Sewerage & Water Board of
NEW ORLEANS, LA

ORIGINAL

Integrated Master Planning RFI

February 18, 2020





REQUEST FOR INFORMATION

CDM Smith

1515 Poydras Street, Suite 1000
New Orleans, Louisiana 70112
tel: 504-799-1100
cdmsmith.com

February 18, 2020

Patti Wallace, Purchasing Director
Sewerage and Water Board of New Orleans
Pwallace@swbno.org
625 St. Joseph Street, Room 131
New Orleans, Louisiana 70165

RESPONDENT:
CDM Smith
1515 Poydras Street, Suite 1000
New Orleans, LA 70112

PRIMARY CONTACT:
Patrick Victor, PE/Client Services Leader
T: 904.504.3621
E: VictorPR@cdmsmith.com

Subject: Request for Information - Integrated Master Planning RFI

Dear Ms. Wallace and Selection Committee:

With the release of this Request for Information (RFI), the Sewerage & Water Board of New Orleans (SWBNO) once again demonstrates its strong commitment as leaders to deliver responsible sewerage, water, and drainage services to the people of New Orleans. CDM Smith shares this commitment and, through our local employees and their families, understands its importance. It is this understanding, our direct local experience with the SWBNO and the City of New Orleans Department of Public Works (DPW), and our technical expertise in master planning that makes CDM Smith uniquely qualified to provide advice and guidance to SWBNO in developing an innovative approach to creating a long-term, integrated master plan in the most cost-effective and efficient manner.

Prudent and creative planning is needed to address critical issues for New Orleans in each of the SWBNO business lines. As evidenced in our submittal, CDM Smith offers you a wealth of multi-disciplinary senior level experience that can be accessed efficiently and deep bench strength of support professionals with extensive experience in every aspect of master planning, are available to participate in relevant workshops. We are a firm of industry leaders with demonstrated experience in bringing success to comparable projects in New Orleans, throughout North America, and globally.

Water is best understood when it is viewed holistically. Water supplies, stormwater, and wastewater are all part of the same hydrologic cycle, and the combined impact on system reliability, flooding, water quality, and wetlands should be considered in an integrated way. With this understanding, CDM Smith believes that there are significant opportunities for the SWBNO to develop a comprehensive and cost-effective integrated master plan based on visionary outlook, sound professional judgment, a complete understanding of inter-program synergies, project life-cycle costs and requirements, and grounded on customer service. In this response to your RFI, we present our successful record of involvement on other similar projects with many communities, which will serve as building blocks for the SWBNO to establish a cost-effective structure and approach for long-term master plan development covering each of SWBNO's key business lines. Please note, that as you review our responses to your three questions regarding the biggest challenges in 50 years, we followed the RFI format and responded to each question with a standalone response. This resulted in some repetition among the answers.

Our team is excited at the opportunity to participate in this RFI process and future workshops with SWBNO. We look forward to working with you to develop innovative planning strategies in more detail and answer any questions you or your team may have. CDM Smith is committed to the SWBNO and looks forward to assisting you in implementing a plan that creates resiliency, provides the greatest community value through multiple benefits, solidifies the City's future, improves quality of life, and strengthens the community's economic and social vitality.

CDM Smith acknowledges receipt of Addendum No. 1 dated February 14, 2020. Thank you for the opportunity to present our qualifications.

Sincerely,

Patrick Victor
Client Service Leader
CDM Smith Inc.

What will be New Orleans' biggest Stormwater/Drainage Challenges in 50 years and what is the best approach to integrated, long-range planning to address those challenges?

BACKGROUND

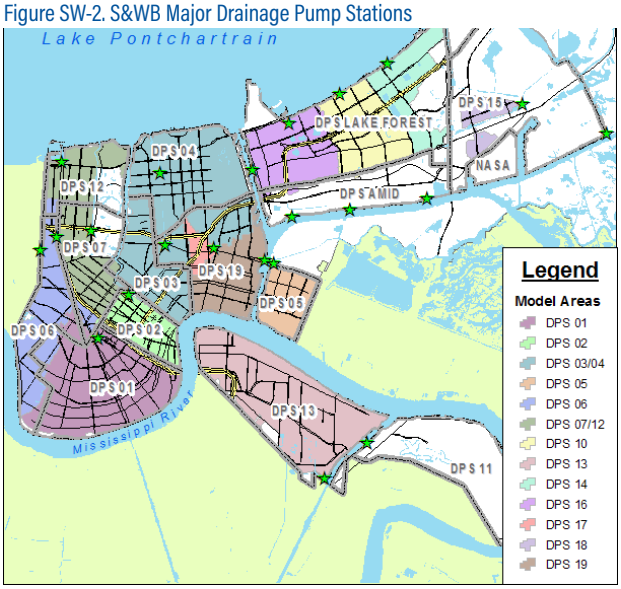
The City of New Orleans is a community that is integrally linked to the Mississippi River, Lake Pontchartrain, and wetlands systems. CDM Smith is intimately familiar with the Greater New Orleans stormwater system through our work evaluating the drainage system post-Katrina, completing the City of New Orleans Drainage Masterplan, developing proof of concept modeling for the Urban Water Plan, and conducting an assessment of all drainage pipe on streets with proposed waterline upgrades. This knowledge gives us the unique opportunity to leverage our understanding of the system and pair it with national expertise, big picture planning, and cutting edge technology.

Two major stormwater plans have been developed within the past 10 years. CDM Smith developed the Stormwater Drainage Master Plan (SDMP) for the City DPW in 2011 which identified potential conveyance improvements from ponding and flooding areas to the SWBNO major drainage pump stations. The 2013 Greater New Orleans Urban Water Plan is mainly a storage solution geared at slowing, storing, and using the water to enhance neighborhoods, with some conveyance increases. It should be noted, that each plan has limitations. The SDMP focused on the DPW system of smaller pipes, and the Urban Water Plan. Some of the suggested changes may not be feasible due to space constraints and costs or minimally beneficial due to the constraints and challenges listed below. An integrated stormwater collection (that includes both the City and the SWBNO component of the stormwater system), green infrastructure runoff storage and treatment and pumping is needed to address the challenges as discussed in the following.

The path forward plan needs to utilize what has been learned from both of these studies and add to them new strategies and technologies to develop a comprehensive plan that includes pipes, pumps, green infrastructure, storage, and evolving technologies to holistically address the system now and in future climate conditions. CDM Smith is uniquely qualified to assist SWBNO with this challenging project based on our direct experience with the City DPW and SWBNO stormwater systems through system-wide dynamic modeling, master planning, feasibility studies, designs for the recent Pontilly and Broadmoor HMGP projects and development of the Green Infrastructure Toolkit. The following paragraphs highlight our insight into Stormwater Challenges and the Best Practices for approaches to address the needs in a systematic and comprehensive approach that is resilient and adaptable to future conditions.

Figure SW-1. City DPW Stormwater System (1,288 miles)

Figure SW-2. S&WB Major Drainage Pump Stations



Case Study

CHANGING THE PARADIGM: STORMWATER MANAGEMENT FOR THE GREATER NEW ORLEANS AREA

PONTILLY STORMWATER HMGP PROJECT

CDM Smith worked with the City to implement a two-pronged approach to address water quality and reduce stress on the stormwater drainage system using green infrastructure techniques. CDM Smith provided a comprehensive design for green infrastructure upgrades to the existing stormwater drainage system to provide greater connectivity, relieve hydraulic bottlenecks, and convey stormwater runoff to parks for detention. CDM Smith also completed a hydrology and hydraulic model evaluation of the potential water quantity benefits of the recommended green infrastructure project.

CITY-WIDE STORMWATER DRAINAGE MASTER PLAN

The New Orleans Stormwater Drainage Master Plan 2011 project included modeling and improvement suggestions for the entire city DPW drainage system, which included 16 major drainage basins that are each served by large stormwater pumping stations and over 6 million linear feet of storm drain. The master plan provides guidance for the City to reduce existing flooding to meet their desired level of service (LOS) and prioritizes improvements. The master plan documentation included: System Understanding, Hydraulic Model Development, Design Standards and Guideline Development, and a Rate Study.

