miccolis is Water Reclamation Facility (WRF) Manager for the City of Bend, he has 19 year of wastewater treatment plant operations experience at the City of Bend and City of Redmond in central Oregon.

George McConnell
George McConnell is the Water Reclamation Facility (WRF) Operations Supervisor for the City of Bend, with over 20 years of wastewater treatment experience at the City of Bend and Sunriver Utilities in central Oregon

Tuesday, September 13
Session 09B: 2 Treatment – Nutrient Removal
11:00AM – 11:40AM

Streamlined Process Selection Helps Utilities Meet Stringent Nitrogen Limits

Brian Graham[1], Anne Conklin[2]
[1]Carollo, United States of America; [2]Carollo, United States of America; bgraham@carollo.com

On January 1, 2022, the Washington State Department of Ecology issued a General Permit to control nitrogen discharges to Puget Sound. This permit caps the annual effluent total inorganic nitrogen (TIN) load from the dischargers to current values. Additionally, the permit requires that discharges conduct a Nutrient Reduction Evaluation to determine what it would take to reduce their effluent TIN concentration to 3 mg/L.

While this is a big change for the Puget Sound dischargers, other parts of the Country have been dealing with limits as low as 3 mg/L for decades. In 1976 dischargers to Tampa Bay needed to reduce their effluent total nitrogen to concentrations less than 3 mg/L and since then there has been general adoption of these low nitrogen limits to other parts of Florida.

Through our experience in meeting these stringent limits in Florida, we have developed a streamlined approach to credibly and efficiently move from the "universe of alternatives" to a shortlist of alternatives for more detailed evaluation. The alternatives are divided into groups according to the process type. Representative technologies are selected from each group and a fact sheet is developed. These

technologies are scored on non-economic factors such as treatment effectiveness, technology establishment, operability, construction sequencing, footprint and flexibility for future upgrades by an independent group of experts. The staff of the owning utility select the criteria that are most important to them using a pairwise comparison technique which results in a weighting for each criterion. The scores and the weights are combined to produce two to three alternatives for in-depth evaluation including process modeling and costing. The benefit of this approach is that it provides a clear roadmap and documentation for the processes selected for the detailed evaluation and allows the detailed evaluations to be focused on the most suitable alternatives.

This presentation will show how this methodology was applied at one utility in Florida that needed to upgrade their process to achieve an effluent total nitrogen concentration of less than 3 mg/L and how this approach allowed for a streamlined selection and ultimate design of the preferred treatment technology.

Brian Graham
Brian Graham is an environmental engineer and operator with 35 years of experience encompassing design and operation of advanced water and wastewater treatment systems, biological nutrient removal, reverse osmosis (RO) water treatment, biosolids management, master planning, wastewater process modeling and computer simulation. He has been involved in the design, startup, and operation of numerous advanced wastewater, water, and RO treatment projects throughout the United States. For Suez (previously known as United Water, Inc.) he was an operator, engineering manager and process engineer for the 42-mgd West Basin Water Recycling Plant in El Segundo, California. Mr. Graham also served as Suez' Senior Director of Operations for the West Division and as Director of Technical Assistance for Suez nationwide assisting with operation, engineering, process troubleshooting, and facility startup activities.

Tuesday, September 13
Session 10B: 1 Risk Assessment & Emergency Response
10:15AM – 10:55AM

Improved Cyber-Defense for the Water/Wastewater Sector

Andrew Ohrt[1], Dan Ervin[2], Mel Damewood[1], Murphy Altunel[1]
[1]West Yost Associates, United States of America; [2]Varius, Inc., United States of America;
aohrt@westyost.com, dan.ervin@variusinc.com, mdamewood@westyost.com,
maltunel@westyost.com

Utilities are under constant attack from malicious actors intending to disrupt operations. With the invasion of Ukraine, the awareness of this reality has increased and Water ISAC and the Department of Homeland Security Cybersecurity and Infrastructure Security Agency have issued numerous alerts and advisories imploring critical infrastructure operators to improve cybersecurity practices. This is despite extensive cybersecurity investments by many organizations.

Utilities must consider how their SCADA and physical asset systems are resilient by design in the face of cyber-incidents. The escalation of control system-based cyber-incidents coupled with the natural

evolution of engineering practices which have removed cyber-physical protections from our water and wastewater systems has created a widespread risk to our physical assets and people.

Developed by Idaho National Laboratory (INL), Consequence-driven, Cyber-informed Engineering (CCE) is an emerging methodology specifically designed to improve the security and cyber-physical resilience of critical infrastructure systems. The presenters are licensed by INL for the methodology and have worked with utilities to conduct CCE-related assessments, emergency preparedness exercises, and design improvements.

This presentation will summarize the four phases of CCE and illustrate examples of how a utility can implement CCE to improve resilience. Examples will include 1) how to better protect existing equipment and processes, a part of our systems that has received too little attention; 2) how to configure and operate physical equipment like pumps, pipes, relays, and valves; and 3) identifying system vulnerabilities due to engineering practices (like a chemical injection pump that can inject dangerous amounts of chemicals), and 4) how to mitigate those vulnerabilities through better engineering practices (like matching pump curves to the actual process needs).

The presentation is fast-paced and offered by leaders in this emerging methodology; West Yost Associates and Varius Inc. Attendees will be able to take lessons learned back to their utility and an understanding of the resources available through AWWA.

Andrew Ohrt
Andrew Ohrt is the Resilience Practice Area Lead for West Yost Associates.

Dan Ervin
Dan Ervin is the Executive Vice President of Varius Inc. He has worked with water and wastewater utilities for over 40 years. He specializes in control system engineering, emergency response planning and facility design.

Mel Damewood
Mel Damewood is a Principal Engineer at West Yost based in Eugene, OR. Prior to joining West Yost, Mel was the Chief Water Operator at the Eugene Water and Electric Board where he served for 30 years.

Murphy Altunel
Murphy Altunel is a control systems engineer with West Yost based in the Portland, OR area.

Tuesday, September 13
Session 10B: 2 Risk Assessment & Emergency Response
11:00AM – 11:40AM

Wastewater Surveillance as an Emergency Response to Infectious Disease Outbreaks

Michael Harry, Devrim Kaya, James Gallagher, Casey Kanalos, Shana Jaaf, David Mickle, Tyler Radniecki, Christine Kelly
Chemical, Biological, and Environmental Engineering, Oregon State University, United States of America;
michael.harry@oregonstate.edu, casey.kanalos@oregonstate.edu

Wastewater surveillance can provide helpful information to public health practitioners and epidemiologists in a timely and cost-efficient manner. Although the COVID-19 pandemic has recently brought wastewater surveillance into the public eye, the Global Polio Eradication Initiative has used wastewater surveillance in many countries for decades to supplement clinical surveillance. Now that the US and many other countries have expanded wastewater surveillance systems to quantify and sequence SARS-CoV-2 (the virus that causes COVID-19), local, state and national public health authorities are gaining experience and confidence in interpreting wastewater data. In response to early success, primarily by researchers at universities across the globe, the CDC has implemented the National Wastewater Surveillance System to coordinate national wastewater surveillance efforts. As such, wastewater surveillance is expected to become a common tool to complement clinical data in response to infectious disease outbreaks.

In September, 2020, the Oregon Health Authority and Oregon State University initiated a statewide COVID-19 wastewater surveillance program to monitor the spread and severity of SARS-CoV-2 infections in over 40 Oregon communities. In addition to measuring the SARS-CoV-2 viral concentrations at the influent of wastewater treatment facilities, the Oregon Health Authority and Oregon State University have engaged in sewershed sampling in several communities to further localize outbreaks to neighborhood-scale hot spots. In this presentation we will describe our experiences and lessons learned in localized short- and long-term sewershed sampling for SARS-CoV-2. The process includes identifying appropriate manholes for sampling using sewer network maps, setting and collecting samplers for 24-hr composite samples, and analysis of wastewater samples for viral concentrations and genetic sequencing. We will describe the correlation between wastewater viral concentrations and variant detection with clinical case rates. Results of our sewershed studies in Newport, Bend, Corvalis, Oregon State University campuses, Redmond, Hermiston, Eugene, Woodburn, Astoria, Grants Pass, and Dallas will be highlighted. Finally, we will discuss the emerging field of interpreting the wastewater viral concentration data for public health and how the approach could be used in emergency responses.

Michael Harry

Michael Harry worked in U.S. Navy as a nuclear field electrician's mate from 2013 to 2016. He then attended the University of Oregon earning a BS om Spatial Data Science and Technology in 2020. In the fall of 2020 he joined Oregon State University as a faculty research assistant in the School of Chemical, Biological, and Environmental Engineering. He is the fieldwork coordinator and GIS analyst leading wastewater collection efforts on the OSU campus and in selected cities around Oregon.

Casey Kanalos

Casey Kanalos graduated from Oregon State University (OSU) with a bachelor's of science in Environmental Engineering in 2017, and continued his studies at OSU to get a MS in Environmental Engineering in 2020. He interned for Crown Oilfield in Louisiana working on a remediation project for oil spills and Clean Water Services in Forest Grove. He gained experience in EPA regulatory methods and the flow of sample custody from collections to analysis. Additionally, at CWS he worked alongside their engineering team in design of a pilot scale bioreactor to study Anammox bacteria and their efficacy of nitrogen removal from wastewater. His MS project investigated adsorbents ability to remove multiple types of compounds from stormwater including heavy metals, PCBs, PAHs, and PFAS. He then joined the OSU Coronavirus Sewer Surveillance project where he supervises student in the laboratory, communicates with wastewater treatment facilities to process samples for COVID-19 analyses.

Tuesday, September 13
Session 11B: 1 Stormwater
10:15AM – 10:55AM

Where Does Deep Infiltration Make Sense In The Northwest?

Kathryn Thomason
Oldcastle Infrastructure; kathryn.thomason@oldcastle.com

Many different solutions can and should be used to meet stormwater volume reduction goals, but have you considered deep infiltration? This presentation will focus on how deep infiltration can reduce CSO events, get past low infiltration till soil layers, and reduce costly infrastructure upgrades.

During the presentation I will:

- Identify where deep infiltration is a preferred solution based on OR and WA geology and groundwater elevations.

- Evaluate the benefits of reducing stormwater volume using deep infiltration.

- Discuss deep infiltration construction methods and how deep drywells can be installed quickly in areas like existing roadways.

- Review several case studies where deep infiltration was used to manage stormwater in the Northwest.

Kathryn Thomason
Kathryn holds a B.A. in Chemical Engineering from Oregon State University and has worked in both the stormwater manufacturing industry and private civil consulting. She has over 15 years of experience in stormwater treatment design including infiltration, detention, rainwater harvesting, and regional stormwater management.

Tuesday, September 13
Session 11B: 2 Stormwater
11:00AM – 11:40AM

Quantifying the Accuracy of Rainfall Spatial Interpolation Techniques

Nathan Foged, Ayman Alafifi, Matt Davis
Brown and Caldwell, United States of America; NFoged@BrwnCald.com, AAlafifi@BrwnCald.com

Rainfall data are crucial inputs for calibrating sewer and drainage models that are used to evaluate system capacity and size capital improvements. Engineers must carefully consider the accuracy of available rainfall data because a poorly calibrated model can lead to undersized or oversized infrastructure, and thus, excessive costs. One major source of inaccuracy is spatial variation. Rainfall is typically collected at a limited number of rain gauges that may or may not be located near the basin of interest. Measured rainfall at gauges must often be interpolated to get the data we need for basin-scale modeling. This presentation will discuss four different techniques for spatially interpolating rainfall data: (1) nearest neighbor, (2) inverse distance weighting, (3) ordinary kriging, and (4) gauge adjusted radar rainfall (GARR). We will describe the accuracy of each of the techniques based on a detailed study conducted for the Milwaukee Metropolitan Sewerage District and will also present the latest results from ongoing studies in

the Pacific Northwest. Participants will learn about the error ranges associated with the different techniques, software, and level of effort needed to implement similar studies for their jurisdictions.

Nathan Foged

Nathan Foged is driving innovation by seeking sustainable and resilient solutions for the water sector and the communities we serve. Nathan has been modeling natural systems and urban infrastructure for more than 20 years, and is keenly focused on new advances in data science and decision support to address climate change risks and vulnerabilities.

Ayman Alafifi

Ayman Alafifi is a water resources engineer with strong experience in decision support tools and technology to support hydraulic and hydrologic models. He has extensive experience in simulation and optimization models, master planning, and data science.

Tuesday, September 13
Session 12B: 1 WATEREUSE
10:15AM – 10:55AM

Advancing State Leve Reuse Policy with Grass Roots Efforts (OR)

Susan Schlangen, Shelly Parini-Runge
WSC Professional Engineer, Clackamas WES External Affairs, sschlangen@wsc-inc.com, sparini@clackamas.us

The WateReuse Pacific Northwest section advocates for a thorough and planned approach to recycled water implementation—an approach that is both sustainable and iterative. By choosing to actively advance water recycling now, communities can avert future water supply issues and choices that will be forced upon them in the future.

As a result of a series of advancing water-reuse workshops, Oregon members were called to action; now is the time for water agency leaders to come together to summon political will, innovate around technical and financial approaches, educate our communities, and champion our aspirational vision. The Oregon subcommittee for Legislative & Regulatory Affairs was formed to address this charge, and has set forth the following action plan:

- Support improvements to regulatory frameworks and processes through partnership and collaboration with DEQ and other clean water associations.
- Develop informational and outreach materials for state legislators, key policy makers, and other state leaders.
- Monitor emerging legislation and regulatory activity that impacts water reuse programs.
- Provide a conduit for networking, information sharing, and support for challenging issues such as grant application development, public perception issues, permitting approaches, and more.

This presentation will share results of our discovery efforts, providing a summary of the “State of Reuse in Oregon” that forms the basis of our collaborative action plan. The discussion will provide context for specific challenges, highlight the opportunities for positive change, and share results of our progress. We

invite engaged attendees to join our mission in establishing strong frameworks for innovative and community-centric water reuse and to be part of next steps in advancing reuse in Oregon.

Tuesday, September 13
Session 12B: 2 WATEREUSE
11:00AM – 11:40AM
Oregon Case Study - TBD

Tuesday, September 13
Session 13B: 1 Collection Systems - Pumping
10:15AM – 10:55AM

"Post-COVID-19 Modern Trash Loading Proves Sewage Pump Clog Resistance Can Not Be Predicted By Impeller Throughlet Size"

Robert Domkowski
Xylem, Inc., United States of America; bob.domkowski@xyleminc.com

Summary:

One leading result of the COVID-19 pandemic has been the significant increase in the mass loading of Modern Trash being experienced in municipal collection systems and impacts of this material on the equipment at the Wastewater Treatment Plants. Ratepayers have fully expanded the breadth of "items that should not be flushed" introducing near-any cleaning wipe, rag and paper towel into collection systems nationwide disrupting normal operations. This presentation reviews the current collection systems situation, examines the challenges that conventional solids-handling pumps cannot overcome, previews laboratory clog testing results and delivers successful solutions proven to minimize disruptions and reduce OPEX in the collection system and at the Wastewater Treatment Facility.

Abstract:

The number one requirement of a solids-handling wastewater pump is its ability to pump unscreened sewage without clogging. The ever-increasing collection system loading rate exacerbated by the effects of COVID-19 further exposes the traditional multi-channel solids-handling impeller as unable to operate without partial to full clogging with soft solids.

A wastewater pump's impeller throughlet size has been frequently used to specify clog resistance, despite data that demonstrates the irrelevance of this measurement, especially when considering handling modern wastewater containing non-dispersibles and FOG. Several published guidelines recommend a minimum impeller throughlet size based upon decades-past ideas. Pump clogging is a critical and highly undesirable operational problem in wastewater pumping, which results in increased operational and maintenance costs (OpEx) necessitating emergency calls from the end user utility. Clogging drastically

reduces pump efficiency, causing increased energy consumption while pump unit mechanical damage to the bearings, seal and shaft unit can result.

This paper will review the historical impeller design perspective as well as discuss the successful modern-day design concepts. The presenter will also establish how a pump's throughlet size has been shown to be a very misleading parameter in specifying solids-handling pump unit clog-resistance. The attributes of various traditional solids-handling impeller type will be reviewed. Finally, attendees will be provided with guidance regarding the importance of a modern solids-handling pump's wet-end design for achieving successful clog-free pump operation while enjoying sustained high hydraulic efficiency and low cost of operation.

Robert **Domkowski**

Bob Domkowski has nearly 40 years of experience in pump selection, application and in pumping station design. His current position is Engineering Consultant at Xylem, Inc., - Flygt. Bob earned his B.S.M.E. degree from Fairfield University in CT. with post graduate engineering studies at U. of Wisconsin-Madison. Bob is the Chairman of the WEF Manufacturer's and Representatives (MARC) Committee, serves on the WEF, NYWEA and NEWEA Collection Systems Committees, is past president of the Submersible Wastewater Pump Association (SWPA), has had numerous technical articles published, presented technical papers at more than 50 water environment conferences, was an author/reviewer of the WEF Manual of Practice (MOP-7), participated as the pump expert at WEFTEC and MA Workshops, serves on the editorial advisory board of Pumps & Systems and is a recipient of the WEF and NEWEA Golden Manhole Awards and has been awarded 5-S Shovels from NEWEA and NJWEA member associations.

Tuesday, September 13
Session 13B: 2 Collection Systems - Pumping
11:00AM – 11:40AM

Safety Is No Accident -- Pump Station Safety And Design

Joe Schmidt
Smith and Loveless, United States of America; jschmidt@smithandloveless.com

Municipal utilities are made up of many different types of equipment that create safety concerns for operation, and wastewater collection systems are no different. This course will discuss the various types of equipment employed by wastewater collection systems and plant operations staff and the inherent safety concerns related to their operation that must be considered during the design phase. The discussion will focus on operator safety while working with equipment within wet wells, dry pits, valve vaults, or above grade enclosures. The course will demonstrate how to identify the safety hazards of different types of collection system and plant operations, and the safety steps and procedures that need to be addressed when operating different types of equipment. Safety concerns covered will range from confined space entry, falls, electrical hazards, pinch points, lifting injuries, noise injuries, and exposure through gasses, liquids, solids, wastewater debris and sharp objects. We will look at the different types of safety risks and how to protect our coworkers. This course will be a basic overview of safety in the workplace with emphasis on collection system equipment and PPE (personal protective equipment) that is involved in each activity. New administrators, operators and designers will be presented with how

wastewater system design can mitigate safety concerns while still achieving the need for effective and affordable service.

Joe Schmidt
Joe joined Smith and Loveless in 2000 as a certified code welder and welded on various equipment for five years. While working with the Union Joe founded the Safety Committee which is still active at Smith and Loveless. Joe then moved to Foreman of the weld and fabrication department at Smith and Loveless and managed both departments for seven years. The last five years Joe has worked in Customer Service and managed the customer service and warranty department. Joe is currently Manager of Municipal Pumping Systems for Smith & Loveless. Joe is an active member of The Safety and Security Committee of The Water Environmental Federation. Joe received his bachelor's in manufacturing from Pittsburg State University in 2004 and Joe also holds a degree in Master of Arts in Business Communication in Project Management.

Tuesday, September 13
Session 14B: 1 Facility Operations & Maintenance
10:15AM – 10:55AM

Chlorine Supply Challenges in the Portland Metro: Lessons Learned and Collaboration

Victoria Boschmans[1], Anne Conklin[1], Dan Laffitte[1], Bhargavi Ambadkar[2], Monica Stone[2], Darren Eki[3], Justine Abrook[4], Noah Harvey[4]
[1]Carollo Engineers; [2]City of Portland Bureau of Environmental Services; [3]Clackamas Water Environment Services; [4]Clean Water Services; vboschmans@carollo.com, Monica.Stone@portlandoregon.gov

In the summer of 2021, chlorine production in the area of Longview, Washington was interrupted due to the failure of critical electrical equipment. As a result, challenging chlorine supply chain issues resulting from the pandemic worsened and had the potential to significantly impact drinking water and wastewater treatment agencies on much of the West coast. This disruption revealed supply vulnerabilities associated with routine chemical delivery for facilities and their treatment processes that are critical in keeping wastewater and drinking water clean and safe.

To address this unforeseen emergency, several water and wastewater agencies in the Portland Metropolitan area collaborated to share strategies for enduring the shortage and building chemical supply resiliency for the future. The purpose of this technical session is to illustrate the emergency chlorine supply shortage response of three Portland Metropolitan agencies including The City of Portland Bureau of Environmental Services, Clean Water Services, and Clackamas Water Environment Services.

This session will present on emergency coordination efforts and lessons learned by these three agencies. The following topics will be discussed:

- Immediate impacts on treatment
- Strategies implemented to temporarily mitigate impacts on treatment
- Temporary solutions including alternative chemicals or changes in treatment strategy
- Considered approaches to build chemical supply resiliency including changes in procurement strategy, treatment processes, and chemical inventory
- How the collaborative emergency response effort provided agency support

At the conclusion of this presentation, attendees will understand how the 2021 chlorine shortage effected City of Portland Bureau of Environmental Services, Clean Water Services, and Clackamas Water Environment Services. In addition, attendees will have insight into how these agencies collectively approached the water quality emergency and developed best practices for chemical supply resiliency.

Victoria Boschmans

Victoria Boschmans is a process mechanical engineer with experience in the evaluation, design, and construction of water and wastewater facilities. Her expertise lies in detailed mechanical design, process sampling and optimization, and real-time process controls. She has worked as a trusted consultant on both U.S. coasts.

Monica Stone

Monica Stone is the Process Control Supervisor for the City of Portland Columbia Boulevard and Tryon Creek Wastewater Treatment Plants. After completing the Water Environment Technology Program at Clackamas Community College over 30 years ago, she worked with local municipalities within the wastewater field to improve operational processes and efficiencies. She holds current Oregon Level IV Wastewater Operator and Collections Certifications.

Tuesday, September 13
Session 14B: 2 Facility Operations & Maintenance
11:00AM – 11:40AM

Making Your Microbes Work for You - The Automation of Anaerobic Digestion

Kathlyn Kinney
Biomethane, LLC, United States of America; kathlyn.kinney@biomethanellc.com

We look to change the way we operate biodigesters so that we can get more out of existing infrastructure. Most wastewater operators lack a visual window into their digester health, making it all but guesswork to resolve existing issues, let alone feel comfortable adjusting parameters to gain additional gas production from existing capacity. We will discuss the possibility of:

19. Identifying and fine-tuning real-time monitoring technology to handle the high solids throughput of anaerobic digesters. This lets operators derisk the process of gaining digester efficiency and substantially reduce the cost of operating digesters.
20. Making RNG (renewable natural gas) more available. By monitoring existing digesters more effectively, we can introduce food waste and problematic wastes like FOG which readily double gas production, fulfilling landfill diversion legislation such as California State Bill 1383 and Washington State House Bill 1114. This likewise opens the door to improve gas production simply by optimizing digester microbial health with the proper nutrients.
21. Allowing municipal governments to better utilize their limited resources. Instead of designating dollars and labor toward rote measurements, we can direct them toward resource efficiency and recovery measures that bring in a net return long into the future.

The Valkyrie real-time monitoring system measures upwards of 15 parameters in a digester influent stream containing up to 20% solids content. The system is undergoing its first commercial installation at

a food processing waste digester as of February 2022. In pilot tests on an operational dairy farm, the Valkyrie demonstrated measurement accuracy within a 5-10% margin of error on 12 key variables, and is being validated on seven additional variables.

A chief argument against replacing national natural gas consumption with RNG (renewable natural gas) is that it is not widely available. Yet many wastewater plants burn around half the gas they produce by flaring it to the atmosphere. Moreover, many wastewater digesters run at suboptimal efficiency, leaving 30-100% of potential biogas production untapped. Ineffectively-run digesters leave a substantial amount of methane emissions to be released from their biosolids output. Improving digester efficiency leads to the capture of these emissions, making digestion substantially more climate-friendly.

Kathlyn Kinney
Kathlyn Kinney, MBA has dedicated her career to accelerating carbon-neutral transportation, with a focus on renewable natural gas (RNG). She entered the industry building biogas purification systems at the Vander Haak Dairy in Lynden, WA. Ms. Kinney now consults for municipalities seeking to upgrade wastewater biogas to RNG with maximum payback, connecting them with leading-edge technologies and custom advice. She has served on the Avista Technical Advisory Committee, Spokane Independent Metro Business Alliance Board, and City of Spokane Sustainability Action Subcommittee.

Tuesday, September 13
Session 15B: 1 Treatment - Aeration
10:15AM – 10:55AM

Full-scale Demonstration of Energy and Carbon-efficient BNR

Pusker Regmi[1], Marty Johnson[2], Caroline Nguyen[2], Ahmed Al-Omari[1]
[1]Brown and Caldwell; [2]WSSC Water; pregmi@brwncald.com

Utilities like WSSC Water are looking to reduce the burden on customers and maintain the affordability of water services through innovative solutions. This paper details the demonstration of one such effective solution resulting in estimated energy and chemical cost savings of ~$500K/yr, decreased carbon footprint; and reduced economic impact to WSSC Water ratepayers. The results are very promising, and plans are underway to expand the operation to the whole plant and implement it at the rest of WSSC Water's WRRFs.

The 26 mgd Seneca WRRF employs a 4-stage Bardenpho process with an anaerobic selector, secondary clarifiers, and filters to meet stringent nutrient limits (total N of 4 mgN/L, total P of 0.27 mgP/L). One of the five process trains was converted to a test train that included the following changes:

1) Pumping of mixed liquor recycle (MLR) reduced from 400% to 200% of the influent flow.

2) Providing Ammonia-based aeration control (ABAC) to maintain dissolved oxygen (DO) levels in all aerated zones based on real-time ammonia probe readings.

3) Discontinuing Methanol addition.

The ABAC operation uses real-time DO and ammonia measurements to adjust blower turndown and valve positioning to meet the setpoints for the system, and includes tracking of real-time DO, ammonia, and nitrate. Based on weekly profiles, the average test train effluent ammonia was less than 0.2 mgN/L, TIN was 1.9 mgN/L, and orthophosphate was less than 0.2 mgP/L. Simultaneous nitrification and denitrification and post-anoxic denitrification were responsible for enhanced nitrogen removal in the test train. A high degree of P uptake occurred even at low DO conditions, resulting in very low effluent P. The low DO operation (~0.3 mg/L) achieved by ABAC resulted in SND and significant aeration savings (~40%) compared to the other trains operated at higher constant DO (~1.5 mg/L). In addition, the test train removed > 4 mgN/L via denitrification in the post-anoxic zones without the use of any supplemental carbon.

The results obtained from this demonstration study will ultimately enhance the sustainability of nutrient removal to meet stringent effluent standards, making it accessible for many more utilities.

Pusker Regmi
Dr. Regmi is a Senior Process Engineer with Brown and Caldwell in Washington D.C. area. His work has resulted in technologies/solutions that are paving the way for a new wave of compact and efficient BNR systems. He is a regular presenter at IWA and WEF conferences. Pusker is a vice-chair of the WEF research and innovation symposium.

