CAROLLO ENGINEERS VOLUME 2 2020 **SPECIAL EDITION**

currents

WATER RESOURCES MANAGEMENT

WORKING TOGETHER TO BUILD A RESILIENT FUTURE

PLUS —

- An Intro to Our Water Resources Practice
- One Water Services
- Stormwater Services
- Water Supply Planning Services
- Climate Change and Resilience Services

THIS ISSUE'S Editorial

KEN WILKINS, PE (kwilkins@carollo.com)

Water is a life-essential element. We need it for our health. Our ecosystems depend on it. And we know that our most precious resource is at risk. We are reminded every year of new, unfamiliar challenges that threaten the quality and quantity of our water supplies. Water scarcity has created unprecedented stresses between urban, rural, and environmental water needs. On the other side of the spectrum, we are confronted by the power of water excess, and the resulting outcomes of unprecedented storm and flood events.

We all understand the importance of water management, and the need to adapt to address current and future challenges. Because historical norms no longer provide a reliable benchmark for the future, we must drive change, and recast our science, engineering, and innovation so that we are better prepared for the "new normal."

Across the country, each geography has its own unique challenges. There is no single "one size fits all" approach to water resources management. Toward that end, we continue to evolve our water resources practice capability and capacity to deliver best-in-class One Water supply, resilience, and stormwater services.

In this issue of *Currents*, we highlight our core service lines, and feature projects that define our water resource practice, including planning and design services, all with our continued focus to create a more resilient and sustainable future.

IN THIS ISSUE

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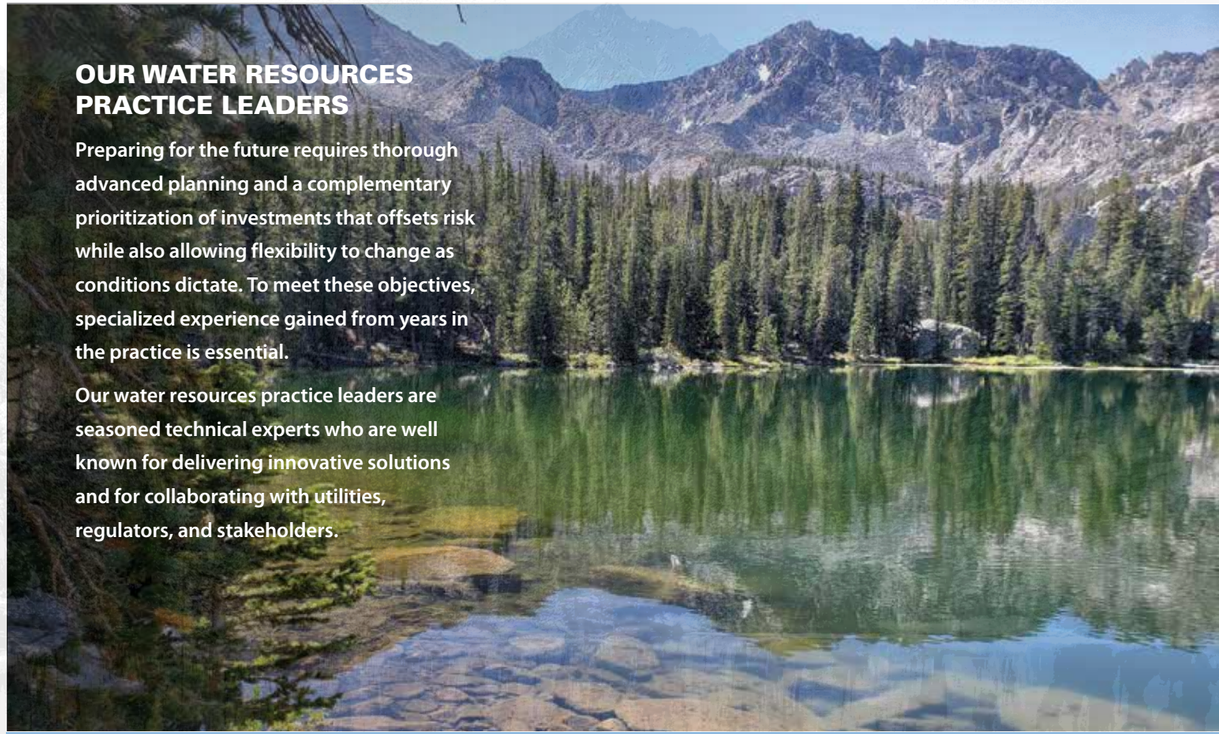
WATER RESOURCES