NEW ORLEANS GREEN INFRASTRUCTURE TOOL KIT

CDM Smith developed a Green Infrastructure (GI) Tool Kit to provide designers, developers, and contractors in the New Orleans GI industry with a set of design details (tools) to facilitate preparation of design and construction projects in targeted locations throughout the city, as well as enforcement of City of New Orleans Stormwater Code, Section 121 of the Building Code. GI projects use vegetation, soils, and natural processes to collect, store, infiltrate and manage runoff and create healthier urban environments.

BIGGEST STORMWATER/DRAINAGE CHALLENGES

1. **Size of the Problem:** 10-year/24-hour storm with approximately 3.5 inches of rain falling in 1 hour. This equates to 17,660 acre-ft of water falling in one hour over the New Orleans drainage area with the pump stations only able to handle 4,106 acre-ft of water per hour.

2. **Limited Area for Storage:** *Built-out conditions with limited space* - The City of New Orleans is almost fully developed, with limited areas to address stormwater problems, especially in the areas of the greatest need in storage.

   Groundwater levels - must be controlled and limits the depth in which above and below ground storage is beneficial.

   Low and Subsiding Topography - significant population resides in the lowest topographic areas (see image tothe right) that are vulnerable to flooding from any significant rain event.

3. **Time:** Significant time will be required to implement the plan. During this time there will be a changes in politics, climate, and technologies. A decision support system is needed to allow the proposed path forward to adapt with changes in opportunities. This system could also be used to communicate at a basic level, the costs, benefits, and significant influencers to decisions for each of the DPS basins. Significant influencers could include cost of land, available open space, number of people, percent of vulnerable population, and volume of flooding. We have a Water Integration Model (WIM) decision support tool that can be readily adapted to SWBNO's unique conditions and needs.

4. **Maintenance:** The New Orleans stormwater/drainage system requires frequent maintenance. A technology tool is needed to support a trained workforce to maintain the different aspects of the drainage system (pumps, pipes, and storage), cost effectively. CDM Smith has developed automated asset inventory and maintenance management systems for more than 100 clients including US Navy bases worldwide.

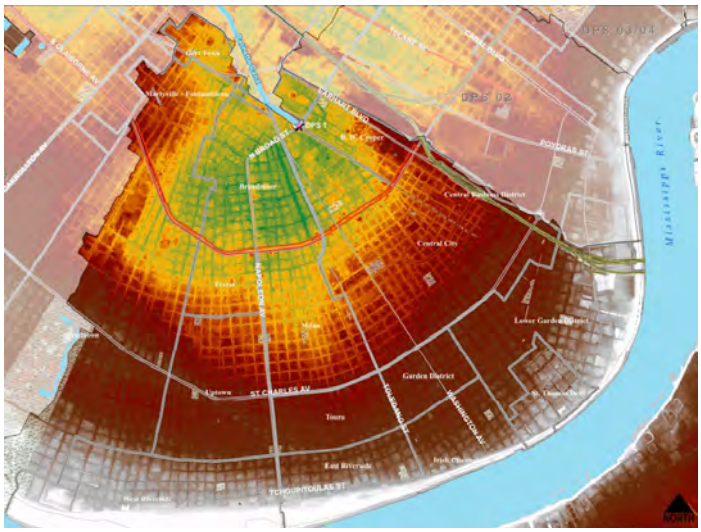
5. **Power:** Having reliable power to operate all pump stations when needed. Relevant information from the Power Masterplan that is currently in progress will be integrated as required. This allows SWBNO to be partially self-sufficient in maintaining and running the stormwater pump stations, but increases vulnerability due to the age of the system and the lack of readily available replacement parts.

6. **Pump Stations and Capacity:** Pump stations are sized for the 10-year/24-hour storm but are limited when rainfall intensity exceeds the average 0.5-inch/hour event. The 25- and 100- year rainfall events also need to be addressed. Most, or all, of the pump stations will need to be upgraded for capacity to meet desired flood control level of service (LOS).

   Some new outfalls to the Mississippi River and Lake Pontchartrain may need to be evaluated to fully utilize pump station capacity. For example, Drainage Pump Station 1 – DPS01 is approximately 7,500 cfs and can only pump 5,800 cfs due to downstream channel storage and conveyance limitations in the Palmetto Canal.

   There is little to no redundancy or integration in pump station utilization. If an intense rain event happens in one station, there is no mechanism to transfer water to another pump station with available capacity.

7. **Differential Settling and Subsidence:** Subsidence must be mitigated through control of water table levels and dramatic fluctuations.



A considerable population of the City is below sea level and in relatively flat conditions with highest elevations near the Mississippi River and levee system.

Case Study

CREATING RESILIENCY FOR ISLAND CITY-STATE

MARINA BARRAGE STORMWATER CONTROL AND WATER SUPPLY PROGRAM, SINGAPORE

Marina Barrage protects a low lying thriving urban center from flooding, creates a 600-acre freshwater reservoir to augment water supplies, and enhances the waterfront with recreational facilities and a visitor center.

Singapore receives 100 inches of rain each year, a huge amount of rain to manage to control flooding and preserve water supply quality. CDM Smith's solution was an elegant, low-level dam with control gates with more than 84,000 cfs of capacity—known as a barrage—that reliably accommodates excess precipitation, provides effective flood control, and enhances water supply and quality. Marina Barrage is not just an impressive technical achievement. During its design, we considered how the complex's technical and architectural features could support and enhance the lifestyle and economic development of Singapore's urban center.

The design of the Marina Barrage was first conceptualized by CDM Smith in a 1983 study for a flood alleviation scheme in Bukit Timah, and was further developed in a 1986 study. In 2002, the Public Utilities Board (PUB) of Singapore retained CDM Smith to perform a detailed engineering study and conceptual and detailed design of the Barrage. Now completed, the principal Barrage facilities include a 1,000-ft-long barrage with nine 5m-tall steel crest gates each 26.8m (80 ft) long and a massive 5.4 bgd pumping station facility with 13 megawatt power station. This project is another major implementation step in a 20-year program of a comprehensive water reclamation system for stormwater, wastewater, and water supply in Singapore.

Research has only recently begun and time is required to study the issue and develop a plan to address it.

The current plan to leave stormwater levels high in between rain events is not currently feasible. Real time data management and integration is needed to properly administrate this process. Canals and systems need to be measured continuously. Pathways for groundwater infiltration need to be created. Weather data needs to be accurately assessed with enough lead time for the system to be drawn down and operated safely.

8. **Funding:** Dedicated funding is needed at the levels required for proactive O&M, rehabilitation and replacement, buyouts, and capital improvements. As stated in the RFI, "Water and Sewer rates had not been increased in more than 20 years and an additional millage for drainage was lost, while the cost of construction, materials and labor had doubled", so sustainable funding is a critical challenge.

9. **Potential Climate Change Impacts:** As climate changes continue, there may potentially be more intense and greater volume design storms and impacts on LOS from climate change. Rising sea levels will affect boundary conditions for Lake Pontchartrain.

10. **Percent of the System that is Significantly Undersized:** There are at least 480 miles of pipe that are below the current minimum size standard of 15". These pipe are mostly in the oldest, and in some cases, also the most vulnerable parts of New Orleans. It is suggested that any roads with primary conveyance capacity less than 24" pipe be increased to meet this minimum.

11. **System Coordination:** *Other Utilities* - Coordinating stormwater improvements with water, sewer, and complete streets programs (and the significant neighborhood and traffic distrucption).

    Reliance on Others: The plan must consider that major components of the City-wide levee, floodwall, and pump station flood control system have been designed and constructed and are operated independently by the U.S. Army Corps of Engineers.

    Neighborhood Identity: Coordination of solutions with neighborhood identity, historical character, and large trees.

12. **Significant Contamination of Soils:** Any storage solutions within the City will require the mitigation of contaminated soils.

