CAROLLO ENGINEERS VOLUME 3 2020

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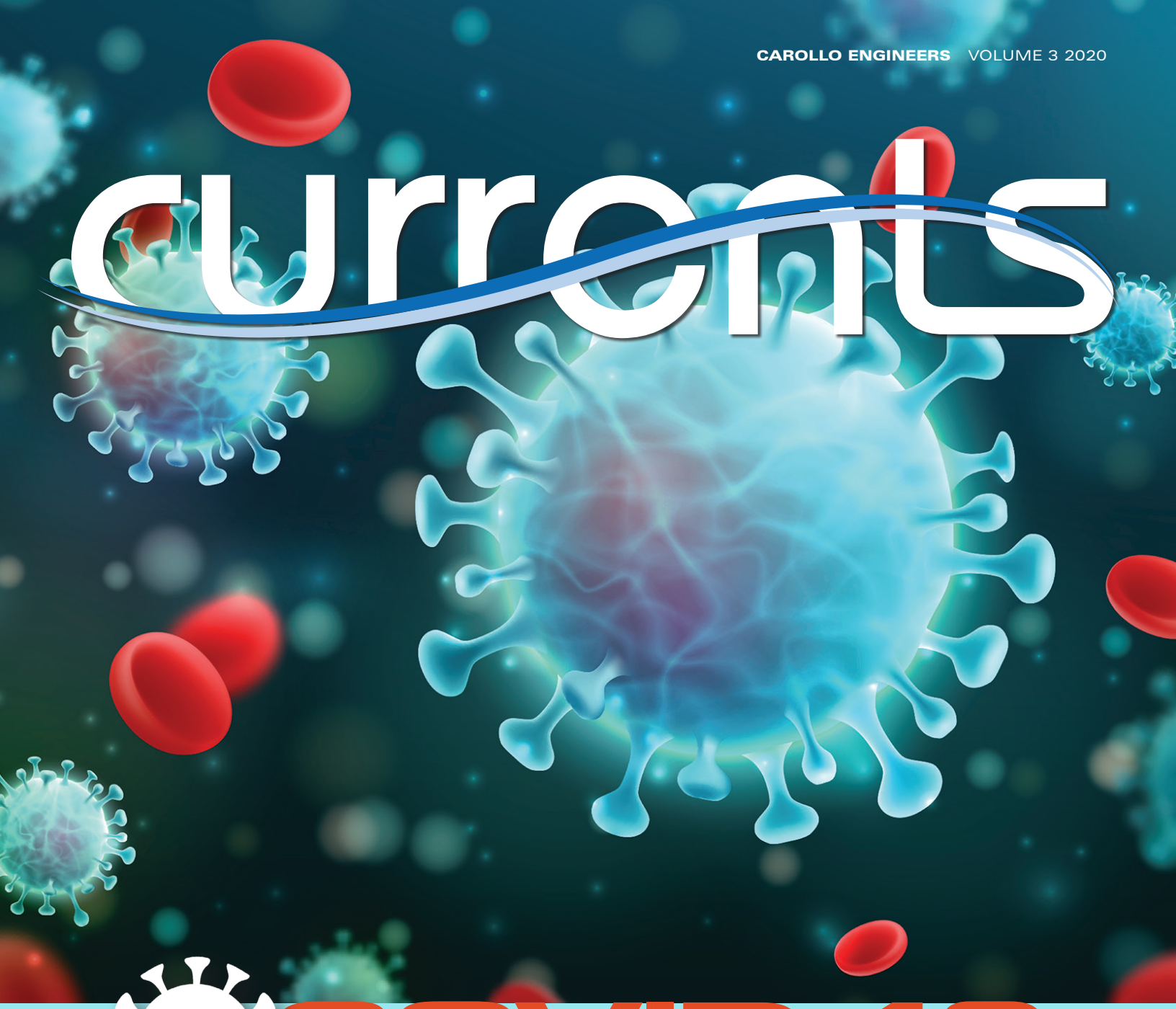

