CAROLLO ENGINEERS VOLUME 2 2023

currents

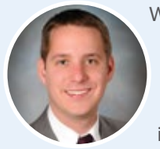
WORLD'S FIRST PFAS REGULATION

HOW TO COMPLY WITH THE PROPOSED RULE

PLUS — Get to Know Carollo's EPIC® Group | Reducing Flood Risk in Aurora, Colorado

THIS ISSUE'S EDITORIAL

NICK WEBBER, PE (nwebber@carollo.com)



Welcome to ***Currents*** 2023 Volume 2!

In this issue's feature story, you'll read about the EPA's upcoming PFAS regulation that was announced in March this year. We present the proposed maximum contaminant levels (MCLs) and Hazard Index (HI) for PFAS compounds, and highlight many site-specific factors that can impact PFAS treatment.

With a quick Q&A session, get to know our EPIC® group—a one-stop shop for all your electrical, programming, instrumentation, and control needs.

And finally, read about a flood mitigation project in Aurora, CO, which used sewer modeling and CMAR delivery to achieve success and finish under budget.

Please reach out to me or the primary authors if you have any questions or comments. Enjoy and take care!

IN THIS **ISSUE**

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Get to Know Carollo's EPIC® Group

Electrical + Programming + Instrumentation + Control = EPIC® Solutions

EPIC® provides a one-stop shop for an array of electrical, programming, instrumentation, and control services — from the planning phases to design and through implementation. Our engineers and programmers use a unique collection of tools and methodologies to get stakeholder input and generate ideas that gain support and are financially defensible. With these plans, we help our clients manage their assets, migrate to new systems, and update their critical infrastructure so they can face the challenges that lie ahead.

OUR EPIC® SPECIFIC SERVICES INCLUDE:

- Master planning
- Electrical systems and arc flash studies
- Full-service electrical and I&C design
- Control and business systems network design
- Electrical safety programs
- Cybersecurity program development
- Human-Machine Interface (HMI) and PLC migration
- Programming standards development
- Radio and telemetry system planning and design

A Minute with EPIC® Leaders:

Jeff Martin and Monte Richard

Public agencies across the country continue to face challenges managing their assets, migrating to new systems, and updating their critical infrastructure. These challenges also affect the electrical and I&C fields. Carollo created the EPIC® group to help our clients face the challenges that lie ahead in this area. EPIC® leaders, Jeff Martin and Monte Richard, talk more about the EPIC® group below.

WHAT IS THE PURPOSE AND THE VALUE OF THE EPIC® GROUP?

Our EPIC® team, comprised of more than 125 engineers, designers, and programmers, is devoted to finding the most reliable power and control solutions available and customizing them to provide best-in-class solutions that fit our clients' unique needs. In today's world, automation and a reliable power system are critical to the success of any utility. Our EPIC® group aims to provide simplified, reliable, and efficient solutions, serving all of our water and wastewater clients' electrical, instrumentation, control, and programming needs.

WHAT MAKES THE EPIC® GROUP DIFFERENT?

The integration of our services, from planning phases to design and through implementation, make EPIC® stand out in the industry. Our collaborative approach includes regular solicitation of stakeholder input, which allows us to understand our clients' needs and design customized solutions and systems that they can be proud to operate. The spectrum of our services is broad, ranging from advanced predictive controls to holistic power-saving techniques, leading to optimized processes and making operations and maintenance staff more efficient.

HOW DOES THE EPIC® GROUP RANK IN THE INDUSTRY?

Since 2008, Electrical Construction & Maintenance (EC&M) has continuously rated our electrical group among the top 21 electrical design firms in the United States.

For more information on our EPIC® group, please reach out to Jeff Martin (jmartin@carollo.com) or Monte Richard (mrichard@carollo.com).

EPIC® combines Carollo's EI&C design group with its programming services to find the most reliable power and control solutions specific to our clients' needs.