13. **Public Safety Concerns:** Mosquito breeding and public safety impact need to be addressed for green infrastructure systems retaining water.

BEST APPROACHES TO ADDRESS THE CHALLENGES

CDM Smith will leverage our direct experience with City DPW and SWBNO on the SDMP, Green Infrastructure Toolkit and the designs for the Pontilly and Broadmoor areas with our knowledge based on more than 200 stormwater clients across the US and the world that are facing similar challenges as the SWBNO. We will draw on our experience to transform the SWBNO into a Utility of the Future with more efficient, reliable and equitable operations. The most important first step in the master planning process is to identify goals SWBNO would like to achieve through the planning process and how best to accomplish them.

Through a facilitated session, the CDM Smith team will work with the SWBNO to establish goals most important to New Orleans and your stakeholders through meaningful community engagement. We will then define the metrics and key performance indicators to measure how these goals are achieved. Discussions in these workshops could revolve around the equity of service throughout the City, the role of innovation, data management, and technology in planning, climate resilience, as well as economic affordability, and workforce development. Once the goals and key performance indicators (KPIs) are established we will drill down to the individual components of the system to identify immediate needs, while maintaining an eye towards the future.

1. **Pump Station Capacity and Power:** An important step in increasing flood control resiliency is to strategically add pump station capacity and utilize full capacity of existing stations. This will require the ability to have reliable power as needed at all stations simultaneously and may require new outfalls and flow rate limitations for downstream systems (e.g., at DPS01 due the flow limitations in the Palmetto Canal).

2. **Green Infrastructure Storage:** There is a need to add storage with the pump stations to achieve flood control reduction in a cost-effective manner. This can be accomplished through adding green infrastructure storage in in City right-of-way lots and large open spaces wherever possible for multi-benefit amenities. We developed the Green Infrastructure Toolkit standards for SWBNO and DPW to guide the evaluation, sizing, design and O&M for these systems.

3. **Buyouts of Vulnerable Areas:** Buyouts in flood prone areas for public safety and cost-effectiveness while creating storage and parks in those areas. Strategic utilization of properties sold to the State of Louisiana post Katrina has helped with implementation in the Pontilly HMGP for the New Orleans Redevelopment Authority (NORA) which worked with our design team to protect lots from redevelopment for addition of green infrastructure and storage. **Figure SW-4** shows the green infrastructure lots and coordination with the Joseph Bartholomew Golf Course and Ponchartrain Park.

Case Study

MANAGING RISK AND CREATING RESILIENCY THROUGH INTEGRATED STORMWATER MANAGEMENT

MASTER STORMWATER MANAGEMENT PLAN AND IMPLEMENTATION, JACKSONVILLE, FLORIDA

Known as "the River City," Jacksonville, FL is defined by an abundance of water including the Atlantic Ocean, Intracoastal Waterway and St. Johns River. Jacksonville's proximity to water brings major flood risk. And, over the years, the water quality and ecosystem of the St. Johns River has been impacted by nutrients, bacteria and metals, throwing off nature's delicate balance.

To combat these issues while also working to reduce flooding and improve water quality, the city entered into a three-decade-long partnership with CDM Smith and the St. Johns River Water Management District to find solutions and establish standards. The result was a comprehensive master stormwater management plan, one of the first of its kind in the U.S., which has guided the city through a broad range of improvements and investments.

Our team developed a prioritized CIP for the City of Jacksonville comprising more than $150M in capital costs, most of which included stormwater structure rehabilitation, repair, and consolidation.

Additionally, CDM Smith has helped the city implement over $100 million in cost-effective capital improvements in a phased approach to control flooding, improve water quality to achieve TMDLs, create community parks, and remediate contamination.

Figure SW-4. Pontilly HMGP Green Infrastructure Project

4. **Coordinating Storage and Conveyance:** "Connecting the dots" of green infrastructure storage with conveyance while not shifting the problem to the next location will allow a phased approach to implement storage and conveyance to the pump stations in a cost-effective manner. The phasing will minimize the construction and traffic disruption due to the extensive stormwater facility infrastructure retrofit needs, which also can be coordinated with street, water, or sewer upgrades to the neighborhoods.

5. **Alternative Street Design for Storage and Conveyance:** Recently, DPW and SWBNO came to an agreement regarding the use of stormwater modular tanks as subsurface storage in the ROW. When applied these tanks could provide 25.5 CF/LF to 71.5 CF/LF within 3 to 5 feet below the road. This storage volume is equivalent to a reduction of approximately 8.5 to 19.5 inches of water in the ROW and an increase in the time of concentration which corresponds to an improvement in downstream flooding.


Figure SW-5: Rendering of Baronne Street with Subsurface Storage Tanks (Image Credit: Dana Brown & Associates)

6. **Climate Change Preparedness:** Planning for climate changes (e.g., greater rainfall intensity and volume, changes in Lake Pontchartrain and Mississippi River stages). Solutions need to be adaptive and flexible to adjust for changes in climate and sea levels.

In addition to the global approaches above, some specific concepts from our experience on the Broadmoor DPS01 Drainage Area design include:

- New Orleans SDMP calculates an additional 4,846,800 CF in additional pipe volume. If we assume that this volume required is not for conveyance, but rather for storage, we can get a sense of the impacts of time of concentration and the required length of streets with needed storage which is about 14% of the streets with speed limits between 30 and 35 MPH.
- Further increases in the time of concentration could also be helped by increasing the size of pipe diameters along streets near pump stations.
- One of the ideas with the greatest potential from the Urban Water Plan is a shared pump station on Claiborne at the Orleans/Jefferson Parish border. This pump station could take stormwater from uptown to prevent or reduce chances of inundating the lower topography around DPS01.

7. **Community Visioning and Outreach:** As citizens, we tend to overlook the value of coordinated public utility systems that integrate water, wastewater and stormwater collection, conveyance, treatment and discharge. Both because we are not aware of how better integration can reduce costs and because we don't understand the degree that integration can improve the quality of our daily lives. We also don't appreciate how utility systems are critical to the economy and to the environment. In implementing an integrated master plan, it is critical to communicate to the public how new policies and investment strategies will benefit their families by: a) reducing household expenses; b) creating new "green" jobs; c) reducing pollution levels; c) providing more recreational opportunities; d) improving health outcomes; and e) improving property values. These benefits act together to create more livable and equitable neighborhoods.

We have assisted many utility clients (e.g., NOLA GI Toolkit, Philadelphia PWD, Jacksonville, and Nashville) by helping the public visualize these benefits (through engaging fact sheets, classroom lesson plans, and brochures)

Case Study

A NEW STRATEGY FOR LOS ANGELES' WATER INFRASTRUCTURE

LOS ANGELES INTEGRATED RESOURCES PLAN (IRP) AND GREEN INFRASTRUCTURE PROGRAM

A partner to Los Angeles for more than 10 years, CDM Smith worked with the City to develop an innovative integrated resources plan (IRP) that applies a one water approach to the City's challenges—looking at water, wastewater and stormwater as a single resource. Examining all three from a holistic perspective, we helped the City build public support for the program, engaging stakeholders in comprehensive effort to satisfy water-quality regulations and implement projects including green infrastructure.

The Los Angeles IRP expanded water treatment and significantly increased conservation efforts. It resulted in a $500M bond measure passed by local residents to fund multipurpose water quality and water resource projects, also leveraging funding from state grants, city departments and nongovernmental organizations.

CDM Smith helped write the bond measure and prepared more than a dozen concept reports for the plan's projects, which were implemented over several years. These included urban lake restoration, wetland parks, green streets, pervious pavement and neighborhood groundwater recharge. The program has won numerous national and state awards, including the 2011 U.S. Water Prize.