COVID-19

Understanding the Industry's Challenges

PLUS —

- Microplastics: They're Everywhere!
- 2020 Bryant L. Bench Scholarship
- 2020 WEF Project Excellence Award

THIS ISSUE'S Editorial

JESS BROWN, PhD, PE (jbrown@carollo.com)

Greetings from my home office to yours! I hope this Currents issue finds you and your loved ones in good health and spirits during these challenging times. 2020 has been a consequential year across the board, and the water industry has been no exception, with COVID-19 impacting every aspect of our field—from staffing to revenue/funding to water demand and distribution to supply chains to workforce locations and mobility…and on and on. Read ahead to learn about a couple ways (coronavirus tracking and distribution system stagnation support) in which Carollo has expanded our services with an eye toward COVID-19 challenges. Also in this issue, we overview the emerging area of micro- and nanoplastics in water, introduce you to the 2020 Bryant L. Bench-Carollo Scholarship winner, and showcase a Gas Recovery Facility and Pipeline Injection Project that won the 2020 Water Environment Federation Project Excellence Award. As always, I hope you enjoy this issue, and please let me or the primary authors know if you have any questions or comments. I wish you the best for the remainder of 2020 and beyond!

IN THIS ISSUE

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Engineers...Working Wonders With Water®

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Microplastics:

REDUCE, REUSE, AND REMOVE

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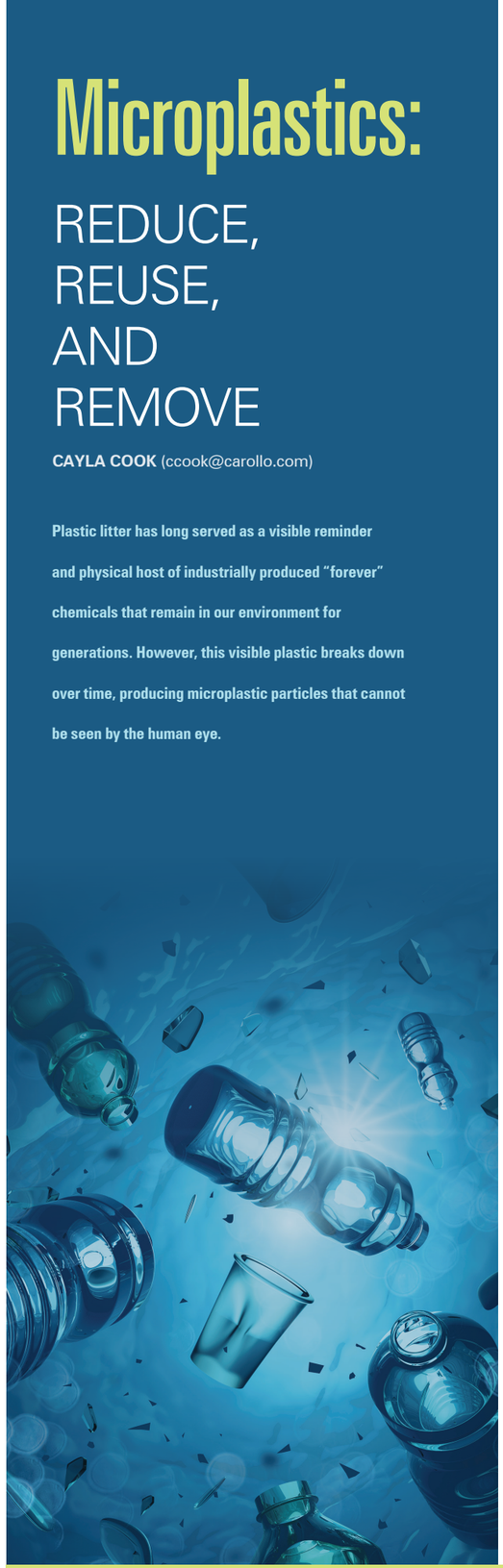
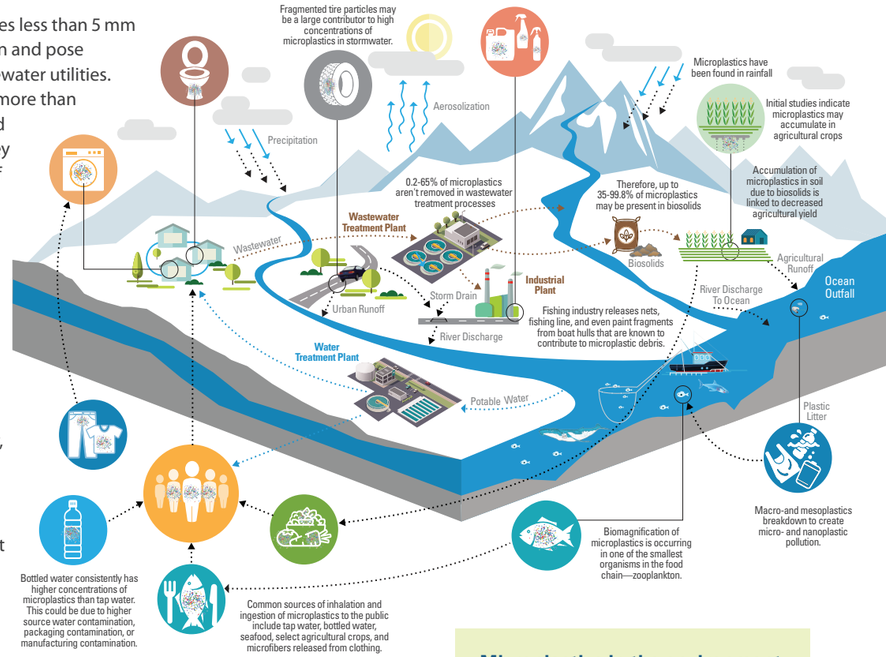
Plastic litter has long served as a visible reminder and physical host of industrially produced "forever" chemicals that remain in our environment for generations. However, this visible plastic breaks down over time, producing microplastic particles that cannot be seen by the human eye.