EPIC® AT-A-GLANCE

125+ ENGINEERS, DESIGNERS, AND PROGRAMMERS

TOP 21 ELECTRICAL DESIGN FIRM IN THE US

2013 YEAR EPIC® WAS ESTABLISHED

2,878 EI&C PROJECTS COAST-TO-COAST

PROPOSED PFAS

National Primary Drinking Water Regulation:

Potential Implications and Solutions for Drinking Water Utilities

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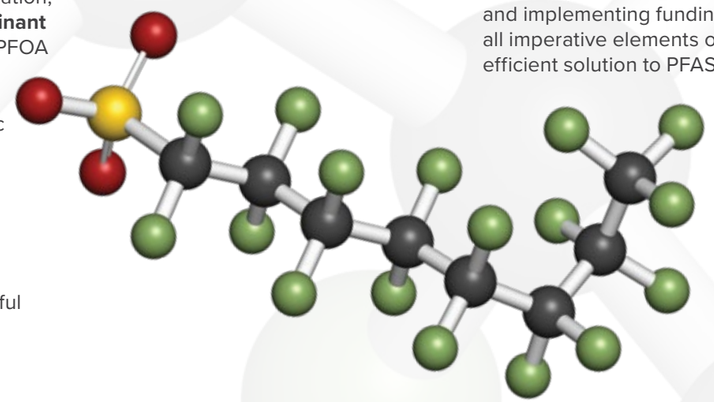
On March 14, 2023, the Environmental Protection Agency (EPA) announced the proposed National Primary Drinking Water Regulation (NPDWR) for six per- and polyfluoroalkyl substances (PFAS). Once finalized, this rulemaking would mark the first PFAS drinking water regulation around the globe.

PFAS COMPOUNDS PROPOSED FOR REGULATION

Name	Acronym	Chain Length	Class
Perfluorooctanoic acid	PFOA	O = octa (8 carbon)	Carboxylic Acid
Perfluorooctanesulfonic acid	PFOS	O = octa (8 carbon)	Sulfonic Acid
Perfluorohexane sulfonic acid	PFHxS	Hx = hexa (6 carbon)	Sulfonic Acid
Hexafluoropropylene oxide dimer acid	HFPO-DA	H = hexa (6 carbon)	Dimer Acid
Perfluorononanoic acid	PFNA	N = nona (9 carbon)	Carboxylic Acid
Perfluorobutane sulfonic acid	PFBS	B = buta (4 carbon)	Sulfonic Acid

PROPOSED MAXIMUM CONTAMINANT LEVELS

EPA established that PFOA and PFOS are likely carcinogens and a safe threshold for drinking water exposure cannot be determined. Therefore, EPA proposed to set the non-enforceable, health-based Maximum Contaminant Level Goal (MCLG) for both PFOA and PFOS at zero. Taking PFAS analysis, treatment feasibility, and cost factors into consideration, **EPA proposed an enforceable Maximum Contaminant Level (MCL) of 4.0 nanograms per liter (ng/L)** for PFOA and PFOS, individually. EPA also determined that 4.0 ng/L is the lowest concentration that PFOA and PFOS can be reliably quantified within specific limits of precision and accuracy across various EPA-certified laboratories nationwide. EPA also considered alternative MCLs for PFOA and PFOS, at 5 ng/L and 10 ng/L, respectively. However, EPA concluded that raising the MCL would result in millions of Americans continuing to be exposed to PFOA and PFOS at levels that are potentially harmful and would not be justifiable under the Safe Drinking Water Act statutory criteria.



THE HAZARD INDEX (IT IS NOT JUST ABOUT PFOA AND PFOS)

Because of their co-occurrence and additive toxic effects, EPA proposed using a Hazard Index (HI) approach to regulate the mixture of PFHxS, HFPO-DA and its ammonium salts (GenX chemicals), PFNA, and PFBS. The proposed HI for a certain mixture is based on the measured PFAS concentrations and the relative health risks associated with individual compounds. A maximum allowable HI of 1.0 has been proposed for both the MCL and MCLG for the mixtures of these four PFAS compounds. HI calculation is presented in the following equation.

$$HI = \frac{([PFHxS])}{(9\ ng/L)} + \frac{([GenX])}{(10\ ng/L)} + \frac{([PFNA])}{(10\ ng/L)} + \frac{([PFBS])}{(2{,}000\ ng/L)}$$

TIME IS OF THE ESSENCE

Public water systems will have 3 years upon the promulgation of the rule to meet the compliance requirements. Utilities may request an extension of up to two additional years if more time is needed for capital improvements. For utilities where additional treatment is anticipated to address the proposed regulation, the clock is ticking!