HOLISTIC MANAGEMENT OF OUR WATER RESOURCES IS ESSENTIAL FOR A SUSTAINABLE FUTURE



OUR WATER RESOURCES PRACTICE LEADERS

Preparing for the future requires thorough advanced planning and a complementary prioritization of investments that offsets risk while also allowing flexibility to change as conditions dictate. To meet these objectives, specialized experience gained from years in the practice is essential.

Our water resources practice leaders are seasoned technical experts who are well known for delivering innovative solutions and for collaborating with utilities, regulators, and stakeholders.

Inge Wiersema, PE, ENV SP

Water Resources Practice Lead & National One Water Services Lead

Inge serves as Carollo's Water Resources Practice Lead and national One Water leader. During her 25-year career, she has specialized in strategic water resources planning, as well as traditional utility master planning for water, wastewater, stormwater, and recycled water systems. During the past five years, she has been focused on One Water planning, bringing all elements of the water cycle together with innovative and sustainable solutions.

Jim Rasmus, PE, BCEE, ENV SP

Stormwater Management Services Lead

Jim serves as the leader of Carollo's Stormwater and Green Infrastructure service line. His 33-year career has been focused on the planning, design, and construction of major water resources projects. He brings experience in watershed management planning and green infrastructure projects to manage stormwater in the urban environment with a multi-benefit approach.

Heather Harris, PE

Texas Stormwater Services Lead

Heather serves as the leader of Carollo's stormwater practice in Texas. She has led and designed numerous stormwater management projects over the course of her 21-year career. She brings keen understanding of stream restoration/stabilization and stormwater management challenges, both in quantity and quality. Previous leadership positions include the Stormwater Committee Chair for both the Texas WEA and the national WEF, and the Advisory Committee to the WEF Stormwater Institute.

Elisa Garvey, PhD, PE

Water Supply Planning Services Lead

Elisa has 18 years of water resources experience and serves as the leader of the Water Supply Planning service line of Carollo's Water Resources Practice. She specializes in water resources planning, including groundwater, stormwater, and watershed management planning, as well as water quality studies. She brings a watershed thinking approach that incorporates the entire water cycle from raw water supply to wastewater and reuse.

Sarah Deslauriers, PE, ENV SP

Climate Change and Resilience Services Lead

Sarah serves as the leader of the Climate Change and Resilience service line. She has 18 years of national experience and specializes in climate change resilience analyses, greenhouse gas emission management, and vulnerability assessments in the water and wastewater sectors. She also brings expertise in water and air quality monitoring and laboratory analysis, master planning, and life-cycle assessments.

One Water
Delivers Integrated Solutions on a Watershed Scale

INGE WIERSEMA, PE, ENV SP (iwiersema@carollo.com)