Tuesday, September 13
Session 15B: 2 Treatment - Aeration
11:00AM – 11:40AM

Solar Powered Floating Aerated Fixed Film Modules for BOD Treatment and Nutrient Removal in Wastewater Lagoons

Lauren Takitch, Wayne Flournoy
Entex Technologies, United States of America; lauren.takitch@entexinc.com

Thousands of wastewater lagoons across the U.S. require BOD and nutrient removal. Of those lagoons, especially those in remote or low funded areas, access to a power source and ongoing electricity costs pose challenges. Solar powered fixed film modules provide aeration, mixing, and biomass for lagoons without a blower building, air distribution manifold, or operating costs.

Solar powered WavTex™ modules feature proven EnTextile™ fabric media sheets and integral aeration. Solar panels reside on top of the floating modules. The blower also resides on the floats yet is protected underneath the solar panels. The system utilizes beneficial microbiology that attaches to the fixed media to digest waste, converting carbon waste into water and carbon dioxide, and ammonia waste into atmospheric nitrogen. During the day, the energy collected by the solar panels power the blower, providing the air to consume carbon waste and convert the ammonia waste into nitrate.

During the night, with no power to drive the blowers, the microorganisms are forced to strip the oxygen from the nitrate molecules generated during daylight conversion of ammonia to continue feeding on the carbon waste, leaving atmospheric nitrogen. The system continues providing treatment during the night, even with cloudy days.

Unlike other in-pond systems, this alternating daylight/nighttime process converts ammonia to atmospheric nitrogen, providing complete nutrient removal. The system provides BOD removal, nitrification and denitrification. Where denitrification is not required, this cycle saves energy by recovering oxygen plus restoring alkalinity for nitrification. Thus, the cycle maximizes the high efficiency and effectiveness of the process. It also provides excellent mixing and additional dissolved oxygen to the rest of the lagoon.

Modules can be used alone, or with additional modules depending on the treatment required. They can be readily moved within the pond. No regular maintenance is required for the media or aeration, and only standard lubrication maintenance is needed for the blower. These energy efficient modules are ideal for remote wastewater treatment lagoons, hog lagoons, winery lagoons and other applications. Clean water ponds looking to reduce algae blooms may also benefit from complete removal of nitrogen nutrients from the water.

Lauren **Takitch**

As a Project Manager at Entex, Lauren is responsible for process design and simulation as well as project execution and start-up. She has expanded her understanding of key technical challenges by taking state Operator training, as well as training on process modeling include BioWinTM modeling software. She has a B.S. in Chemical Engineering and a minor in Environmental Engineering from Penn State University, which fostered her original interest in water quality and wastewater treatment.

Lauren held co-op positions in R&D with Kimberly-Clark Corporation and Technical Sales with Nalco Water. Through her work with Nalco, she gained experience in chemical wastewater treatment.

Tuesday, September 13
Session 16B: 1 Construction & Alt Delivery
10:15AM – 10:55AM

Incentivizing Partnerships for Green Stormwater Infrastructure in Seattle

Dustin Atchison[1], Brian Mickelson[2]
[1]Jacobs Engineering, United States of America; [2]Seattle Public Utilities; dustinatchison@gmail.com

Seattle Public Utilities (SPU) is expanding the use of green stormwater infrastructure (GSI) approaches to meet community and system needs in the City of Seattle. Doing so requires building innovative, cross-sector partnerships that leverage investments, accelerate and amplify existing work, and support a broader set of community outcomes than SPU would be able to deliver alone. Partners may include community groups, other City departments, private development, or any party interested in delivering a GSI project. A foundational component for this work is the ability to financially incentivize potential partners to design, construct, and maintain GSI.

SPU's ability to engage the broader community in GSI work requires greater certainty for potential partners around where SPU can partner, specifically where SPU can provide funding for GSI projects. Relying on results from past planning efforts, that indicate where system problems are likely to exist, SPU aims to create a searchable map to proactively engage potential partners and leverage collective investment to build GSI on parcels and public rights-of-way (ROW) across the City. This presentation will provide a high level overview of work to develop a webmap that shows geographic eligibility for GSI

program partnering dollars, and associated the stormwater performance criteria, which include two funding categories: water quality and flow control.

In addition to establishing the geographic areas where SPU is willing to partner, SPU is also striving to establish a consistent unit cost basis that establishes what SPU will pay for managing a unit of stormwater. This policy was developed through a comprehensive review of DWW capital project costs, as well as a survey of existing partnering programs at peer municipalities.

This paper will present the approach and key findings from this effort to define the approach for measuring unit costs based on historical delivery of GSI projects, describing partnership delivery models and developing a range of incentive payments in consideration of different stormwater performance standards and bonuses for expanded benefits.

Dustin Atchison
Dustin Atchison is Jacobs' Global Technology Lead for Stormwater and Watershed Management with over 25 years of experience (17+ at Jacobs/CH2M) in water resources and stormwater management. Mr. Atchison is a recognized regional and national leader in green infrastructure with project management and technical expertise in development of master plans, guidelines, education and implementation of stormwater solutions that bring multiple benefits to communities. Dustin supports Seattle Public Utilities as the technical director for the consultant team supporting delivery of their green stormwater infrastructure program.

Tuesday, September 13
Session 16B: 2 Construction & Alt Delivery
11:00AM – 11:40AM

Finding the Silver Bullet

Vu Han[1], **Randy Mueller**[2], **Jeff Maag**[3], **Brent Cline**[4]
[1]City of Portland, Bureau of Environmental Services; [2]Jacobs Engineering Group; [3]City of Portland, Bureau of Environmental Services; [4]City of Portland, Bureau of Environmental Services;
Vu.Han@portlandoregon.gov, randy.mueller@jacobs.com

A program to expand the secondary treatment process at the Columbia Boulevard Wastewater Treatment Plant is currently under construction. At the heart of the program are substantial and disruptive modifications and improvements to the Silver Tunnel, a pump/piping gallery built in the 1970's. These modifications are critical to the construction of several new facilities at the plant that include two new secondary clarifiers, a RAS pump station, and a new solids treatment facility. In operation for fifty years, the Silver Tunnel is packed with existing process piping, mechanical equipment, electrical power and control cabling, and other ancillary systems necessary to support the secondary treatment process and other plant operations. Key modifications and improvements to the Silver Tunnel include the demolition of aging and/or abandoned piping and equipment, the installation of new process piping and equipment, and the relocation of major electrical gear to address resiliency issues, all while maintaining operation and permit compliance. Completing this work is complicated by complex constructability and sequencing issues, loss of institutional knowledge due to retirement and turnover of plant staff, the lack of consistent and complete record drawings, and most importantly the need to maintain an operational facility during

construction activities. To overcome these challenges, the team utilized several strategies to support their design efforts which included coordinating with the contractor early and often (which included a two-day campout in the Silver Tunnel), taking full advantage of the CM/GC delivery platform, dozens of field walks to dissect and fully understand the myriad of both new and old process and utility piping present in the tunnel, three dimensional scanning and modeling to assist with pipe routing and clash detection, sequencing planning to build a robust construction schedule, and discussions with plant operations staff to confirm shutdown allowances and limitations. The planning and design tools utilized to develop solutions and coordinate with plant operations staff and the CM/GC team are representative of tools that would be valuable for any wastewater agency conducting complex upgrades within existing operating (and aged) facilities.

Vu Han

Vu Han has been with the City of Portland, Bureau of Environmental Services (BES), for over 30 years. He has managed various capital improvement projects at the Columbia Boulevard and Tryon Creek wastewater treatment plants in Portland, Oregon. Vu is currently the Solids Area Lead for BES on the Secondary Treatment Expansion Program at the Columbia Boulevard WWTP. Vu holds a B.S. in Mechanical Engineering and a M.S. in Engineering Management from Portland State University. He is a licensed professional engineer in Oregon.

Randy Mueller

Randy Mueller is a project manager with Jacobs Engineering Group in Portland, Oregon and has been working in the field on engineering for 18 years. Randy is currently the Tunnels Facility Lead for the Columbia Boulevard WWTP Secondary Treatment Expansion Program in Portland, Oregon. Randy received his undergraduate degree in environmental engineering from Michigan Technological University and master's degrees in environmental engineering and mechanical engineering from the University of Connecticut and Portland State University, respectively. Randy is a professionally licensed engineer in Oregon and Washington and is also a certified project management professional.

Tuesday, September 13
Session 17A: 1 Collection Systems - Planning
1:15PM – 1:55PM

Preliminary Design & Outreach for Replacement of an Aging Wastewater Lake Line

Cheyenne Thompson[1], Erik Waligorski[1], Joe Stowell[2]
[1]Carollo Engineers, Seattle WA; [2]City of Renton, Washington; cthompson@carollo.com, jstowell@rentonwa.gov

The City of Renton (City) owns and maintains the Kennydale Lake Line System (Lake Line), an 8-inch diameter line in Lake Washington that serves approximately 55 properties in a waterfront residential community. The 4,700-foot-long line begins at a flush station that intakes fresh lake water to “flush” the contents downstream to a separate lift station, which pumps flow to the City’s gravity wastewater network.

In 2018, under an emergency order, the City completed a significant cleaning and condition assessment project (including construction of temporary in-lake manholes). The information collected during this activity allowed an assessment of the remaining useful life of the system. While failure by corrosion/degradation is not imminent for the majority of the lake line system, the risk of complete failure caused by a blockage in the pipe or damage by outside factors (i.e. caught by boat anchor) and the complexity and associated timeframe of permitting and construction has prompted design of a replacement system.

An alternatives analysis for a replacement system was completed that evaluated the following options: 1) gravity sewer deeper in the lake, 2) gravity sewer on land, 3) replace in the lake in its current location, 4) vacuum sewer on land, and 5) grinder pump system on land. Based on technical feasibility, permitting restrictions and costs, the grinder pump system was selected as the preferred alternative to move forward into the preliminary design phase.

The grinder pump system involves installation of a small grinder pump station for each property currently served by the Lake Line. The grinder pump stations will intercept flow from the residential side sewer and convey it to a new force main located in the adjacent roadway. Due to the impacts of this project on the private properties within the service area, public outreach and education has been a significant part of the preliminary design efforts.

This presentation will review the alternatives analysis completed to select the preferred alternative and outline challenges, lessons learned, and next steps for project components including emergency storage, backup power, easements, property access requirements, constructability considerations, community feedback, and long-term operation and maintenance of the system.

Cheyenne Thompson
Cheyenne Thompson has nine years of experience with the design and permitting of municipal stormwater and wastewater pump station and conveyance projects. Her primary design focus is site civil including earthwork and utility improvement, in addition to condition assessments and alternatives analyses.

Joe Stowell
Joe Stowell is the Wastewater Utility Engineering Manager for the City of Renton, Washington, having over 27 years of experience in the design, management, and delivery of wastewater CIP projects from small collection system projects to a $140 million dollar MBR treatment plant."

Tuesday, September 13
Session 17A: 2 Collection Systems - Planning
2:00PM – 2:40PM

Making Sense of It All: A User-Friendly Visualization Tool to Analyze Model Results

Ayman Alafifi, Thomas Suesser, Angela Wieland
Brown and Caldwell, United States of America; aalafifi@brwncald.com, tsuesser@brwncald.com

Hydraulic models are instrumental in helping to identify system deficiencies and make capital investment decisions. These models often generate extensive and overwhelming outputs, making it difficult to summarize and communicate key insights to decision makers. Identifying new ways to present model results to non-technical users can increase model credibility and empower decision makers to make more informed investment decisions.

Brown and Caldwell (BC) and the City of Medford (Oregon) are completing a city-wide stormwater master plan project, which includes development of comprehensive hydrologic and hydraulic models to aid in identifying and prioritizing capital project needs. To facilitate efficient review and decision-making during model development, BC developed a modular, interactive dashboard tool using open-source technology (R and Microsoft PowerBI). The tool reads model results from multiple Stormwater Management Model (SWMM) output files and updates tables, maps, and graphs in a pre-configured PowerBI dashboard. This enables rapid compilation, presentation, and comparison of results from multiple model scenarios. The workflow seamlessly connects model outputs to dashboard visuals, which:

1) Significantly reduce review time during model development and interpretation, enabling users and reviewers to toggle between interim results under varied thresholds and design criteria;

2) Improve quality control processes, allowing for more flexibility and efficiency through multiple model revisions;

3) Deliver valuable insights to the client; and

4) Adapt to multiple SWMM platforms, creating efficient, reproducible workflows.

BC used the tool to organize and analyze results from a calibrated, city-wide stormwater model built using CHI's PCSWMM. The model includes over 200 miles of modeled pipes, culverts, creeks, irrigation canals, and ditches, and 19 modeled storage facilities – all subject to varied design criteria. BC evaluated the system under eight scenarios representing four design storms and two land use conditions.

Processing model results using this tool enables in-depth discussion among stakeholders. The project team used the tool to organize flooding nodes into problem areas, filtering for different criteria such as design storm deficiency, flooding duration, or ponding depth to prioritize capital project needs. Adaptation of the tool continues to expand its potential utility to other hydraulic modeling applications beyond stormwater.

Ayman Alafifi
Ayman Alafifi – Ayman is a water resources engineer with 10 years of experience in decision support tools and technology to support hydraulic and hydrologic models. He has extensive experience in simulation and optimization models, master planning, and data science.

Thomas Suesser
Thomas is a senior staff water resources engineer and the technical lead for the Medford Stormwater Master Plan. He has been involved in the development of multiple stormwater master plans, and has experience with the development, calibration, and analysis of water and stormwater models using PCSWMM, XPSWMM, and InfoWater.

Tuesday, September 13
Session 18A: 1 Utility & Asset Management
1:15PM – 1:55PM

Doing More With Less: Adaptable Tools For Prioritizing System Repairs

Adam Donald, Scott Duren
Water Systems Consulting, United States of America; adonald@wsc-inc.com, sduren@wsc-inc.com

Ongoing inspections and system data collection tools are rendering static master plans inadequate for utility planning. Additionally, inadequate historical spending in infrastructure has left a rising need for investment with limited budgets. Living toolsets that are continuously updated are necessary to meet the evolving needs. WSC has worked with Portland Bureau of Environmental Services (BES), the City of Milwaukie, Oak Lodge Water Services, and numerous other agencies on developing rehabilitation decision-making tools of varying complexity to meet each client's unique system needs and help make the best capital improvement decisions each year that fit within the available budget.

Our presentation will showcase a range of prioritization tools, from simple GIS-based systems to more complex quantified risk comparisons to augment traditional master planning with tool sets that automatically adapt to updates in condition data. Common issues that we have encountered, along with different solutions that have been implemented, will include:

- Data limitiations and gaps and how they can be overcome;
- Identification of investments in data collection that maximize return on investment;
- Standardiziation of condition information across long time periods and different methods of collection;
- Ability to normalize risk across different types of assets to make CIP decisions;
- Methods for defining criticality for use in prioritization and scheduling; and
- Assessing in-house capabilities versus contracting needs to drive planning.

By the end of this presentation, attendees will understand what is needed to implement an asset prioritization program within their respective systems based on their goals and overall budget. Additionally, attendees will learn which data investments add the most value for optimizing maintenance decisions.

Adam Donald
Adam Donald is an Associate Engineer based in WSC's Portland Office. He has 6 years of experience and is a registered professional engineer in OR, WA, and CA. His experience focuses on sewer master planning and asset rehabilitation. When he's not working, Adam enjoys riding his bike around the City and exploring Portland's food scene with his wife.

Scott Duren
Scott Duren is a Vice President and Project Manager for WSC in their Portland office. He has 20 years of experience in helping utilities make investment decisions with their infrastructure and is a registered Professional Engineer in OR, WA, and CA. Scott enjoys attending a wide-variety of sporting events with his wife to cheer on their 10-year old son, Jack.

Tuesday, September 13
Session 18A: 2 Utility & Asset Management
2:00PM – 2:40PM

360-Degree Cameras: A New Vantage on Water/Wastewater Infrastructure

Mackenzie Capaci, Robyn Wilmouth
Kennedy Jenks, United States of America; mackenziecapaci@kennedyjenks.com, robynwilmouth@kennedyjenks.com

The operations and maintenance (O&M) of collection and conveyance systems and treatment facilities is challenging, especially as personnel encounter insufficient and/or inaccurate information from record drawings and O&M manuals. Often the sector faces the challenge of the loss of historical or institutional knowledge, which impacts our ability to ensure safe access into and out of our industry's infrastructure. As we move forward and continue to "Adapt with Purpose," we must identifying new operational approaches while holding safety paramount. Beginning in 2018, the presenters incorporated 360-degree technology into project work with large municipal clients in the Puget Sound area. Initial uses included: planning for confined space entry into wet wells of pump stations and conveyance lines; minimizing personnel confined space entry during construction and inspection; post-construction documentation of facilities, and condition assessment for large and small spaces. The presentation will include discussion of two types of 360 camera's used, a comparison of the pros/cons of the different technologies as they pertain to different needs of various types of system owners, and a look to the future for ways to expand the utilization of this technology.

This presentation will include a series of case studies of uses for 360-degree technology to address the needs of the water and wastewater industry. During the past two years, the need for virtual accessibility has been pivotal. The use of 360 imaging and the creation of 3D model spaces enabled key aspects of the design process to continue and enhanced not only consultant/client communications but improves the efficacy for field staff to communicate to remote team members to better understand a site or state of equipment. This presentation will also discuss and highlight the challenges, successes and lessons learned during the piloting of these technologies. Lastly, the presenters will provide a facilitated discussion of future uses of the technology with the audience. For example, topics may include how facilities can incorporate 360-degree technology into: asset management, condition assessment and predictive maintenance, confined space registers, and integration into Building Information Modeling and 3D virtual model spaces.

Mackenzie **Capaci**
Mackenzie is a registered civil engineer and a certified Grade 2 Wastewater Treatment Plant Operator, with 7 years in industry. Mackenzie has experience in data management for large scale asset management projects, design of water facilities and distribution systems, and supported plant operations at various treatment plants and superfund well sites. Her focus remains on water and wastewater infrastructure design, asset management, condition assessment, environmental health and safety, program management, and master planning.

Robyn **Wilmouth**

Robyn is a certified project manager and water resources and environmental professional with over 15 years of experience in the design and construction of water and wastewater systems. Before joining Kennedy Jenks, Robyn focused on developing solutions to improve sanitation, enhance water quality, and reduce human health risk in the international development sector. She is a highly competent project manager and logistician with an extensive record of implementing complex, field-based investigations internationally as well as providing design and engineering services during construction for US-based projects. Robyn is proficient at stakeholder and civic engagement, facilitation of workshops, and communication to diverse audiences.

Tuesday, September 13
Session 19A: 1 Construction & Alt Delivery
1:15PM – 1:55PM

Strategies for Managing Supply Chain Issues and Cost Escalation

Mike ConnJ
J-U-B Engineers, Inc, United States of America; mconn@jub.com

In the current global economy, water and wastewater utility owners are facing an unnerving reality of supply chain and materials cost escalation issues and disruptions with nearly every project they undertake. Contractors are faced with bidding projects with unprecedented uncertainty in their bids for materials availability, lead times and extreme pricing volatility.

Over the past 2+ years since the beginning of the COVID 19 pandemic, owners, engineers, attorneys, and contractors have been sitting at the table facing these issues time and time again. This presentation will help Owners and Engineers to identify why these are occurring, the potential risks to projects, and share some strategies and resources for managing the disruptions and escalation that is prevalent in our current construction environment. Contracting approaches, procurement alternatives, and managing cost and risk allocation will be discussed.

In addition to Construction, this presentation will also review strategies that agencies are taking to manage supply issues for the water-wastewater industry operational consumables like chemicals, and services including pros/cons to various approaches and limitations with procurement laws.

The goal of this presentation is to foster a dialogue between industry leaders and professionals to discuss options to navigate the volatility of our current market.

Mike Conn

Mike is a J-U-B Water Treatment Group Regional Lead who has been with J-U-B for nearly 20 years. Mike's work includes program management for Water and Wastewater systems throughout the intermountain west. His project experience includes water and wastewater system planning and funding, design, project management, construction administration.

Tuesday, September 13
Session 19A: 2 Construction & Alt Delivery
2:00PM – 2:40PM

Words every Engineer love, but Commissioning Managers dread… "Largest installation ever" / "Full System Integration" / "First of its kind"

Kiersten Lee[1], Fred Brown[2], Paul Mueller[3]
[1]MWH Constructors, United States of America; [2]City of Spokane; [3]Jacobs Engineers;
kiersten.lee@mwhconstructors.com, fbrown@spokanecity.org, paul.mueller2@jacobs.com

The purpose of this presentation is to share lessons learned from installation through commissioning and start-up (C&SU) of a membrane filtration system designed to treat up to 75 MGD of secondary effluent.

The City of Spokane (City) completed a major facility upgrade to the Riverside Park Water Reclamation Facility (RPWRF) in August of 2021. The project, commonly called the Next Level of Treatment (NLT), included the addition of a new membrane filtration system, the largest single installation of its kind in the World.

Due to magnitude of the Project, all ancillary systems to support the operation and maintenance of the membrane system were the first of their kind, specifically the clean-in-place (CIP) system and corresponding CIP neutralization tanks. One example of lessons learned included the hydraulic challenges of upsizing the ancillary pumping systems, which are "normally" on across-the-line starters. When scaled up to meet the demand of the RPWRF, the project team observed significant water hammer on multiple systems, as well as capacity impacts to existing facility pump stations. Another unique challenge was chemical foaming in the CIP tanks. The foaming was initially observed during membrane flushing and persistent throughout C&SU. The foaming was a challenge the vendor, engineer nor construction team had ever encountered before.

In addition to the new infrastructure the City, in parallel, upgraded the entire RPWRF SCADA system. Typically, with vendor packaged systems the programing exists on external PLCs and limited I/O is integrated into the overall facility SCADA system. However, the NLT project included a full system integration of the vendor programming, as well as custom SCADA screens to match the existing facility system graphics. The full system integration created unique challenges between the vendor and the City's programming standards and graphics.

Throughout the NLT Project, the team worked through numerous challenges to troubleshoot and optimize the RPWRF. The team's objective was to ensure a seamless transition to the City's operation staff, deliver a quality project on time and under budget that positively impacted the Spokane community. This presentation will explain how the team resolved each challenge, share lessons learned and C&SU best practices.

Kiersten Lee
Kiersten Lee manages MWH's commissioning and start-up group, which includes process mechanical, I&C integration, electrical and treatment process specialists. Kiersten's education and background is in hydraulics and water/wastewater treatment and has 11 years of experience in the water and wastewater industry.

Fred Brown

Fred Brown is an engineer for the City of Spokane at the Riverside Park Water Reclamation Facility. Fred has over 26 years of experience in the industry and is a licensed wastewater operator.

Paul Mueller

Paul Mueller is a principal process engineer with Jacobs Engineers in the Corvallis, Oregon Office with over 32 years of experience. He specializes in water and wastewater treatment process design and analysis, with a special emphasis on membrane treatment processes.

Tuesday, September 13
Session 20A: 1 WATEREUSE
1:15PM – 1:55PM

City of Boise Recycled Water Program – Start Up (Phase 1)

Emily O'Morrow, Royce Davis
Brown and Caldwell, City of Boise Recycled Water Program Manager, eomorrow@brwncald.com, rdavis@cityofboise.org

The City of Boise (City) Recycled Water Program (RWP) enables the vision and outcomes set forth by the Water Renewal Utility Plan (Utility Plan). This program will shift how Water Renewal Services (WRS) uses and manages water and will enhance water resiliency and environmental outcomes while protecting economic development and public resources. The RWP combats future water shortages by recycling water within the city's service area through aquifer recharge and industrial reuse. Aquifer recharge represents long-term investment in future water supply by enabling continued future aquifer withdrawal. Diversifying water supply sources for industry will relieve pressure on groundwater.

The City's RWP will be developed in a three-phase process:

Phase 1: Program Development. Phase 1 includes development tasks to establish a City recycled water utility framework and prepare for RWP implementation. The outcome of these activities will be a permitted recycled water utility with community buy-in that supports a resilient water supply with a more sustainable and equitable future for Boise's citizens. The following six areas of work are the primary focus of this phase:

1. Program management
2. Community engagement
3. Recycled water utility development
4. Permitting
5. Water quality and pilot testing
6. Land acquisition

Phase 2: Solutions Development. Phase 2 finalizes meaningful design criteria and organizational

changes through a Project Definition Report and Recycled Water Program Workforce and Organizational Strategy.

Phase 3: Design, Construction, and Commissioning. Phase 3 brings the RWP vision into a reality by moving concepts developed in Phases 1 and 2 into design details followed by construction and commissioning.

This presentation will focus on the progress of Phase 1 of the three-phase process.

Tuesday, September 13
Session 20A: 2 WATEREUSE
2:00PM – 2:40PM

Onsite Non-Potable Water System Rule (WA decentralized reuse)

Mamdouh El-Aarag
Washington Department of health, Civil Engineer

In the face of ever-decreasing water supplies and increasing demands on those supplies resulting from population growth, new approaches to develop alternative water supplies is needed. One of these approaches is water reuse. Reclaimed water is the main option for water reuse in the State of Washington. Onsite non-potable water systems will be another option as the Department of Health has initiated rulemaking to meet the directive in Engrossed Substitute House Bill (ESHB) 1184 (Chapter 156, Laws of 2021). This presentation will go through the proposed onsite non-potable water system rule in Washington State. The new rule will establish risk-based water quality standards for onsite treatment of non-potable alternative water sources for non-potable end uses.

Tuesday, September 13
Session 21A: 1 Facility Operations & Maintenance
1:15PM – 1:55PM

Developing a Bench Scale Test to Evaluate Operational Digestion Stability and Capacity

Ornella Sosa-Hernandez, Peter Schauer
Clean Water Services, United States of America; sosahernandezo@cleanwaterservices.org

Anaerobic digestion is a very robust process as long as feed composition, feed rates, and stable operating conditions (e.g. mixing and temperature) are maintained. However, digesters are often operated as “black boxes” when the ability to make visual inspections is limited and only grab samples and laboratory analyses can indicate the potential for upset conditions. At the Rock Creek Water Resource Recovery Facility (WRRF) owned and operated by Clean Water Services (CWS), the five digesters lack individual feed

flow meters or gas production meters and this gap in operational data slows the identification of unstable conditions.

To improve knowledge of the digestion process, CWS is working on the development of an easily implementable bioassay that benefits Operations and the Capital Improvement Program to:

- Help identify conditions that can cause upset events or instability.

- Determine capacity limitations and/or requirements for future construction projects.

- Evaluate impacts from co-digestion of high strength waste.

The assay compares the initial rate of biogas production from acetate addition to batch reactors containing freshly collected digestate and the biogas production rate of digestate alone. The ratio of these rates can be tracked over time and used as an indicator of process upsets caused by volatile acids accumulation and additional capacity of the system to convert organic matter to biogas.

The following results have been obtained from the initial tests performed at the Durham WRRF with digesters that have individual feed and gas measurements:

- Reliable measurements are obtained within 3-12 hours, making this test valuable for operations to respond to critical conditions.

- Gas recovery from acetate has been repeatable indicating that recovery calculations from different feed sources can be evaluated.

- The bioassay results and the full-scale digester gas production are comparable, which helps in circumstances where limited gas flow data is available (e.g. individual gas flow measurements are not available at the Rock Creek facility).

