



# Carollo Research Group

*25 Years of Applied R&D*



# Water is our singular focus



Today, our clients face hurdles that reflect a changing water industry. Aging infrastructure, increasingly stringent water quality and discharge limits, public demand for sustainability, emerging contaminants, climate change, variable water supplies—these are not only obstacles of the present but measures of success for the future.

## With them, we, too, must evolve and advance.

The Carollo Research Group was created for and with our clients to address these mounting modern issues through applied research and development (R&D). From developing immediately actionable solutions to exploring ideas and technologies of the future, this diverse team of in-house engineers, scientists, planners, modelers, and researchers is dedicated to listening to our clients' needs and innovating how they work with water.

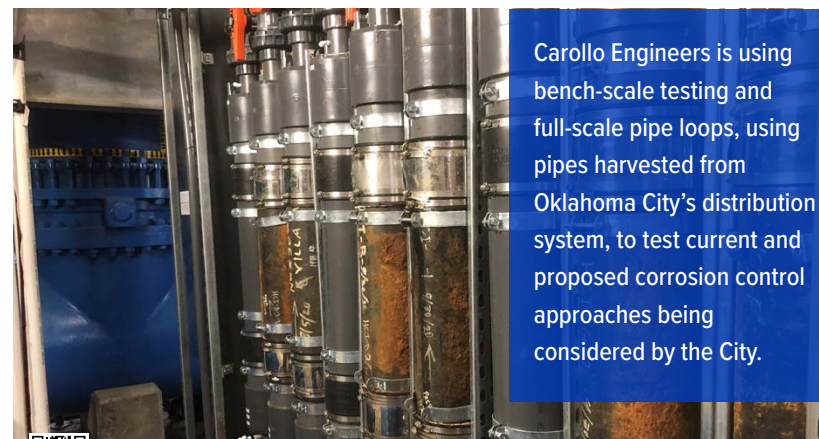


Good solutions buy time. Great innovations change the world.

## Select Focus Areas

Carollo Engineers' applied R&D can be observed in every corner of water, wastewater, stormwater, and reuse. Here are just some of our technical areas of focus:

- Automated process control strategies
- Algal toxin prediction and treatment
- Biological drinking water treatment for surface water and groundwater
- Computational fluid dynamics (CFD) modeling
- Contaminants of emerging concern (CECs), including per- and polyfluoroalkyl substances (PFAS) and micro- and nano-plastics
- Conventional treatment optimization
- Decision support systems
- Desalination and open-platform membrane filtration
- Digital water tools, artificial intelligence, machine learning
- Distribution system water quality and corrosion
- Novel process development and optimization for potable reuse
- Wastewater intensification
- Ultraviolet (UV) disinfection



Carollo Engineers is using bench-scale testing and full-scale pipe loops, using pipes harvested from Oklahoma City's distribution system, to test current and proposed corrosion control approaches being considered by the City.



SCAN TO SEE MORE.

## Carollo Engineers at a Glance

**270**

dedicated R&D projects with over 200 utilities in the last 10 years.

**\$16M**

in funded R&D in the last 5 years alone.

**35**

peer-reviewed publications since 2020.

**6**

process patents with three more pending.



# Innovation to Impact

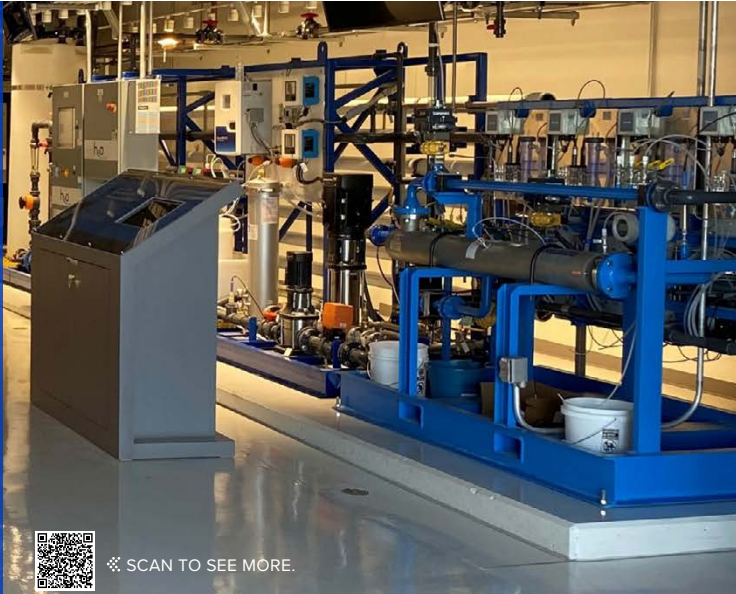
Carollo Engineers is known for its creative problem solving and industry-leading innovation. Neither involves waiting for Eureka lightbulbs or interpreting crystal balls.