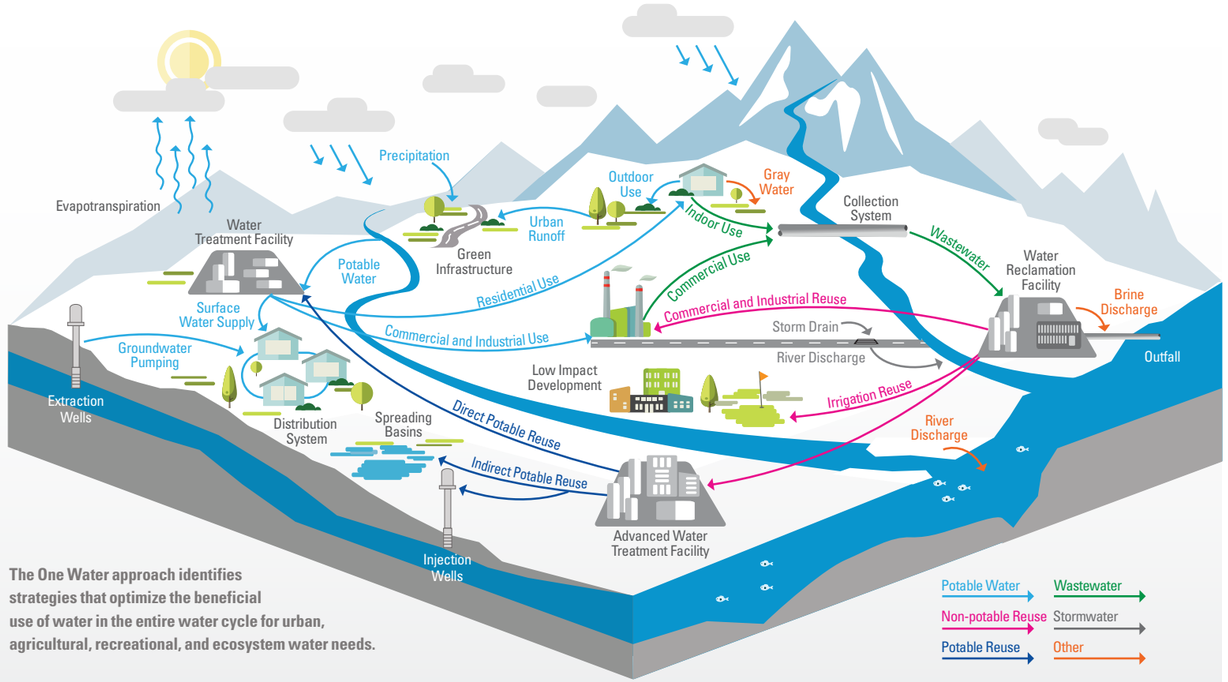
One Water can mean many things to many people. However, there are common themes, often included in One Water vision statements. Carollo has facilitated One Water visioning exercises for multiple clients across the United States using various tools and tactics. For example, we recently used instant polling word clouds and conducted a virtual brainstorming exercise using a web-based "sticky note wall" to quickly and effectively adapt to the current COVID-19 situation. This has allowed us to collaborate remotely in new and fun ways!

Today's complex water challenges require creative solutions. As part of those solutions, more and more communities are adopting a "One Water" approach to achieve sustainable, reliable, and resilient water systems, which consider the entire water cycle as an integrated system and promote collaboration beyond typical institutional boundaries.

Carollo's focus and passion for water, combined with our collaborative culture and emphasis on innovation, are a perfect match to support our clients with implementing a One Water approach.

As a One Water leader, we deliver water management solutions for our clients that achieve the following:

- **Promote Watershed Scale Collaboration.** We partner with utilities to facilitate a collaborative process that brings a variety of perspectives and parties together to achieve a common vision.
- **Provide Multi-benefit Solutions.** Our focus is to identify and implement affordable and equitable solutions that provide multiple benefits and balance urban, rural, and ecosystem needs.
- **Achieve Sustainability and Resilience.** We incorporate sustainable and resilient strategies to manage our finite water resources as One Water.



The One Water approach identifies strategies that optimize the beneficial use of water in the entire water cycle for urban, agricultural, recreational, and ecosystem water needs.

ONE WATER PLANNING

Carollo's long history of integrated master planning has provided a solid foundation for our water resources planning team to embrace the One Water framework. Some recent One Water planning efforts that Carollo has worked on include One Water LA, One Water Morro Bay, and the Denver One Water Plan.

Our experience demonstrates that the One Water approach can be applied to agencies of any size, from those serving a population of 10,000 to 4 million. We work with utilities to take a phased approach to develop a One Water Vision and define plan objectives to tailor our work to meet the desired outcomes and local priorities.

We intentionally engage multiple agencies and stakeholder outreach elements when developing the community's plan. The key to success is a prioritized or trigger-based implementation plan with some quick victories that can be accomplished in the near-term to create momentum, making the One Water vision a reality!

CITY OF MORRO BAY, CA

POPULATION: 10,000

Carollo prepared an integrated master plan for the City of Morro Bay that considered the entire water cycle. With sea level rise triggering the need to relocate the water reclamation facility, new supply options such as ocean desalination, indirect potable reuse, and groundwater were evaluated to reduce dependence on imported water and achieve long-term supply resilience and reliability.