This presentation will include additional results from the following evaluations:

- Implementation of the test at the Rock Creek facility.

- Comparison of results obtained from the two facilities.

- Gas recovery from additional co-digestion substrates.

Ornella Sosa-Hernandez
Ornella Sosa-Hernandez is an Operations Analyst in the Technology Development and Research group at Clean Water Services. She received her Ph.D. of Science and Engineering from the Monterrey Institute of Technology and Higher Education in Mexico specializing in Environmental Systems after obtaining a Bachelor of Science in Biotechnology Engineering.

Troubleshooting a Process Upset: Experience at Portland's CBWTP

Scott Weirich[1], Monica Stone[3], Jen Murphy[1]

[1]Parametrix, United States of America; [3]Portland Bureau of Environmental Services;
Monica.Stone@portlandoregon.gov, JMURPHY@PARAMETRIX.COM

The City of Portland's Columbia Boulevard Wastewater Treatment Plant (CBWTP) experienced a filamentous bulking process upset starting in April 2021. This presentation is a case study of the investigation to determine the causes and the solutions to the issue.

Operational changes due to construction, plant repairs, a regional sodium hypochlorite shortage, and extreme temperatures all generally contributed to the process upset, but extensive investigation was necessary to determine the specific causes. Investigative methods included microscope analysis, extra field sampling, and historical data analysis. Key factors determined through these analyses include:

- Filament proliferation identified: types 1701 and 1863, which indicate high F/M and low DO

- Low PAOs for an anaerobic selector and poor selector COD removal

- Low Dissolved Oxygen (DO) levels in the aerated zones according to the Palm-Jenkins Curve

- Unequal clarifier loading reducing the ability to handle bulking

Thus, the immediate factors leading to the overgrowth of filaments are poor selector performance and high loading causing high F/M and low DO in the initial aerobic cells. The plant then had to mitigate the present process upset and develop a plan to prevent similar challenges in the future. The following key changes were recommended, and are currently being implemented as possible:

- Reduce loading to the aerobic zones

- Maintain a higher aerobic SRT

- Optimize the aeration system to provide higher DO levels to the first aerobic zones

- Utilize more proactive RAS chlorination and implement higher doses when needed

- Optimize clarifier flow split and RAS rates to even out clarifier blankets

Process upsets are challenging issues. Often a wide variety of investigative techniques are needed to narrow down the problem and to provide an effective solution. This case study shows many of the investigative techniques used and possible solutions to such an upset.

Monica Stone
Monica Stone is the Process Control Supervisor for the City of Portland Columbia Boulevard and Tryon Creek Wastewater Treatment Plants. After completing the Water Environment Technology Program at Clackamas Community College over 30 years ago, she's worked with local municipalities within the wastewater field to improve operational processes and efficiencies. She holds current Oregon Level IV Wastewater Operator and Collections Certifications.

Jen Murphy
Jen Murphy is a Sr Project Manager and NW Water Market Lead at Parametrix. She has over 16 years of experience partnering with clients to deliver pump station and treatment upgrades at facilities with

capacities from up to 800 MGD. She is passionate about providing creative client centric solutions, innovation within the water industry, and empathy led storytelling.

Tuesday, September 13
Session 22A: 1 Resiliency
1:15PM – 1:55PM

Hitting the Curve Balls - A Water Resiliency Framework that Integrates Utility Investments, Communications, and Decisions Making

Holly Tichenor[1], Rachel Garrett[1], Frank Dick[2]
[1]Brown and Caldwell, United States of America; [2]City of Vancouver, WA; htichenor@brwncald.com, rgarrett@brwncald.com, Frank.Dick@cityofvancouver.us

What do you do with a Utility Rate Study recommending major policy and rate changes, competing programs and messages, and a CIP that is doubling in a City with limited resources? In the City of Vancouver, Washington's case, we seized the moment to work on strategy, communication and alignment before diving in deep into the turbulent waters of change!

Our utilities face a vast array of competing demands and uncertainties that require new approaches to creating alignment and pathways for resilient outcomes. The demands range from growth and development pressures, stabilizing rates while covering program costs, changing regulations, and managing aging assets to protecting the environment, responding to climate change, addressing equity challenges, and ensuring system resiliency. Addressing these issues requires well-thought-out planning and communication approaches that utilities can use to inform critical decisions, effectively engage with communities, and integrate with broader utility/city strategic planning processes. Brown and Caldwell (BC) and the City of Vancouver, Washington (City) will describe how the power of meaningful engagement and communications can prepare our communities and leaders to better address the complex needs.

The City worked with BC's Strategic Communications team to develop a Water Resiliency Framework and Strategy to align communications internally and externally with City officials and stakeholders. This process brought together a cross-functional team of City department leaders ranging from finance, management, engineering, planning, and public information. The Framework has guided Public Works' updated CIP, Strategic Plan, community engagement, Council communications, and more. The Framework has bolstered support for long-term investment needs and led to clear funding/financing strategies and rate stabilization recommendations. The Framework focuses on how all water connects to benefit community health, economy, infrastructure, and the environment.

The City of Vancouver's water resiliency strategy recognizes the inherent connection between all water resources and related systems. Now is the time for transformative and integrated water solutions—combining water, surface water, and wastewater—that address holistic City goals.

This presentation will cover alignment across city departments, framework development with multi-department involvement, identifying and building financial support, workshop planning to keep elected officials informed, and development of a community engagement and strategy plan.

Holly Tichenor

Holly Tichenor is a strategic planning and communications expert who leads Brown and Caldwell's Oregon operations. Her work has largely focused on communications strategies that enhance utility performance, inter-agency collaboration, stakeholder participation, new water program development, and addressing of emerging needs such as PFAS, climate resiliency, funding, water reuse and broader resource recovery initiatives. She has a BA in Journalism from the University of Texas at Austin.

Rachel Garrett

Rachel Garrett is a Strategic Communications Specialist for Brown and Caldwell, who recently spent 8 years working for Seattle Public Utilities managing water, wastewater and stormwater-focused communications and community engagement programs. She has a BA from the University of Colorado and an MA in Environmental Policy with a focus in Water Resource Management from the Middlebury Institute of International Studies at Monterey.

Frank Dick

Frank oversees sewer and wastewater engineering functions including capital projects, wastewater system planning, interface with the City's contract operator for wastewater (Jacobs), and the city's fully delegated pretreatment program. He has worked in these functions in Vancouver for 11 years. He has developed energy management programs for both of Vancouver's wastewater and water utilities.

Tuesday, September 13
Session 22A: 2 Resiliency
2:00PM – 2:40PM

Implementing Resiliency – Moving from Aspiration to Reality

Bhargavi Ambadkar[1], Dave Green[2], Dave Brunkow[2], Muriel Gueissaz-Teufel[1], Vu Han[1]
[1]City of Portland BES; [2]Jacobs; bhargavi.ambadkar@portlandoregon.gov, Dave.Green1@jacobs.com, David.Brunkow@jacobs.com

Portland BES has embarked on one of their largest ever upgrade programs at the Columbia Boulevard Wastewater Treatment Plant (CBWTP), the Secondary Treatment Expansion Program (STEP) which includes a collection of new facilities (designed to meet current codes) as well as upgrades to existing facilities (typically designed to older codes/standards).

Level of Service (LOS) goals were previously developed as part of the Bureau of Environmental Services (BES) Resiliency Master Plan, in alignment with the Oregon Resiliency Plan. These Levels of Service goals dictate minimum levels of treatment and recovery goals after a significant seismic event. For the STEP projects, these Levels of Service goals have been applied to not only seismic events, but also flooding events, power outages and structural failures.

Although the new secondary clarifiers and the new solids treatment facilities are designed for seismic and flooding resiliency, the existing secondary treatment process facilities at the CBWTP (built on wooden piles in the 1970s) are susceptible to a number of failure scenarios. Three failure scenarios were developed as a means of identifying resiliency investments that would align with the Level of Service goals:

Failure Scenario 1 – Plantwide power loss

• Assume complete loss of incoming power with incoming power restored within 2 to 3 days

Failure Scenario 2 – Significant seismic event

• Assume long-term plantwide power loss (longer than 3 days), coupled with structural failure and/or significant damage to secondary process facilities

Scenario 3 – Flooding event in secondary process

• Assumes loss of secondary treatment for minimum of 1 week to several months' duration

Wastewater utilities across the Pacific Northwest are facing unprecedented capital expenditures related to ensuring that treatment facilities are resilient to a wide range of disasters (climate change, flooding, seismic events, extended power outages, and failure of aged infrastructure). This presentation walks through the approach and decision process used to evaluate the impacts of these failure scenarios at CBWTP and how investments were strategically targeted to meet BES' Level of Service goals.

Bhargavi Ambadkar
Bhargavi is an Engineering Manager for Portland BES. She oversees design and construction of treatment plant and pump station projects at BES and previously served as the design manager for Secondary Treatment Expansion Program (STEP). Bhargavi holds B.E. and M.S degree in Civil Engineering.

Dave Green
Dave Green is a project manager for Jacobs with almost 40 years of experience on wastewater treatment and biosolids projects. He has led facility planning work, as well as detailed design for large complex treatment projects, up and down the West Coast. Dave is currently the project manager for the design of Portland's Secondary Treatment Expansion Program (STEP), a $300M upgrade at the Columbia Boulevard Wastewater Treatment Plant. Dave holds a B.S. degree in Civil Engineering and a M. S. in Environmental Engineering, both from the University of Missouri.

Dave Brunkow
David is a technologist with Jacobs focusing on wastewater and water treatment projects. He has been with CH2M/Jacobs since 1986. These days his project assignments often involve in-house technical consulting, design QC and planning and executing project sequence and commissioning efforts. He is currently providing field support for construction of Portland's Secondary Treatment Expansion Program (STEP), a $300M upgrade at the Columbia Boulevard Wastewater Treatment Plant. David holds a B.S. degree in Civil Engineering and a M.S. in Environmental Engineering, both from Oregon State University.

Tuesday, September 13
Session 23A: 1 Treatment – Nutrient Removal
1:15PM – 1:55PM

Commissioning And Startup Of The First Full-Scale Sidestream Treatment System In The Western U.S.

Felipe Munoz, Nikolaus Hlavacek, Ameen Razavi, Fatemeh Shirazi, Mike Falk (HDR)
Microvi Biotech Inc., United States of America; fmunoz@microvi.com

Reliable nutrient removal continues to be a high-priority issue for treatment agencies facing stringent discharge limits, especially for those located adjacent to bays and estuaries. Reducing nutrient discharge without taking on large capital costs may be attained via treatment of sidestream (filtrate) flows coming from anaerobic digesters. In many cases, treatment of 1% of the total plant flow as sidestream can reduce up to 20% of the nutrient (Nitrogen) load entering the main treatment works. In 2021, Oro Loma Sanitary District (OLSD), in partnership with Microvi, commissioned the first sidestream treatment process in the Western U.S.

The process makes use of Microvi's MicroNiche Engineering (MNE) technology. MNE "biocatalysts" are synthetic polymeric composites containing a high density of specific organisms capable of degrading inorganic and organic matter in water. The MNE biocatalysts for sidestream treatment are capable of oxidizing high levels of ammonia, converting it to nitrite and nitrate.

The deployment of MNE technology is highly suited to utilize existing assets. At OLSD, a 30,000-gallon sedimentation basin was retrofitted to retain the raw filtrate. A set of redundant diffusers, pipework and an air blower were repurposed to provide the necessary oxygen to an existing 90,000-gallon aeration basin. Supplemental alkalinity dosing was controlled automatically via a pH feedback loop. A stainless steel quiescent (settling) zone was installed to retain the MNE biocatalysts within the basin.

Results indicate that ammonia removal by MNE biocatalysts is optimal even at the lowest blower setting, thereby saving energy. The system can reliably remove upwards of 150 kg-N/day at steady-state.

The commissioning process found that the technology was robust. After process upsets (e.g., digester downtime) and routine flow shutdowns, the system's performance recovered quickly. Further, the operational requirements of the MNE system are simple with no complex control systems or downstream solids management, thereby requiring minimal operator involvement.

The implementation of the MNE technology at OLSD is the first-of-its-kind in the Western U.S. with broad applicability across a number of use-cases where sidestream ammonia removal can reliably enhance nutrient removal while achieving cost-savings.

Mike Falk

Mike Falk has been at HDR since 2008 where he has been working on nutrient management challenges ever since. Most notably, he has been working on nutrient related issues for the Bay Area since 2009 that is taking a Baywide approach, with recent support on Puget Sound. This presentation is focused on a EPA Regional Grant that is supporting technology innovation in this case on the dewatering return streams at WRRFs.

Tuesday, September 13
Session 23A: 2 Treatment – Nutrient Removal
2:00PM – 2:40PM

IFAS Media for Single Tank Nitrification/Denitrification

Lauren Takitch, Wayne Flournoy
Entex Technologies, United States of America; lauren.takitch@entexinc.com

A housing development in Powder House Pass, SD needed a 25,000 gpd treatment plant to meet effluent requirements of 10 mg/L BOD and < 1.0 mg/L ammonia-nitrogen. Entex supplied the internal equipment, controls, and instrumentation for the equalization tank, aeration tank, secondary clarifier, tertiary filtration, and sludge digestion tank.

Three WavTex™ moving media modules, containing a high surface area, three dimensional, EnTextile™ fabric media, were installed in the aeration tank. The media consists of buoyant sheets that are tethered to the bottom of the modules, allowing the sheets to stand and continuously wave freely when underwater. Because the media sheets are only tethered to the bottom of the modules, there is no chance of media breakage and there is no need for retention screens. The modules have integrated aeration that provide the dissolved oxygen for the treatment, provide biomass scouring, and enhance the mixing in the tank. The three-dimensional structure of the woven EnTextile media is designed to simultaneously promote both aerobic and anoxic processes within a single aerated tank. The biofilm that resides in the outer zones of the sheet, which are in contact with the aerated water, removes BOD and facilitates nitrification. The interiors of the media sheets are anoxic, allowing for denitrification.

As a result of this WavTex IFAS process, the plant consistently met or exceeded the ammonia-nitrogen and BOD removal requirements, even in the cold winters of the Black Hills of South Dakota. Furthermore, even though the tank was fully aerated, the effluent total nitrogen achieved was 0.2 mg/L, corresponding to nearly complete denitrification.

Lauren Takitch

As a Project Manager at Entex, Lauren is responsible for process design and simulation as well as project execution and start-up. She has expanded her understanding of key technical challenges by taking state Operator training, as well as training on process modeling include BioWinTM modeling software. She has a B.S. in Chemical Engineering and a minor in Environmental Engineering from Penn State University, which fostered her original interest in water quality and wastewater treatment.

Lauren held co-op positions in R&D with Kimberly-Clark Corporation and Technical Sales with Nalco Water. Through her work with Nalco, she gained experience in chemical wastewater treatment.

Tuesday, September 13
Session 24A: 1 Treatment – Digital Tools
1:15PM – 1:55PM

Sludge Characterization and 3-D Computer Analysis for Large New Secondary Clarifiers

Shinjiro Miyawaki[1], Jeff Maag[2], Stefan Chabane[2], Bhargavi Ambadkar[2], Corey Klibert[1], Glen Daigger[3]
[1]Jacobs Engineering; [2]City of Portland Bureau of Environmental Services; [3]University of Michigan;
shinjiro.miyawaki@gmail.com, Jeff.Maag@portlandoregon.gov, stefan.chabane@portlandoregon.gov,
Corey.Klibert@jacobs.com, gdaigger@umich.edu

Two new circular clarifiers at the Columbia Boulevard Wastewater Treatment Plant (WWTP) will expand the sustained peak secondary treatment capacity to 130 mgd. The primary objective was to maximize the peak secondary treatment capacity of the expanded system using limited available area at the WWTP. The two new clarifiers have a sidewater depth of 21.3 feet and a diameter of 145 feet, and are designed to achieve surface overflow rate (SOR) up to 1,800 gallons per day per square foot. Preliminary 3-D computational fluid dynamics (CFD) analysis identified that, due to the high SOR desired, characterization of the solids at low concentration, 500 mg/L or lower, was essential to properly optimize the clarifier configuration. Consequently, solids characteristics were measured in the field and the results were used in CFD analysis.

A batch-type test for flocculent settling was performed to measure the settling velocity and mass fraction of large and medium flocs. The height and diameter of the column were 6.0 feet and 6 inches, respectively, and five sampling ports were provided on the column at one-foot intervals. Three-dimensional CFD analysis was conducted to compare different types of energy dissipation inlets (EDIs), center wells, and peripheral baffle shapes. User-defined expressions were added to a commercial general-purpose CFD solver software package, ANSYS CFX, to model transport of water and solids in the clarifier.

Results from diluted flocculent settling tests showed that a larger fraction of flocs settled faster than expected based on literature and previous projects with medium to low sludge volume index (SVI). On average, 90 percent of large and medium flocs settled at 5,300 gallons per day per square foot, while 70 percent of large and medium flocs were expected to settle at 3,800 gallons per day per square foot. This difference agrees with general understanding of the difference between mixed liquor with lower and higher SVI. As a result of the CFD analysis, the optimal clarifier configuration consists of a Los Angeles-EDI, a 40 foot diameter and 11 foot deep center well, and a McKinney baffle.

Shinjiro Miyawaki
Shin Miyawaki uses 3-D computer models of water flow to design a wide variety of structures at Jacobs. He received his Ph.D. in Civil Engineering from the University of Iowa, continued his research at the same university, and joined Jacobs six years ago.

Jeff Maag
Jeff Maag is a civil engineer at the City of Portland Columbia Boulevard Wastewater Treatment Plant (CBWTP). He is the design lead on the liquids portion of the Secondary Treatment Expansion Project (STEP). He received a Bachelor of Science in Civil Engineering from the University of Wisconsin – Milwaukee.

Stefan Chabane
Stefan Chabane is a Wastewater Operations Specialist at the City of Portland Columbia Boulevard Wastewater Treatment Plant (CBWTP). He is currently a grade 2 wastewater operator in Oregon, with previous certifications in California as a grade 2 in wastewater, distribution and water treatment.

Corey Klibert

Corey Klibert specializes in biological treatment design of wastewater treatment plants, with particular focus on the fundamental research, piloting, and modeling of new technologies and advanced processes. He has also led the process planning and design of several large-scale wastewater treatment projects from conceptual planning through facility startup and commissioning.

Glen Daigger

Dr. Daigger is President and Founder of One Water Solutions, LLC, a professional services firm serving the water sector. He provides strategic advice and technical analysis of water solutions which protect public health and the environment for the communities and industries served. Dr. Daigger is also Professor of Engineering Practice at the University of Michigan.

Tuesday, September 13

Session 24A: 2 Treatment – Digital Tools

2:00PM – 2:40PM

Is The Northwest Ready For Digital Twins? Giving Operators One System With All the Information They Need to Make Real-time Operational Decisions And Optimize The Treatment Process.

Alex Puryear, Brian Vu

Xylem; alexander.puryear@xylem.com, Brian.vu@xylem.com

European wastewater treatment plants have been leveraging digital twins in their wastewater treatment process for years. With increasing regulations in our region, optimizing the treatment plant to give operations the ability to leverage data to improve processes and increase effluent quality is now more critical than ever. Are we ready?

Flows into the treatment plant are inherently variable, both in terms of flow rate and water quality, due to wet weather, seasonal changes, and diurnal patterns. The system enables the plant to continually adapt itself to provide the optimal treatment conditions at the lowest cost for the full dynamic range of flows. The power of leveraging digital twins does not come from simply integrating and collecting data, but from the ability to provide utilities with insights derived from that data.

Deployed as a real-time decision support system, the solution creates a digital twin of the plant process to simulate the complex biological and chemical processes taking place within sewage treatment facilities and model the optimal scenarios to improve operations. This provides utilities with data-driven recommendations to optimize plant performance — without new infrastructure. By combining cutting-edge digital intelligence with the operational expertise of plant operators, utilities can ensure regulatory compliance at less cost.

Utilities integrate historical and real-time SCADA and LIMS water quality data, weather data, and other relevant data points into one centralized system. This visibility to their treatment plant provides a simple, transparent and continuously updated view of current operations.

The data is used to create a digital twin of the plant that accurately forecasts operating conditions, and an optimization algorithm recommends the optimal treatment conditions for the current wastewater flow and composition. This is a feed-forward loop rather than a feedback loop.

These powerful analytic tools, give operators one system with all the information they need to make real-time operational decisions and optimize the treatment process.

To cost effectively meet new compliance regulations, wastewater treatment plants will need to consider new approaches. This presentation will explain how digital twins can be leveraged in a treatment plant and give specific examples from over 40 wastewater treatment plants worldwide.

Alex Puryear
Alex's time within the water industry has focused on bringing software and data solutions to water utilities. These solutions have focused on optimization of collection systems as well as wastewater treatment processes. Alex has worked extensively with both private and public water utilities across the United States and Canada. Alex holds a B.A. from Arizona State University, School of Technology and Innovation and a MBA from Gonzaga University, School of Business.

Brian Vu
Brian Vu currently serves as a Sr. Practice Solutions Architect at Xylem Inc., helping solve wastewater challenges using digital intelligent solution all around the world. Brian has previous severed as the Assistant Manager for the City of Grand Rapids Water Resource Recovery Facility. Brian started in the industry 15 years ago in Granville where he learned the disciplines of the wastewater treatment process at the Clean Water Plant. Brian holds a Class A wastewater certificate in the state of Michigan and has a Bachelor of Science degree in Chemistry

Tuesday, September 13
Session 17B: 1 Collection Sytems - Stakeholders
3:00PM – 3:40PM

An Update on Bend's Citywide Septic to Sewer Program

Susanna Julber
Barney & Worth, Inc., United States of America; susannajulber@barneyandworth.com

Abstract

In 2019, the City of Bend, Oregon implemented a citywide septic to sewer conversion program for households still reliant on septic systems. The ultimate solution, crafted through extensive community outreach – including a community advisory committee and policymaker workshops, balances the needs of septic system homeowners and sewer ratepayers. This presentation recaps lessons learned from the decision-making process and provides an implementation update.

Introduction / Overview

Many communities have homes that still use septic systems. As unsewered neighborhoods are annexed and sewer becomes available, these homes need to connect to sewers. Bend has some 2,600 households

still reliant on septic systems. Most of these homes were annexed years ago after being developed in unincorporated Deschutes County neighborhoods. The largest concentration of unsewered properties is in Southeast Bend where construction of the Southeast Interceptor (SEI), a major sewage conveyance pipe, was nearing completion. This triggered mandatory sewer hookups for many homeowners who were close to the interceptor.

Before the SEI was completed, Bend City Council appointed a committee to recommend solutions for a cost-effective plan to transition these homes to sewer. The City contracted with a team of engineering, financial and public involvement experts to develop a design for the sewer, a financial strategy, and lead the outreach process. The committee's policy and financial strategies set the framework for Bend's successful Neighborhood Extension Program (NEP).

Results

Through the NEP, residents in areas that are currently unsewered can apply for funding to complete sewer projects. The program is funded through citywide utility rates and allows residents to apply for sewer funds. Up to $2.5M is available annually, balancing the needs of residents and sewer ratepayers.

The NEP has been popular with unsewered neighborhoods. In 2021, 17 neighborhoods applied for over $27 million in project costs. Surrounding Central Oregon communities – Madras, Terrebonne, and Tumalo – are looking at this program as a model, as their aging and failing septic systems can pose environmental and health risks, and limit redevelopment potential.

Susanna **Julber**

Susanna Julber has over 25 years of experience in project management, land use planning, and policy analysis across Oregon. Susanna specializes in community engagement on complex projects. She is skilled at managing complex projects that address community priorities and developing plans that are implemented. Prior to joining Barney & Worth, Susanna was with the City of Bend, where she managed a $190M Bond Measure for Transportation projects, and led the community involvement, research, and development of the City's Septic to Sewer conversion program, among other high-priority projects. Susanna also served as a Field Representative for Senator Jeff Merkley's Office, where she collaborated with county commissions, tribes, local labor groups, environmental organizations, and social service organizations to identify local issues that required federal assistance and legislative opportunities.

Tuesday, September 13
Session 17B: 2 Collection Sytems - Stakeholders
3:45PM – 4:25PM

How to Put a Pipe Through a Nature Park: Partnership and Communication

Jadene Stensland
Clean Water Services, United States of America; stenslandj@cleanwaterservices.org

In early 2021, Clean Water Services (CWS) began a two- year utility construction project to replace the 40 year old sanitary pipe which runs through the popular Tualatin Hills Nature Park, a 220-acre "crown jewel" nature and wildlife reserve. The project will also enhance the environment and wildlife habitat around

Cedar Mill Creek. Ultimately, the project team created a 360-degree Virtual Reality tool to allow the public to experience changes in vegetation growth during and after construction.

http://webbuilds.virtual-insights.com/cedarmill360/

As part of the design planning process, CWS partnered with Tualatin Hills Parks and Recreation District (THPRD), to understand park users' needs and create an alignment alternatives selection process. They met with THPRD, Friends of the Parks groups and held a public open house in July 2019. The open house produced input that helped shape the project and the communication strategy.

The area surrounding the park is owned by a complex mix of public and private entities. CWS worked extensively with these stakeholders to obtain easements and ensure access and permission to operate during construction.

CWS communicated the facts of the project using a variety of tools and tactics, and an equity lens, including:

- A comprehensive communication plan
- Fact sheets and FAQs in Spanish and English- in the park and online
- Park signage, using images and icons, in Spanish and English
- Detailed bilingual construction-related trail map. Printed versions were available in the park and digital versions were online
- A PowerPoint presentation, used for online presentations with neighborhood groups.
- Information provided to park advisory committees and volunteers, park users, four city neighborhood advisory committees and condo associations, light rail riders, nearby businesses, county road information, environmental organizations and elected officials.
- Use of social media channels and targeted Nextdoor outreach
- Public information staff presence on the trail at significant times
- Three "Coffee with the Contractor" meetings: CWS staff and construction contractor were at the nature park entrance for three hours to talk with park users, offering donuts, coffee and project information
- Development of a 360-degree Virtual Reality tool to allow the public to experience changes in vegetation growth during and after construction

Jadene Stensland
Jadene Stensland, PE is the Principal Engineer at Clean Water Services. She was a PNCWA Stormwater Committee Past Chair. She has over 25 years of professional experience in municipal engineering, including prior work experience as a Deputy City Engineer. She has a MS in Bio-Resource (Ecological) Engineering with a minor in Civil Engineering from Oregon State University, a BS in Environmental Engineering from Cal Poly, SLO and a Professional Certificate in River Restoration from Portland State University. Additionally, she hold Level 3 operator certifications in water and wastewater treatment and conveyance.

3:00PM – 3:40PM

Your Other Permit: Air Contaminant Discharge Permits for Water Resource Recovery Facilities

Chris Maher, Jamie Hughes, Bob Baumgartner, Patrick Orr, Tom Stow, Chad King, Kevin Wegener

Clean Water Services, United States of America; maherc@cleanwaterservices.org, HughesJ@CleanWaterServices.org

NPDES permits often receive the most focus at Water Resource Recovery Facilities (WRRF), but as industrial manufacturing facilities they are also subject to Air Contaminant Discharge Permits (ACDP). Understanding these permits is equally important from a compliance perspective, and air discharge should be thought of as equal to effluent discharge as a source of pollutants to be controlled. This is increasingly relevant as we as an industry develop processes to enhance and accelerate the transfer of organic carbon to gaseous carbon through biogas production.