Microplastics, which are polymeric particles less than 5 mm in size, have gained international attention and pose considerable concern for water and wastewater utilities. As microplastic research progresses, and more than 192 countries enact bans on manufactured microplastics, scientists have identified key concepts to understand the prevalence of the issue:

- Microplastics are *everywhere*. This is no hyperbole: every environmental compartment ever sampled has microplastic litter—even rainfall in some of the most remote locations on Earth.
- Every day we inhale, drink, and consume microplastics.
- Even if we stop producing plastic today, microplastic concentrations in the environment will continue to *increase* for decades.

Thus, it's no surprise that this contaminant is present in treated and untreated drinking water, wastewater treatment plant effluent, stormwater, and biosolids.



Ecological and Human Health Concerns

Experts have long known the hazards of aquatic species and humans ingesting large plastics; however, the visible spectrum of plastic litter may be the tip of the iceberg for toxicity, since smaller particles can translocate and deposit within tissue. These toxicological and environmental concerns are summarized in Table 1 below and are considered some of the regulatory drivers for monitoring microplastics in drinking water.

Microplastics in the environment are known to harbor up to 5,000 times the concentration of harmful bacterial communities, such as antibiotic-resistant bacteria, and up to 1,000,000 times the concentration of other harmful contaminants.

Microplastic Removal and Possible Regulations

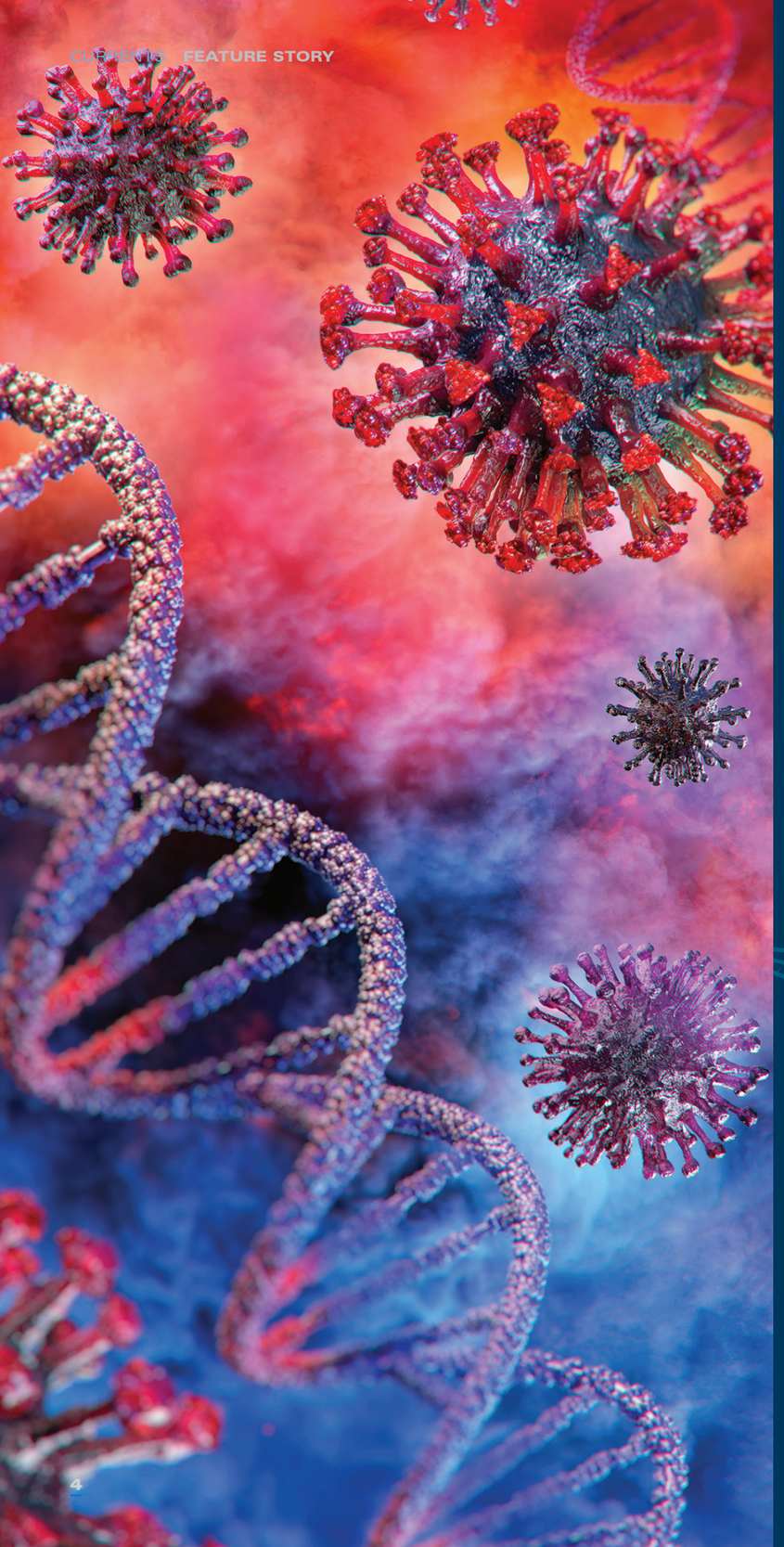
As methods of detection to quantify smaller microplastics continue to advance, estimated removal rates have dropped. Previously, peer-reviewed studies for particles ≥100 µm reached a consensus of 98-99.8% removal rates in wastewater treatment plants, with 0.5-2% of microplastics in the effluent; however, it's now emerging that microplastics within the 1-10 µm range account for 95% of particles present in drinking water, and microplastics within the 10-100 µm range account for up to 95% of particles present in treated wastewater. Removal rates as low as 35% are observed when quantifying small microplastics. Additionally, quantities of microplastics of 1-5 µm in size are shown to increase up to 16% in advanced treatment plants, suggesting that current processes fracture particles to an infinitesimally smaller size.