CITY AND COUNTY OF DENVER, CO

POPULATION: 620,000

The Denver One Water Plan is a collaborative effort of the City and County of Denver, the Mile High Flood District, the Water Connection, Denver Water, Metro Wastewater Reclamation District, and the Colorado Water Conservation Board. Carollo is working across these institutional boundaries to develop a collaboration framework and policies that enhance watershed health while meeting urban, rural, and ecosystem water needs.

CITY OF LOS ANGELES, CA

POPULATION: 4 million

Carollo led a team of 20+ subconsultants to identify collaboration opportunities to integrate the entire water cycle. The plan guides the City with billion-dollar water infrastructure decisions needed to achieve the water goals of the Sustainable City Plan. Carollo helped the City actively engage the diverse group of stakeholders throughout the planning process, including the prioritization of water supply strategies and development of policy ideas.

WATER RESEARCH FOUNDATION
Assessment Framework and Rating System for One Water Cities

The purpose of The Water Research Foundation Project #4969 is to develop an assessment framework and rating system that allows utilities to measure progress toward implementing One Water principles. Carollo is excited to be part of a new partnership with the One Water Solutions Institute of Colorado State University and the Institute for Sustainable Infrastructure, conducting interviews with a wide range of utilities across the United States and internationally. Our literature research, a broad utility survey, interviews, and case studies will be used to develop a One Water Guidebook and Rating System for One Water cities. Stay tuned for more information as this initiative takes shape!

Colorado State University · One Water Solutions Institute · carollo · Institute for Sustainable Infrastructure · The Water Research Foundation

STORMWATER MANAGEMENT

Meeting Challenges with a Solution That is Right for You

JIM RASMUS, PE, BCEE, ENV SP (jrasmus@carollo.com) ■ **KEN WILKINS, PE**

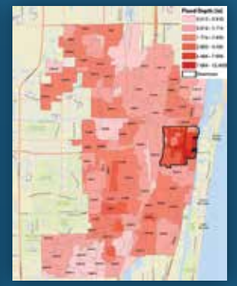
From a water resource perspective, stormwater presents both threats and opportunities. In many areas, the risk and consequences of extreme flooding pose an immeasurable threat to our health, safety, and economic well-being. In other locations, there are benefits to treating stormwater to remove potentially harmful contaminants from this precious resource, or to capturing or repurposing the stormwater as a supplemental supply source. These benefits represent transformative opportunities to improve supply resilience and ecosystem vitality.

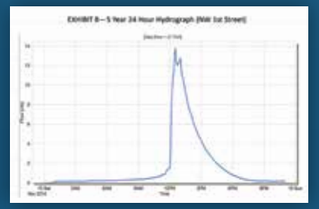
In either case, addressing stormwater challenges requires adaptive, innovative solutions that address interrelated—and often competing—technical, institutional, and policy-level elements as projects mature from planning through implementation.

ADDRESSING THE THREAT: ADVANCED MODELING YIELDS AFFORDABLE GREEN SOLUTION FOR FLOOD-PRONE AREAS

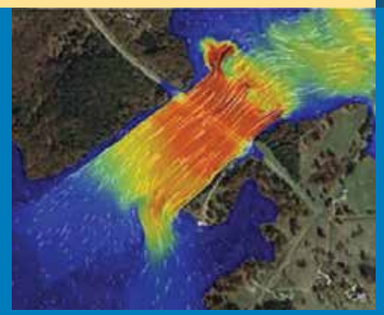
The community of Boynton Beach, Florida, is experiencing a "new normal" relative to more severe rainfall and flooding. The impacts of flooding to the community are significant and limit basic daily functions, from school pickup and drop-off to emergency vehicle access and egress.

To reduce flooding hazards in the community, Carollo modeled 69 miles of drainage facilities with InfoSWMM, a stormwater modeling and simulation software, and used the hydrologic and hydraulic model results to prioritize 10 capital improvement projects. These projects included drainage upgrades, new pipelines, storage facilities, and green infrastructure to control flooding and improve water quality throughout the community. The projects were completed for a total of $11.8M.





To mitigate recurring flooding in Boynton Beach, Carollo modeled 69 miles of drainage facilities and identified 10 new stormwater mitigation strategies.