Clean Water Services' (CWS) Rock Creek WRRF has operated under an ACDP issued in 2008, expired in 2013, and extended until 2020 when CWS and Oregon DEQ began working together to reissue the ACDP. Given the time passed since the original permit was issued, CWS had lost institutional knowledge in ACDP's across regulatory, engineering, maintenance, and operations disciplines relating to emission sources and pollution control equipment.

Oregon's regulations pertaining to air quality are extensive and complex. Engine generator classification was challenging, depending on type, age, fuel mix, operation, location, maintenance, and date of major maintenance. A major rebuild of one of two engine generators meant different classifications and compliance requirements for two identical units. Determining compliance potential required equations and conversions uncommon to wastewater operators and process engineers. Mechanical engineering and maintenance technicians dealt with engine tuning, exhaust stack source testing, equipment obsolescence, and detailed review of rebuild costs.

Added to the internal CWS team, a legal expert was retained to assist with interpreting the complex regulations and a mechanical engineer was tasked to assist with testing and calculations. The future of gas utilization at the facility involves a choice between on-site co-generation and pipeline injection of renewable natural gas. This business analysis and project timeline also had to be debated. Other sources of airborne contaminants received equal scrutiny. The distribution of work and contributions of individual specialists across the team increased everyone's subject knowledge expertise.

In sharing this experience, the audience will understand the basic components of an ACDP, units and calculations of emissions, in-house source testing, regulation outline, and permit negotiations.

Chris Maher

Chris Maher was a Class A operator at the Upper Blue Sanitation District in Breckenridge, CO for 13 years where he earned his MS degree in Environmental Engineering through the Illinois Institute of Technology. He has been with Clean Water Services for 6 years where he is now a Senior Operations Analyst and a Grade IV certified operator.

Jamie Hughes

Jamie Hughes is a Water Resources Analyst in the Regulatory Affairs Department at Clean Water Services, a water resource management utility in Washington County, Oregon. At CWS, Jamie assists in

the implementation of the watershed-based NPDES permit and permit-related programs including the water quality credit trading program for temperature.

Tuesday, September 13
Session 18B: 2 Facility Operations & Maintenance
3:45PM – 4:25PM

Getting More for Less: The Benefits of Process Optimization

Richard Kelly[1], Lance Mason[1], Adam Klein[1], Jessie Hartman[2], Brandon Pechin[2], Laurie Pierce[3]
[1]Brown and Caldwell; [2]City of Boise, ID; [3]Pierce County, WA; rkelly@brwncald.com, lmason@brwncald.com

While flows and loads to wastewater treatment facilities grow steadily with population, the ability of utilities to expand the facilities is not always able to keep up with these ever-increasing demands. This can be exacerbated as new regulations, such as the nitrogen limits currently being put into effect in the Puget Sound region, further reducing capacity of facilities and adding additional strain on utilities to expand sooner than originally planned.

Though strained, many facilities have untapped capacity that could help reduce these constraints, or the ability to meet more stringent effluent limits efficiently without the need for costly capital improvements. As an example, a review of Pierce County's Chambers Creek Wastewater Treatment Plant (WWTP) systems resulted in several process optimization improvements, which included:

22. **Aeration control.** Review of system resulted in implementation of cascade dissolved oxygen (DO) control, which stabilized the DO, improved process performance and stability, and reduced power demands.
23. **Sidestream treatment**. Optimized the sidestream treatment process to remove more nitrogen made main-stream biological nutrient removal (BNR) more efficient and easier to control.
24. **Chemical flocculation.** Chemical addition to the mixed liquor has provided an extra layer of reliability when faced with bulking and/or pinfloc conditions. Expected expansion of the secondary clarifiers has not been necessary due to chemical addition, resulting in capital savings.

The City of Boise realized similar benefits with aeration optimization at the Lander Street WWTP, with improved energy efficiency and an increase in overall system capacity for nutrient removal gained through reductions in aeration operating setpoints.

Using examples throughout the Pacific Northwest and the US, this presentation will show the benefits gained by utilities who completed process optimizations, which have included increased system capacity, improved or expanded ability to meet stringent effluent limits, and improved overall process efficiency.

Richard Kelly
Rick Kelly is the West Wastewater Region Practice Lead for Brown and Caldwell. Based in Seattle, WA,

Rick has been working in wastewater processes for 17 year, assisting utilities with process design, troubleshooting, and optimization.

Lance **Mason**

Mr. Mason has 26+ years of experience in the water/wastewater treatment with Brown and Caldwell, CH2MHill, and Severn Trent. Project experience extends to operations management, project management, and engineering. Operations consulting and operator training have been the primary focus for the last 20-years. Project experience extends to all over the US with international experience in U.K., Canada, South Africa, UAE, and Brazil. Previous experience with being an adjunct professor at Gateway Community College in Phoenix, AZ while also working as a operations consultant for a nationwide engineering firm (Brown and Caldwell).

Tuesday, September 13
Session 19B: 1 WATEREUSE
3:00PM – 3:40PM

LOTT Reclaimed Water Infiltration Study – Start to Finish

Wendy Steffensen, Jeff Hansen
LOTT Environmental Project Manager, HDR, wendysteffensen@lottcleanwater.org,
jeff.hansen@hdrinc.com

The LOTT Clean Water Alliance provides services to treat wastewater for the urban areas of Lacey, Olympia, and Tumwater in Thurston County, Washington (at the southern end of Puget Sound). Since 2006, LOTT has also produced Class A Reclaimed Water, which is used for irrigation and other non-drinking purposes or is sent to infiltration basins where it recharges groundwater. LOTT's long-range plan for meeting future wastewater needs has been centered on expanding reclaimed water production and groundwater recharge. To address questions about possible health and ecological effects from residual chemicals that may remain in reclaimed water, LOTT conducted an in-depth scientific study. The study was intended to provide local scientific data and elicit community perspectives to help inform decisions about future reclaimed water treatment and uses.

The study, scoped in 2013, was a multi-year, four-task project. Task 1: Water Quality Characterization involved monitoring of surface water, groundwater, and reclaimed water to establish baseline water quality conditions. Task 2: Treatment Effectiveness Evaluation utilized tracer testing, water quality sampling and modeling to understand fate and transport of residual chemicals within the study area. Task 3: Risk Assessment was a stepwise analysis to consider potential exposure and risk to human and ecological health. Notably, the infiltration of reclaimed water was found to pose no ecological risk and very low human health risk. Task 4: Cost-Benefit Analysis assessed the efficacy of advanced treatment trains to reduce potential risk from residual chemicals. Study results support the continued use of reclaimed water for groundwater replenishment. Continued monitoring and sampling efforts to better understand sources of chemicals of interest will help inform source control and pretreatment activities. Tracking changes in our scientific understanding of these chemicals, new and different chemicals, and

regulations will be important in assessing if additional actions are warranted in the future to mitigate risk.

This presentation will provide an overview of the study and its findings.

Tuesday, September 13
Session 19B: 2 WATEREUSE
3:45PM – 4:45PM

Reuse Regulator Session and Q&A (WA, OR, ID, TBD)

Oregon Reuse Regulator, Idaho Regulator, Washington Reuse Regulator, Other State Regulator (CO, NM, NV, UT)

Regulations for recycled water have historically been driven from a state level which leaves a regulatory framework that is unique for each state. From a regulatory standpoint, water reuse will be discussed from the regulating agencies in the Pacific Northwest: Oregon, Washington, and Idaho. Additionally, other states will be participating to discuss their considerations and differences from the Pacific Northwest. The rules and considerations for protection of public health and the environment from each states perspective will be discussed along with questions from the moderator and the audience.

Tuesday, September 13
Session 20B: 1 Resiliency
3:00PM – 3:40PM

Using Elutriation to Calculate the Particle Size Distribution in Effluent

Justen Eckhardt, Scott Mansell, Steve Thompson, Bob Baumgartner, Kenneth Williamson
Clean Water Services, United States of America; mansells@cleanwaterservices.org

Particle size distributions (PSD) of wastewater treatment effluents are rarely measured, but can have important water quality implications because such distributions often control the settling and dispersion of the effluent particles in the receiving waterbody. This lack of data often limits a full understanding of the fate of particles and particulate-associated constituents in receiving waterbodies.

Clean Water Services (CWS) discharges about 30 MGD of tertiary treated wastewater from its Rock Creek facility to the Tualatin River and about 4 MGD of secondary treated wastewater from its Forest Grove facility to a natural treatment system (NTS). This study was initiated to gain an improved understanding of the PSD of each of these effluents in order to predict the potential removal of the TSS and associated organic carbon in the Forest Grove effluent in the NTS, and the potential contribution of the particulate organic carbon and phosphorus within the Rock Creek effluent to sediment diagenesis in the Tualatin River. The study used an elutriation apparatus to measure the PSD of the effluents and the organic carbon and particulate phosphorus associated with each particle size. The elutriation apparatus consisted of a series of small upflow columns with sequentially increasing diameters to produce settling environments of decreasing critical settling velocities. Effluent from the two treatment plants was passed through this

apparatus to collect settled particles. TSS and water quality measurements were done for each column, and mass balances was used to determine the PSD and potential particulate organic carbon and phosphorus removals as a function of particle size. These experiments showed that the discharged TSS in the Forest Grove effluent would settle nearly completely in the NTS, but that less than half of the particles in the Rock Creek effluent were expected to settle in the Tualatin River and contribute organic carbon and phosphorus to the river sediments. This information was used as supporting information related to CWS' NPDES permit renewal and will be used for future updates to the Tualatin River TMDL for phosphorus.

Scott Mansell
Scott Mansell is a Principal Engineer in the Research and Innovation Dept at Clean Water Services where he's been since 2017. Scott works at the nexus between research and environmental engineering leading project on a wide variety of topics including water quality modeling, continuous sensing in the natural and engineered environments, trace organics, and emerging contaminants. Prior to working at CWS, Scott earned a PhD in Environmental Engineering from UC Berkeley in 2012 and spent five years in consulting.

Tuesday, September 13
Session 20B: 2 Resiliency
3:45PM – 4:25PM

The Tools to Combine Co-digestion with Existing Infrastructure to Fight Climate Change

Tim Mills[1], Christian Aristizabal[1], Jacob Corum[2]
[1]Brown and Caldwell; [2]City of Gresham, OR; Tmills@brwncald.com, caristizabal@brwncald.com, jacob.corum@greshamoregon.gov

Upgrading existing municipal anaerobic digesters (AD) provides the best pathway for your agency to meet commonly accepted global climate action goals. Prioritizing methane emission reduction is seen as a highly effective means of reducing near-term global warming, which was affirmed by over one hundred countries in 2021 when they entered the "Global Methane Pledge." The agreement aims to limit methane emissions by 30% by 2030 and creates potential eligibility of funding opportunities for municipalities endeavoring to take on resource recovery.

Co-digestion has proven to be valuable on many levels, and facilities plan to receive more organic waste and continue operation into the future. New governmental incentives and industrial partnerships are on the horizon. However, co-digestion is a significant change in operations and increases demands on aging systems and plant staff. AD designed over 30 years ago require upgrades to meet the challenges of co-digestion, including capacity for increased gas production, organics receiving stations, operational changes, and safety mechanisms and protocols.

This presentation will showcase upgrades of existing AD to address common condition issues, increased gas capacity, specific features of co-digestion, organics receiving, and operational safety. Work includes addressing the relatively new ANSI biogas code (B149.6) and aspects of the digestion systems for several Oregon facilities. Data was reviewed to understand digester performance under high organic loadings and

exploration of dewatering impacts. Operation and maintenance provided input during the design process to make improvements to organics receiving facilities, including addressing the uniquely corrosive organic material received and screening needs. Design features include modifying digester gas system control to nearly double capacity with existing piping and adding overflow capacity to manage risks from rapid volume expansion.

New tools can be designed along with rehabilitation to modernize AD. The right tools simplify the adoption of new ways to operate, gaining support at all-levels for the important cause of fighting climate change

Tim Mills
Tim Mills is a senior managing engineer with Brown and Caldwell having 20-years of experience. His project work over the last 10-years has focused on digester improvements projects throughout Oregon including modernization for resource recovery.

Christian Aristizabal
Christian Aristizabal is a process mechanical engineer with Brown and Caldwell. His experience includes digester improvements for biogas capacity and safety, and organics receiving stations.

Jacob Corum
Jacob Corum is an Engineer I for the City of Gresham WWTP. Jacob's background includes operating and maintaining the Gresham FOG system, as well as managing the FOG program for the City's WWTP in his current role.

Tuesday, September 13
Session 21B: 1 Construction & Alt Delivery
3:00PM – 3:40PM

Navigating Supply Chain Disruptions and Inflation with Estimating and Scheduling

Bob Griesinger
Murraysmith; Bob.Griesinger@murraysmith.us

Public agencies are facing market volatility caused by supply chain disruptions and accelerating inflation. This presentation will cover how Murraysmith effectively navigates this volatility to bring best-value solutions to projects and municipalities.

By leveraging relationships with major equipment and building material manufacturers, our firm gains insight into the major supply chains feeding into the construction market, which is the foundation of our strategic supply chain monitoring process. Since the outbreak of COVID-19, we have been collaborating with partners to closely monitor construction supply chain disruptions and impacts on market prices for materials and equipment.

The sources and references utilized are AGC of America, American Institute of Architects (AIA), Bloomberg Markets, Department of Commerce, Engineering News-Record (ENR), Kitco (metals products retailer), Portland Cement Association, Producer Price Index (PPI), World Steel, US Pipe, Skanska, Mortenson, U.S.

Bureau of Economic Analysis, U.S. Bureau of Labor and Statistics, and more. Some of the trends we closely monitor are lead times, material and labor cost, logistics, transportation impacts, bid results, and current construction market conditions.

This data is used to update project cost models utilizing software tools by HCSS, such as Heavy Bid and Preconstruction Services. Allowing us to download direct cost information into Microsoft Project and Primavera P6, these two tools enable us to provide accurate costs information tied directly to scheduled delivery dates. By integrating this data into our strategy, can provide more complete and accurate estimates to our municipal partners for all disciplines and project stages.

Equipped with the information resulting from this process, our municipal partners have been able to pre-order long lead items, allowing them to save on increased costs, avoid project delays, stage projects to take advantage of cash flow projections, accelerate the bidding process (on some projects) to take advantage of contractor availability, and postpone projects that no longer make financial sense.

This presentation outlines how public agencies and consultants can navigate the challenge of developing reliable cost estimates during these unprecedented current market conditions to minimize risk, increase efficiency, keep pace with project timelines, and stay on budget.

Bob Griesinger
Bob is a Certified Professional Estimator with nearly 40 years of construction experience focused on civil engineering and construction management across seven states and five countries, including 20 years of experience working as cost estimator. He is deeply engaged with the construction market to proactively address material and labor cost changes. His capabilities include negotiating prices, organizing bids, preparing cost reports, coordinating design-build projects, and developing schedules and cash flow forecasts.

Tuesday, September 13
Session 21B: 2 Construction & Alt Delivery
3:45PM – 4:25PM

Carmel Area Wastewater District WWTP Rehabilitation and Replacement Projects

Ron Walz, David Kennedy, Nick Lazarakis
Kennedy Jenks, United States of America; ronwalz@kennedyjenks.com, davidkennedy@kennedyjenks.com, nicklazarakis@kennedyjenks.com

The Carmel Area Wastewater District (CAWD) and its predecessor, the Carmel Sanitary District, have worked with Kennedy Jenks for almost a century to deliver design and construction support for the 10 MGD WWTP facility. In addition to protecting the environmentally important water environment in the Carmel California area, recycled water from CAWD WWTP is used by the iconic Pebble Beach Golf Course located nearby.

Ten years ago, CAWD looked forward to the next era of successful operations and requested Kennedy Jenks perform a WWTP facility-wide condition assessment and asset management update. This exercise identified rehabilitation opportunities and new improvements to the WWTP that were supported and funded in the subsequent Capital Improvements Plan (CIP). The CIP outlined a 15-year plan that is being accomplished in only 10 years using a two phased approach which bundles the smaller projects.

The $14M Phase 1 project completed construction in 2018 and incorporated energy management planning into the design and construction of the following replacement and new improvements.

- DAFT mechanical components
- Aeration blower
- Stormwater pump station and forcemain
- RAS and WAS pumps and piping
- Dewatering screwpress
- 1-water pump station
- 3-water strainers and bypass
- Anaerobic digester and associated control building
- Sodium hypochlorite and sodium bisulfite storage and feed facility
- Overhaul of main and standby power system, including a new switchgear

The $8M Phase 2 project is completing construction and included design and construction of the following replacement and new improvements.

- Four influent pumps
- Two automatic bar screens
- Grit washing unit
- Grit tank collector mechanism
- Modifications to reduce grit buildup in channels
- 3W system pressure controls and new pump VFDs
- Sludge holding tank and associated mixing system
- Four MCCs

The presentation will include an overview of both Phases with a specific focus on innovative permanent improvements, temporary systems, and construction sequencing to keep the WWTP operational during construction.

Ron Walz

Ron Walz is a senior engineering manager with 34 years of experience in wastewater planning and design, with responsibilities ranging from project engineer and project manager to senior reviewer. Ron's primary responsibilities include wastewater collection and conveyance, treatment plant hydraulics, process review, and detailed design of wastewater treatment systems. He has a strong background in construction management and complex retrofit wastewater treatment plant projects. Ron is the PM for the Phase 2 design and construction project.

David Kennedy

David Kennedy has decades-long experience in program and project management as well as the investigation, planning, design, and construction inspection of water and wastewater systems, utility infrastructure systems and environmental management assignments. His project work has been primarily in the western region of the United States although through his professional association activities, he has developed knowledge of practices throughout the United States. David continues to provide project oversight, review and direction on high priority projects. He served as President of Kennedy/Jenks

Consultants from 1979 to 2006 and was the Resident Engineer for the 1970 CAWD WWTP improvements.

Nick Lazarakis
Nicholas (Nick) Lazarakis is a civil engineer and Project Manager with over 8 years of engineering experience with a primary focus on providing detailed design and construction support of water infrastructure projects, including drinking water and wastewater treatment, collection, and distribution. Nick is skilled in preparing technical memoranda, engineering predesign reports, contract specifications, and design drawings. His various project roles have included serving as project manager, providing engineering services during construction, and providing project oversight of construction projects. Nick worked with Patrick Treanor, now with CAWD, on the initial condition assessment and project development as well as the Project Engineer for both Phase 1 and 2 projects.

Tuesday, September 13
Session 22B: 1 Utility & Asset Management
3:00PM – 3:40PM

Programmatic Delivery of Pipe Replacement to Minimize Risk for Least Cost

Amy Carlson[1], Shelby Smith[2], Debbie Harris[3]
[1]Jacobs; [2]Brown and Caldwell; [3]City of Bellevue Utilities; amy.carlson1@jacobs.com

The City of Bellevue Utilities Department faced a backlog of over 1,000 storm and sewer pipe assets with significant structural defects in 2020. As the City worked to develop long-term asset management tools to prioritize these repairs and replacements based on probability and consequence of failure, they also wanted to address the near-term, ever-growing backlog and capitalize on strong contractor interest and competitive bidding due to the COVID-19 pandemic. Rather than wait until the asset management tools were ready and suffer market cost increases, the City initiated an annual program and entrusted Jacobs with prioritizing and developing designs for eighty (80) of those backlog assets. Jacobs tapped their experience and tools to perform a rapid prioritization of the backlog of pipe assets, quickly recommending assets for inclusion in the City's 2020 Pipe Defect Repair Project and efficiently developing fix methods understanding the pros and cons of trenchless vs. conventional technologies. Once assets were identified for inclusion in the 2020 project, Jacobs and team streamlined design preparation and submitted a 60% design a month after assets were determined. Similarly, the permitting process was made more efficient by bundling individual pipe assets into fewer individual City permits. The Jacobs team ensured that the City would get the best price for the work by setting up the bid packages to be attractive to bidders, using straightforward language and splitting the repairs into two bid packages: trenchless vs. dig and repair. The bids for both of the bid packages came back at less than the engineer's estimate. As construction of the 2020 pipe defect repair project was nearing completion in Q3 of 2021, the City asked Jacobs to proceed with the 2021/2022 Pipe Defect Repair projects, this time including nearly 200 individual pipe assets. This presentation will describe the delivery process, how inflation and anticipated market conditions informed the analysis, and how lessons learned from each year are leveraged to strengthen future iterations of the program.

Amy Carlson
Amy Carlson is a Civil Engineer with Jacobs. Amy is a third-generation engineer with a passion for strategically addressing complex urban and suburban infrastructure problems with solutions that

provide multiple benefits. She has worked to balance 'people needs' with 'environmental needs' on infrastructure planning and design projects throughout her career. Amy has a BS in Civil Engineering from the University of Michigan and an MS in Civil Engineering from the University of Washington. Outside of work, Amy enjoys gardening, fly-fishing, and occasionally enjoying a meal with adults, as she and her husband have two small children.

Tuesday, September 13
Session 22B: 2 Utility & Asset Management
3:45PM – 4:25PM

Resource Constrained? A Case Study on EconH2O for Capital Program Planning

Lanelle Ezzard[1], Brian Landau[2]
[1]HDR Engineering, Inc, United States of America; [2]City of Bellevue, Utilities Engineering Division;
lanelle.ezzard@hdrinc.com, BLandau@bellevuewa.gov

Utilities are investing billions to solve their most pressing problems. Faced with dire water supply problems, some utilities envision becoming leaders in recycled water. Others faced with significant water loss and impacts to the utility's revenue stream are charging ahead to become leaders in smart water. Considering the level of financial resources input to realize these benefits Utilities are required to ask, "Even if we encumber the necessary cash and/or can secure alternative funding, can we deliver a $xxx million or more annual CIP?" Furthermore, "What level of staffing is required to deliver a CIP of this size?"

Like most local government agencies, the City of Bellevue, Washington, is responsible for a wide variety of infrastructure assets, including water, sewer, and stormwater. Bellevue has developed a streamlined CIP budget planning process, a proactive asset renewal program, and initiates ongoing system assessments to continue to deliver quality service to customers. For Bellevue, development of a balanced CIP and meeting CIP accomplishment metrics is driven by an overriding factor: employee resources. Understanding and right-sizing employee resource requirements provides a basis to develop and prioritize capital improvement projects and potential programmatic mitigations.

To address full time employee (FTE) resource constraints, Bellevue is applying a HDR tool, EconH2O™ that incorporates established concepts for capital improvement capable of optimizing not only on financial and affordability conditions, but also on FTE resource constraints. The goals of adapting the tool for Bellevue's CIP budget planning purposes are to fit the staffing needs of an implementable CIP, improve CIP accomplishment, reduce utility system and level of service risks, and comply with the fiscal limitations and obligations of the City.

Using a project completed in 2021 as a case study, we will discuss EconH2O™ development, identification of constraints, and determination of a prioritized CIP project list and associated resources requirements. The City of Bellevue, Utilities and HDR initiated the project for a customized capital planning prioritization tool for its 10-year planning horizon across water, sewer, and stormwater. HDR's EconH2O™ is a decision support tool for planning prioritization, that can facilitate the entire CIP planning process.

Lanelle **Ezzard**
Lanelle Ezzard has more than a decade of experience providing engineering consulting services to offer

strategy and implementation for large-scale capital infrastructure projects and programs. She has a broad project experience background that involves risk analysis, quality control, planning, program management, and project delivery. Throughout her career, Lanelle has performed critical functions as part of a risk assessment production team, technical assistance program on behalf of a US federal agency, and program and advisory services teams. Lanelle is a Water/Wastewater Engineer with HDR based in Seattle, WA.

Brian Landau

Brian Landau is a strategic leader with over 20 years of water resources and utility management experience; improving organizational, program, and project performance with innovation and team building. Brian has a strong track record of developing, implementing, and improving effective operational and capital programs. An innovative manager committed to staff development and experienced at maximizing talent in limited resource environments. Brian is the Utility Systems Planning Manager, Utilities Engineering Division of City of Bellevue, WA.

Tuesday, September 13

Session 23B: 1 Treatment - Energy

3:00PM – 3:40PM

Hydrogen Fuel From Biogas – Future or Not?

Vanessa Borkowski, Pooja Sinha, Nicole Stephens, Dian Zhang, Dru Whitlock

Stantec, United States of America; vanessa.borkowski@stantec.com, pooja.sinha@stantec.com

Hydrogen can be derived from Water Resource Recovery Facilities (WRRFs) through methane source. Hydrogen is a clean transportation fuel, identified as a Zero Emission Vehicle along with electric vehicles. Indeed, production of hydrogen fuel is currently being incentivized in California as recognized in the Assembly Bill 32 (AB32), since it offers the potential to reduce greenhouse gas emissions compared to other conventional fuel technologies.

Biogas which mainly consists of methane and carbon dioxide is being produced at WRRFs during anaerobic digestion process. Technologies such as Steam-Methane Reforming (SMR), converts biogas to produce hydrogen. SMR is one approach that can be implemented at WRRFs to recover hydrogen, represented by the following reaction:

Steam-Methane Reforming Reaction

$CH_4 + H_2O$ (+ heat) à $CO + 3H_2$

WWRFs are capable of producing methane on a consistent basis due to the constant influent wastewater flows. This potential hydrogen fuel supply from the methane is complemented by the global pledges to achieve net zero carbon emissions by 2050 through the Conference of Parties and Paris Agreement and State of California mandate to achieve the same by 2045. These commitments and current incentives are

laying the foundation for clean energy production such as SMR for hydrogen fuel cells to become the resource of the future. The transportation industry has mainly benefited from hydrogen fuel as an alternative resource to conventional fuels. The State of California is aggressively accelerating towards building hydrogen fueling stations with the goal to achieve carbon neutrality. The new Las Vegas hydrogen production plant is being constructed to support demand in California, where the raw material of this plant is about 50% biogas.

This presentation evaluates the current landscape of WRRF-derived hydrogen for transportation fuel in terms of available incentive pathways, policies, and economic feasibility; identifying obstacles that would need to be overcome for hydrogen to become a more competitive fuel source; future developments required in this area; and evaluates how WWRFs can effectively produce valuable clean

Pooja Sinha

Tuesday, September 13
Session 23B: 2 Treatment - Energy
3:45PM – 4:25PM

Net-Zero WRRF Goes Carbon-Negative via Innovative Public Private Partnerships

Margaret Laub
Anaergia, United States of America; margaret.laub@anaergia.com

Building upon the momentum of a public private partnership (P3) that delivered energy neutrality to Victor Valley Wastewater Reclamation Authority (VVWRA)'s Water Resource Recovery Facility (WRRF), VVWRA and Anaergia teamed to implement California's first WRRF-based pipeline renewable natural gas (RNG) project. This initiative demonstrates the critical role WRRFs of all sizes can play to combat climate change, increase resilience, and create alternative revenue streams.