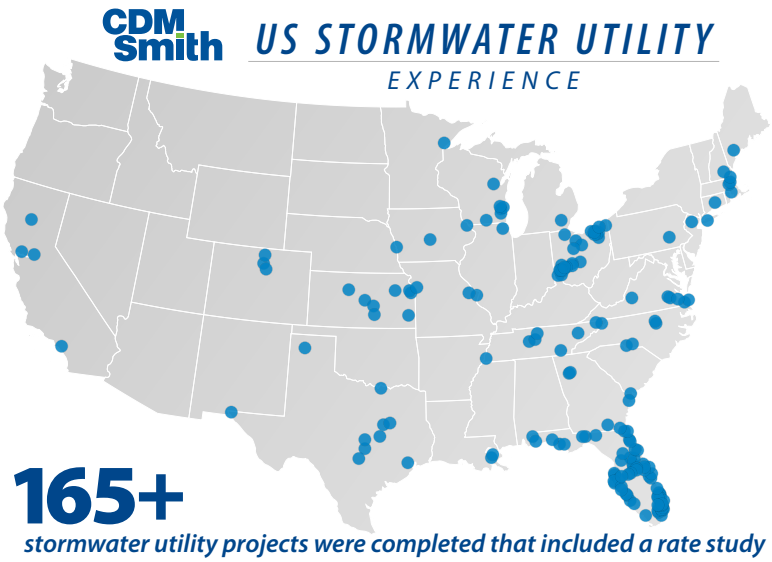
and by facilitating public involvement activities that allow residents to work with officials to study and assess integrated, holistic solutions in ways that the public can relate to (such as scenario planning with highly graphical outputs). The value of this community engagement and visioning cannot be overstated, because even the best plans will not be implemented unless there is strong support from the public, the business community, key community stakeholders, and elected officials—based on a shared vision of the future of the city.

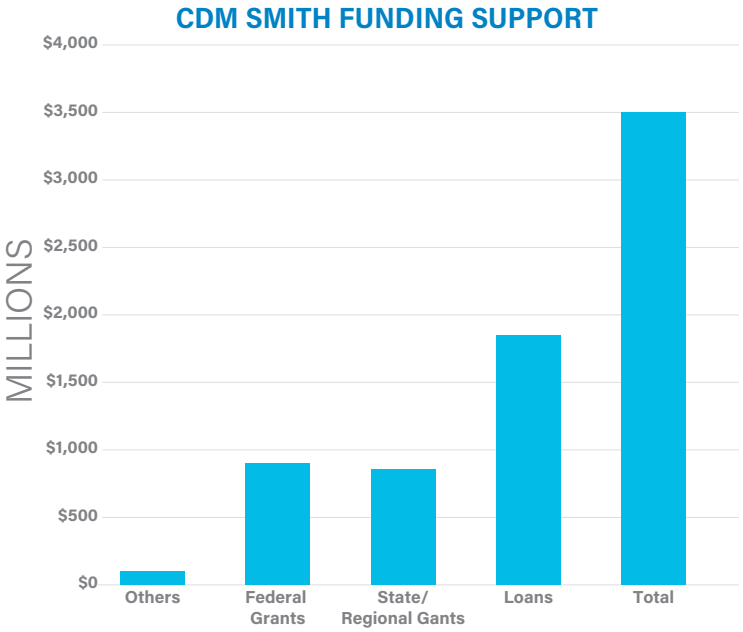
8. Sustainable, Low-Impact Development: An integrated utility master plan should coordinate with and address community planning and resiliency planning. This is because utilities should not only be integrated with each other and be responsive to future demand, they should also be designed in ways that contribute to making the city more sustainable. For example, smart growth, Transit-Oriented Development (TOD) and other low-impact development (LID) strategies not only to reduce our carbon footprint (by increasing use of transit and non-motorized transportation) but also by significantly reducing impervious surfaces and stormwater flows. These reductions are achieved by reducing travel and parking demand (and therefore reducing roads and parking lots), by reducing building 'footprints' (less roof area), and by preserving or creating green spaces that absorb/buffer stormwater impacts.

By developing practical strategies to reduce impervious surfaces in the city and introducing green infrastructure systems that collect, store, and biofiltrate stormwater runoff we can simultaneously: a) reduce the volume of stormwater that needs to be conveyed and treated, and thereby reduce pollutant loads suspended in stormwater runoff; b) protect water quality and drinking water sources; c) optimize our infrastructure and minimize operations and maintenance costs; d) reduce urban flooding; and, e) reduce the urban heat island effect and increase the city's tree canopy and its evapotranspirational cooling benefits and thereby reduce cooling energy costs. These low-cost, low-tech 'green' solutions result in cleaner water, cleaner air, and lower greenhouse gas production, and contribute greatly to improved health, environmental sustainability and climate resiliency.

10. Dedicated Funding: A dedicated sustainable funding source is needed for capital improvements, operation and maintenance (O&M), and asset rehabilitation and replacement. The stormwater utility has been shown to be fair and equitable, and CDM Smith has implemented more than 107 stormwater utility programs across the U.S. in 24 states and for 10 communities in Canada.

These utility dollars can be leveraged for bonds and augmented with grants and loans to systemically fund the program now and in the future, In addition to our stormwater utility success, we have assisted our clients with more than $3.5 billion in grants and loans over the past 30 years, including over $500 million for the Rouge River program (1988) in the Detroit area, which is part of the GLWA system that is shown as one of our showcase projects.





CDM Smith have assisted our clients with more than $3.5 billion in grants and loans over the past 30 years.

What will be New Orleans' biggest Drinking Water Challenges in 50 years and what is the best approach to integrated, long-range planning to address those challenges?

BACKGROUND

The New Orleans metropolitan area is home to nearly 1.2 million persons and the SWBNO provides drinking water to more than 350,000 persons, businesses, and industrial users within the City limits. Two water purification facilities, the Carrollton (East Bank) and Algiers (West Bank) Water Treatment Plants (WTPs), process raw water from the Mississippi River and distribute it through more than 130,000 service connections and 1,600 miles of water mains. Population and water demand have both changed rapidly and dramatically after Hurricane Katrina.

The Mississippi River provides a reliable water supply, but drawing source water from the southern-most reaches of North America's largest river system presents some of the country's most variable and difficult to treat water. Influences include seasonal weather patterns and storm events; agricultural and urban runoff; upstream industrial and municipal wastewater discharges; and potential contamination from non-point sources, spills, and other vulnerabilities. The resulting water quality is characterized by high levels of turbidity, natural organic matter, bromide, hardness, algae, nutrients, pathogens, and other suspended and dissolved constituents.

Outside of the SWBNO's service area, public and private drinking water providers use both groundwater and surface water to meet the region's water demands.

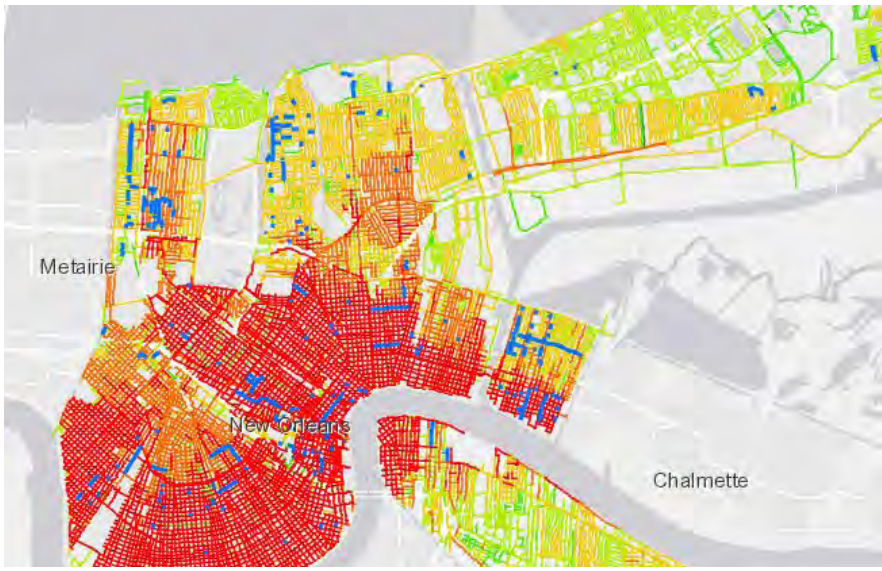
BIGGEST DRINKING WATER CHALLENGES

Several of the 50-year challenges, we previously identified for SWBNO's stormwater and wastewater systems also apply to the drinking water system and fall into the general categories of:

- Aging infrastructure
- Future regulations
- Climate change, resiliency, and reliability
- Capital funding and sustainable operations
- Changing workforce

The following pages present eight critical challenges specific to the SWBNO's drinking water system. Several of these challenges are likely priorities now for SWBNO and will continue over the next 50 years; and others will become priorities depending on the course of future regulations, impacts of climate change, decisions made by the SWBNO, and other uncertainties.