Carollo has completed a 2D HEC-RAS 5.0 over-topping analysis for Franklin County Water District on their earthen emergency spillway. Results above show the water velocities over the roadway downstream.

Floodplain Modeling for Extreme Event Provides Basis for Dam Spillway Improvement, Franklin County Water District, Texas

HYDRAULIC AND HYDROLOGIC (H&H) EVALUATIONS. After a flood event that saw the water surface elevation at Lake Cypress Springs rise to a maximum of 383.92 feet, Carollo completed a feasibility analysis for structural alternatives to curtail flooding, completed a hydraulic analysis on the Morning Glory Spillway, and evaluated the emergency spillway using 2D HEC-RAS modeling. The Carollo team also determined the requirements from various regulatory agencies to construct the alternatives, evaluated water rights scenarios, and determined the associated costs.

HIGHLIGHTS

- Provided H&H analyses to determine a solution to diminish flooding events.
- Involved water resources, floodplain/stormwater management, 2D modeling, and water rights analysis.
- Provided the District with recommendations and public presentations to involve the community in the decision-making process.

On Lankershim Boulevard in North Hollywood, we updated an existing design to provide flood control and groundwater supply benefits through the use of drywells.

STORMWATER **AS A RESOURCE**

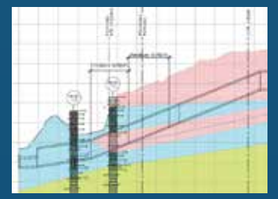
The Carollo team has served in significant leadership roles in stormwater and green infrastructure projects for the City of Los Angeles. Our engagement began with early involvement in planning and designing a variety of green infrastructure projects funded by Proposition O, the City's $500M bond fund dedicated to stormwater quality, which was initiated in 2006. From this effort, our team was hired to help the City optimize 11 multi-benefit green infrastructure projects in 2014.

In November 2018, the County of Los Angeles passed Measure W, a dedicated tax measure to fund $285M per year exclusively for stormwater quality projects. In 2017, the City turned to the Carollo team to assist them with program management services to best prepare for this funding. This effort included financial planning, resource planning, project delivery, project prioritization, and project controls. The team is working to provide conceptual and preliminary design services for over 25 regional-scale water quality improvement projects.

Dashboards developed by the Carollo team helped the City visualize, evaluate, prioritize, and select projects with the highest scores.

FOCUS ON **PROJECT IMPLEMENTATION**

Rigorous Engineering Analysis Translates to Low-cost, Low-risk Construction



Managing runoff from extreme storm events can translate to large gravity conveyance systems. In many instances, the gravity flow dictates deep pipe installation, which adds risk and can require costly specialty construction methods.

Our experience on several projects shows that a rigorous route analysis, coupled with thorough geotechnical investigations, often leads to lower-cost, lower-risk design and construction alternatives. Examples include avoiding soil transition zones and changes in pipe slope and depth.

Thoughtful Outreach Strategy Can Change Impacted Customers to Collaborative Advocates

New stormwater conveyance solutions often impact residents during construction. The magnitude of those effects will vary from modest to severe disruptions to traffic and access and egress to homes, as well as general disruption of necessary daily activities.

Our experience on several projects shows that residents' concerns can most often be addressed through open dialogue and simple modifications to project elements. Examples of modifications include limiting construction to non-peak travel hours or making special provisions to keep daily routines, such as school drop-off and pick-up, unimpaired.

WATER SUPPLY PLANNING

Our Future Depends On It!

ELISA GARVEY, PhD, PE (egarvey@carollo.com)

Reliable and resilient water supplies are the lifeblood of our communities. In the 2019 State of the Water Industry Report (AWWA, 2019), water industry professionals ranked the top 10 most important issues, with long-term water supply coming in 3rd place, watershed/source water protection in 5th place, and groundwater management/overuse in 7th place. These concerns are compounded by the uncertainty and potential adverse impacts of climate change on water supply and water quality:

- More intense short-term and prolonged droughts.
- Reduced surface water and groundwater availability.
- Decrease in river, streams, and lake water quality.
- Increased water demands and consumptive use.