VVWRA operates a 14MGD advanced treatment facility in Victorville, CA. VVWRA sought to better utilize biogas, offset electricity costs, and achieve net-zero. To achieve these goals and mitigate risk, VVWRA partnered with Anaergia to design, build, and finance upgrades to increase digestion capacity and deploy cogeneration modules to achieve energy neutrality.

Following the project's success, VVWRA sought to maximize co-digestion and expand on energy and infrastructure benefits realized thus far. At the increased levels of biogas achieved from Phase 2 co-digestion, analysis confirmed he highest-value beneficial use was upgrading to pipeline quality renewable natural gas (RNG) for pipeline injection. This approach has added benefit of generating carbon-negative fuel, an invaluable tool in achieving carbon-neutrality goals and mitigating climate change.

Completed in 2021, the P3 includes WRRF upgrades for expanded co-digestion (new liquids receiving, high-solids mixers in each digester) and biogas utilization facilities (biogas conditioning, RNG membrane upgrader, and utility interconnection). Ancillary upgrades (e.g., dedicated digester feed lines) were provided to support overall WRRF operations and address capital improvement needs. The project tripled VVWRA co-digestion and associated biogas production. Anaergia owns and operates the compact RNG

facilities (less than one-quarter acre), so that VVWRA may continue to focus on its core mission. VVWRA continues to benefit from energy resilience and electric grid independence via cogeneration using natural gas (funded by the project). In addition, VVWRA receives new revenue streams via lease payments from Anaergia, additional tipping fees, and RNG sales revenue sharing.

Pairing existing public infrastructure with private investment provides an effective and responsible means to expand resource recovery capabilities, opening the door for ambitious and innovative initiatives. This partnership demonstrates a replicable model to expeditiously transform wastewater treatment facilities into energy-neutral or -positive resource recovery centers.

Margaret Laub

Margaret Laub is responsible for business and project development for resource recovery projects on the west coast, with a focus on public-private partnerships (P3) with municipal wastewater treatment facilities to enhance anaerobic digestion and utilize biogas. She interfaces with clients, stakeholders, and internal teams to educate team members on organics-to-energy opportunities and develop projects – driving them from concept to construction. Her six years of experience have largely focused on advancing energy projects with public partners to deliver infrastructure upgrades, enhanced resiliency, reduced carbon footprint, and economic benefits. Margaret has a Bachelor's Degree in Environmental Engineering from Harvard University, with a secondary concentration in Statistics. Margaret is a Certified Energy Manager (CEM).

Tuesday, September 13
Session 24B: 1 Treatment - Sidestream
3:00PM – 3:40PM

Ultra Fast Startup and Robust Operation of North America's First Complete Granular Sludge Deammonification System

Mudit Gangal[1], Cody Schoepke[2], Willie Driessen[3]
[1]Ovivo USA; [2]Fond du Lac WRRF, WI; [3]Paques BV; mudit.gangal@ovivowater.com

Sidestream Nitrogen removal via deammonification has been established as an accepted and efficient method of treating high nitrogen return streams at water resource recovery facilities (WRRFs) to optimize nutrient removal at the plant with minimal operational and maintenance (O&M) inputs. Complete granular sludge deammonification systems which optimize the deammonification process further, while popular in EU and globally, have only recently been introduced to North America. This paper discusses the startup and operations over two years, of a full scale complete granular sludge deammonification system in the United States including operational data and lessons learned.

The Fond du Lac WTRRF, WI selected the Ovivo-Paques AnammoPAQ complete granular sludge deammonification system to be implemented at their facility to treat the highly concentrated nitrogen rich stream produced after centrifugation of co-digested biosolids from their temperature phased anaerobic digestion system. The system was designed to treat the centrate with an influent concentration of 1,200 mg/l Ammonia-N to reduce the same to < 200 mg/l without addition of external alkalinity. Also as part of the performance guarantee, testing had to be carried out in peak Wisconsin winter to ensure operation under worst case conditions. The system was seeded in January with granular Anammox sludge and even in the depths of winter the system was able to startup within 1 week of seeding i.e. reach 90%

Ammonia-N removal (far exceeding the performance guarantee goal). The system was further operated with varying operating flow and load variations including several shock treatments, under peak winter conditions and it was seen that the system maintained consistent treatment with effluent Ammonia-N values typically less than 150 mg/l, without addition of any supplemental alkalinity.

The data from the plant thus showed the complete granular sludge deammonification system proving itself as a quick starting and robust process along with being a compact and cost effective upgrade at the Fond du Lac WTRRF. The system helped substantially reduce the Nitrogen loads going back to the head of the plant, while significantly reducing the energy and chemical costs associated with the treatment, thereby helping optimize the overall O&M costs at the facility.

Mudit Gangal

Mudit Gangal is a Product Manager in the Biosolids Management & Resource Recovery group for Ovivo in North America in their Austin, TX office. He has been with Ovivo for over 5 years and has over 13 years of experience with process design and marketing of biosolids management systems and advanced biological water and wastewater treatment processes including nutrient removal and recovery. Mudit was previously with Suez North America for 8 years and has a Bachelor of Engineering in Biotechnology from SJ College of Engineering, India, a Master of Engineering Management from Duke University, USA and a Master of Business Administration from the Indian School of Business, India.

Tuesday, September 13
Session 24B: 2 INFLOW PRESENTATION
3:45PM – 4:25PM

Introducing Future Leaders of Water

Serina Fast Horse, Katelin Godwin, Asa Reyes-Chavez, Edgar Sanchez Fausto, Geneva Schlepp, Madison Whitlow-Hewett

The InFLOW program (Introducing Future Leaders of Water) is focused on providing opportunities in the water industry to underrepresented communities. This program includes a five-part workshop series which focus on providing information related to the water/wastewater industry, networking, skills development, employment opportunities, and conference preparation. This year, PNCWA has six participants in the program and each participant will present on their experiences and what it's like entering the water industry from their perspective.

Bios

1. Serina Fast Horse
    - Serina Fast Horse is Lakota & Blackfeet and currently serves as the program coordinator for the Institute for Tribal Government at Portland State University. She is the owner of Kimimela Consulting, and through her work, she is helping build collaborative relationships between Indigenous people and various agencies.
2. Katelin Godwin

- Katelin Godwin graduated from Oregon State University in September 2021 with a degree in Ecological Engineering. She continues to strive for excellence in her training and work at Jacobs Engineering as a Junior-Intermediate Civil/Environmental Engineer. After a year of missed opportunities during virtual learning, she is excited to make strong connections in the engineering and water resource community.

3. Asa Reyes-Chavez
    - Asa Reyes-Chavez, joined Parametrix, Inc. as a Water Solutions Engineer, EIT, as she finished up her Bachelor's of Science degree in Civil Engineering at Washington State University in 2020. She has experience modeling and designing various components of W/WW conveyance and collection facilities as well supporting construction administration phased projects. She's passionate about the water industry and is striving to learn about more innovative technologies to design & upgrade our water systems to promote climate, racial, and economic justice. She joined the 2022 InFLOW cohort to learn more about the water industry, PNCWA, and connect with more professionals.
4. Edgar Sanchez Fausto
    - Edgar Sanchez Fausto is a Technology Development & Research Intern at Clean Water Services. He graduated from Portland State University in June 2021 with a degree in Environmental Engineering. Edgar is excited to get insights from people working in the water industry and learn new skills to apply in his own work. He believes water is key to all living things and is super important for a healthy community. He strives to help sustain this key resource.
5. Geneva Schlepp
    - Geneva Schlepp is a civil engineering intern with Jacobs Water and Wastewater Treatment Group out of the Bellevue, WA location. She earned a B.S. of Civil Engineering from Washington State University and will pursue a M.S. of Civil Engineering with a wastewater treatment specialization at the University of Washington this coming fall. Geneva's experience includes stormwater design, treatment plant improvements, and wastewater treatment design. Additional areas of expertise include constructed wetlands for domestic wastewater treatment and impacts of climate change specific to the PNW. Geneva is also active in professional water industry organizations including PNCWA and AWWA.
6. Madison Whitlow-Hewett
    - Madison Whitlow-Hewett is a graduate from Portland State University's Environmental Engineering program. She is an EIT and OIT currently working at Westhaven CSD's drinking water plant. She is passionate about using her degree to promote equity in underserved communities and would like to help rural communities update their drinking water infrastructure.

Wednesday, September 14
Session 25A: 1 Leadership
8:00AM – 8:40AM

Utility Leadership: What I Wish I Had Known (Panel Discussion)

Jon Skidmore[1], Haley Falconer[2], Neil Jenkins[3], Jennifer Coker[4]
[1]Murraysmith; [2]City of Boise; [3]Eagle Sewer District, [4] City of Sandy; Jon.Skidmore@murraysmith.us, hfalconer@cityofboise.org, NJenkins@eaglesewer.org, jcoker@ci.sandy.or.us

As wastewater professionals, much of our time is devoted to addressing our most technical challenges. However, our world is changing and requires utility leaders to adapt and prioritize in the face of competing challenges. Our communities are becoming increasingly expensive, often outpacing our ability to recruit talent, we face climate-related challenges, and our technical training doesn't prepare us for these issues. Successful utility management requires us to consider a broad collection of societal factors. At PNCWA we need to recruit members of our teams – city managers, finance directors, attorneys – to better understand and address the expanding water world. Like water, we need to adapt to changes with our non-technical teammates to assure we manage appropriately based on our changing world.

This panel will engage high-level managers of wastewater utilities and public works departments in our region in a discussion about how our business is increasingly influenced by items not related to the movement and treatment of water.

This discussion will:

25. *Advance meaningful non-technical discussions at PNCWA.* To successfully manage our utilities and serve our communities, we need to discuss things outside the traditional scope of our roles. Topics will likely include housing affordability in the Pacific Northwest, and recruitment challenges, board and community politics, the role of our utilities in climate resiliency efforts and others.
26. *Exchange ideas, stories, and experiences to help address these challenges.* Panelists and attendees will provide insight on various issues that we can use in our daily professional lives and perhaps create the basis for more formal PNCWA conversations.
27. *Recruit non-technical members of our teams into the conversation.* As much as we like to discuss centrifuges and digesters, many teammates who help us address these issues don't need that much detail. Strategically bringing in other professionals with different perspectives will allow us to address these items holistically.

This forum is an initial attempt to broaden the conversation at PNCWA to attract instrumental members of our teams by focusing on issues that need more than the engineering expertise to address.

Jon Skidmore
Jon has been working in land use planning, utility master planning and project delivery for over 20 years. For the past 10 years, Jon led the City of Bend's infrastructure and land use modernization projects as the Assistant City Manager. Jon works with engineers, planners, and other professionals to tailor solutions that address growth management challenges and meet community needs and financial expectations. He recently joined Murraysmith to focus on infrastructure and land use planning for other communities throughout the Pacific Northwest and beyond. He has a degree in political science from the University of Oregon and a Master of Urban and Regional Planning degree from Portland State University.

Haley Falconer
Haley Falconer is the Environmental Division Senior Manager for the City of Boise. In this role, Haley is responsible for the implementation of the city's long term strategic plan for water renewal, managing regulations and water quality, and overseeing an innovative materials management program. When not

working, Haley enjoys exploring Idaho with her spouse, two young children, and rambunctious, yet snuggly, rescue pup.

Neil Jenkins
Neil holds a bachelor's degree in Civil and Environmental Engineering and a master's degree in Civil Engineering. He is a licensed professional engineer in Idaho. He is an accomplished wastewater engineering project manager. During his private-sector career working for a leading engineering firm, he delivered a wide variety of studies, plans and capital projects for many clients throughout Idaho. As General Manager of Eagle Sewer District, Neil leads the district under the direction of a five-member board. He sets the long-term vision for the district while supervising day-to-day administration and operations.

Jennifer Coker

Wednesday, September 14
Session 25A: 2 Leadership
8:45AM – 9:25AM

Leadership Lessons in Unexpected Places

Allison Hornak[1], Emily O'Morrow[2]
[1]HDR, United States of America; [2]Brown and Caldwell, United States of America;
Allison.Hornak@hdrinc.com, eomorrow@brwncald.com

Engineers habitually talk about the technical innovations needed to complete our work, but often the equal hurdle is the capacity of the people charged with the work. Before COVID, the "grey-tsunami" flooded our industry, and now with "the great resignation," work force gaps continue to be a problem at all levels of our organizations. However, these gaps also provide opportunities for emerging leaders within our industry. The question becomes, "How can young leaders develop the skills they need to prepare for new roles?" We have personally found that the biggest growth often comes from unexpected places: such as mentors outside our organizations, engaging in professional organizations, and from pursuing unique project opportunities.

Mentorship often leads to professional development inside an organization- a senior leader takes a junior engineer under their wing and help them grow. External mentorship can have equally beneficial outcomes. In 2019 we formed a mentor circle who get together for coffee once a month. This mentor circle is made up of an unexpected quartet: three consultants and one client; two rising professional women, two mid-level men; all with different technical focuses— committed to each other's growth. We meet over coffee and bring our challenges and successes to share with the group. We've all gained additional conflict management and team building skills, learned to give candid and honest feedback, share our perspective (often differing) in a respectful way, and always find something to laugh about. Our lesson learned: take the risk to set up something that seems "awkward" and show up with your honest self to get the biggest return on investment.

In 2019, Haley Falconer asked us to join her in planning PNCWA 2020. We were empowered to set vision and were the responsible charges for all decisions. We were supported by a team of advisors and peers who challenged our ideas, safeguarded our decisions, and provided the opportunity and space to lead.

Together we delivered a successful conference in Boise despite a global pandemic. Our lesson learned: Any experience, with trusting foundations built on shared outcomes and values can provide unexpected leadership opportunities.

Allison Hornak
Allison Hornak is a project engineer at HDR with roughly five years experience. She has worked on a mix of municipal and industrial wastewater design and construction projects, primarily focusing on facility planning and process mechanical design. Born and raised in Alaska, her favorite things to do in spare time all include getting outside into the mountains or forests.

Emily O'Morrow
Emily O'Morrow is a project engineer, program manager, and project manager at Brown and Caldwell with four years of experience. Her work has primarily focused on utilities making the transition from traditional wastewater treatment to recycled water facilities and programs. In her spare time you can find her in the foothills running with her dog, Eva.

Wednesday, September 14
Session 25A: 3 Leadership
9:30AM – 10:10AM

Leadership Panel: Evolving Leadership in an Evolving World

Amy Dammarell[1], Lara Kammereck[2]
[1]HDR, United States of America; [2]Carollo Engineers, United States of America;
amy.dammarell@hdrinc.com, lkammereck@carollo.com

Over the past 2 years, the traditional work style has been interrupted with many organizations navigating in-person, virtual, and/or hybrid work arrangements. This panel will include discussion topics around change management, organizational and personal leadership. Specific topics will include the eveolving role of leaders; and mentoring, knowledge transfer, and building teams in a virtual or mixed environment.

A panel of up to 4 pairs of mentors/mentees (total of 8 individuals) will be developed with Conference Committee and Leadership Committee. This will include individuals just joining the workforce in the last 2 years along with those with longer tenure that are adjusting to this recent disruption.

Anticipate the panel will include diverse gender and age leaders at both private and public agencies from Washington, Oregon and Idaho.

Amy Dammarell
Amy is a Senior Vice President and a Director of Professional Services for HDR's Water Business Group. She has over two decades of experience supporting clients of all types deliver their infrastructure programs. She most enjoys finding solutions that result multiple benefits for the human and natural environments. She received her BS in Wildlife Ecology from University of Illinois and her MS in Engineering from Portland State University.

Lara Kammereck
Lara is a Senior Vice President at Carollo Engineers, Inc. She has over two decades of civil engineering experience focused on water and wastewater master planning for public utilities. She received her B.S. in

Civil Engineering from Gonzaga University and her MBA from Seattle University. She is the President Elect on the PNCWA Board.

Wednesday, September 14
Session 26A: 1 Collection Systems
8:00AM – 8:40AM

Breathing life into Retired Infrastructure for Wet Weather Storage

Steven Drangsholt, Casey Gish
Brown and Caldwell, United States of America; sdrangsholt@brwncald.com, cgish@brwncald.com

In a continual effort to enhance the water quality of Puget Sound, the City of Everett (City) is working to reduce unplanned combined sewer overflows (CSOs) at four outfall locations along the shores of the Possession Sound. In 2012, the City acquired the decommissioned Kimberly-Clark pulp and paper mill wastewater treatment plant (KCWWTP) with the goal to retrofit the plant into a wet weather storage facility. Through site condition assessment, alternative design concept development, and creative thinking, the City and Brown and Caldwell (BC) developed a planning level design for reviving the KCWWTP into the Port Gardner Storage Facility (PGSF).

Following a site condition assessment, climate change resiliency evaluation, and alternatives analysis, planning level design of the future facility began. The condition assessment included a plant wide drone inspection and visual review of existing plant assets. The climate change resiliency evaluation considered how sea level rise may impact the site and capacity of the facilities' existing deep water outfall. Using the findings of the condition assessment, BC collaborated with the City to develop four alternative site configurations to retrofit the KCWWTP infrastructure. Input from City engineering staff, utility leadership, and operations developed and refined the alternatives, culminating in a planning level design for converting the KCWWTP into a wet weather storage facility.

This planning level design of the future facility includes screens and grit separation for combined sewer solids removal, a retrofit of the existing aeration basin and secondary clarifiers into combined sewer storage, building an onsite stormwater equalization and treatment system, and constructing a new effluent pump station. This presentation will demonstrate how the City of Everett used creative problem solving to repurpose defunct infrastructure to meet current and future needs to protect the waters of the Puget Sound. This talk demonstrates how collaboration and incorporating perspectives from multiple stakeholders is critical to meeting the City's current and future needs.

Steven Drangsholt

Steven Drangsholt is a project and program manager with 15 years of experience in wastewater and stormwater analysis, planning, and design. His expertise includes program/project management, asset management, facility and collection system planning. He has a passion for marketing and communications shown through his work as a sales leader at Brown and Caldwell. His passion extends beyond just the work to training the next generation of water professionals in the discipline of marketing and storytelling. Steven is currently serving as the WEF Speaker for the House of Delegates.

Casey Gish
Casey Gish is an environmental engineer with experience in municipal wastewater treatment. He holds a master's in environmental engineering from the University of Washington and is part of Brown and Caldwell's (BC) process mechanical group in the Seattle office. Casey's experience includes treatment plant hydraulic modeling and hydraulic profile development, treatment system process modeling, aeration system design, pump system modeling and pump sizing, transient modeling, project management, and facility planning. Casey serves as a Water Environment Federation (WEF) Delegate for PNCWA.

Wednesday, September 14
Session 26A: 2 Collection Systems
8:45AM – 9:25AM

City of Bellevue Pipe Defect Evaluation and Trenchless Repairs

Craig Christensen
David Evans and Associates, Inc., United States of America; craig.christensen@deainc.com

Over the past two years, the City of Bellevue Utilities Department (City) has requested the assistance of the Jacobs Engineering Group (Jacobs) and David Evans and Associates (DEA) to address the City's backlog of sewer and storm drain pipe (asset) defects. To address this backlog, Jacobs and DEA developed separate "dig and repair" and "trenchless" construction contract packages.

The scope of these projects is broken down into the following tasks:

- Prioritization of assets in City's database (Jacobs)
- Evaluation of City-selected assets (DEA)
- Design of repairs (trenchless - DEA and dig and repair – Jacobs)
- Construction management of repairs (trenchless - DEA and dig and repair – Jacobs)

This presentation will focus on evaluation and trenchless repairs.

After the City identifies the assets to be included in the project, DEA was tasked with leading the evaluation phase. The first and most important evaluation step was to setup a large master spreadsheet and file folders to track all information for each asset. The second step was to review each asset's closed circuit television (CCTV) video inspection from the City's records. These reviews were done prior to looking at any of the City's review comments or design recommendations so that a fresh perspective could be had. While watching each CCTV, first the asset location, diameter, material, and length were noted and then very detailed notes were taken on the type and location of any pipe defects. If additional CCTV was needed, that was requested from the City.

Either at a later date or concurrently to the CCTV review, a site visit was completed for each asset that included a topographic survey, structure measurements, and photos. All of the evaluation information was then used to determine if a trenchless repair or dig and repair was the most suitable approach.

For design of the asset's defects using trenchless repairs, the evaluation information was then used to determine which method of repair(s) were recommended: cured-in-place pipe (CIPP) full length liner, CIPP spot repair liner, CIPP tee/lateral liner, or pipebursting. Once a method was selected, construction plans and specifications were prepared for City review and approval.

Craig Christensen

Craig Christensen has over ten years experience in planning, design, and construction observation of water, storm drain, and sewer facilities. He has a B.S. in Civil Engineering from the University of Washington and is a registered Professional Engineer in the state of Washington. Craig has assisted in the pre-design, design, bidding, correspondence, construction, and post-construction tasks of various projects including the repair and/or rehabilitation of sewer piping, storm piping, water piping, wastewater treatment plants, lift stations, reservoirs, and roads and streets. He has prepared reports, memos, pay estimates, shop drawing reviews, comprehensive system drawings, project manuals, project technical project manuals, drawings, construction cost estimates, quantity takeoffs, operation and maintenance manuals, and bid and contract documents. Other specific tasks include hydraulic modeling, drafting, construction support, inspection, background research, site layout, utility (sewer, storm, water, electrical, cable, TV, gas, etc.) research, and associated documentation. He also has technical proficiency in AutoCAD, SewerGEMS, WaterGEMS, SWMM 5.0, WWHM3, MS Word, MS Excel, and MS PowerPoint. His communication skills and organized project approach assure the client that the project is addressed in an efficient and complete manner. Craig has served special purpose districts and cities in western Washington for over ten years. In this capacity, Craig has gained the confidence of his clients to understand their needs beyond the limits of the project, in the context of the agencies challenges and opportunities.

Wednesday, September 14
Session 26A: 3 Collection Systems
9:30AM – 10:10AM

Teamwork Overcomes Challenging Site Conditions in Major Utility Replacement

Jeff Moss[1], Marcus Byers[2]
[1]Murraysmith; [2]Kleinfelder; Jeff.Moss@murraysmith.com, mbyers@kleinfelder.com

The City of Renton Downtown Utility Improvements Project included replacing City-owned water, wastewater, and stormwater utilities in preparation for major redevelopment and revitalization of the more than 100-year-old downtown area. Challenging factors required the project team to collaborate and adapt to deliver a successful project, including pipe inverts in excess of 20 feet deep; a tie-in to the King County Eastside Interceptor in excess of 30 feet deep; highly variable soil conditions; shallow ground water; areas of contaminated soil and groundwater; extensive existing and legacy utilities; and maintaining access to residences and businesses located along busy streets. The project included over 8,000 linear feet of 8- to 24-inch diameter sewer main and appurtenances, as well as the design of approximately 6,100 linear feet of storm drain, and over 3,300 linear feet of 12-inch diameter water main and appurtenances. Close collaboration between the City, design consultants, construction management team, and the contractor allowed adaptation to varying site conditions and led to successful completion of the complex and high-risk project ahead of schedule and under budget.

This presentation will focus on aspects of the project that presented significant risk to the City in the form of high bid costs, high change order likelihood, or damage to adjacent properties. Mitigation strategies considered for each will be presented, along with how they were ultimately addressed in the Plans and Specifications. Lessons learned will be shared on topics including construction dewatering; excavation, shoring, backfill, and asphalt patching; protection of and damage to existing utilities; traffic control and phasing; and subcontractor qualification for specialty construction. Participants will become better equipped to address similar risks on their projects.

Jeff Moss

Jeff is a Civil Engineer at Murraysmith focused on wastewater and water design, planning, and construction projects for municipalities throughout the Northwest. He has experience with the design, construction, and operation of pump stations, conveyance systems, and treatment plants. Jeff was the lead designer on the Renton Downtown Utilities Improvements Project (DUIP) for the sewer improvements, was the lead specification writer for the project, and provided engineering services during construction.

Marcus Byers

Marcus has been with Kleinfelder for over 17 years and has over 25 years of experience. He is Principal Geotechnical Engineer and works on a variety of utility, transportation, and infrastructure projects throughout the Northwest and Western Canada. Marcus was the lead geotechnical engineer and Kleinfelder's project manager on the DUIP project, overseeing Kleinfelder's geotechnical, hydrogeologic, and environmental design services, and construction testing and inspection services.

Wednesday, September 14
Session 27A: 1 Construction & Alt Delivery
8:00AM – 8:40AM

Supply Chain Market Outlook and Risk Mitigation Strategies

Michael Fuss, Ryan Spanton, Todd Pike
Stantec, United States of America, Goble Sampson, IMCO; michael.fuss@stantec.com, rspanton@goblesampson.com, tpike@imcoconstruction.com

The global pandemic has produced unprecedented, once in a generation supply chain and market upheaval. The reality is we have experienced unrivaled short term increases in costs, difficulties in obtaining supplies, and limited supply alternatives. We will attempt to shed light on the significant cost and market impacts we have all experienced, the current trends, and share strategies to mitigate risk and market impacts going forward. We will present national and regional market trends focused on the water/wastewater industry, and expound on several price, delivery, and cost risk mitigation strategies from an engineering and vendor perspective. We are optimistic about the future and the market returning

to something like near pre-pandemic standards, but it will take time and risks will continue. Market risks can be mitigated, and resources are accessible through pre-planning, pre-engineering, advance purchasing, effective contingency planning, engaging your market advisors and considering alternative delivery. Our seas have been rough but understanding the trends and options available for your projects will keep you afloat and help you find calmer seas.

Michael Fuss

Michael Fuss, P.E., MBA, is the Senior Principal Inland NW Practice Lead for Stantec Consulting Services Inc in Boise, ID. Michael provides leadership for water consulting needs, asset management programs, and business development. Supporting business development efforts across all divisions of Stantec, Michael assists with scope definition, and providing associated competitive design project pricing as needed. He's passionate about building strong teams and collaborative partnerships between technical experts and the communities we serve to sustainably solve current public works challenges.

Ryan Spanton

Ryan Spanton brings extensive experience to the discussion with 21 years of Municipal and Industrial water and wastewater expertise. His background includes 6 years as a sales engineer at Goble Sampson and 15 years in various capacities with an equipment manufacturer in; project management, company leadership roles, biological process design and general equipment applications. Prior to that he had 11 years' background in Environmental Chemistry, focusing in Radiochemistry and Organic Sample analysis, for GC and GC/MS compounds, plus extensive experience in hazardous waste and groundwater sample remediation/characterization program management.

Todd Pike

Todd Pike is one of IMCO's top design-build managers with nearly 30 years of experience in the heavy civil construction industry. He has managed some of IMCO's most challenging and successful water and wastewater projects, along with alternative delivery contracts for private and public owners throughout Washington and Idaho. He collaborates with project teams, clients, and design partners to provide a wide range of services, working with design teams and leveraging his field and estimating experience to provide accurate cost estimates. His construction knowledge and early involvement with preconstruction benefit project planning, minimizing impacts to all stakeholders. Todd's positive approach, patience, and sense of humor make him a highly-sought-after leader.