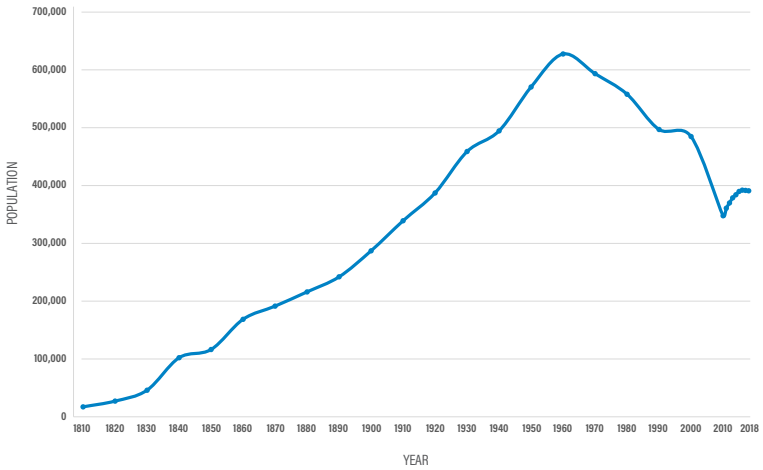
1. **Right-Size the System:** New Orleans' population peaked around 1960 at more than 600,000; steadily declined and leveled out at approximately 450,000 by the early 2000's; and then dropped to less than 300,000 after Hurricane Katrina in 2005. As the City recovered from Katrina, the population has grown to more than 400,000 in 2020. Accurate population and demand projections will be critical to right-size the drinking water system for current and near-term needs, and plan for future growth and changes in consumption by residential, commercial, and industrial users. Evaluating population and industrial growth trends in the region— the New Orleans Metropolitan Area, is important to developing broader, regional alternatives.



According to the SWBNO the majority of the city's water mains are over 100 years old.


The Carrollton WTP (240 mgd) serves over 300,000 persons on the East Bank of Orleans Parrish.


The Algiers WTP (40 mgd) serves over 50,000 persons on the East Bank of Orleans Parrish.



Source: New Orleans Population. (2019-11-06). Retrieved 2020-02-08, from http://worldpopulationreview.com/us-cities/new-orleans/

2. **Mitigate Water Losses:** SWBNO's non-revenue water has been estimated to range between 30% and 65%. These losses translate into larger, more expensive facilities to supply, treat, and distribute the lost water; and every gallon lost increases energy and chemical costs. Based on available reports, costs to repair/replace SWBNO's underground piping have been estimated at more than $3 billion and will take decades to implement. Rapidly evolving technologies for conducting condition assessments of pipelines and underground assets will be critical to identify problems and prioritize projects. Advanced analytics of real-time operational and performance data will also be helpful to predict failures before they occur, avoid emergencies and the resulting damages claims, and prioritize improvements to realize the greatest value with limited funding. An example of leveraging predictive analytics in the water industry is through the use of PipeCAST™. This advanced tool was developed by CDM Smith and integrates real-time system performance data with a GIS-based hydraulic model. The result is a cloud-based predictive model that presents system performance data on easy-to-read dashboards and alerts staff of potential problems for underground assets.

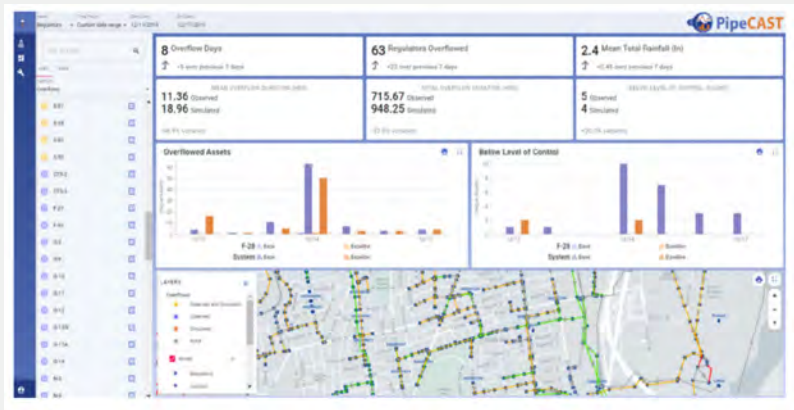
3. **Implement More Effective and Efficient Technologies:** Construction of the SWBNO's drinking water infrastructure began more than 100 years ago, which is why challenges such as the existing drinking water cross-connection to the Carrollton power plant still exist and must be addressed in any future system upgrade.. While numerous repairs, expansions, and upgrade projects have met water quality and production needs to date, it will be necessary to replace system components with modern equipment and advanced technologies to meet safety, water quality, reliability, and economic requirements over the next 50 years or longer. Intakes, pumping, power, and conveyance facilities for the raw and/or treated waters will require upgrades to improve reliability and efficiency. Critical treatment processes that will require improvement include disinfection, DBP control, filtration, and corrosion control. Proven alternative treatment technologies such as ozonation, high-rate clarification, ballasted flocculation, biologic filtration, membrane filtration, UV disinfection, and membrane softening all have been used to address water quality concerns and meet production reliability and resiliency goals on Mississippi River water or similar difficult to treat sources.

PIPECAST, AN INNOVATIVE ONLINE PLATFORM THAT BREAKS DOWN BARRIERS AND ENABLES REAL-TIME SYSTEM UNDERSTANDING AND PROACTIVE DECISION MAKING

METROPOLITAN DISTRICT COMMISSION'S CLEAN WATER PROJECT, HARTFORD, CONNECTICUT

CDM Smith has developed an innovative system management tool called PipeCAST™. It is a web-based dashboard that conveys actionable insights and evaluates effectiveness of operations and maintenance activities, performs what-if analyses, and directs resources to assets in-need. PipeCAST leverages the collective expertise of CDM Smith's civil and water-resource engineers and modelers, sensor/SCADA network engineers, application developers, and data engineers to proactively deliver answers and insights tailored specifically for our clients. PipeCAST can take the guesswork out by offering direct insight and actionable alerts derived through the latest advancements in intelligent water modelling. Powered by a digital twin, or virtual replica of the system, real-time simulations are calculated of system performance according to current weather and precipitation conditions. Discrepancies between the digital twin and real-world observations reveal operational insights and potential physical infrastructure problems. Ultimately, PipeCAST equips utility leaders and staff with real-time answers about their system and its operational performance, taking the guesswork out of the equation.

While the first release of PipeCAST focused on sewer system performance, water distribution will be included in a future release and can be adapted as a valuable water system communication tool for our clients when trying to communicate the benefits of alternatives to stakeholders. Dashboards can be created to show the effectiveness (based on the criteria set by the stakeholders) of the existing conditions and proposed alternatives. Additionally, the tool can be integrated with real time or historic data to show the simulated performance of each alternative.



Case Study

This tool has been successfully applied by the Hartford MDC to manage CSO and collection system performance. With looming CSO notification legislation, a common concern with wastewater utility officials and utilities already facing financial challenges maintaining and replacing aging infrastructure, PipeCAST condenses all information collected by a wastewater utility, such as rainfall data, level and flow in the collection system and at CSO outfalls and generates near real-time reports on the operations of its assets. For Hartford MDC, every day at 2 A.M., data is pulled from the past 24 hours, used to run their simulations model, and shown along with model results in an online dashboard. The benefit of a system like PipeCAST is its ability to integrate data that's already being collected and centralize it in one system to proactively monitor and maintain the collection system and optimize the system to minimize CSOs across a range of storm events. An example dashboard from our project in Hartford, CT is shown above.