Carollo is on the forefront of helping utilities with water supply planning, addressing a variety of issues and developing a range of solutions from those with a singular focus to fully integrated approaches. As each water utility faces its own set of unique challenges, we tailor our planning approach to deliver plans that simultaneously support a long-term vision and short-term needs.

While we can characterize these national trends in water supply issues and the potential water supply impacts from climate change, the needs of water purveyors across the country are highly variable with respect to the specific issues, the scope of the issues, the scale of the system, and the degree of anticipated change in future hydrologic conditions. Across the country, water agencies are responding to current and future water supply needs by planning and implementing projects from potable reuse to desalination to stormwater capture.

With 40 percent of water industry professionals feeling only moderately or less than moderately prepared (AWWA, 2019) to address long-term supply needs, there is much work to be done! Carollo's Water Supply Planning group is expanding to help utilities across the country do just that. This growing group of passionate water planning professionals delivers a wide range of services, such as groundwater sustainability plans, surface water models, watershed management studies, water conservation analysis, and integrated water resources plans.

Making Use of a Compromised Groundwater Source

BRACKISH DESALINATION STUDY – AUSTIN, TX

Drawdown of the Barton Springs Edwards Aquifer during drought conditions is linked to adverse impacts on the quality and quantity of Barton Springs, which supports endangered species habitat and recreation. The Barton Springs Edwards Aquifer Conservation District needs additional water supplies that would allow them to reduce extractions from the Edwards Aquifer during drought conditions. The feasibility study investigated alternatives that included brackish groundwater desalinization combined with aquifer storage and recovery, and a green power source (landfill methane) to offset the facility's energy demands.

Rethinking Supply Availability

NON-POTABLE WATER STRATEGIC PLAN – AURORA, CO

Aurora Water recognized the potential to optimize various water supplies to efficiently meet short-term and long-term demands. The optimization process began with a collaborative workshop aimed at challenging the previous assumptions regarding various water supplies and availability of each supply. A new basis for developing water supply strategies was established in the plan, including the use of untreated mountain supplies, untreated lower South Platte return flows, and under-utilized winter flows from the Sand Creek Water Reuse Facility.

Developing Regional Water Supply Solutions through Collaboration

POLK REGIONAL WATER SUPPLY DEVELOPMENT PROJECT – POLK COUNTY, FL

While fresh groundwater from the Upper Floridan Aquifer is currently the source of potable water supply for essentially all of Central Florida, regulators have determined that future potable water supplies must come from alternative sources. As new water supplies were expected to involve sources that were distant and expensive to treat, it became necessary to share alternative water supply sources among communities to reduce costs and maximize opportunities for co-funding. The feasibility study involves investigation of over 260 miles of pipeline route alternatives, preliminary designs of two new reverse osmosis water treatment plants, and conceptual designs of two surface water facilities with an aquifer recharge facility option.

Improving Groundwater Sustainability

PASO BASIN SUPPLEMENTAL WATER SUPPLY STUDY – SAN LUIS OBISPO COUNTY, CA

Lowering groundwater levels in the Paso Robles Groundwater Basin threatened the sustainability of this basin, which supplies the majority of its agricultural and urban users. The evaluation of supplemental water options included procuring available water from the State, local surface water, local exchanges, and recycled water. For each option, the water availability, infrastructure needs, institutional conditions, and benefits (through groundwater modeling analysis) were characterized. Ultimately, the study provided a menu of options for diversifying the supply portfolio.

Reference: AWWA 2019 State of the Water Industry Report

Building CLIMATE RESILIENCE has never been more important!

SARAH DESLAURIERS, PE, ENV SP (sdeslauriers@carollo.com)

Our climate is becoming increasingly variable, altering our planet's water cycle. In turn, we now must take a holistic view of our water systems—crossing institutional boundaries and employing adaptive management approaches. Only then can we create resilient solutions that last generations.

Building climate resilience requires multi-faceted approaches that achieve the following:

- ***Improve and Achieve Resilience.*** Embed adaptive measures into projects and develop approaches to better manage water now and in the future.
- ***Promote and Facilitate Institutional Collaboration.*** Develop partnerships with regulatory agencies to address climate issues.
- ***Provide Multiple Benefits.*** Develop climate mitigation and resilience solutions that address challenges and benefit communities and the environment.