Instead, we define innovation as the iterative, stepwise implementation of creativity. With attention, diligence, and collaboration, this process achieves implementable solutions that bring justifiable value to ratepayers.

Creativity is all about connecting the dots.



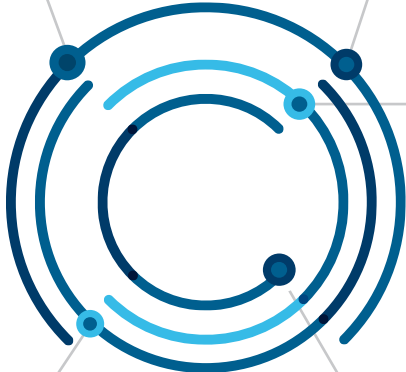
Potable water reuse is gaining acceptance as a preferred solution because of its lower relative cost compared to other (imported) water supplies. However, moving from non-potable recycled water to purified recycled water more than doubles energy use and requires highly-trained operations staff. In light of these challenges, Carollo Engineers and an international team of researchers have been evaluating the promise of artificial intelligence (AI) and machine learning (ML) to reduce energy and chemical use, supplement operations and maintenance, and provide greater confidence in water quality. Extensive success has been documented, with full-scale trials demonstrating at least a 10% reduction in energy use and demonstration-scale trials predicting membrane performance.



SCAN TO SEE MORE.

## Carollo Research Group applied R&D is founded on these five steps:

- 1. **Industry Research:** Working hand-in-hand with Carollo Engineers' client service teams, our first priority is to identify needs, drivers, and trends across the water sector and amongst our clients. At this stage, our focus is to listen and learn, no matter how big or small the issue.
- 2. **Refine:** After defining our industry's imperatives, our cross-disciplinary team sources and prioritizes ideas with the most merit, potential impact, and applicability to our clients' needs. From traditional concepts to out-of-the-box approaches, no stone goes unturned.



- 3. **Demonstrate:** Next, we analyze, scale up, and validate the most promising ideas through comprehensive bench testing, studies, and modeling. By substantiating our alternatives in a controlled environment, we bolster our clients' confidence in full-scale implementation.
- 4. **Implement:** Once we've verified a solution's benefits and limitations, we execute it with our clients and partners across the country. With every project, implementation balances effectiveness, resiliency, cost, accessibility, and operational demands.
- 5. **Share:** Finally, to expand the awareness and adoption of new solutions, we share the outcomes of our process through knowledge-transfer workshops, conferences, and regional, national, and international publications.

*With our sights set on what more we can do, this living process is continual, ever-evolving, and requires being attuned to our clients, their water systems, and the communities they serve.*