4. **Remove Emerging Contaminants of Concern (CECs):** The public, environmental groups, regulators, media, and other stakeholders will continue to increase focus on CECs. CECs linked to the Mississippi River include perfluoroalkyl and polyfluoroalkyl substances (PFAS), algal toxins, pharmaceutically active compounds (PhACs), endocrine disruptors, brominated and iodinated DBPs, nitrosamines, legionella resistant pathogens, and other currently unregulated compounds. Regulatory development processes and health effects science can take years to study the risks for CECs and promulgate regulations. However, in our age of instant information, the public and advocate groups across the U.S. have demanded that water suppliers remove these contaminants before comprehensive regulations are finalized. The SWBNO will need to increase monitoring for CECs, assess advanced treatment processes for their destruction or removal, and consider the potential restrictions on disposal practices for residuals generated at the WTPs.

Case Study

INNOVATIVE, AFFORDABLE SOLUTIONS THAT LAST

CITY OF DALLAS ELM FORK WTP, DALLAS, TEXAS

In 1988, CDM Smith and the City of Dallas began a project to upgrade and expand the aging, maintenance intensive Elm Fork WTP (180 mgd capacity, originally built in the 1940s). Similar to SWBNO's Carrollton and Algiers plants which treat Mississippi River water, the Elm Fork WTP treats water from a highly variable and challenging source (the Trinity River) with:

- High levels of turbidity, natural organic matter, bromide, hardness, algae, and nutrients
- Agricultural and urban runoff
- Impacts from upstream industrial and municipal wastewater discharges

Also similar to the SWBNO plants, the Elm Fork WTP used chloramines for primary and residual disinfection and DBP control, and practiced combined clarification and partial softening with ferric chloride and lime.

Working closely with the City, state regulators, public, and other stakeholders, CDM Smith assessed the drinking water system from the river intake, through pumping, treatment, and distribution. We also conducted a 14-month pilot study to meet current and future regulations, mitigate tastes and odors, and address other water quality concerns. By 1995, the Elm Fork WTP had been transformed into a state-of-the industry water purification system featuring a new intake and low lift pump station, new raw water ozonation facilities, improved clarification/lime softening, high-rate biologic filtration, new treated water storage, and high-service pumping. The innovative process improved turbidity removal and primary disinfection, reduced DBPs, eliminated tastes and odors, and increased production capacity to 330-mgd within the original pretreatment basins and filters. Over the past 25 years, the plant has reliably and efficiently met new water quality regulations and the City's increasing water demands.

5. **Disposal of Drinking Water Plant Residuals:** Another consideration is the long-term plan for disposing of residuals generated at the Carrollton and Algiers WTPs. It is our understanding that currently, water treatment residuals are discharged to the Mississippi River. Drinking water treatment residuals. residuals contain suspended and dissolved solids, treatment chemicals, and compounds such as precipitates, oxidation byproducts, and DBPs that are formed during treatment. In many parts of the U.S., discharge of water treatment plant wastes to surface waters is restricted or prohibited due to toxicity to aquatic or marine environments, and/or adverse impacts on downstream water users. Options for SWBNO to consider may include discharge of the sludges to the sanitary sewer, land application, clarification and recycling of the liquid residuals' streams, and dewatering/disposal of the solids at municipal landfills.

6. **Optimize Information and Asset Management:** As new equipment and emerging technologies replace aging infrastructure, more data will be generated and monitored. The information must be analyzed and acted upon to realize value, whether measured by improved water quality, fewer service interruptions, lower operating costs, longer equipment life, faster responses to customer concerns, or other metrics. Centralized and/or offsite monitoring will continue to increase, as will automation of operations and reporting. Integrating data from SCADA, CMMS, GIS, O&M, billing, and other sources is a complex task. Cybersecurity to protect the data and physical security to protect people and assets must also continue to advance as new threats evolve.

7. **Hire, Train, and Retain Drinking Water Professionals to Replace an Aging Workforce:** Pumping water from the Mississippi River, treating it to meet or exceed industry standards and the public's expectations for health and aesthetics, and continuously delivering it to over 350,000 customers at desired quantities and pressures, requires highly trained and committed professionals. From the most senior managers, to the many engineers, planners, chemists, operators, technicians, mechanics, electricians, programmers, accountants, communications specialists, and other valued employees, nearly 25% of the SWBNO's workforce is eligible for retirement. As new equipment, facilities, and processes are implemented, more specialized skills and training will be required for the workforce of tomorrow.

Current Number of Board Employees and Employees Eligible for Retirement

DEPARTMENT	% ELIGIBLE FOR RETIREMENT
Operations - Water Purification Plant	32.0
Operations - Water Quality Laboratory at Carrollton Plant	33.3
Operations - Water Pumping & Power	24.0
Operations - Sewage & Drainage Pumping Stations	28.6
Facility Maintenance	27.9
Engineering	37.5
Networks	17.9
Support Services	28.4
Environmental Affairs	33.3
Total	*24.6*

With nearly 25% of current employees eligible for retirement, the SWBNO faces the need for a workforce with more specialized skills and training.

8. **Build Community Confidence and Support for an Integrated Water Master Plan:** Regional solutions may provide more affordable and resilient water services to the New Orleans Metropolitan Area. Regional solutions rely on collaboration, trust, and support from the communities, regulators, stakeholders, and most importantly the 1.2 million residential, commercial, and industrial users. As described in the Task Force Report and the RFI, for the Integrated Master Plan to be successful, it must be inclusive, transparent, efficient, and accountable. This will require a plan that is both strategic in its vision, goals, and objectives; and tactical in its implementation and measurements of progress and success. The Integrated Master Plan must include a comprehensive outreach and education program to exchange ideas, build consensus, set goals, and communicate performance to all stakeholders.

CUTTING-EDGE RESEARCH AND DEVELOPMENT LABORATORY

CDM Smith maintains three in-house laboratory facilities with necessary equipment and experienced staff to complete bench-scale investigations and specialized analysis for our clients, as well as advanced research activities. The laboratories are equipped with tools and analytical equipment to measure and evaluate chemical, biological, geochemical, physical, modeling, molecular, material property, and dynamic parameters. Our primary laboratory resource is the CDM Smith Research & Testing Laboratory in Bellevue Washington, a 1,000-square-foot facility established for conducting customized treatability studies, jar testing, and research and development for water treatment, wastewater treatment, bioenergy, remediation, and other technology areas involving process engineering, chemistry, and microbiology. The Bellevue Research & Testing Laboratory has eight staff members experienced in performing treatability studies to evaluate aerobic and anaerobic biological treatment, biological nutrient removal, metals removal, chemical precipitation and clarification, filtration, bioremediation, bioenergy, and chemical oxidation. Additionally, our laboratory staff have the in-depth experience and cutting-edge tools to perform evaluations of advanced water treatment processes including ozonation and ultraviolet radiation combined with the advanced oxidation process (UV-AOP).




INDUSTRY-LEADING PFAS RESEARCHERS BRING EXPERTISE

CDM Smith staff are principal investigators (PI) or co-PIs on nearly 20 PFAS research projects that are providing new understanding of how PFAS behave in the environment and identifying new technologies to treat contaminated water and break down PFAS. Our experts include Charles Schaefer, Jr., PhD, Dora Chiang, PE, PhD, and Jennifer Hooper, PE, meaning the city will be supported by experts who are at the forefront of industry understanding of PFAS and how to most effectively treat it. Additionally, our PFAS experts are leading in the assessment of the applicability of Rapid Small-Scale Column Test (RSSCT) for removal of emerging contaminants.

As with any emerging contaminant, regulatory standards continue to evolve, and additional studies are being conducted to better understand the dangers of PFAS. Our experts are heavily involved in government-funded research studies on this complex group of chemicals. Our PFAS experience is comprehensive, with a vast research portfolio, in-house laboratory capabilities, and proven experience implementing solutions for numerous clients. We have conducted PFAS-related work at more than 110 U.S. locations and more than 60 international sites. We support 65 PFAS R&D and treatability clients and partners and have conducted 21 PFAS treatability and R&D projects in our Bellevue lab since 2015.