Wednesday, September 14

Session 27A: 2 Construction & Alt Delivery

8:45AM – 9:25AM

Staying Ahead of Traffic – Fast-Tracking a Sewer Design in Advance of Highway Expansion

Hunter Bennett-Daggett[1], Wade Denny[2], Gordon Munro[1]

[1]Tetra Tech, Inc.; [2]Clean Water Services; hunter.bennettdaggett@tetratech.com, dennyw@cleanwaterservices.org

Clean Water Services' (the District's) Fanno Creek Interceptor is a large-diameter sanitary sewer located parallel to Highway 217 in Beaverton, Oregon. In early 2021 the District learned that an imminent Oregon Department of Transportation (ODOT) project would construct new traffic lanes over portions of the interceptor.

A vault over the interceptor was identified by ODOT as a potential concern because it was not designed for traffic loading. The vault's original flow monitoring weir had been removed once modern flow monitors were added to the system, and it now functioned only as a manhole to receive flows from two City of Beaverton sewer lines.

Tetra Tech and District staff evaluated the vault and identified options for modifying or replacing it. The vault was in poor condition due to corrosion, impeded laminar flow, and required frequent maintenance to remove debris. Modifying the vault to sustain traffic loading was evaluated, but the selected option was to replace the vault with a new manhole and modify the connecting sewers. This would simplify the complicated pipe geometry around the vault and alleviate the past maintenance difficulties encountered by the District's maintenance department.

The highway project was due to bid within two months of the vault evaluation, limiting the time available to design and construct the sewer modifications. District, ODOT, Beaverton, and Tetra Tech staff worked together on the design process. Initially the work was planned to be bid separately and constructed by a District-hired contractor during the course of the highway project. However, during the sewer design, input from the highway project contractor led ODOT to decide to merge the sewer modifications into the existing project as a change order.

Additional challenges included:

- Limited project work area between existing freeway and active railroad tracks.
- Need to bypass existing sanitary flows—up to 25,000 gallons per minute during a five-year storm.
- High groundwater due to nearby Fanno Creek.
- Required excavation to a depth of approximately 30 feet.
- Nearby waters of the state.

By working collaboratively and maintaining flexibility, the team met the required schedule. It is anticipated that construction will be completed during summer 2022.

Hunter Bennett-Daggett

Hunter Bennett-Daggett, P.E. has 17 years of experience in design, permitting, and construction on wastewater and water projects. At Tetra Tech, Hunter is involved in the design, permitting, and construction of wastewater treatment facilities, pump stations, sewer conveyance systems, water distribution systems, and fisheries projects.

Wade Denny

Wade Denny, P.E. holds a bachelor of science degree in environmental engineering and a master's in business administration. Wade is a licensed civil engineer and has focused his career in sanitary and stormwater capital program management within the public services sector for the past 15 years. Currently, Wade is a principal engineer in the Utility Operations Department at Clean Water Services.

Wednesday, September 14
Session 27A: 3 Construction & Alt Delivery
9:30AM – 10:10AM

Managing Large Storm Flows in Urban Spaces

Christa Lee [1], Alan Lord [2] Tina Hastings [3], Chris Stoll [4], Geneva Schlepp[5], Ryan Dunne [6]
[1]City of Tacoma [2]Seattle Public Utilities, [3]Jacobs, [4]Kennedy Jenks; chrisstoll@kennedyjenks.com, Geneva.Schlepp@jacobs.com, Ryan.Dunne@jacobs.com

Lewiston, Idaho is in the middle of one of their City's largest capital improvement projects. Although most of the old wastewater treatment plant is receiving a renovation, one area that had remained untouched was the grit removal system. The City, Contractor and Engineer were able to identify ways to bring grit removal into the current project with these additional limited funds, which included retrofitting the old grit system with a new system to raise the capture efficiency – saving capital and installation costs. The old grit system did not have as high of a rated capture efficiency as seen today, but through teamwork during the construction of the overall project, additional funds were made available for the City to use. Following the installation of one of the new grit removal systems, a side-by-side test was completed to compare the old and new system performances. This presentation will present the collaboration the City went through to get the improvements added to the project, the grit removal testing procedure, and the performance test results.

Chris Stoll
Chris Stoll is a Project Manager and Project Engineer with Kennedy Jenks. Chris has over 10 years of experience managing, designing and planning sewer and water projects. Chris has been involved with multiple pipe projects in dense urban settings. Chris is a licensed professional engineer (in WA and OR), a project management professional and an Envision certified sustainability professional.

Geneva Schlepp
Geneva Schlepp is a civil engineering intern with Jacobs Water and Wastewater Treatment Group out of the Bellevue, WA location. She earned a B.S. of Civil Engineering from Washington State University and will pursue a M.S. of Civil Engineering with a wastewater treatment specialization at the University of Washington this coming fall. Geneva's experience includes stormwater design, treatment plant improvements, and wastewater treatment design. For the Georgetown Wet Weather Treatment Station project, Geneva supported the startup and commissioning activities. Additional areas of expertise include constructed wetlands for domestic wastewater treatment and impacts of climate change specific to the PNW.

Ryan Dunne
Ryan Dunne is a Professional Associate in the Infrastructure and Advanced Facilities group at Jacobs. He received a bachelor's degree in Water Resources Engineering from Humboldt State University. His six years of experience includes Green Stormwater Infrastructure (GSI) design and conveyance system modeling to reduce combined system overflows. Ryan supported civil site design and has provided

construction support over the last two years as a Field Engineer and Deputy Project Manager at the Georgetown Wet Weather Treatment Station.

Wednesday, September 14
Session 28A: 1 Innovative Stakeholder Involvement
8:00AM – 8:40AM

Strategies for Engaging Residents in Private-Side Service Line Inventories

Samantha Becker
TruePani, United States of America; sam@truepani.com

The requirement of the new LCRR to inventory both public-side and private-side service line materials presents a unique challenge to water systems that have historically focused on maintaining the publicly owned and operated distribution assets. The identification of private-side service line materials can often be costly, disruptive, and resource-intensive and could benefit from early engagement with residents and homeowners. Building robust and resident-centered communication and education campaign can help water systems more easily comply with new LCRR requirements. By increasing private stakeholder participation in identifying service lines, sampling programs, and replacing service lines, a water system can more effectively plan to meet LCRR compliance dates and reduce lead exposure in their community from the private side of the water main.

Detailed communication and outreach workflows paired with educational materials specific to LCRR are important in collaborating and establishing credibility with the owner of the private side of the water main. The learning goals:

- Learning goal 1: LCRR recap, how water systems will have to interact with private side
- Learning goal 2: Communications workflow and educational materials
- Learning goal 3: Methods for private stakeholder participation/engagement in identifying service lines, sampling programs, and replacing service lines

Samantha **Becker**
Sam graduated from Georgia Tech with a bachelor's degree in Civil Engineering in 2016 and went on to receive her master's of public health degree from the University of Michigan in 2019. She is the co-founder and CTO of TruePani, a communications and consulting firm focused on protecting public health by delivering safe, point-of-use water to everyone.

Wednesday, September 14
Session 28A: 2 Innovative Stakeholder Involvement
8:45AM – 9:25AM

Bringing Everyone To The Table: Engaging Large Stakeholders Groups For Basin Planning

Clara Olson[1], Jen Murphy[1], Mackenna Bell[2], Julie Matney[3]

[1]Parametrix; [2]Multnomah County Drainage District; [3]Portland Bureau of Environmental Services;
colson@parametrix.com

Effectively engaging stakeholders is a vital aspect of watershed and basin planning work, especially when it comes to managing public and natural resources equitably. The engagement process consists of three distinct tasks: communicating goals and project updates, collecting feedback from stakeholders, and collaborating with stakeholders establish the plan's conclusions. In this presentation, the speaker(s) will review how project teams can couple emerging engagement tools with a straightforward approach that reaches each group of stakeholders to arrive at a consensus.

The Peninsula Drainage District No. 1 (PEN1) is a 900-acre subbasin located in the Columbia River floodplain of Portland, Oregon. A culturally significant area, the PEN1 basin includes the historic Vanport City that was flooded after a railroad berm collapsed in 1948. Today, the area is managed by the Multnomah County Drainage District (District), who partners with the City of Portland (City), Metro, and the Port of Portland to maintain and operate this flood control system. Parametrix is working with the District and City to develop a drainage and water quality master plan that will identify opportunities to improve habitat, water quality, and drainage system function in PEN1.

An important objective of this project has been to conduct inclusive, accessible, and authentic stakeholder engagement. Because the PEN1 district is comprised of many property types with unique needs – like the Portland Expo Center, Portland International Raceway, Heron Lakes Golf Course, Vanport Wetlands, and other businesses – conducting inclusive stakeholder engagement was a distinct and intriguing challenge.

In this presentation, the speaker(s) will detail the multiple approaches they took to involve stakeholders as much as wanted. Tactics included a one-day site visit for the entire PEN1 basin; a virtual stakeholder survey to gauge interest, concerns, and priorities; an interactive ArcGIS web map that documented feedback and compiled survey information; an open house style stakeholder meeting; and a dynamic story map with project information and survey for the broader public. We will review these tools and present some of the results of these efforts, which helped the team effectively collaborate to develop a multifaceted and adaptable master plan.

Clara Olson
Clara Olson, PE, is a civil engineer at Parametrix who works on stormwater planning projects such as CIP updates, comprehensive plans, and stormwater management plans. She contributes to the field work, data analysis, project planning, and overall documentation. Clara is the deputy project manager for the PEN1 Drainage and Water Quality Master Plan.

Wednesday, September 14
Session 28A: 3 Innovative Stakeholder Involvement
9:30AM – 10:10AM

Indigenous Community Collaboration: An Investment in Our Collective Futures

Serina Fast Horse
Kimimela Consulting LLC, United States of America; serina@kimimelaconsulting.com

The City of Portland, Oregon Water Bureau has begun an exciting endeavor to build collaborative relationships with local Indigenous community members. The origins of this work are based in an acknowledgment of Indigenous peoples as the original inhabitants and stewards of the lands we occupy as well as a recognition of powerful potential of Indigenous traditional ecological and cultural knowledge to help restore balance to our shared ecosystems. Kimimela Consulting, an Indigenous women owned business, has been appointed to lead the collaborative process with the goal of collectively creating a plan for the future of an empty agricultural parcel located next to the bureau's new filtration facility. With years of experience on land-based, community-led projects, Serina from Kimimela Consulting would like to share some important lessons learned and stories of hope for the future. Engaging in this work is inherently beneficial as it uplifts the perspectives and needs of a historically marginalized community. It is work that also benefits the land and water through land tending practices and planting plans that promote ecosystem harmony and balanced relationships to nature. Additionally, this work provides opportunities for reciprocal knowledge sharing that can create lasting synergies and connections for working together for healthy lands, waters, and communities. Working to include indigenous peoples within the wastewater industry can help with workforce development and result in synergies between stakeholders and operations at our wastewater treatment facilities.

Serina Fast Horse

Serina Fast Horse (Lakota & Blackfeet) is an emerging leader in the Indigenous community of Portland. She is a recent post-baccalaureate graduate from Portland State University where she earned a double major Bachelor of Science degree in Community Development and Indigenous Nations Studies. Her undergraduate studies were interdisciplinary and heavily focused on environmental studies and sustainability. She is driven by her passion to embrace Indigenous knowledge and empower Indigenous voices to help create a holistic path to healing our ecological and social communities for our future generations. She is the owner and founder of Kimimela Consulting whose mission is to cultivate synergies between Indigenous land stewards and organizations interested in collaboration on projects, especially land restoration initiatives. She has given presentations at Confluence Field School, the City of Portland Tribal Nations Summit, and the Urban Ecosystem Research Consortium Symposium.

Wednesday, September 14
Session 29A: 1 Resource Recovery
8:00AM – 8:40AM

The Challenges and Benefits of Renewable Natural Gas Production – An Oregon Story

Mark Van Eeckhout[1], **Steve Barnhardt**[2], **Luke Werner**[3], **Benjamin Bosse**[3]
[1]City of Springfield, Oregon; [2]City of Eugene, Oregon; [3]Kennedy Jenks Consultants;
mvaneeckhout@springfield-or.gov, SBarnhardt@eugene-or.gov, LucasWerner@KennedyJenks.com, benjaminbosse@kennedyjenks.com

The Metropolitan Wastewater Management Commission (MWMC) Eugene/Springfield Water Pollution Control Facility (WPCF) in Eugene, OR is a 34 MGD plant that generates 400,000 to 500,000 cubic feet per day of biogas from 4 anaerobic digesters. For over 10 years the facility has operated a combined heat and power cogeneration facility, however changing priorities and the desire to fully utilize all biogas caused the plant to investigate alternative biogas utilization strategies.

The Renewable Natural Gas (RNG) Upgrades Project (Project), commissioned in December 2021, is the first RNG facility at a Publicly Owned Treatment Works to come online in the state of Oregon. The Project now receives close to 100% of the biogas produced by the WPCF and upgrades the biogas to RNG for injection into the gas utility pipeline. The Project includes H2S and moisture removal, Pressure-Swing Adsorption (PSA) technology to scrub the Biogas to a high-BTU, natural gas quality Product Gas, and compressors to meet the gas utility's injection criteria. A Tail Gas stream comprised of carbon dioxide and trace amounts of methane and VOCs not captured by the PSA is conveyed to a Regenerative Thermal Oxidizer for destruction. A Receipt Point Facility operated by the gas utility, Northwest Natural, was constructed at the WPCF site to take transfer of the gas while simultaneously monitoring the quality, pressure, temperature, and quantity of Product Gas. The MWMC is working with BlueSource to register and broker the sale of renewable energy credits, including federal RINs and state carbon fuel standard credits.

The Project was designed to have the capability to run continuously in response to fluctuating biogas availability, and automatically adjust operations to consistently meet Project performance requirements. Plant staff have worked in collaboration with the biogas upgrading equipment vendor Greenlane Biogas to fine-tune operation and troubleshoot issues. This presentation will highlight technology selection, challenges with equipment procurement and construction, coordination with stakeholders and lessons learned along the way.

Mark Van Eeckhout

Mark Van Eeckhout is a Civil Engineer with the Metropolitan Wastewater Management Commission (MWMC) and the City of Springfield Environmental Services Division. He serves as a project manager for the MWMC, overseeing capital projects including the construction of Renewable Natural Gas facilities. He has worked for the City of Springfield since 2013, prior to which he worked for Los Alamos National Labs as an environmental engineer.

Steve Barnhardt

Steve Barnhardt has over 34 years experience in the wastewater industry. He has worked at 5 wastewater plants in Nebraska and Oregon, and has worked at the Eugene/Springfield WPCF for 21 years. He has been the Operations Supervisor at the Eugene/Springfield WPCF for the last 8 years. He holds a level IV DEQ Wastewater System Operator Certificate, and is a member of the ORACWA Energy Group and the PNCWA Operation and Maintenance Committee.

Luke Werner

Luke Werner is a Senior Associate Engineer who has been with Kennedy Jenks for over 21 years and is a registered professional engineer in seven states. His focus has been in the design of solids handling processes, rehabilitation of anaerobic digesters, integrating grease and food waste receiving programs for co-digestion, and implementing biogas utilization opportunities.

Benjamin Bosse

Benjamin Bosse is an Associate Engineer who has been with Kennedy Jenks for over 16 years and is a registered professional engineer in Oregon. His design experience with municipal wastewater includes

collection and conveyance, liquid stream processes, and solids handling and digestion facilities, including cogeneration and Renewable Natural Gas projects.

Wednesday, September 14
Session 29A: 2 Resource Recovery
8:45AM – 9:25AM

Gassy Decisions – Idaho Falls Wastewater Biogas Beneficial Use

Dru Whitlock, Madison Bertoch, Nick Smith
Stantec, United States of America; dru.whitlock@stantec.com

The City of Idaho Falls, ID has been taking steps to move forward with expansion of the renewable energy portfolio within the City. Hence, the City initiated work with its engineering team to consider the biogas generated at its wastewater treatment plant (WWTP) for either potential power generation (engine generators or microturbines) to add to the existing renewable power portfolio or through upgrading the biogas for use as a renewable natural gas (RNG) for sale and potentially leveraging available incentives. The Team first reviewed existing capacity and conditions at the WWTP biogas and solids handling system. This assessment was followed by estimating future growth, evaluating similar facilities, and providing conceptual designs for the three alternatives of engine generators, microturbines or RNG to accommodate future capacity. Finally, the Team developed capital costs, operational costs and qualitative metrics to determine the feasibility of selecting one of these options for future development. The results are in and the City is in the final adjudication process for the future of their biogas resource. This study will be of any utility looking to make use of their biogas and of particular interest to smaller utilities and the options available to them.

Dru Whitlock
Mr. Drury Whitlock is a Stantec Vice-President responsible as Global Practice Leader within the wastewater field specializing in biosolids and biogas recovery and reuse. Mr. Whitlock is has over 20 years experience in this field. While not at work Mr. Whitlock enjoys time with his family and engaging in outdoor activities.

Wednesday, September 14
Session 29A: 3 Resource Recovery
9:30AM – 10:10AM

When you have Too Much Digester Gas – The Role of Storage and Balancing Supply and Demand

Kelly Wood[1], Shawn Spargo[2]

[1]Environmental Services, City of Portland OR, United States of America; [2]Kennedy Jenks, City of Portland OR, United States of America; kelly.wood@portlandoregon.gov, ShawnSpargo@KennedyJenks.com

The City of Portland Bureau of Environmental Services (BES) has constructed a Renewable Natural Gas (RNG) facility to beneficially reuse surplus digester gas. BES uses the new RNG facility to deliver cleaned digester gas to NW Natural. To maximize the amount of gas generated and to keep organic waste out of landfills, BES is constructing an Organic Waste Receiving Facility (OWRF) that will accept food waste in an agreement with Metro. BES also plans to increase primary digester capacity through co-thickening of primary and secondary solids. These two changes are expected to substantially increase the amount of gas produced by the plant's primary digesters. However, the current gas storage facility is contained in an aging facility and solids are routed through a network of four digesters that date back to the founding of the plant in 1952. The focus of this effort was to evaluate the best use of the plant's secondary digesters and provide adequate gas storage based on operational needs, while maximizing return on investment. This presentation will encompass the alternatives analysis process that resolved conflicting viewpoints on future digester gas and solids storage, addressed asset management considerations, and accounted for financial constraints through a net present value comparison.

Kelly Wood

Kelly Wood is a civil engineer working for the Bureau of Environmental Services at the City of Portland. She has a BS in Biology, an MS in Civil and Environmental Engineering and 25 years of experience. She manages pump station and wastewater treatment projects.

Shawn Spargo

Shawn Spargo has more than 20 years of experience completing civil and wastewater capital improvements projects. Over the past 12 years, his focus has been on planning, permitting, design and construction of wastewater treatment plants, collection system rehabilitation, sewage pumping facilities and biosolids management projects.

Wednesday, September 14
Session 30A: 1 Planning
8:00AM – 8:40AM

Bellevue Watershed Management Plan Development

Amy Carlson[1], John Lenth[2], Jerry Shuster[3]
[1]Jacobs; [2]Herrera; [3]City of Bellevue Utilities; amy.carlson1@jacobs.com, jlenth@herrerainc.com

The City of Bellevue is committed to improving and protecting the aquatic health of water bodies within its boundaries while supporting a vibrant and climate-resilient community. Urban development in Bellevue over the past 100 years has dramatically impacted the health of the streams within the City, resulting in widespread disruption in the ecological function of the City's streams. To initiate its watershed planning efforts, Bellevue conducted a watershed assessment through which limiting factors were identified. Building on the watershed assessment, the Watershed Management Plan (WMP) directs investments to high-priority watersheds providing measurable environmental benefits to stream health within a shorter time frame than past or current approaches, maximizing the return on the City's

investment in stream health. The Jacobs team assisted the City in assigning management strategies of 'protect', 'improve', and 'sustain' to each of the City's subbasins. These assigned management strategies, along with characterizations of the sensitivity to each subbasin to both climate change and to population growth/development, informed where investments in stream health will be made across the City. The WMP has an investment plan with recommended projects, policies, programs, and operational plans to meet performance goals for Bellevue's streams. Integrating investments for watersheds with those of other City departments, including Transportation, Parks, and Community Development, maximizes overall benefit to the community and makes the most of limited public dollars. The WMP includes an adaptation strategy which identifies the investments in watershed and stream health that are necessary to adapt to a changing climate. The WMP includes a long-term strategy to protect the City's watersheds from the impacts of the tremendous growth and re-development occurring currently in the City, leveraging partnerships with the business community and non-profits. These partnerships were identified by finding an intersection of purpose between restoring stream and watershed health and advancing economic growth and environmental conservation within the City of Bellevue. This presentation will focus on lessons learned and best practices in the City's effort to protect and improve the condition of their water bodies through climate change and a time of unprecedented population growth and urban development in Bellevue.

Amy Carlson
Amy Carlson is a Civil Engineer with Jacobs Engineering. Amy is a third-generation engineer with a passion for strategically addressing complex urban and suburban infrastructure problems with solutions that provide multiple benefits. She has worked to balance 'people needs' with 'environmental needs' on infrastructure planning and design projects throughout her career. Amy has a BS in Civil Engineering from the University of Michigan and an MS in Civil Engineering from the University of Washington. Outside of work, Amy enjoys gardening, fly-fishing, and occasionally enjoying a meal with adults, as she and her husband have two small children.

John Lenth
John Lenth currently serves as the Water Practice Director for Herrera where he oversees an integrated team of scientists, engineers, and landscape architects with broad expertise in water resource science, planning, and design. Over his 25 years with the firm, he has managed numerous water resource projects involving a wide range of disciplines including: watershed and stormwater infrastructure planning, pollutant source and BMP effectiveness monitoring, and policy review and development. He received a MS in Environmental Science from Western Washington University and a BA in English from Seattle University.

Wednesday, September 14
Session 30A: 2 Planning
8:45AM – 9:25AM

A Decision Model for Resilient Communities: Flood Risk, Ecosystem Services, and Property Values

Doug McClintic
StormSensor, United States of America; doug@stormsensor.io

In the age of climate change, most communities are making plans towards resiliency. As these plans are developed, it is important to consider the tradeoffs needed to preserve the community while still allowing for growth.

We often hear about changing property values and the positive economic growth that new development—and redevelopment—can bring to a community. However, the goods and services that natural ecosystems provide, such as timber production, clean water, flood protection, and biodiversity support, are often left out of this conversation.

The services provided by untouched ecosystems often compete with property values and expanding development. Ignoring ecosystem services when making planning decisions could lead to the potential loss of important tools that could be used for climate mitigation and adaptation, making the goal of resilience even harder for a community to achieve. On the flip side, creating and restoring natural systems can help provide a first line of defense against flooding impacts.

To effectively plan for resilience, communities need to be able to visualize the value of the services their ecosystems provide in context with both appraised property values and the risks posed by climate change.

This session will explore by way of a case study how incorporating ecosystem services into the planning process could assist communities in making wiser management decisions optimizing existing natural systems to mitigate the risks posed by climate change. The results of these efforts may also inspire communities to restore ecosystems, such as coastal wetlands, to further mitigate climate risk.

Doug McClintic
Doug McClintic manages sales in the western US for StormSensor, a climate technology company. Prior to StormSensor Doug worked for Badger Meter and Kamstrup, selling meters and meter reading technologies to municipal utilities and water districts. He has a BS degree in Business and minor in Forestry from Oregon State University.

Wednesday, September 14
Session 30A: 3 Planning
9:30AM – 10:10AM

Water Resource Recovery Facilities….It Isn't Simply Wastewater Treatment and Disposal Anymore

James Clark
Black & Veatch, United States of America; clarkjh@bv.com

This presentation will look at water scarcity including pressure from population growth and distribution; provide statistics about how much usable water there is available and how it is being used; discuss the importance of reusing water to the maximum extent possible, and beneficially recovering and using other resources from wastewater including nitrogen, phosphorous, energy, and organic biosolids. Examples of how and where this is being done will be presented. Roadblocks to potable reuse, such as compounds of emerging concern and negative public perception will also be explored.

James Clark
James H. Clark is a senior vice president of the engineering/construction firm Black & Veatch Corporation. Located at the firm's Los Angeles office, he has managed environmental and water quality improvement

projects with constructed value exceeding $3 billion, including serving as the Senior Process Engineer and a Project Manager for the design of the City of Los Angeles Hyperion Treatment Plant, a 15-year, $1.1 billion wastewater treatment and reclamation project which was named one of the ten most outstanding public works projects of the 20th Century by the American Public Works Association (along with the Golden Gate Bridge, Hoover Dam, and the Panama Canal); and managed the design for the $200 million facility to provide full secondary treatment to the Orange County (CA) Sanitation District Plant No. 1. He was the Project Director for design, construction, and commissioning of the 1,800 ML/d, $328 million CDN Seymour-Capilano Filtration Plant for Metro Vancouver (Canada), which includes the world's largest potable water UV disinfection facility. He recently managed the design for the $140 million expansion of the Orange County (CA) Water District Groundwater Replenishment System, one of the most famous indirect potable reuse projects in the world, which completed construction in 2015. He was also the Project Director for the design and construction of the City of Los Angeles $45 million Echo Park Lake rehabilitation, which was one of the five finalists for the 2015 ASCE OPAL award. He also managed the preliminary and final design for the $500 million Sacramento (CA) Regional County Sanitation District biological nitrogen removal facilities, with construction completion scheduled for 2020.

Clark served as president of the Water Environment Federation (WEF), a global technical, scientific, and educational water quality organization, during 2001-2002. In 2004 he received WEF's prestigious Charles Alvin Emerson Medal for outstanding service to the wastewater collection and treatment industry, and in 2009 was awarded the Englebrecht International Achievement Award for sustained and significant contributions in the international field. He was awarded Honorary Membership in 2012; fewer than 140 individuals have been so honored in the organization's 90 year history. In November 2004 he was named one of the 50 most influential people in the public works industry by Public Works magazine, and was named the 2005 "Outstanding Civil Engineer in the Private Sector" and the 2018 "Lifetime Achievement Award" by the Los Angeles Section and Region 9 of the American Society of Civil Engineers.

Wednesday, September 14
Session 31A: 1 Treatment - 101
8:00AM – 8:40AM

Coagulant/Polymer 101: Fundamentals of Sedimentation and Dewatering

Yong Kim
UGSI Solutions, Inc., United States of America; ykim@ugsicorp.com

Since the chemistry of coagulant and flocculant is different, the mechanism of coagulation and flocculation is fundamentally different. Various topics regarding coagulation and flocculation are discussed from the perspective of engineers and operators. It includes basic polymer chemistry, effects of dilution water and mixing profile, methods of achieving efficient polymer solution, and case studies of emulsion and dry polymer application.

Characteristics of polymer are discussed regarding physical form, molecular weight, charge density, and size distribution. Proper way of handling and storage of high molecular weight polymer is reviewed as well

as the shelf-life of neat polymer and diluted polymer solution. Considering the increasing trend of utilizing reclaimed water for polymer mixing at wastewater treatment plants, the effect of dilution water on the quality of polymer solution must be checked. It includes chlorine level, hardness, temperature, pH, suspended solids, turbidity and TDS. Aging of polymer solution is seriously affected when reclaimed water is used for polymer mixing.