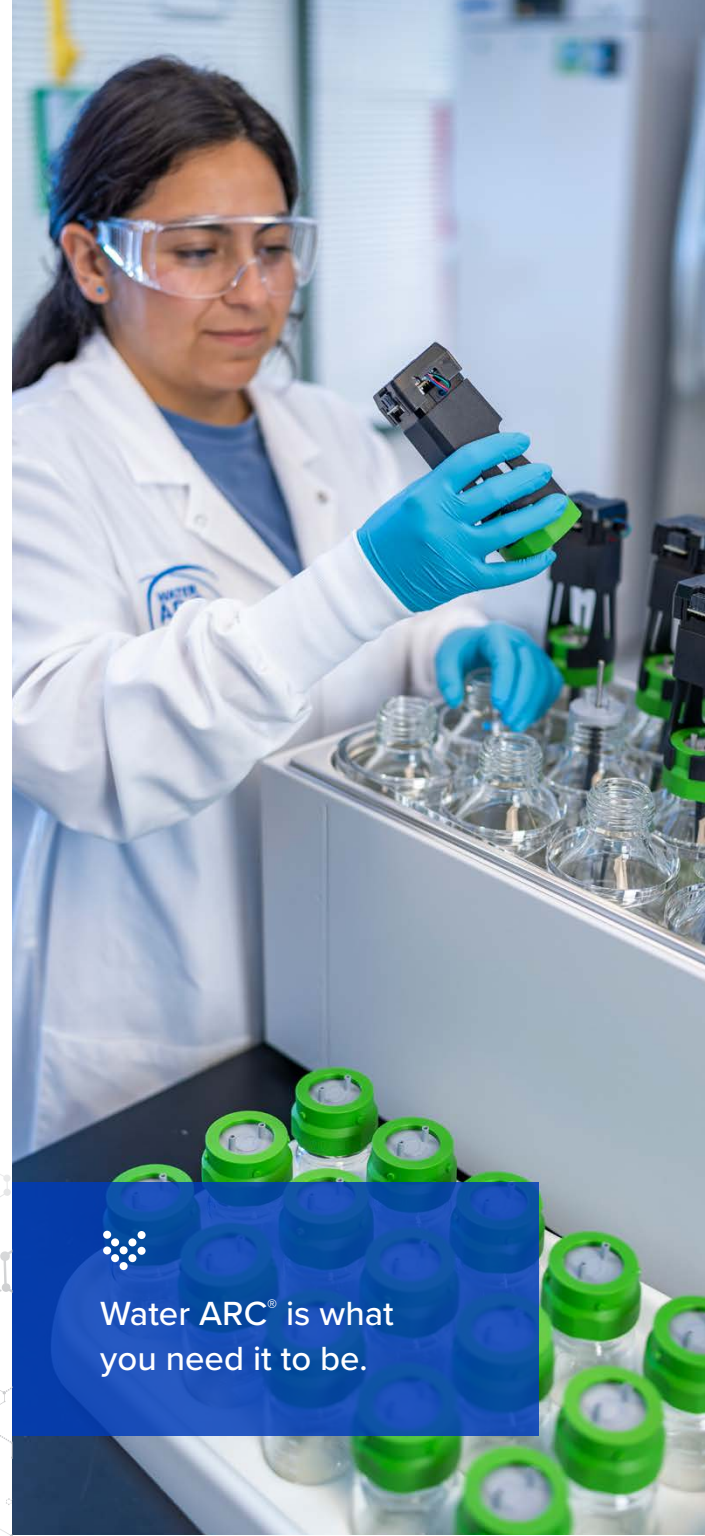
# Applied Research by Design

Carollo Engineers operates the 8,900-square-foot Water Applied Research Center (ARC®), dedicated to serving the strategic planning needs of both our municipal and private sector clients.

This state-of-the-art R&D hub offers laboratory-based bench treatability testing and full-service support for field, pilot, and demonstration studies. Its facilities also bolster equipment testing, training, troubleshooting, and quality control reviews and features a fabrication workshop to develop and build custom bench- and pilot-scale testing equipment. From single-sample tests to bench and pilot tests simulating multiple treatment processes, Water ARC® can scale up or down to meet any request.



SCAN TO SEE MORE.



Water ARC® is what you need it to be.

And, because Water ARC®'s activities are intersectional with Carollo Engineers' vision, its full-time staff of process experts, laboratory technologists, and mechanical engineers robustly collaborate with our firm's design and project teams. Together, we refine our R&D efforts against each client's specific conditions and project requirements, so that viable alternatives can be thoroughly tried and tested with us before being implemented at the pilot or full scale.

Whether improving existing processes and technologies or minimizing risks for early adopters of new technologies, Water ARC® is equipped to deliver a full range of applied research services.

## Some of Water ARC®'s testing capabilities include:

- Adsorptive media
- Advanced oxidation
- Biological filtration
- Coagulation/flocculation/sedimentation
- Disinfectant dose response
- Flavor profile analysis
- Lead and copper corrosivity studies
- Microfiltration (MF) and ultrafiltration (UF)
- Nutrient removal studies
- Organics characterization
- Ozone
- PFAS media
- Reverse Osmosis
- Simulated distribution system tests
- Ultraviolet disinfection



Located in Boise, Idaho, Water ARC® manages a multi-million-dollar inventory of custom-made, pilot, and demonstration-scale equipment.

# Pioneering research is the cornerstone of our industry

As a primary author and co-author to hundreds of industry guidance manuals and references, Carollo Engineers has contributed to many of our industry's standards and best practices. The shared results of our collaborative R&D have benefited the entire water sector.

**carollo®**

For more information about Research and Development at Carollo Engineers, contact Dr. Jess Brown at [jbrown@carollo.com](mailto:jbrown@carollo.com).