TABLE 1: Toxicological and Environmental Concerns of Plastics

CONCERN	DRINKING WATER	WASTE-WATER	BIOSOLIDS
TOXICOLOGICAL CONCERNS			
Adsorption or release of environmental contaminants, such as DDT[1], PCBs[2], and PFAS[3]	●	●	
Unit processes fracturing microplastics to a more toxic size range	●	●	●
Disinfection producing microplastics-derived DBPs[4]	●	●	
Impacts of polymers and polymer-associated additives	●	●	
Possible physical deposition in the human body leading to health impacts	●		
Increased presence of antibiotic-resistant bacteria on microplastics	●	●	
ENVIRONMENTAL CONCERNS			
Direct contribution to environmental pollution		●	●
Decreased agricultural yield, shift in plant speciation, and shift in soil properties			●
Accumulation of microplastics in agricultural plants and soil			●

Notes: (1) DDT = Dichlorodiphenyltrichloroethane; (2) PCBs = Polychlorinated biphenyls; (3) PFAS = Perfluoroalkyl substances; (4) DBPs = Disinfection byproducts.

The California State Water Resources Control Board recently adopted its own definition of microplastics: any particle that consists of ≥1% of synthetic material and ranges in size from 1 nm and 1 mm. Non-defining criteria of microplastics (e.g., morphology and polymer type) includes biodegradable polymers, recycled polymers, microfibers, fragments, and films that end up in the water cycle. California plans to utilize this definition for water quality monitoring of microplastics starting in July 2021. The ultimate goal is to encourage stakeholders to reduce, reuse, and remove plastic from water resources.



COVID-19

HELPING CLIENTS NAVIGATE THE COVID ERA

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KATIE DAVIS, PhD

KAREN LEONARD

COVID-19 (COVID), an illness caused by the SARS-CoV-2 virus, has had a profound impact on the water industry. As the COVID pandemic impacted communities throughout the United States, it revealed many of the critical dependencies water utilities have on key employees and supplies. Water utilities have had to enact response plans for continuing operations and have been asked to consider how to maintain critical functions with limited staffing and resources. To help our clients address these challenges, Carollo has been involved with several operation-focused initiatives, such as:

"All-hazard" preparedness. As part of the Risk and Resilience Assessment (RRA) and Emergency Response Plan (ERP) efforts required by the 2018 America's Water Infrastructure Act (AWIA), Carollo has been assisting water utilities across the US to achieve a state of "all-hazard" preparedness—providing the planning, documentation (ERP updates, pandemic plans, continuity of operations plans, etc.) and supplementary training necessary to respond to emerging threats—like COVID and unprecedented wildfires—quickly and efficiently.

Critical staff planning. Carollo developed an easy-to-use pandemic planning tool that allows managers to understand the potential impact to operations resulting from shortages of their available skilled workforce as a result of COVID-19. The tool presents information in a dynamic dashboard format that can demonstrate options and impacts before critical staffing outages happen, and in real time, as the situation changes and emergency responses are activated. Should there be a need to communicate to stakeholders or the regulatory community, the online dashboard delivers clear and easily understandable information.

The Carollo Research Group has also led initiatives focused on COVID-related technical opportunities and impacts, including: (1) surveillance testing of SARS-CoV-2 at wastewater facilities, and (2) formalized guidance for prolonged distribution system stagnation. More detail on these two initiatives is provided below.

Between 2013 and 2014, Israel experienced a regional polio outbreak. Local officials used the existing sewage surveillance program to identify and track the poliovirus by sampling at sewage trunk lines and wastewater treatment facilities, using these data to prepare mitigation strategies. Through this program, Israeli communities were able to identify the neighborhoods most affected by the outbreak and implement patient screening and immunization campaigns. These efforts ultimately resulted in early outbreak detection and quick medical responses that limited the total number of infected patients and minimized long-term effects, such as paralysis, for already infected individuals.