BEST APPROACHES TO ADDRESS THE CHALLENGES

Developing the Integrated Water Master Plan is critical to improve the regions' public health, quality of life, economic growth, and resiliency to address climate change and other challenges over the next 50 years and beyond. Over the last 70 years, CDM Smith has partnered with many of the largest water suppliers in the U.S. to plan for each cities' unique challenges. The attached chart provides the major planning steps for SWBNO to consider to address the current challenges with the drinking water system and address future changes in climate, technology, and regulation.

ENGAGING AND INVOLVING THE COMMUNITY AND STAKEHOLDERS TO BUILD CONSENSUS

Case Study

We know how to focus information so that it is clear and useful to stakeholders and decision makers, and because of this we have a track record of facilitating agreement on contentious water issues.

CDM Smith prepared the City of San Diego's first Long-Range Water Resources Plan (LRWRP). CDM Smith completed a comprehensive update that incorporated a more robust decision-making approach; comprehensive public stakeholder involvement; incorporated climate change impacts on water demands and water supplies; and evaluated comprehensive water supply portfolios to develop a long-term strategy for meeting multiple City objectives. Of note, because of the cost of the program the City could not get buy in from different City departments and could not agree on how to spend resources. The City asked for CDM Smith support so the Mayor and City Council could better understand the challenges. CDM Smith facilitated several workshops with the business community and major stakeholders that were concerned about the rate increases but had economic interests in the water being safe and reliable. As a result of these meeting, the outside stakeholders came to the City Council strongly recommending approval of the rate increases. The LRWRP and its recommendations were unanimously supported by the City's stakeholder advisory committee and the City Council. The LRWRP won the national 2014 Grand Prize in Planning Award from American Academy of Environmental Engineers and 2014 Superior Planning Award from International Water Association.

For the Los Angeles Water Integrated Resources Plan (WIRP)/OneWater LA Plan, CDM Smith, working as the lead firm of a joint venture, completed the City's first ever WIRP, where water, wastewater and stormwater were fully integrated. Building from the success of the WIRP, the City launched its new OneWater LA Plan, which emphasizes total integration of water among all 20 city departments. The City hired CDM Smith as the prime consultant, with Dan Rodrigo, serving as project manager, designing the stakeholder process and helping craft guiding principles approved by a stakeholder group of over 150 people.

Integrated Approach to Long-Range Planning for the SWBNO Drinking Water System

1. Conduct Outreach and Identify Key Performance Indicators (KPIs)
2. Establish Service Reliability Goals, Water Quality Reliability Goals, and Resiliency and Sustainability Goals
3. Develop Decision-Making Process
4. Refine Population and Demand Projections
5. Update Hydraulic Models
6. Assess the Water Supply, Treatment, and Storage/Distribution Facilities- Condition, Capacity, Compliance, and Performance
7. Identify, Develop, Evaluate, and Compare Alternatives
8. Select Preferred Alternatives
9. Prioritize Potential Capital Improvement Projects and Strategic Programs
10. Document Data Gaps and Identify Next Steps
11. Prepare 50-year Integrated Water Master Plan Report
12. Define Schedule to Periodically Revisit and Revise Integrated Water Master Plan
13. Integrate Community into the Integrated Water Master Plan

What will be New Orleans' biggest Wastewater/Sewerage Challenges in 50 years and what is the best approach to integrated, long-range planning to address those challenges?

BACKGROUND

SWBNO owns two secondary wastewater treatment facilities that are both under contract operations. The East Bank Wastewater Treatment Plant (WWTP) began operation in 1977 as a pure oxygen activated sludge facility designed to treat 122 mgd on an average annual basis to meet secondary treatment standards. The West Bank WWTP was also put on-line in the 1970's to meet secondary standards and is designed to treat an average daily flow of 20 mgd. Our understanding is that biosolids generated from both the East Bank and the West Bank plants are incinerated at the East Bank WWTP. In addition, SWBNO is responsible for over 80 lift stations and more than 1400 miles of collection system piping.

BIGGEST WASTEWATER/SEWERAGE CHALLENGES

Currently there are myriad of challenges that face SWBNO in the wastewater/sewerage arena, and these challenges will increase and morph as time passes. Yet, with challenges come opportunities to rebuild and recreate the wastewater utility through integrated planning, to cost-effectively address the issues of today and prepare for the expected challenges of the future in concert with work in the drainage/stormwater and water systems.

We have identified ten of the most pressing challenges as we see them and have expanded on some of these challenges in the approach that follows:

1. **Aging Infrastructure:** Much of the wastewater infrastructure including the Collection, Pumping, Transmission, and Treatment Systems has reached its useful life, and/or was significantly compromised during Hurricane Katrina resulting in reactive versus proactive maintenance.
2. **Excessive Infiltration and Inflow (I/I):** Excessive I/I in the system reduces the capacity of the collection and treatment systems and results in sewer back-ups and system overflows, impacting the environment and public health.
3. **Climate Change:** Impacts of climate change including higher intensity and more frequent storm events will tax the already fragile system, increasing infiltration and inflow and thus sewer system overflows, and sea level rise could minimize the capacity of the treatment plants to discharge flow.
4. **System Redundancy and Resiliency:** The ability of the wastewater collection and treatment system to operate reliably is, in part, impacted by the reliability of the power supply feeding the pumping station and treatment facilities, but also the reliability and redundancy of the power system within the sites, as well as the redundancy and reliability of critical pieces of equipment on-site. The ability of the systems to rebound after a storm event is essential in building the trust of the community.
5. **Revised Regulations:** The treatment facilities are currently required to achieve secondary treatment standards, however, due to hypoxic conditions in the Gulf of Mexico nutrient limits may be on the horizon. Nitrogen removal in an oxygen activated sludge system is especially challenging. In addition, revised air emissions regulation associated with the sewage sludge incinerators could alter the economics of sludge disposal alternatives. Emerging contaminants, including PFAS, could also impact treatment requirements and sludge disposal options.

Throughout the planning process sewerage/wastewater, water, and drainage/stormwater systems, CDM Smith will work as one integrated team identifying options that holistically provide the most cost-effective approach to managing SWBNO's needs and provide benefits to the community.

6. **Limited Funding with Significant Capital Improvement Required:** The significant capital investment required to upgrade infrastructure to improve reliability and bring up to current codes and standard practices will require tough decisions in the prioritization of projects overtime to be able to manage reasonable rate increases.
7. **Uncertainty in Biosolids Management:** The cost and options available for biosolids management are rapidly changing due to emerging contaminants, available landfill space and regulations surrounding land application.
8. **Replacing an Aging Workforce**: Aging workforce is an issue that utilities grapple with across the nation. Capturing the institutional knowledge of the retiring staff, retaining mid-level staff, and being competitive in attracting new, qualified staff to the utility will be challenging, yet provides job opportunities for residents.
9. **Renewal of Contract Operations Contract:** The two treatment plants are currently operated under contract operations. The renewal of this contract in combination with the capital improvements at the plant requires clearly defined contract language to protect SWBNO.
10. **Public Education and Support:** Regaining the trust of the public in the SWBNO's ability to effectively operate and maintain the utility systems as well as educating the customers on the required investments to improve the systems and the subsequent impact on rates will be an ongoing and challenging effort, but also an opportunity to provide meaningful community engagement and workforce development.

BEST APPROACHES TO ADDRESS THE CHALLENGES

CDM Smith has and is engaged with numerous facilities facing similar challenges as the SWBNO and will draw on our experience to guide the SWBNO into a Utility of the Future with more efficient, reliable, and equitable operations. We will review and build upon recent work including the SWBNO Customer Advisory Committee and the local Hazard Mitigation Plan to continue progress forward.