ADDRESSING PFAS CONTAMINATION IN DRINKING WATER IS MORE THAN JUST TREATMENT

Complying with the upcoming regulation is not just identifying the most cost-effective treatment technology. Addressing PFAS contamination in drinking water is an evolving task that could be simplified by proactive planning. **It is never too late for utilities to characterize PFAS occurrence and obtain a good understanding of potential PFAS sources.** Assessing community-wide source mitigation opportunities with regional partners and preventing PFAS from entering the local drinking water supplies shall take the priority alongside the development of potential treatment strategies. Alternative water supply planning, determining the level of treatment required for specific source(s), developing a public engagement plan to facilitate public education and communication, regulatory approval planning, and implementing funding strategies to support capital improvements are all imperative elements of proactive planning that will result in a holistic and efficient solution to PFAS contamination in the long run.

Treating PFAS is not only about technology selection among GAC, ion exchange, and high-pressure membranes. The feasibility and economics of PFAS treatment can be impacted by many site-specific factors, as shown on the right. Although the specific drivers will continue to evolve, it isn't too early for utilities to start investing in understanding their own opportunities and challenges as they relate to addressing PFAS in the overall water cycle within its own communities.

FACTORS IMPACTING PFAS TREATMENT

- Site constraints
- Other water quality challenges and treatment goals, such as manganese, taste and odor compounds, disinfection byproduct precursors
- Integration into existing treatment trains
- Avoidance of change in finished water quality or other unintended consequences
- Degree of treatment system flexibility
- Equipment and material availability
- System operation (e.g., desired level of automation)
- Treatment residual management approach
- Project schedule and delivery approach
- Funding mechanisms and opportunities
- Compliance schedule and public perception

REDUCING FLOOD RISK in a Highly Urbanized Area

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City of Aurora, CO – Fitzsimmons-Peoria Stormwater Outfall Project

Most urban areas in the U.S. were built before stormwater managers truly understood the extent of the impact of converting pervious areas into impervious areas or just how much the population would grow—both in number and geographic area. As a result, a significant portion of stormwater infrastructure, particularly in the older portions of our cities and towns, are well undersized for the intended levels of service.

REDUCING FLOODING RISK IN AN OLDER PORTION OF THE CITY OF AURORA

A highly congested and rapidly developing area of the City was subject to chronic flooding due to undersized stormwater infrastructure constructed in the 1970s. As a result, the City prioritized the implementation of the Fitzsimmons-Peoria Stormwater Outfall Project to comply with current stormwater standards.

The project was a large-scale effort that replaced approximately 15,000 feet of aging, 24- to 96-inch storm drain pipes through a highly urbanized area that is undergoing rapid redevelopment. **The improvements will provide improved flood protection for approximately 230 residences and 40 businesses.**

To improve success in meeting these goals, Carollo assisted the City with contracting a Construction Manager at Risk (CMAR) contractor, BT Construction. Our final design efforts were completed as a collaborative team consisting of the City, the CMAR contractor, and Carollo. Together, we evaluated alternatives to mitigate these constraints throughout the project while minimizing public disruption and project cost.

Notable Project Design Elements

- **Minimizing construction impact.** Measures were taken to minimize disruptions to the community, as portions of the existing infrastructure flow through highly developed areas.
- **Trenchless crossings of major roadways.** These were needed to minimize traffic disruptions. Variability in ground conditions required different trenchless technologies to ensure successful installations.
- **Discharges not affecting the regulated Sand Creek floodplain.** Our team proved that the increased flows would result in a no-rise condition of the floodplain to avoid a Letter of Map Revision (LOMR).

SEWER MODELING AND ENHANCED CONSTRUCTION TECHNIQUES

Computer Modeling Efforts

Carollo conducted a complex computer modeling effort using InfoWorks ICM in both 1-dimensional (1-D) and 2-D components. These models were constructed to confirm that the new stormwater pipeline and connections were sized to adequately convey predicted stormwater flows, reducing the risk of flooding. The 1-D components evaluated underground infrastructure; the 2-D components evaluated how much stormwater would remain on the ground surface.