SEWAGE SURVEILLANCE PROGRAMS

Before COVID, sewage surveillance programs were used to track the presence of, and changes in, viruses and bacteria that cause contagious illnesses such as polio and salmonellosis. These programs have shown that increases in pathogen concentrations in wastewater are typically followed by increases in positive clinical diagnoses for local patients. Today, we can apply the same techniques to sample and test community wastewater for COVID as a practical, cost-effective, and immediate way to monitor infections and potential outbreaks.

Viral loads of SARS-CoV-2 can be tested and monitored to provide an idea of a community's general health by identifying "hot spots" with increased infection rates, helping to identify trends in infection and enabling utilities to characterize the efficacy of their treatment processes. Sewage surveillance programs have already demonstrated successful tracking of SARS-CoV-2 in France, Australia, the Netherlands, and the United States.

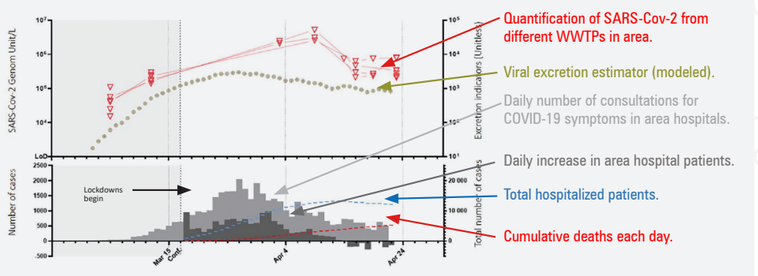

FIGURE 1. A COMPARISON OF SEWAGE SURVEILLANCE DATA FOR SARS-COV-2 AND EPIDEMIOLOGICAL DATA ON COVID-19 IN AN AREA OF PARIS, FRANCE (ADAPTED FROM WURTZER ET AL., 2020).

Figure 1 offers an evidence-based view of the viral load within one Parisian community during an early part of the pandemic. The data presented can be used to support decisions made on public health mitigation strategies.

This type of approach was demonstrated by Israel's experience with the poliovirus (sidebar shown on previous page), in which wastewater surveillance was effectively coupled to other public health services to create a powerful and potentially more cost-effective mitigation strategy to reduce the community spread of the disease.

How We Can Help

Carollo's Water Applied Research Center (Water ARC®) group has developed a set of services to support our clients with these tracking programs.

For clients who wish to develop sewage surveillance programs that effectively detect and evaluate viral loads over time, our Water ARC® group offers custom sampling plans and reliable testing and analytical services.

- **Sampling Plans Tailored to Community Needs:** Sampling plans are detailed outlines of how, when, where, and which pathogens are measured and for what purpose. We can develop a variety of plans that address different client needs and data objectives, focusing on assessing the level of infection, identifying trends in infection, and assessing risk within wastewater treatment plants.

Water ARC® is a state-of-the-art facility in Boise, Idaho, that provides lab-based treatability testing, pilot and field equipment, small pilot construction, and pilot-facility design services to support a wide range of testing needs for our clients.

- **Analytical Services for SARS-CoV-2 Testing:** Although there is no standard method for testing SARS-CoV-2 genes in wastewater, Water ARC® developed a method using RT-qPCR to quantify the target genes based on Centers for Disease Control recommendations. We can also test for a surrogate virus commonly found in human feces to demonstrate the presence and relative contribution of human sewage to specific sewersheds.

Public Service Announcements

Government shutdowns have forced many people to stay home and away from traditional office settings and schools, having unintended effects, such as prolonged water stagnation. Prolonged stagnation can intensify the effects of stagnation, including the loss of disinfectant residual, nitrification, and corrosion.

To inform clients on how to best manage stagnation, Carollo prepared a public service announcement and a brochure that raised awareness of issues related to prolonged drinking water distribution system stagnation and to encourage discussions to develop utility-specific responses. This brochure included guidance to: assess water age vulnerabilities in distribution systems during stagnation, provide water quality monitoring, manage stagnant zones, offer support for building recommissioning, and provide public communication. Released in May 2020, the brochure was intended to help during the re-openings occurring across the United States. Nevertheless, the guidance is still relevant as some re-openings have been implemented at a slower pace and distribution systems may still experience unusual flow patterns.