It is imperative that we identify risks and water infrastructure vulnerabilities to develop cost-effective and proactive mitigation and adaptation strategies in the face of our changing climate and water cycle. We must ask ourselves as planners and engineers, **"What do we need to plan/design for?"** This question can help identify the following key considerations:

- Providing flexibility to receive variable influent water/wastewater quality.
- Increasing redundancy to reduce or eliminate downtime.
- Managing assets to avoid outages, damage, contamination events, etc.
- Avoiding risks related to natural hazards and/or malevolent acts.
- Avoiding risks related to critical dependencies (chemical deliveries, access, etc.).
- Increasing reliability and resilience through regional solutions.

Interconnections should be considered to allow for exchanging resources in water-scarce regions.

THE INCREASING FREQUENCY OF CASCADING EVENTS THREATENS OUR WATER QUALITY AND INFRASTRUCTURE

The 2018 wildfire season in California was the deadliest and most destructive on record. The season was followed by heavy precipitation, leading to high levels of sediment in the runoff that severely degraded water quality. In some cases, the turbidity levels were too high to successfully treat for potable uses!

With the increasing frequency of wildfires and atmospheric rivers, changes in treatment operations and/or treatment processes may be necessary to reliably treat and maintain water service to customers experiencing back-to-back impacts.

The photos above show a pristine water supply prior to a wildfire (that damaged PVC pipes) and was followed by a heavy precipitation event that led to runoff rich in loose sediment and ash, causing high turbidity in the receiving reservoir.

CAROLLO'S CORE CLIMATE CHANGE AND RESILIENCE SERVICES

Our core services acknowledge the importance of and need for addressing both the mitigation of and adaptation to climate change. As the risks posed to water supply and system infrastructure evolve, we have the ability and tools available to properly assess those risks and modify operations and designs to adapt water systems.

> **"In most regions, water resources managers and planners will encounter new risks, vulnerabilities, and opportunities that may not be properly managed with existing practices."**
>
> —Third US National Climate Assessment

Mitigation and Adaptation

Inventory and manage greenhouse gas emissions and identify and implement projects and policies to increase resilience.

Vulnerability/Risk and Resilience

Evaluate the vulnerability of water system assets by assessing their exposure, sensitivity, and adaptive capacity.

Collaboration/Stakeholder Engagement

Cross institutional boundaries and disciplines to identify solutions that meet urban, rural, and ecosystem needs.

Legislative and Regulatory Advocacy

Track and represent the water/wastewater sector to legislative and regulatory bodies on climate change and resilience issues.

Greenhouse Gas (GHG) Emissions Inventory

Metro Wastewater Reclamation District, Denver, CO

Carollo built an emissions inventory tool for the treatment facility and METROGRO Farm to fully account for annual GHG emissions, establish a baseline to measure progress toward performance improvements and reduction goals, and assess the District's ability to comply with regulatory changes, evaluate impacts and benefits of operational changes, and evaluate potential energy efficiency measures.