The concept of two-stage mixing and sufficient residence time in emulsion polymer activation is justified with theoretical study and lab data. Its benefit is clearly illustrated by pilot testing at F. Wayne Hill WRC of Gwinnett County, GA, which was performed by Jacobs Engineering. Different polymer mixing systems from three manufacturers were evaluated by monitoring polymer dose required, polymer solution concentration, cake solids, and TSS level of centrate. The results from pilot study demonstrated that an optimally designed two-stage mixing system was able to reduce polymer consumption by 25%, while produce better quality centrate.

Activation of dry polymer must follow the same principal, two-stage mixing and sufficient residence time. Since much longer mixing time is required for dry polymer than emulsion polymer, it is critical to provide uniform and low energy mixing in the mix tank. Non-uniform mixing energy will cause considerable amount of polymer chains to be broken. Dry polymer system developed based on this principle was installed at the Fairfield-Suisun Sewer District in northern California. The plant realized 42% polymer savings after one year operation of new dry polymer system and the increase of sludge throughput by 18%.

Yong Kim
Dr. Yong Kim is Technical Director at UGSI Solutions, Inc., Vineland, NJ. His technical interest includes fluid mixing and turbulence, surface chemistry, solid-liquid separation, water disinfection. He was previously employed by USFilter and Siemens Water Technologies and has been actively involved in the activities of the Solids Separation Subcommittee of WEF. As a PhD Chemical Engineer, he has authored a book entitled “Coagulants and Flocculants: Theory and Practice,” and published over 40 technical papers. During his 33- year professional career in water industry, he has been awarded seven (7) US patents.

Wednesday, September 14
Session 31A: 2 Treatment - 101
8:45AM – 9:25AM

It Doesn’t Have to Stink: Wastewater Odor Control 101

Ian Watson
USP Technologies, United States of America; iwatson@usptechnologies.com

When problems of wastewater odor arise, there are numerous solutions available to the wastewater utility, and yet determining which solution will provide best outcome is often extremely difficult. Appropriate for wastewater collections and treatment professionals of all levels, Odor Control 101 will examine the basic concepts of odor generation and emission, and what to do when odors become a problem. This presentation will additionally cover use cases and limitations of the majority of available

aqueous and vapor phase control solutions, with the goal of empowering the treatment professional to select the best odor control solutions for their facility.

Ian Watson
Ian Watson is a chemical engineer and for the past 19 years he has worked directly with municipalities to develop and implement chemical treatment solutions in collection systems and treatment plants for odor control, phosphorus, alkalinity, and more. In his current role as a Technology Development Manager at USP Technologies, he works to launch new technologies and services to serve the wastewater treatment market. He is an active member of the WEF Air Quality and Odors Emissions Committee, and a board member on the California Water Environment Association's Engineering and Research Committee.

Wednesday, September 14
Session 31A: 3 Treatment - 101
9:30AM – 10:10AM

High Solids Digestion for Resource Recovery, Energy Resiliency and Revenue

Margaret Laub
Anaergia, United States of America; margaret.laub@anaergia.com

Anaergia's Omnivore high-solids digestion (HSD) AD platform triples capacity of existing digesters to maximize existing WRRF infrastructure. Anaergia's sludge screw thickener recuperatively thickens digestate to decouple SRT from HRT, allowing digesters to operate at significantly higher solids content at similar SRT and greatly reduced HRT. Excess water separated from digestate is returned to headworks for treatment and/or nutrient recovery, while thickened solids (~12% TS) return to digesters. This allows operations at up to three-times solids concentration (6-8% TS) and organic loading rates up to 0.33 lb-VS/ft3/day. By decoupling SRT from HRT, Omnivore provides SRT well over 15-day regulatory requirements. With additional AD capacity, WRRFs can rapidly accommodate increased sludge loads, external high strength waste (HSW) for co-digestion, and improve resiliency.

South San Francisco-San Bruno Water Quality Control Plant (WQCP) capital improvement planning identified a need for additional AD capacity and initially prescribed construction of a new AD facility. Design by Carollo Engineers incorporated Omnivore digester retrofits to cost-effectively provide necessary capacity and avoid the need to build an additional digester. The retrofit also increases redundancy, improves digester performance, and provides flexibility for future co-digestion of HSW and increased biogas production. In late 2020, construction was completed to retrofit Digester 1 (0.83 MG) with one skid-mounted SST for recuperative thickening, three high-solids submersible PSM digester mixers, three mixer service boxes, and all ancillary equipment.

HSD system performance was validated through third-party performance tests. The WQCP realized these benefits:

- Avoid major capital expenditure of additional digester
- Address capital improvement needs
- Redundant digester capacity

- Reliable stabilized biosolids production
- Improve digester and mixing performance
- High-efficiency mixers with lowest lifecycle cost
- Future-proofing for load growth and feedstock changes
- Enable HSW co-digestion
- Support increased biogas production for revenue and energy neutrality

Approach may be replicated to cost-effectively improve biosolids management while enabling municipalities to leverage existing infrastructure for resource recovery.

Session will discuss considerations, advantages, and applications of HSD at WRRFs. It will detail third-party acceptance testing data demonstrating successful operation of Omnivore, and achievement of new standards in high-performance mixing. Discussion will include agreement between in-field performance testing and modeled WQCP mixer performance, and implications.

Margaret Laub

Margaret Laub is responsible for business and project development for resource recovery projects on the west coast, with a focus on public-private partnerships (P3) with municipal wastewater treatment facilities to enhance anaerobic digestion and utilize biogas. She interfaces with clients, stakeholders, and internal teams to educate team members on organics-to-energy opportunities and develop projects – driving them from concept to construction. Her six years of experience have largely focused on advancing energy projects with public partners to deliver infrastructure upgrades, enhanced resiliency, reduced carbon footprint, and economic benefits. Margaret has a Bachelor's Degree in Environmental Engineering from Harvard University, with a secondary concentration in Statistics. Margaret is a Certified Energy Manager (CEM).

Wednesday, September 14
Session 32A: 1 Treatment
8:00AM – 8:40AM

New Grit Management System Makes Immediate Improvements

Patrick Herrick[1], Rick Murray[2]
[1]Hydro International, United States of America; [2]City of Meridian Public Works Department/Wastewater; pherrick@hydro-int.com

The City of Meridian, ID has been one of fastest growing communities in the country over the past several years. Along with that growth comes the responsibility to ensure that the city's infrastructure can handle those incoming families and businesses. In 2015 design work started for a major upgrade to the wastewater treatment plant with a new headworks being part of the plans. A large quantity of screening and grit found in the anaerobic digesters lead plant staff to explore technologies that maximize capture. The existing screens and mechanically induced vortex systems simply were not removing enough material at the headworks. Upgrading this area of the plant would significantly improve downstream operations.

In evaluating grit removal systems, the plant staff weighed capture efficiency, maintenance requirements and cost. An influent grit characterization study indicated a high quantity of fine grit in the influent and a

stacked-tray grit removal system was selected for the basis of design. When the system was commissioned in April 2019 the plant staff saw a significant increase in the volume of grit produced. The 4 yd3 grit bins that had previously filled every 3 – 4 days now had to be emptied every day. The new headworks proved to be so resilient that plant staff tested the headworks by using it to re-process debris from the digester.

This paper will provide an overview of the decision-making process and results of installing a stacked tray grit removal system in a new headworks at the Meridian Wastewater Treatment Plant. Details of the design process, construction and impacts of the new grit removal system will be presented.

Patrick Herrick
Pat Herrick is Sales Director for Hydro International which specializes in supply of unique, high performance equipment and systems for removal of grit, sugar sand, abrasives and fixed solids. Mr. Herrick has worked with market leaders in liquid/solid separation for over 25 years. He has experience in both the municipal and industrial markets providing equipment solutions. Mr. Herrick has a Bachelor of Science degree in Industrial Technology from Illinois State University in Normal, IL.

Wednesday, September 14
Session 32A: 2 Treatment
8:45AM – 9:25AM

First North American Installation of an Adaptive Clarifier Inlet

Mario Benisch
HDR, United States of America; mbenisch@hdrinc.com

In 2018 the adaptive clarifier inlet was first introduced in North America as a potential alternative to effluent filters. Since then, the first US installation has been commissioned in Virginia. This presentation will summarize the lessons learned and result from a multiday stress test.

Conventional clarifiers are generally limited in their performance by the settling characteristics of the biological sludge and hydraulic conditions in the clarifier. The Hydrograv Adapt variable inlet structure (HA) changes that. Unlike traditional inlet structures, mixed liquor is introduced near the bottom of the clarifier below the sludge blanket. In addition, the inlet elevation and opening height adapts to the load thus always operating in ideal hydraulic conditions. Embedded in the functioning principal is the blanket filtration. Since MLSS is introduced near the bottom of the sludge blanket, all flow has to travel (filter) through the blanket. This results in effluent TSS values rivaling that of a dual media filter. Upgraded clarifiers (in Europe) have demonstrated a 60% to 95% reduction of clarifier effluent solids and proven capacity gains up to 50%.

This first US installation required a complete redesign of the adaptive inlet structure to accommodate a center driven clarifier with a suction scraper. All other installations have been in clarifiers with a peripheral drive with a fixed inlet structure.

For this installation no structural upgrades were needed to accommodate the additional weight (~15 tons) but in order to provide adequate operator access the bridge had to be raised 4 ft.

Up until the pandemic installation of the adaptive inlet proceeded without major issues but like most things at the time came to a halt spring of 2020, weeks before the scheduled startup testing.

While the adaptive inlet has been in operation for more than a year, official commissioning and field adjustments have been delayed. This meant that the adaptive inlet was not operating in correct position for much of the first year. Yet still the average effluent turbidity was below 2 ntu and lower than the control clarifier. Final commissioning and testing is scheduled for March of 22.

Mario Benisch

-1998: Graduated from University of Stuttgart, Germany with MS in Environmental Engineering
-Since 1998 with HDR in Portland OR
-Now senior wastewater process engineer with focus on nutrient removal and recovery, dewaterability and process based dewatering improvements.

Wednesday, September 14
Session 32A: 3 Treatment
9:30AM – 10:10AM

An Alternative to the SRT for Sequencing Batch Reactor Design and Operation

Nicholas Guho[1,2]
[1]Carollo Engineers, United States of America; [2]University of Idaho, Moscow, ID, United States of America; nguho@carollo.com

The solids retention time (SRT) and its inverse relationship with the net specific growth rate of the microbial consortium are fundamental tools in the design and operation of activated sludge systems. These tools are conventionally applied to sequencing batch reactors (SBRs), despite being derived for continuous flow systems at steady-state. To reconcile this discrepancy, the SRT is traditionally quantified at an arbitrary point in the SBR cycle and its inverse is interpreted as the average net specific growth rate of the consortium. While this practice is common, it has not been validated.
This presentation explores a new method to calculate the average net specific growth rate in SBRs operated at inter-cycle steady-state. For SBRs without influent biomass, the average net specific growth rate is determined exactly with the new method, whereas the traditional approach underestimates it by as much as 100%. The new method also estimates the average net specific growth rate in SBRs with influent biomass more accurately. Finally, the new method outperforms the traditional approach in numerous applications, including assessing washout conditions and establishing empirical correlations. These results demonstrate that the traditional approach to applying and interpreting the SRT in SBRs is flawed. However, the relative error accompanying its use in biological nutrient removal SBRs with negligible influent biomass and decay is small (less than 10%), suggesting that safety factors incorporated into conventional design may have compensated for discrepancies to date. While the relative error may be small in some instances, the new method is recommended as it is easily calculated from routine or readily estimated operating variables and is more accurate.

Nicholas Guho
Nick is a technologist with Carollo Engineers with over 13 years of research experience in biological wastewater treatment and resource recovery.

Wednesday, September 14
Session 25B: 1 Resource Recovery
10:30AM – 11:10AM

Case Study: Improving Plant Performance by Eliminating Sidestream Phosphorus Loads

Nathan Brown[1], Nicole Stephens[1], Dan Freedman[2]
[1]Stantec Consulting Services - Denver, Colorado; [2]Metro Water Recovery - Denver, Colorado;
nathan.brown@stantec.com

Increasingly stringent nutrient limits have driven the development of various biological phosphorous removal (BPR) alternatives. While the resulting impacts to receiving streams are positive, unintended consequences have been realized at facilities operating in BPR modes. Anaerobic digestion of biological solids from BPR processes and the recycle of dewatering sidestreams to the main plant have been associated with detrimental impacts to BPR performance, increased nuisance struvite formation, and deterioration of digested sludge dewatering performance. These challenges, along with the industry trend toward a circular economy, prompted the development of phosphorus recovery technologies that break phosphorus recycles and generate marketable fertilizer products. This presentation will highlight a case study where implementation of BPR drove the comprehensive evaluation and complex construction of the world's largest pre-dewatering phosphorus sequestration and recovery system.

As part of the Metro Water Recovery (Metro) Phosphorus Initiative, a Nuisance Struvite and Dewaterability Improvements Project was implemented to evaluate technologies that address detrimental operations and maintenance consequences associated with BPR. The District evaluated pre- and post-dewatering recovery alternatives using process and thermodynamic modelling, pilot studies, comparable case studies, and a sustainable business case evaluation. The evaluation resulted in the selection and implementation of the MagPrex™ pre-dewatering phosphorus sequestration and recovery system manufactured by CNP.

The MagPrex™ reactor, commissioned in 2020, has successfully eliminated the biosolids train's phosphorus recycle at the 220 mgd Robert W. Hite Treatment Facility (RWHTF) thus allowing the secondary BPR process to achieve lower effluent total phosphorus water quality. Metro Water Recovery has seen a 25%+ reduction in polymer addition since the facility began operation coupled with a dramatic decrease in the formation and deposition of nuisance struvite throughout the biosolids train. Furthermore, an existing anammox process downstream of the MagPrex™ reactor has seen no negative impacts to its nitrogen removal capabilities. The project at RWHTF was awarded the Water Environment Federation (WEF) Project Excellence Award in 2021.

Nathan Brown
Mr. Brown is a Principal Process-Mechanical Engineer with 18 years of experience delivering greenfield and retrofit upgrades to municipal and industrial water resource recovery facilities. His technical expertise includes mainstream and sidestream nutrient removal and recovery, process modeling,

aeration and blower design, and biosolids treatment. Nate served as the Design Manager for the MagPrex upgrades case study in Denver, Colorado.

Wednesday, September 14
Session 25B: 2 Resource Recovery
11:15AM – 11:55AM

Sustainable Solutions: Regional Resource Recovery in Central Oregon

Christina Davenport[1], Brittany Parks[2]
[1]Brown and Caldwell; [2]Leeway Engineering Solutions; cdavenport1@brwncald.com, Brittany.park@leewayengineeringsolutions.com

United Nations sustainability goals include finding innovative solutions for resource recovery as an alternative to waste disposal. Communities throughout the northwest increasingly turn to resource recovery solutions to manage wastes and nutrients. Multiple hauled liquid waste streams are a growing concern for the City of Bend in Central Oregon. Currently, millions of gallons of fat, oil, and grease (FOG) waste; high strength brew waste; septic system and portable toilet wastes are applied to agricultural land. This is not a sustainable practice and does not align with City goals of reducing the carbon footprint and greenhouse gas admissions. As one of the fastest growing regions in the United States, application sites are diminishing as the volume of waste is increasing. In addition, the City of Bend is losing the opportunity to generate revenue through tipping fees and resource recovery that may reduce overall utility rates for customers. There are many stakeholders interested in finding solutions to handle this regional problem including surrounding cities, breweries, restaurants, and waste haulers. Adequate engagement and education with community, industry and City leaders is necessary to shift the perception of these "wastes" to be recognized as "resources".

Strategic analysis of alternatives for waste management helps determine the best course of action for handling the resources in a community. The goal is to find sustainable solutions that protect public health and the environment, benefit all stakeholders, and reduce costs to ratepayers, businesses, and industry. This presentation will provide an overview of the project, including stakeholders, communications, effective collaboration, public private partnership, and possible solutions/outcomes. Identifying alternatives that will give the stakeholders options to consider for future feasibility studies and master planning activities.

Christina Davenport

Christina recently joined Brown and Caldwell as an Integrated Resource Planning Leader, with a focus on industrial pretreatment, resource recovery and reuse. She has 20 years' experience developing and managing public and environmental health programs for local and state government. Most recently as the Industrial Pretreatment Manager for the City of Bend where she regulated a thriving brewing industry. She understands the complexities of industrial wastes including regulatory and public health challenges and is passionate about finding unique solutions to reduce constituents in wastewater while finding beneficial reuse options. Her focus is to consider communities holistically with a triple bottom line approach, involving all potential stakeholders, changing waste to resource and creating opportunities to reduce rates while protecting the environment.

Brittany Parks
Brittany is a chemical and environmental engineer specializing in project management, troubleshooting, and operations of wastewater treatment facilities. At the beginning of her career, she managed industrial water systems, including a 28 MGD treatment plant. Later, she managed wastewater capital improvement projects at the City of Bend. Now she is a Project Manager for Leeway Engineering Solutions working on an array of water infrastructure projects. Through her experience managing multi-disciplinary teams for projects, Brittany has developed a collaborative approach to design and project management. Resulting in projects that are built to perform for the whole life cycle. From the start of design through project startup and operation, she will deliver projects that are cost-effective and sensible to build and maintain.

Wednesday, September 14
Session 26B: 1 Stormwater - Quality
10:30AM – 11:10AM

Treating Phosphorus in Stormwater—Using Current Data to Design for Success

Jeremiah Lehman
Contech; jeremiah.lehman@conteches.com

Phosphorus (P) pollution from stormwater runoff is a well-documented cause of impairment in freshwater bodies, resulting in eutrophication, algae blooms, poor water clarity, and aquatic habitat degradation. Removing P can be difficult for many treatment BMPs, especially swales and bioretention systems which contain organic components in their composition and risk exporting P at higher concentrations than the influent. Current data compiled from the International BMP Database confirms limited effectiveness in P treatment by bioretention systems, especially in the dissolved form as measured by orthophosphate (OP). This is mirrored by several studies conducted for the Washington Department of Ecology, which recently modified its bioretention media soil specification to limit P export.

Performance is better for other BMPs, including manufactured treatment devices (MTDs) which utilize some sort of filtration mechanism to reduce P concentrations in effluent. However, these mechanisms differ in their ability to actively remove dissolved P concentrations through biological processes or adsorption, versus relying on physical removal of sediment and associated particulate P to achieve a reduction in total phosphorus (TP). With regulations taking a sharper focus on dissolved species of P such as OP due to their direct impact on algal growth, there is great interest in understanding which MTD design aspects optimize soluble P removal. For this study, ten different MTDs employing varying filtration unit operations were evaluated for removal of TP and OP. These included membrane filtration, chemically active media filtration, high-rate biofiltration, and hybrid systems. Data was collected according to the Washington State Department of Ecology's program for field evaluation of MTDs (the Technology Assessment Protocol—Ecology (TAPE)), which each of the systems completed by successfully demonstrating 50% reduction of TP concentrations. The resulting analysis demonstrates that some conditions can lead to OP removal by systems that only utilize physical filtration; however, these systems

may also require frequent maintenance. Better understanding of TP and OP field testing data will assist regulators and site designers in meeting TMDLs and other P treatment goals by selecting BMPs that are appropriate to site conditions and pollutant sources.

Jeremiah Lehman
Jeremiah is a Regional Regulatory Manager for Contech Engineered Solutions, focusing on the Northwest US. During his 20 years as a stormwater engineer, he has been active in the design, development, and performance testing of innovative stormwater treatment systems throughout the US, Italy, and New Zealand. He holds a Master's Degree in Environmental Engineering from Tulane University and is a registered PE in the State of Washington.

Wednesday, September 14
Session 26B: 2 Stormwater - Quality
11:15AM – 11:55AM

Assessing Water Quality Improvement At The Carli Creek Regional Stormwater Project

Christopher Desiderati, Ron Wierenga
Clackamas Water Environment Services, United States of America; cdesiderati@clackamas.us, rwierenga@clackamas.us

Stormwater management is an ongoing challenge in the United States. As state and municipal agencies grapple with conflicting interests like encouraging land development, complying with permits, and charges to steward natural resources for the long-term, some agencies may turn to constructed wetlands as functional natural analogs for attenuating pollution delivered by stormwater runoff. In 2018, Clackamas Water Environment Services opened the Carli Creek Water Quality Project, a 15-acre constructed stormwater wetland adjacent to Carli Creek, a small, 3500-ft tributary of the Clackamas River in Clackamas County, OR. The combined creek and facility drain an industrialized, 438-acre, impervious catchment. The facility consists of a linear series of a detention pond and three bioretention treatment cells, contributing a combined 1.8 acres of treatment area. This study evaluated pollutant levels against International Stormwater BMP database benchmarks, Oregon Water Quality Criteria, and pollutant removal performance. Concentration and mass-based reductions were calculated for 10 pollutants and compared to daily precipitation totals from a nearby precipitation station. Mass-based reductions were generally higher for all pollutants, largely due to runoff volume reduction in the facility. Concentration-based reductions were highly variable and suggested export of certain pollutants (e.g., ammonia), even when reporting on a mass-basis. Mass load reductions for total dissolved solids, nitrate+nitrite, dissolved lead, and dissolved copper were 43.3 ± 10%, 41.9 ± 10%, 36.6 ± 13%, and 43.2 ± 16%, respectively. *E. coli* log-reductions ranged from -1.3 — 3.0 on the terrace, and -1.0 — 1.8 in the creek. Oregon Water Quality Criteria were consistently met at the two in-stream sites on Carli Creek for *E. coli*, and for dissolved cadmium, lead, zinc, and copper. The precipitation record during the study was useful for explaining certain pollutant reductions, as several mechanisms are driven by physical processes, however it was not definitive. The historic rain/snow/ice event in mid-February 2021 appeared to impact mass-based reductions for all metals. Qualitatively, precipitation seemed to correlate closest with ammonia-nitrogen export. This study is useful in establishing a framework and baseline for understanding this one-of-a-kind regional stormwater treatment project.

Christopher **Desiderati**

Chris Desiderati is a candidate for a Professional Masters of Environmental Science and Management degree at Portland State University. His undergraduate degree, earned in 2010, was a B.S. of Chemistry with a focus on Organic Chemistry. Chris works in Source Control with Clackamas Water Environment Services where he leads pollution prevention and environmental monitoring initiatives.

Ron Wierenga

Ron Wierenga is the Environmental Services Manager for Clackamas Water Environment Services, where he leads WES's operational and strategic planning for improving water quality and watershed health, pollution prevention, development and industrial wastewater permitting, and environmental monitoring.

Wednesday, September 14

Session 27B: 1 Treatment - Biosolids

10:30AM – 11:10AM

KIS Plan for Meeting Total Phosphorous Limits and Biosolids

Ken Windram

HAYDEN AREA REGIONAL SEWER BOARD, United States of America; ken@harsb.org

The Washington Department of Ecology, through a TMDL, set dissolved oxygen levels in the Spokane River requiring the wastewater treatment plant's effluent Total Phosphorous to be less than 0.05 mg/l. The Hayden Area Regional Sewer Board (HARSB) choose a 2-phase approach to meeting the TMDL limits. The first Phase was to improve Biological Nutrient Removel (BNR) for Nitrogen and Total Phosphorous. Then optomize Total Phoshorous Removal (BPR) to determine the best tertiary treatment design. The Phase 2 first step was to select a design team that were experts in their field. HARSB would pre-slect and pre-purhcase project equipment to meet the design requirements. A general contractor pre-qualification process was implemented to have only experienced contractors on the project.The overall result was that HARSB staying in control of the project, getting the best equipment and the best general contractor and staying within a tight project budget and schedule.

This presentation begins with a review of the plant's BPR Operation. Then explain the operational game plan to ensure compliance with the 0.05 mg/l Total Phosphorous effluent limit. The decision was to build a "water" treatment plant to treat the wastewater secondary effluent for Total Phosphorous should the BPR process shutdown. The tertiary water treatment system would be designed by an equipment manufacture that builds water treatment plants every day. Special HDPE storage tanks and pump station would be needed for the trertiary treatment system operation. The Total Phosphorous chemical coagulant would be selected based on the final biosoloids disposal plan. Speaking of biosolids, Total Phosphorous is only removed from the treatment plant with the biosolids. Since HARSB did not have a biosolids treatment system, a new biosolids plan and equipment would be designed for long term biosolids disposal including tertiary treatment solids.

Ken Windram

40+ years' experience in wastewater operations and management working at over 50 wastewater

treatment facilities from 50,000 gallons per day to 450 million gallons per day capacity. Wastewater licenses: New York Grade 2, Massachusetts Grade 7, Indiana Grade 4, Hawaii Grade 4, Washington Grade 4, Idaho Grade 4. I have worked for Envirotech Operating Service, Metcalf & Eddy, USFilter, and Veolia Water. I was the USFilter project manager for the design, build, own and operate 13 MGD Honouliuli Water Recycling Facility (largest water recycling project in Hawaii (2000)). My current position is administrator, responsible charge operator and the tertiary treatment design leader and construction manager at the Hayden Area Regional Sewer Board.

Wednesday, September 14
Session 27B: 2 Treatment - Biosolids
11:15AM – 11:55AM

Pivoting into a Sustainable Class A Biosolids Management Program

Mark Cullington[1], Kristin Preston[2], Katie Spilker[1], Charles Wright[1]
[1]Kennedy Jenks Consultants; [2]City of Albany; MarkCullington@kennedyjenks.com,
kristin.preston@cityofalbany.net, Charleswright@kennedyjenks.com

The Albany-Millersburg Water Reclamation Facility is an activated sludge plant that is designed to treat a dry weather flow of 12.3 million gallons per day (MGD) and a peak wet weather flow of 68 MGD. The original plant was constructed in 1952 with many upgrades over the years. In 2009, significant improvements were made including a solids reduction process that failed to perform and resulted in undigested solids being sent to the landfill. This is unsustainable from both an economic and environmental standpoint, so the City began to look into alternative solids handling options. Additionally, the City's dewatering equipment was aging, overused, and needed to be replaced.

The City engaged with Kennedy Jenks early on in the process to complete an alternative analysis, feasibility studies, and pilot projects. The City selected composting to a Class A biosolids product as the treatment process for its undigested, dewatered solids. Kennedy Jenks led the City through the design process and assisted in construction oversight of the new biosolids facilities, which will be completed in April 2022.

Equipment changes include two new FKC rotary screw presses, a dewatered solids conveyor system, and a new polymer addition system within the existing Biosolids Dewatering Building. The Biosolids Storage Building will be enclosed and have a canister system for treating odors. Composting facilities are being constructed to process solids and ground yard waste for beneficial use as a Class A biosolids product. This includes covered piles, with in-ground aeration utilizing Engineered Compost Systems technology, a biofiltration odor control system, and covered storage for amendments and finished compost.

This presentation will outline the project details, vision, and drivers. Attendees will learn about developing a biosolids management solution, including identifying key design criteria, selecting the best solids treatment alternatives, addressing important challenges like odor control and equipment selection, and working with staff and stakeholders.