Although COVID has disrupted our day-to-day lives, it has also created opportunities and increased the ability of organizations to apply for funding to help cover the cost of these services and other critical services during this time. COVID has caused our clients to face increased financial uncertainty. It is very important for us to understand what funding and grant opportunities are available, educate ourselves on these opportunities, and then educate and assist our clients in attaining those funding and grants.

We are all adapting to a new normal that has forced us to shut down, shelter in place, and upend our everyday lives to mitigate the pandemic. As we continue to manage these new realities, Carollo and its Water ARC® group have found ways to help clients face their challenges head on.

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CONSIDERATIONS FOR PROLONGED STAGNATION OF DRINKING WATER IN DISTRIBUTION SYSTEMS

Stagnation can occur in drinking water distribution systems (DWDS) that experience low water demands and in localized areas of high water age, such as dead ends, oversized pipelines, and storage tanks. Prolonged stagnation can occur in these areas and in others, such as residential developments, office spaces, businesses, and schools, where water demand decreases due to significant disruptions in occupancy lasting a month or more.

Prolonged stagnation can intensify the effects of stagnation, including the loss of disinfectant residual, nitrification, and corrosion. This public service announcement aims to achieve the following:

1. Build awareness for issues related to prolonged DWDS stagnation.
2. Stimulate conversations to develop utility-specific responses to prolonged DWDS stagnation.

Our public service announcement on stagnant water resulting from government shutdowns was designed to help our clients manage water quality.

2020 Bryant L. Bench **SCHOLARSHIP**

Carollo awarded its fifth Bryant L. Bench Scholarship to **CHARLIE LIU** during a live, virtual AWWA prestigious Virtual Scholarship Recognition Event on June 22, 2020. Charlie, a doctoral student at the Colorado School of Mines, was awarded $10,000 due to his passion for providing innovative solutions to the world's water challenges. The recipients can use the award to further their education in their chosen field.

The Bryant L. Bench Scholarship was launched in honor of Carollo's Water Practice Director, Bryant Bench, whose innovative treatment concepts have helped improve drinking water quality across the country. Bryant was a mentor to his peers and a friend to all, and his legacy in the industry will stand firm for decades to come.

Charlie shares Bryant's passion for the water treatment industry. He has focused his research on developing and evaluating cost-effective treatment methods for PFAS removal. In the past three years, he has built and deployed automated activated carbon, ion-exchange, high-pressure membrane, and PFAS destructive technology systems, and has accumulated a great deal of data on PFAS treatability.

Congratulations, Charlie!

Pipeline Injection Project is chosen for the 2020 WEF Project Excellence Award

Congratulations to South Platte Renew for receiving the Water Environment Foundation's (WEF) prestigious 2020 Project Excellence Award. Carollo was proud to partner on this pioneering Gas Recovery Facility and Pipeline Injection Project, which recovers and conditions methane gas from the Water Resource Recovery Facility's (WRRF's) anaerobic digesters, so it can be injected into Xcel Energy's natural gas pipeline for downstream use as transportation fuel. Completion of this project in October 2019 marks the first renewable natural gas (RNG) pipeline injection project implemented at a WRRF in Colorado.

The project includes a biogas upgrading system that converts raw biogas to RNG, an interconnect facility, and an RNG pipeline that conveys pressurized, treated biogas to Xcel Energy's existing 20-inch natural gas pipeline. Thanks to incentive credits from the EPA's Renewable Fuel Standard Program and California's Low Carbon Fuel Standard program, South Platte Renew anticipates a 20-year net revenue of $17 million, and a project payback period of 5 to 7 years.

The Pipeline Injection Project is an example of how WRRFs can positively contribute to their communities, foster regional partnerships, and improve sustainable practices. By converting their raw biogas to RNG for injection into the pipeline and downstream use as transportation fuel, South Platte Renew now offsets the equivalent of 2,000 gallons of gasoline per day and more than 13.5 million petroleum-fueled passenger vehicle miles per year.

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