Climate Change Vulnerability Assessment

Sand Island Wastewater Treatment Plant, Honolulu, HI

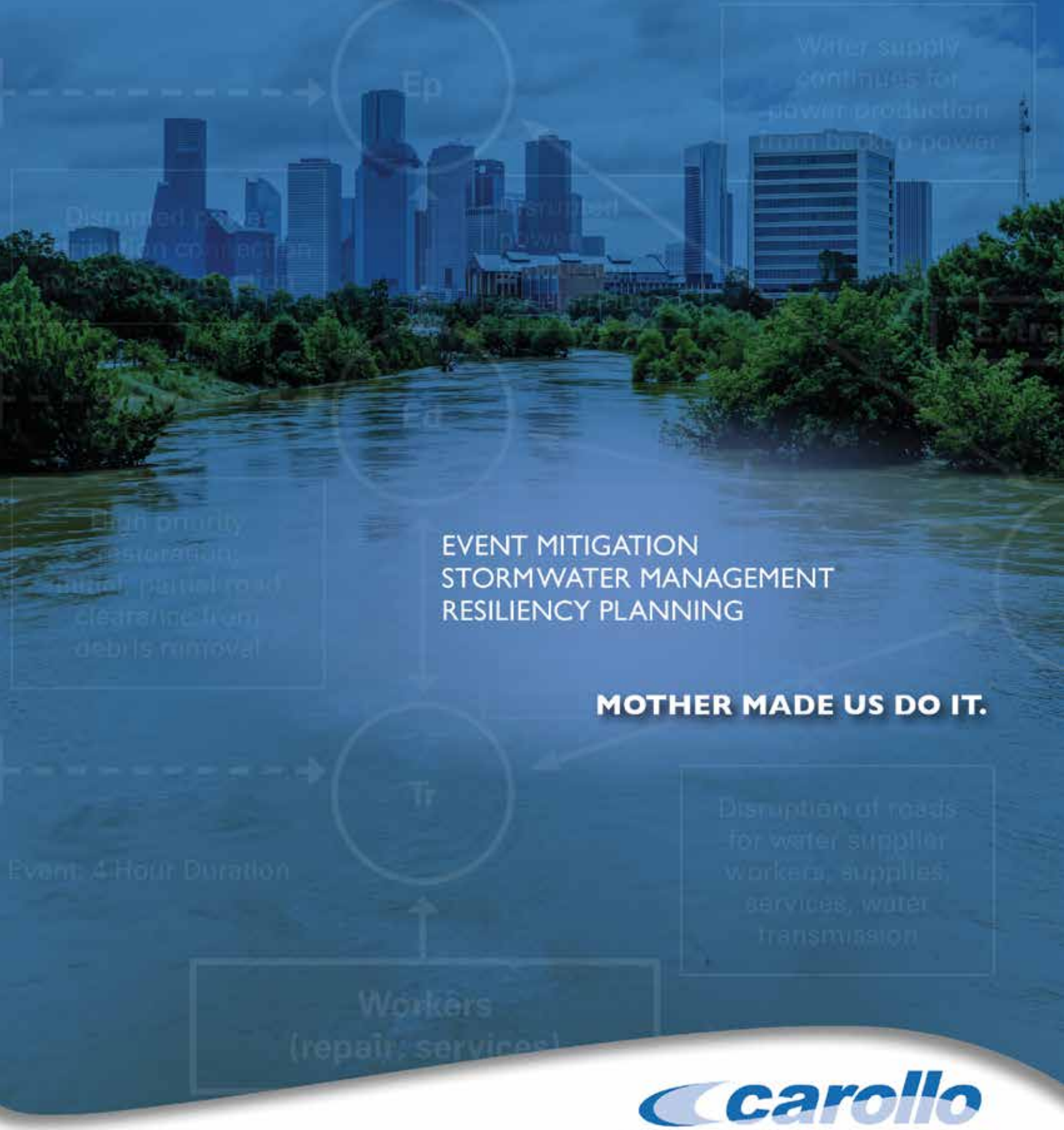
Carollo is performing a climate change vulnerability assessment evaluating the impacts of sea-level rise, storm surge, and erosion through year 2100 to the Sand Island Wastewater Treatment Plant and Sewer Basin, including 16 pump stations. The resilience report recommends projects and strategies to provide reliable wastewater treatment and conveyance and to address response and recovery strategies following a disaster such as a hurricane or tsunami.

Regional Climate Vulnerability Assessment Framework

Coastal Resilience Partnership, Southeast Florida

Carollo assisted a regional partnership consisting of 11 coastal communities and Palm Beach County to develop a climate vulnerability assessment framework. This framework provides a methodology for prioritizing needs and delivering adaptation strategies to protect critical assets in this coastal region. Carollo also helped foster continued collaboration through the development of guidance principles that serve as the foundation for embedding resilience in future planning.

Water Resilience. Adapting to Our Changing Environment.



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Engineers...Working Wonders With Water®

WATER
OUR FOCUS
OUR BUSINESS
OUR PASSION

From floods to droughts, Mother Nature can wreak havoc on your infrastructure and system operation. We prepare you for the very worst she dishes out. Our engineering is innovative and holistic—accounting for water supply, stormwater management, event mitigation, resiliency planning, and more. The end result is reliable system performance and infrastructure that lasts a lifetime, no matter what comes your way.

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