Kristin Preston

Kristin Preston is the City of Albany's Public Works Operations Manager responsible for the daily operation and maintenance of the City's water, wastewater, stormwater, and transportation utilities. Kristin has 22 years of civil and environmental engineering and public works experience working in both the private and public sectors.

Charles Wright

Charles Wright has been working on water, wastewater, water distribution, and collection facilities infrastructure planning, design, and construction management projects for more than 25 years. He has been with Kennedy Jenks' since 2005 working in their Eugene, Oregon office. Charles has specific expertise in wastewater treatment process design and solids handling. He has been a project team member, lead Project Engineer and Project Manager for numerous projects in Oregon and northern California.

Wednesday, September 14
Session 28B: 1 Facility Operations & Maintenance
10:30AM – 11:10AM

A New Standardized On-Site Capture Efficiency (SCR) Sampling & Testing Protocol for WWTP Screens

James Impero, Abner Aviles
Ovivo USA, LLC, United States of America; james.impero@ovivowater.com, abner.aviles@ovivowater.com

For approximately two decades, consulting engineers have asked screen manufacturers to provide third party, independent test results documenting the capture ratios of their screen's debris removal efficiency. Have these results truly been reproducible at your wastewater plant?

Decades of third-party capture testing of screens in the UK have been a good thing. However, the screenings capture data proved only the "Capability" of that particular screen tested and under those specific UK flow conditions. Expecting identical capture results from the same manufacture's screen at wastewater facilities with differing hydraulics, variable wastewater velocities, TSS & FOG loading characteristics, let alone up-front grinders is neither practical thinking or proven in the field to be true for 40%-45% of the current installation history in the US. Why? It is the very subject of this paper & conference presentation. There are definite wastewater similarities from site to site; however, there are also many dissimilarities that require screening equipment modifications to achieve the true screenings capture capability of any manufacturer's screen. This presentation will discuss an inexpensive upstream and downstream on-site sampling method & procedure, as well as a protocol and accepted test methodology that can be performed at any municipal wastewater treatment facility or local third party laboratory to measure solids capture efficiency of any newly installed screen(s) at startup, including older screen installations that have fallen short of owner expectations.

This presentation will reveal standardized sampling hardware, process & procedure, as well as simple bench-top test method for determining the screenings capture of any headworks or membrane protection screen. A single day sampling method & protocol will be described in detail that will provide a screen's

site-specific debris capture efficiency. This standardized sampling and testing protocol can be performed by screen manufacturers, plant operators, and/or third party laboratory technicians.

When incorporated into a consulting engineer's screen specifications it will require all bidding manufacturers to meet a desired screen capture efficiency (±X%) in the bid spec. The awarded manufacturer will be responsible for meeting the specified screenings capture.

James **Impero**
Senior Engineering Specialist
25 Years in Industrial Waste Water design
5 Years; BRACKETT GREEN, Group Product Manager
15 Years; EIMCO/OVIVO, Senior Engineering Specialist/Research & Design
BS Chemistry/University of Buffalo
MS Environmental Engineering/Rice University
Post Grad/Rice University in Hydrology/Geology/Formation Modeling

Abner Aviles

Wednesday, September 14
Session 28B: 2 Facility Operations & Maintenance
11:15AM – 11:55AM

Protecting and Preserving a Concrete Jungle

Jeff Maag[1], Muriel Gueissaz-Teufel[1], Randy Mueller[2], Rich Forrest[2], Dave Brunkow[2], Al Owens[3]
[1]City of Portland, United States of America; [2]Jacobs; [3]ACMS NW / Stantec;
jeff.maag@portlandoregon.gov, Randy.Mueller@jacobs.com, Aowens@acmsnw.com

With the large investments in wastewater infrastructure dating back to the inception of the Clean Water Act in the 1970's, and a focus that has been on treatment processes, many wastewater utilities are faced with the need to extend the life of aged and deteriorated concrete tankage that is critical to its operation. After more than fifty years of service, significant degradation of the Columbia Boulevard Wastewater Treatment Plant four pairs of aeration basins is visible, exposing the steel reinforcing and making it vulnerable to corrosion. The degraded concrete has a pH less than 10.0 and no longer provides corrosion protection for the steel reinforcing. Surface rehabilitation of the concrete was selected to restore the basins and extend their service life for another projected 25 years. Since the active basins provide critical capacity during wet weather events, rehabilitation of the basins was constrained to the short, dry-weather season, driving the schedule and key decisions. The rehabilitation process included hydro demolition of the outer concrete layer combined with the application of a new layer of mortar to seal and protect the exposed aggregate and rebar followed by an epoxy finish design to protect the mortar from abrasion and chemical attack. Due to the age and inconsistent makeup of the existing concrete, hydro demolition of the outer layer of concrete was a delicate procedure that required careful monitoring to prevent uneven removal. Only concrete with a pH less than 10.0 was removed and therefore required frequent testing. Application of the mortar was labor intensive and required multiple crews to stay on schedule. After applying epoxy to the cured mortar of the first two basins, it was determined that the stringent and time-

consuming testing requirements along with some uncertainty regarding the expected service life extension was not worth the cost of the epoxy layer. Epoxy for the future basins was removed from the project scope. This presentation will present the approach and lessons learned – technical and contractual, used on the aeration basins at CBWTP and provides a roadmap for accomplishing these concrete rehabilitation projects, particularly during a constrained outage window.

Jeff Maag

Jeff Maag is a civil engineer at the City of Portland Columbia Boulevard Wastewater Treatment Plant (CBWTP). He is the Liquids Area Lead for BES on the Secondary Treatment Expansion Project (STEP). He received a Bachelor of Science in Civil Engineering from the University of Wisconsin – Milwaukee. He is a licensed professional engineer in Oregon.

Randy Mueller

Randy Mueller is a project manager with Jacobs Engineering Group in Portland, Oregon and has been working in the field on engineering for 18 years. Randy is currently the Tunnels Facility Lead for the Columbia Boulevard WWTP Secondary Treatment Expansion Program in Portland, Oregon. Randy received his undergraduate degree in environmental engineering from Michigan Technological University and master's degrees in environmental engineering and mechanical engineering from the University of Connecticut and Portland State University, respectively. Randy is a professionally licensed engineer in Oregon and Washington and is also a certified project management professional.

Al Owens

Al Owens is a Construction Manager for ACMS NW at the City of Portland Columbia Boulevard Wastewater Treatment Plant (CBWTP). He is the designated lead for the "Liquids" portion of the Secondary Treatment Expansion Project (STEP) which he aids in overseeing daily contractor activities and coordinates activities between the contractor and the plant staff. Mr. Owens has 35 years of heavy industrial construction/D.O.D. and was a structural engineer from the University of Washington – Seattle

Wednesday, September 14
Session 29B: 1 Collection Systems - Planning
10:30AM – 11:10AM

Collection System Yoga - How Post Falls Flexibly Balanced Growth and Budget Constraints

Kyle Meschko, James Bledsoe
Keller Associates, Inc., United States of America; kmeschko@kellerassociates.com, jbledsoe@kellerassociates.com

Post Falls, situated between Spokane, Washington, and Coeur d'Alene, Idaho, is among the fastest-growing cities in the Pacific Northwest. This amount of growth puts an immense strain on existing infrastructure, and it also creates unique challenges to pay for improvements within existing budgets. Post Falls recently completed a collection system planning study and associated improvements to help the City

balance these demands. Through innovative and flexible solutions, the City has been able to position itself well for immediate growth with a balanced budget approach.

Suburban growth can cause a chain reaction that overwhelms the downstream collection system. For Post Falls, a long-term solution involved a regional pump station that could bypass the downstream bottlenecks, pumping directly to the Water Reclamation Facility (WRF). However, the cost of this was not financially feasible at the time. The City needed a solution to accommodate growth as well as give the City time to fund the long-term project. Also, the solution needed to accommodate substantial expansion, such as lift station flows that would be 20 times larger in the future.

To meet the growing demands in the area, an innovative lift station facility that utilizes equalization was constructed. The lift station operates by pumping the peak flows to the equalization basin and then discharging during low flows at night when the downstream system has capacity. The lift station was sized to incorporate several phases to increase the capacity as the continued growth occurs; in addition, controls and integration were also considered to occur in phases. The equalization storage fulfills the City's long-term goals of providing emergency storage at key lift station facilities. Ultimately, the collection system improvements provided exceptional flexibility in funding, schedule, utilization of existing infrastructure, and long-term adaptability to the ever-growing City of Post Falls.

Kyle Meschko
Kyle has spent his career developing innovative water and wastewater solutions with clients. His experience with water resource projects includes all phases of collection, distribution, and treatment as well as planning, design, and construction. Kyle has a bachelor's degree in civil engineering from the University of Idaho.

James Bledsoe
James Bledsoe has been providing wastewater planning and design services for over 20 years. He holds a master's degree in civil and environmental engineering from Brigham Young University and is a licensed professional engineer in five western states. At Keller Associates, he oversees the company's planning efforts and has served as the project manager for the Post Falls collection system master plan.

Wednesday, September 14
Session 29B: 2 Collection Systems - Planning
11:15AM – 11:55AM

Maximizing Return on Investment by Optimizing and Prioritizing Capital Improvements

Katie Maschmann[1], Julia Matton[2]
[1]HDR; [2]WCS; kathryn.maschmann@hdrinc.com, Julia.Matton@wcsengineering.com

Johnson County Wastewater (JCW) is a regional service provider for over 400,000 customers in 16 municipalities in the Kansas City Metro area. JCW's system includes 7 wastewater treatment facilities (WWTF), 31 pump stations, and a collection system containing over 2,250 miles of pipe. As the system continues to grow and age, investments in maintenance and renewal to continue to meet JCW's high level of service and manage risk will continue to grow. Additionally, JCW is in the process of planning and

executing multiple large WWTF capital upgrade projects and wet weather capacity enhancement initiatives to address upcoming regulatory drivers from state and federal agencies. These increasing investment needs, coupled with limited resources, has driven JCW to continuously improve service delivery while continuing to execute day-to-day work functions. Taken together, these programs result in over $2 Billion in upcoming investment needs that require an effective prioritization process that balances water quality, customer service, and program execution with regulatory and rate payer expectations.

JCW has adopted optimization as a tool to prioritize investment needs in the collection system. JCW retained HDR and WCS to develop and prioritize the long-term plans for the four oldest and largest basins in the system. Using JCW's calibrated hydraulic model and Optimatics' Optimizer software, the team identified the optimal combination of conveyance improvements, storage facilities, treatment plant improvements, and infiltration and inflow (I/I) reduction. Following identification of required improvements, a prioritized capacity improvement plan (CIP) was developed using Optimizer coupled with sound engineering judgement including construction phasing and staging alternatives. Through this process the team prioritized projects with low cost and high utility value and phasing to gain the highest immediate benefit for every capital dollar spent.

This presentation will focus on what it takes to achieve a successful optimization implementation based on the lessons learned from four successive projects with JCW.

Katie Maschmann

Katie Maschmann is a planning engineer based in HDR's Portland, Oregon office. Since 2013, she has provided hydraulic modeling and planning services for municipal utilities including master planning, capacity studies, and optimization. Katie is passionate about helping utilities tackle complex wet weather issues in the collection system.

Julia Matton

Julia Matton joined WCS Engineering as an Optimization Engineer in 2020. Julia's work in the water and wastewater planning field has supported long-term planning initiatives for utilities of every size across the United States, Australia and New Zealand. Julia's broad range of experience across water distribution and wastewater collection systems informs her planning expertise from a holistic approach.

Wednesday, September 14
Session 30B: 1 Climate Science
10:30AM – 11:10AM

Climate Adaptation and Combined Sewer Overflow Infrastructure: State of the industry

Drew Henson[1], Amina Kedir[2], Anna Marburg[1], Janice Johnson[2], Erika Schuyler[1]
[1]Murraysmith; [2]King County - Wastewater Treatment Division (WTD); Andrew.Henson@murraysmith.us, amkedir@kingcounty.gov, Anna.Marburg@murraysmith.us

Incorporating potential climate impacts into wastewater capital planning is an emerging topic that is affecting utilities across the nation. To inform its own long-term planning, King County Wastewater Treatment Division (WTD), located in Seattle, Washington, sought to understand the state of these efforts. King County provides wholesale wastewater conveyance and treatment of flows from 17 cities, 16 local sewer utilities, and one tribal government. WTD and its consultant teams interviewed peer wastewater

agencies and reviewed published literature to gather information on current strategies, methods, and findings related to climate adaptation and Combined Sewer Overflow (CSO) facilities. The strategies identified through this effort will assist WTD in preparing for and adapting to climate change in its capital program.

The project team gathered information on how peer agencies are incorporating climate change impacts into their capital delivery process via a questionnaire followed by a phone interview. Key topics explored in the interviews included quantifying climate change impacts and uncertainty, CSO reduction and sizing decisions for capital planning and design work, financing and costs, and equity and social justice (ESJ) and public involvement. These discussions revealed agencies are at various stages of considering climate change impacts on their sewer systems. Many agencies are still considering their approach to incorporating climate change projections into their CSO and wastewater programs.

Three main themes emerged from the literature review: real-world effectiveness of GSI in reducing CSOs, ESJ and public involvement impacts, and decision-making under uncertainty. Some modeling studies showed potential for volume reduction to CSOs using GSI, but real-world observations had difficulty quantifying volume reductions from GSI. The literature suggested that both the distribution of CSO outfalls and the financing of system upgrades can have equity implications. Finally, the literature suggested strategies to support decision-making for infrastructure investments even with large uncertainties about future conditions.

These findings have been shared via a public report and are being used within WTD to inform the long-term planning process, as well as develop adaptation and resiliency strategies using current climate data and modeling tools. This presentation will discuss the findings of this project.

Drew Henson

Andrew Henson has over 16 years of professional experience in civil engineering planning, H/H modeling, design, and permitting. He has recently worked on several large projects involving planning level analysis, regulatory compliance, climate change impacts, inter-agency coordination, comprehensive sewer planning, green stormwater infrastructure, and options analysis.

Amina Kedir

Amina Kedir is a Water Quality Planner and Project Manager at King County Wastewater Treatment Division and supports King County's long-term planning processes focused on future regional water quality investments. She supports the development of several wastewater system planning efforts, such as the Combined Sewer Overflow Program and climate change to ensure WTD's ability to meet future wastewater needs and develop adaptation strategies to achieve environmental compliance.

Anna Marburg

Anna enjoys talking to clients about their needs (including budgets) and takes pride in translating technical model output into real-world terms. She earned her Ph.D. from the University of Wisconsin - Madison in 2006.

Wednesday, September 14
Session 30B: 2 Climate Science
11:15AM – 11:55AM

Too Hot! Thermal Modeling for NPDES Temperature Mitigation

Jen Murphy, Chloe Nichol, Brandon Moss, Jacob Stolle
Parametrix, Inc, United States of America; JMURPHY@PARAMETRIX.COM, cnichol@parametrix.com, bmoss@parametrix.com

NPDES permit requirements related to water temperature across the United States are becoming more stringent as climate change impacts increase and the impacts of excess thermal load on environmental systems are better understood. While there are several ways of reducing the excess thermal load of municipal resource recovery facilities (RRF) on receiving water bodies, the majority of programs with large scale thermal load reductions are either reactive (i.e., implemented through permit renewals for existing facilities) or are for new industrial discharges, where the thermal load is more predictable. As such, there is a need for a more accurate way to anticipate thermal loads of proposed plants.

Parametrix was recently part of a project with uncertainty regarding the ability of a future RRF to meet long-term effluent temperature permit requirements. To remedy this, the project team and internal Parametrix developers created a thermal model to estimate RRF effluent temperatures using key thermodynamic principals, environmental data, and various system configurations. Parameters considered were based on integration of several past studies on treatment plant thermal modeling and included:

- Heat flux from external sources including:
    - Solar and atmospheric radiation
    - Aeration
    - Conduction and convection
    - Evaporation
    - Mechanical equipment
    - Biological reactions
    - Advective and diffusive mixing
    - Humidity
    - Ambient air temperature
    - Air speed
    - Process basin configurations (e.g., FRP or concrete covers; footprints and depths; primary, recycled, and secondary process flows, etc.)

Specifically, the developed model utilizes five years of historic environmental data from the National Energy Research Laboratory climate data repository. Preliminary Biowin process model results, and SWMM collection system data predicting collection system flows over the next 20 years. The model can also be used to forecast the effects of various cooling methods such as additional shading, addition of heat exchangers, and different discharge pipeline configurations on the discharge temperatures.

It is anticipated that this type of modeling is going to increase in frequency and importance as the impacts of climate change increase. This presentation will cover the academic basis for the modeling approach,

specific considerations and complications of implementation, model results and findings, approaches to mitigate excess thermal loads, and potential future developments.

Jen Murphy

Jen Murphy is a Sr Project Manager and NW Water Market Lead at Parametrix. She has over 16 years of experience partnering with clients to deliver pump station and treatment upgrades at facilities with capacities from up to 800 MGD. She is passionate about providing creative client centric solutions, innovation within the water industry, and empathy led storytelling.

Chloe Nichol

Chloe Nichol is an engineer in training at Parametrix within the Pacific Northwest water markets. She provides support for mechanical engineering design, modeling, controls, and field assessment support to local agencies and industrial clients. Her work includes pump stations, treatment processes, and facility redesigns for both water and wastewater systems.

Brandon Moss

Brandon Moss is a professional engineer at Parametrix within the Pacific Northwest water markets. He provides hydraulic, mechanical, and civil engineering design, modeling, simulation, and field assessment support to local agency, industrial, and tribal clients. His work supports water and wastewater projects including rehabilitation and replacements of force mains and pump stations, treatment processes and hydraulic designs, and reclamation plant upgrades.

Wednesday, September 14
Session 31B: 1 Treatment – Industrial Pretreatment
10:30AM – 11:10AM

Using FTIR Technology to Quantify Gas Emissions in Conveyance Systems

Justen Eckhardt, Steve Thompson, Scott Mansell, Kenneth Williamson
Clean Water Services, United States of America; mansells@cleanwaterservices.org

Gaseous emissions are common within both sanitary and storm sewers. These emissions can result from particular industrial discharges or from biological or chemical reactions. Many of these can be health and safety hazards which can be avoided by appropriate use of handheld gas monitoring instruments. These instruments commonly check for concentrations of oxygen, hydrogen sulfide, carbon monoxide, and other combustible or volatile organic gases.

Clean Water Services (CWS) personnel commonly use such gas monitoring instruments before opening and when working in manholes or other potentially hazardous areas as part of required safety protocols. Recently, we have experienced a number of occurrences of handheld gas monitoring instrument repeatedly detecting hazardous gases within particular portions of the conveyance system in an industrial area. This has prevented personnel from performing maintenance and other essential functions on the sewer infrastructure in this area. Facing unknown gases that triggered hazardous alarms, we initiated a comprehensive sampling and analysis study that utilized grab and continuous sampling methods and analyzed the samples off-site using standard EPA gas analysis methods. The study was unable to identify the gas(es) responsible for the alarms, but did help narrow down potential source locations.

To expand our ability to increase monitoring both spatially and temporally, we have initiated the use of Fourier Transform Infrared spectrometry (FTIR) to identify offending gases. FTIR is unique in that it can simultaneously identify multiple compounds in real time by analyzing absorbance spectra across a band of infrared wavenumbers. While most FTIR instruments are made for benchtop use, CWS purchased a portable FTIR instrument designed specifically for gas analysis in the field at low PPM to PPB detection levels. The instrument identifies gases using a spectrum library of over 350 individual gases.

In this presentation, we describe the results of our use of FTIR spectrometry to identify and quantify harmful gases within our sewer system and trace them to their source. In addition, we discuss the role of FTIR in our future efforts to monitor greenhouse gases from our facilities, aid in air quality permitting, and help to identify gases from digestion and other processes.

Scott Mansell
Scott Mansell is a Principal Engineer in the Research and Innovation Dept at Clean Water Services where he's been since 2017. Scott works at the nexus between research and environmental engineering leading project on a wide variety of topics including water quality modeling, continuous sensing in the natural and engineered environments, trace organics, and emerging contaminants. Prior to working at CWS, Scott earned a PhD in Environmental Engineering from UC Berkeley in 2012 and spent five years in consulting.

Wednesday, September 14
Session 31B: 2 Treatment – Industrial Pretreatment
11:15AM – 11:55AM

Aeration & Mixing in Industrial Wastewater

Brad Eberspecher
IPEX, United States of America; Brad.Eberspecher@ipexamerica.com

Many industrial customers generate substantial volumes of high strength wastewater that can create problems when discharged to municipal wastewater collection and treatment systems. As a result, cities are recognizing the impacts to their systems and are increasingly issuing significant surcharges based on waste strength and volumes, sometimes even requiring pretreatment to lower the strength of their wastewater before discharging it.

Vortex Force™ aerators are well suited for aeration and mixing in the pretreatment of industrial wastewater before it is discharged to municipal systems. These aerators utilize unique hydraulics and the kinetic energy of flowing wastewater to efficiently add dissolved oxygen and maintain completely mixed conditions. Aeration systems that utilize Vortex Force™ aerators can help industrial wastewater producers overcome several challenges.

- Reduction of waste strength (BOD, COD, etc.)
- pH neutralization
- Eliminates offensive odors
- Solids can be kept in suspension

Vortex Force™ aerators have no moving parts, with each aerator requiring only a single pump to provide the recirculating flow. The unique hydraulics draws in air and creates intense turbulence that breaks up the incoming air stream into small bubbles that are carried downward to the bottom of the tank. The recirculating flow creates currents in the tank maintains completely mixed conditions. The flow exiting the aerator can also be directed to aid in the removal of suspended solids.

Existing installations and laboratory performance testing that has been completed to date show that Vortex Force™ oxygen transfer performance is more than adequate, while the costs of both electricity and operator labor for maintenance are a small fraction of other options.

Municipal applications also exist currently, but are currently limited to collections and conveyance applications due to a lack of adequate performance data for process aeration applications. But as the use of Vortex Force™ aeration expands, more performance data will be documented and made available, and eventually Vortex Force™ aeration will replace existing technologies in process treatment of industrial and municipal wastewater.

Brad Eberspecher
Education: BS Civil Engineering (University of Nebraska-Lincoln) – May, 1997
Experience (25 years):
Brad has 25 years of professional experience that spans public works, licensed water/wastewater operation, engineering consulting, engineered sales and business development with a primary focus on water and wastewater.

Wednesday, September 14
Session 32B: 1 Social Equity
10:30AM – 11:10AM

Supporting a City for Everyone with DEI and Recycled Water

Haley Falconer[1], Andrea Hall[2], Erin Cox[2]
[1]City of Boise, Water Renewal Services; [2]Brown and Caldwell, United States of America;
hfalconer@cityofboise.org, ahall@brwncald.com, Ecox@BrwnCald.com

The City of Boise is striving to uplift the community by incorporating diversity, equity, and inclusion (DEI) into the fabric of how it operates and provides services to its residents. Boise's motto is "creating a city for everyone," and it takes that adage seriously as it endeavors to be a community that supports equity and access for all through thoughtful policy and intentional action. Public works in many places have inadvertently created inequality through their policies and decision-making processes. Boise is an innovative city that is embedding DEI into how public works projects are planned, prioritized, and executed in the community.

Boise has embarked on developing a Recycled Water Program to enact the concepts and outcomes set forth by the Water Renewal Utility Plan. This program will shift how Water Renewal Services (WRS) uses and manages water. It will enhance water resiliency and environmental outcomes while protecting economic development and public resources. The Recycled Water Program will combat future water shortages by recycling water within Boise's service area through aquifer recharge and industrial reuse.

Diversifying industrial water supply sources will relieve pressure on groundwater and preserve water resources. WRS plans to incorporate DEI into each element of the Recycled Water Program, developing a framework that identifies equity goals, objectives, processes, and measurable outcomes to incorporate community-centered equity considerations into each program element.

To accomplish its DEI goals, WRS will perform a community analysis profile to better understand the community, equity circumstances, and challenges to inform the Equity Framework. The team will conduct listening sessions to align city and department level equity priorities and equity levels of service. WRS will also hold workshops with city staff to develop a community-centered and outcome-based equity framework that will establish goals, procedures, and priority actions to be enacted through the Recycled Water Program. Additionally, DEI considerations will be embedded into major decisions and policies of the Program, in particular policy making, land acquisition, and workforce development.

Haley Falconer

Haley Falconer is the Environmental Division Manager at the City of Boise where she provides direction for environmental and sustainability initiatives across the City. The Environmental Division serves as a resource for City operations, including Water Renewal Services, which is the is the utility that cleans the city's used water and will be home of the newly formed Recycled Water Program.

Andrea Hall

Andrea Hall serves as Brown and Caldwell's Senior Director for DEI who has led initiatives for multiple national and international companies, bringing data-driven insights to decision-making. She is supporting Boise to prioritize DEI in decision-making and advance DEI as WRS transitions to a recycled water provider.

Erin Cox

Erin Cox is Brown and Caldwell's Water Resources Practice Lead for the Pacific Northwest who supports incorporation of DEI into water resources projects when possible. Her work focuses on climate change and resilient infrastructure, water quality, and stormwater. She is supporting multiple facets of the Recycled Water Program.

Wednesday, September 14
Session 32B: 2 Social Equity
11:15AM – 11:55AM

DE&I: Where Are We? Where Can we go from Here?

Emily Flock[1], Nicki Pozos[2]
[1]Keller Associates; [2]The Formation Lab; eflock@kellerassociates.com, nicki@theformationlab.com

The Racial and Social Justice subcommittee (RSJ) surveyed PNCWA members to collect information and insight on current diversity, equity, and inclusion (DE&I) programs and practices in their organizations. This presentation will summarize and discuss organizations' current DE&I practices based on the survey responses, establishing a general overview of where we, as PNCWA organizations, are in our DE&I journeys. The sharing of the survey results aims to facilitate knowledge and experience sharing between

our member organizations, recognize that we are all in this journey together, and we can help each other strive to do and be better. Additionally, we will present potential next steps and practices organizations could explore and implement, as well as tips for how someone could go about beginning conversation and promoting change for these practices within an organization.

Emily Flock

Emily Flock, PE has been working with communities and their infrastructure needs for 8 years. Her educational background is in environmental engineering. Emily's primary focus is water, wastewater, and stormwater master planning. She values the collaborative and system-wide approach of the master planning process. Emily is a member of the PNCWA Racial and Social Justice (RSJ) Subcommittee. Her RSJ journey started outside of the professional realm with diversity, equity, and inclusion discussions and training in communities she is a part of. Her tools and language to facilitate hard conversations continues to grow with these experiences.

Nicki Pozos

Nicki Pozos, PhD, PE brings 20 years of experience developing infrastructure projects in the Pacific Northwest. Nicki brings a diverse background, encompassing a PhD in Civil Engineering, former work as a life coach, and current work helping leaders evolve their relationships with their staff, themselves, and their communities. She has worked extensively with public works departments, leading elected officials through decision processes, overseeing rate and system development charge studies, and leading preliminary design of a billion-dollar infrastructure project. Nicki is a recognized leader in promoting diversity within the water industry. She has presented on diversity and bias at numerous local and regional conferences, ranging from operator trainings to keynote presentations. Nicki is Board President of Women Leading Water, an organization dedicated to creating a more equitable future.