Pipeline Design and Construction

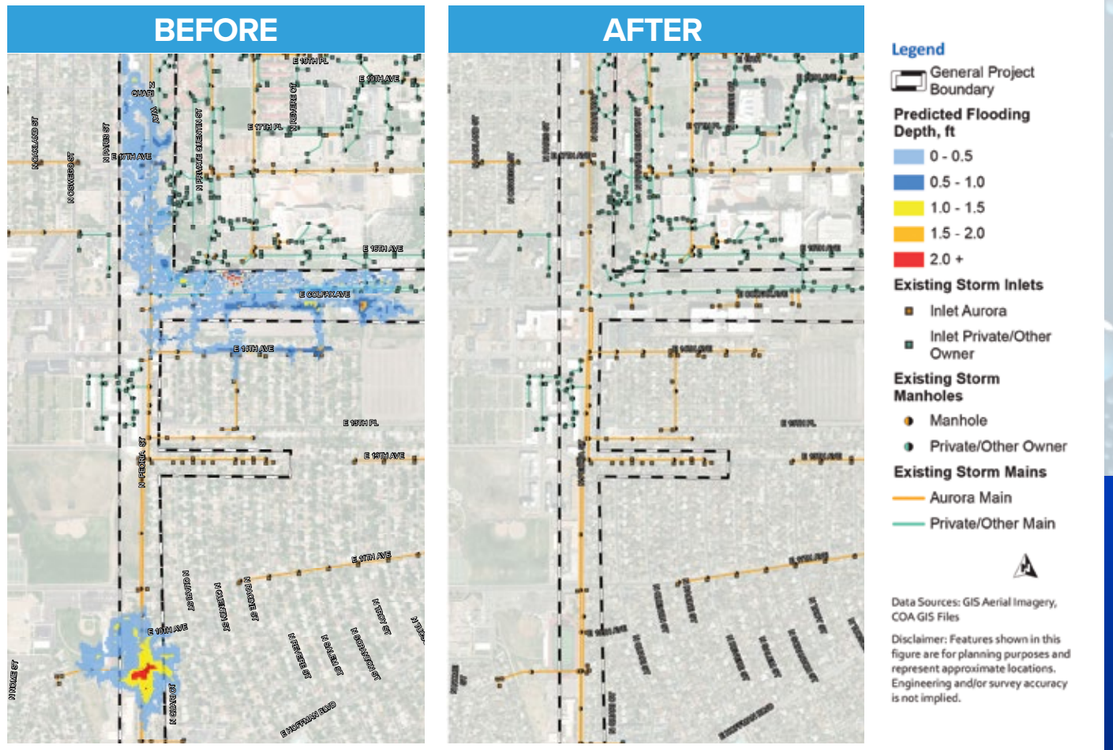
Pipeline routing was established to protect existing utilities and infrastructure while minimizing disruptions to traffic. Pipeline alignments were selected with consideration to construction sequencing, required traffic control devices and diversions, cost, and construction duration. The project also required numerous large manholes and junction structures. These structures were designed as a combination of both cast-in-place and pre-cast structures, with a preference for pre-cast to minimize construction duration where feasible.

Most of the pipeline was constructed using open trench construction with passive shoring (trench boxes) and some limited active shoring (slide rail with minimal dewatering needed using sump pumps). Four major arterials required large diameter trenchless crossings. The variability of ground conditions required a combination of open face tunnel boring machine (TBM) for two of the tunnels and closed face microtunnel boring machine (MTBM) for the other two crossings. The City, CMAR contractor, and Carollo evaluated each construction technique and approach with consideration to cost, feasibility, safety, and minimizing public impact.

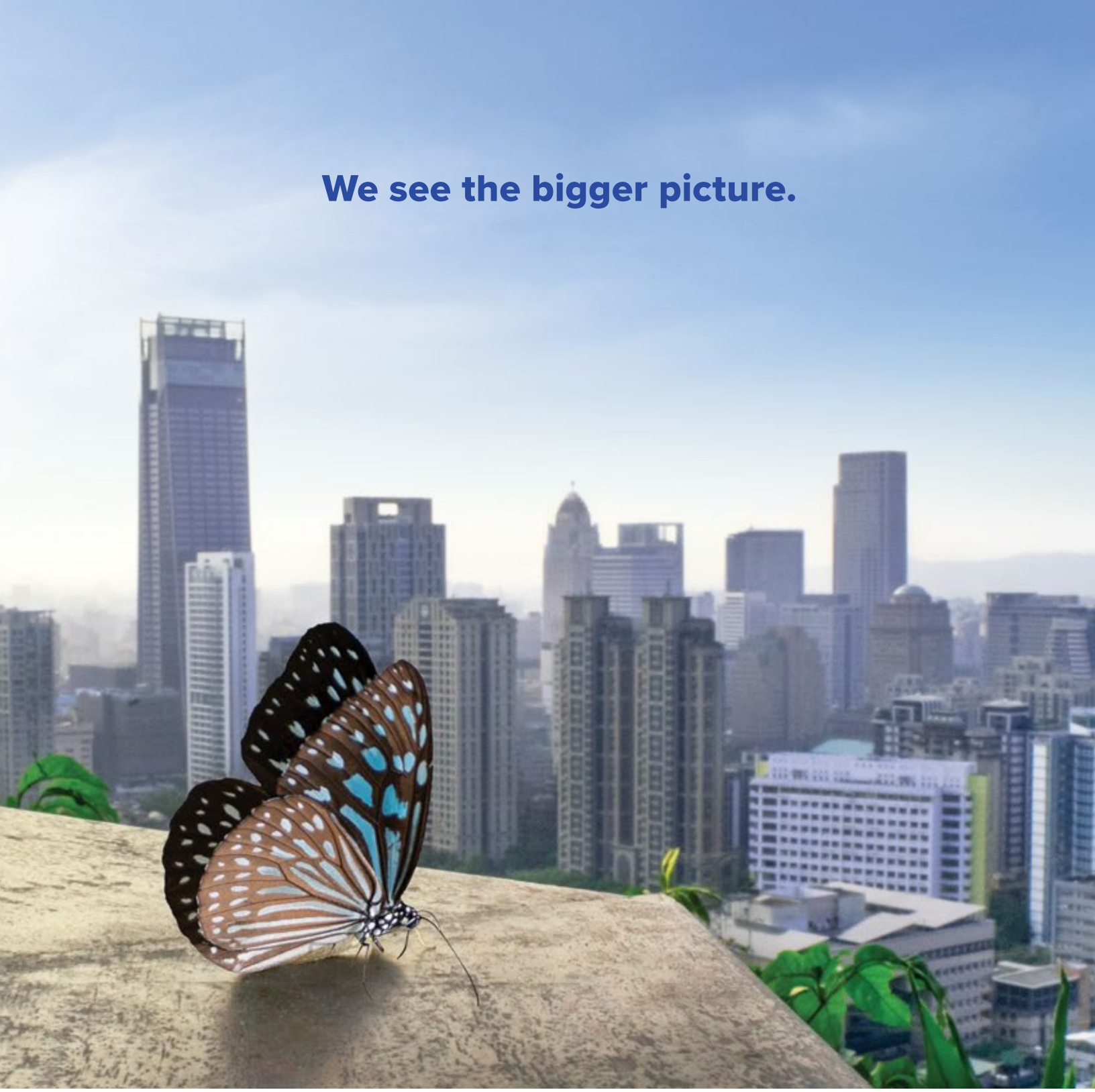
SUCCESSFUL PROJECT OUTCOME AND DELIVERY

The new storm drain system has the capacity to collect and convey a larger flow rate to the discharge at Sand Creek. Carollo performed Hydrologic Engineering Center's River Analysis System (HEC-RAS) modeling of Sand Creek utilizing the existing published Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) maps and base flood elevations with new flow rate inputs for the project basin. While the discharge flow rate increased significantly, the discharge time was well ahead of the peak attenuation of base flood elevations at our discharge location. Therefore, we were able to prove a no-rise condition and avoided the need to submit a LOMR.

Using the CMAR delivery method, the City was able to develop alternatives during the design phase that improved basin stormwater management, mitigated risk, minimized public impacts, and totaled an overall cost within the Contractor's $31M Guaranteed Maximum Price.



The flooding predictions for an Aurora neighborhood were modeled using InfoWorks ICM software. The results of the model for the 100-year design storm event are depicted in the above graphics, and highlight the reduction in flooding predictions once the proposed changes are completed.



We see more in water—more than the science, more than the planning, and more than the design. We see the families and communities we serve, and the increasingly fragile ecosystems we must protect. For 90 years, we've been inspired to develop the most innovative solutions in the water industry, designed to improve our lives and the lives of all living things. It just doesn't get any bigger than that.

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