Establishing Master Planning Goals and Objectives: The most important first step in the master planning process it to identify goals SWBNO would like to achieve through the planning process and how best to achieve them. As shown below, for the recent Wastewater Master Plan we prepared for the Great Lakes Water Authority (GLWA) in Detroit, through a series of stakeholder meetings the five over-arching outcomes were established. For each outcome, key performance indicators were established.

Through a facilitated session, the CDM Smith team will build upon and refine the outcomes established by the Customer Advisory Committee on New Orleans sewerage, water, and drainage utilities. We will work with the SWBNO and its Customer Advisory Committee to establish outcomes most important to you and your stakeholders through meaningful community engagement that captures the voices of customers throughout the City. We will then define the metrics and key performance indictors to measure how these goals are achieved over time. Discussions in these workshops could revolve around the equity of service throughout the City, the role of innovation and technology in planning, climate resilience, as well as economic resilience and affordability, and workforce development. Once the goals and KPIs are established we will drill down to the individual components of the system to understand immediate needs, while maintaining an eye towards the future.

Establishing Planning Criteria: Important early in the process is an understanding and agreement of the planning criteria to be used in the assessment of alternatives, including population served, influent flows and loads, effluent criteria, flood levels and design storms, and costing criteria. Understanding the current service area, flows and loading, the impact of infiltration and inflow in the system, and high flow management at the treatment facilities is critical to defining the task. With this existing information, projections of future wastewater flows and loadings over the planning period can be estimated. The population of New Orleans in the recent past has been on a steady decline since its peak in the 1960's and experienced a significant drop post hurricane Katrina in 2006. Today the population is approaching the pre-Katrina population. This is similar to what CDM Smith and the City of Detroit faced in their planning process. In one sense this presents a challenge due to the reduction in revenue from the reduced number of users, but as we have learned with other communities, this also provides an opportunity in terms of increased aeration volume for nutrient removal, increased system redundancy, and opportunities for downsizing and optimizing existing systems.

For Upper Blackstone Clean Water serving the metropolitan Worcester, Massachusetts area, CDM Smith developed a wastewater Master Plan establishing a multi-year, multi-million dollar improvements program to upgrade their aging treatment system to meet current codes and standards, to progressively improve treatment efficiency and effluent quality over-time, and to better manage peak flows at the treatment facility while managing rate increases to the customers. Like New Orleans, the population of Worcester never reached projected population around which the plant was designed. Although the planning resulted in an increase in the design peak flow to the plant from 120 mgd to 160 mgd, the design average daily flow was reduced from 56 mgd to 45 mgd. This reduction in average annual flow enabled the conversion of a conventional activated sludge system to an enhanced biological nutrient removal system for nitrogen and phosphorus removal. In addition, a wet weather discharge system was incorporated to bypass the secondary treatment system during extreme flows while enabling permit compliance through the blending of primary and secondary effluent. The three-phased design and construction program over 12 years first addressed preliminary and primary treatment upgrades, high flow management and disinfection as well as an overall electrical system upgrade; the second phase upgraded the secondary treatment system to BNR; and the third phase addressed biosolids management.

For over two decades CDM Smith has worked with Upper Blackstone Clean Water to upgrade and expand their treatment system.

Equally important is to understand current and projected regulatory requirements and system goals early in the planning process. Although the two treatment facilities currently are only required to meet secondary treatment standards, future nutrient limits for discharge to the Gulf of Mexico could likely be on the horizon during the planning period. In addition, permitting associated with contaminants of emerging concern (CECs) in the wastewater effluent, air permits or biosolids could dramatically shift the wastewater industry. CDM Smith prides itself in planning treatment plant upgrades with the flexibility to cost-effectively and progressively move a utility forward while managing potential changes in regulations. Again, for Upper Blackstone Clean Water, at the time of planning, EPA had not issued a new NPDES permit, however, based on permits being issued in the region we assumed that some level of nitrogen and phosphorus removal would be required. As such, we designed the facility with the ability to operate in the MLE mode (for nitrogen removal); the A/O mode (for phosphorus removal) and the A2/O mode (for both nitrogen and phosphorus removal). The added cost for providing this flexibility was negligible in the program costs but proved invaluable when the permit was finally issued.

Innovation and Technology in Planning: As the Program Manager for the Hartford, Connecticut Metropolitan District Commission's CSO Program, CDM Smith has been responsible for the planning and preliminary design of over $900 million of improvements in the City to meet Consent Decree requirements over 20 years for SSO and CSO control. As a part of this work, CDM Smith has developed the PipeCAST™ tool which integrates data already being collected and centralizes it in one system to proactively manage and plan for overflow events across a range of storm events. The tool offers high level reports of system performance, flags potential issues within the system, and provides a dashboard that simulates the entire system with a "digital twin". Although SWBNO does not operate a combined collection system the tool can be used to effectively manage a separated system heavily influenced by infiltration and inflow with a vast array of pumping systems. By using technology to create a "Smart Water" system, staff can assess and utilize real-time data to make appropriate decisions in the moment. In addition, through the assessment of system trends, operators can be alerted to aberrations in the system that should be checked. Lastly, the tools can be used to make smart choices on where to spend limited operation and maintenance dollars.

Case Study

CSO PROGRAM MANAGEMENT AND GREEN INFRASTRUCTURE

METROPOLITAN DISTRICT COMMISSION'S CSO PROGRAM AND GREEN INFRASTRUCTURE PROGRAM, HARTFORD, CONNECTICUT

Since 2005, CDM Smith has been the Program Management Consultant (PMC) for the Metropolitan District Commission's (MDC) $2 billion Clean Water Project (CWP).

To assist MDC in implementing this program, CDM Smith provides a wide array of services, including concept development, engineering design, overall design oversight, construction coordination, development, implementation, and continuous improvement of standard procedures, processes, planning, systems, and tools to forecast, monitor, measure, and report on project and program schedules and budgets. CDM Smith also assists MDC with managing consultants, contractors, and general construction safety and traffic management.

HARTFORD METROPOLITAN DISTRICT COMMISSION HEADQUARTERS GREEN INFRASTRUCTURE IMPROVEMENTS PROJECT

This Green Infrastructure Improvement Project incorporates sustainable design elements to demonstrate different approaches to infiltrating and/or cleaning stormwater. These improvements included capturing stormwater runoff from the roof through roof leaders and out letting into stepped rain gardens, using permeable pavers and porous flexible pavement for stormwater infiltration and bioretention basins along the street to collect and cleanse stormwater runoff.

Assessment of Alternatives: When faced with significant capital improvement needs, it is important to view the entire system holistically, understand how changes in one system can impact downstream systems, and first identify those near-term, high return-on-investment projects that will facilitate operations, reduce electric and chemical demand, and/or improve the efficiency of the system. It is also critical to understand the investment necessary to maintain the functionality of existing systems, but with each project assess whether we can "build-it-better" vs. replace in-kind.

Finally, it is important to look towards those transformative projects which significantly change how flow or biosolids are treated. While in the midst of the Master Planning for GLWA, we were able to recommend operational adjustments that could significantly reduce the amount of ferric chloride addition at the plant which were implemented resulting in significant cost savings. In addition, we were able to recommend scaling back an ongoing capital project, when it was identified that replacement of all 16 chlorinators was not required to meet existing chlorine demands. Rather than upgrading the existing screening and grit removal systems in-kind, which were currently ineffective, we recommended a transformative project to include fine screens, screenings washer/compactors and stacked tray grit removal system to significantly improve the removal of grit and screenings removal, thereby dramatically reducing the operation and maintenance costs of downstream equipment. Like SWBNO, GLWA uses high purity oxygen activated sludge in their treatment process. For GLWA we recommended improvements to this system to enable enhanced biological phosphorus removal, improve plant hydraulics, and improve oxygen efficiency. These projects are expected to have a return on investment of 5 to 10 years.

Early wins will be identified during the Master planning process that could immediately benefit operations and/or produce cost savings.

Resource Recovery:

As wastewater treatment facilities move towards water resource recovery facilities, it is essential in the planning process to identify and monetize resource recovery opportunities, related to biosolids management, water reuse and nutrient recovery. CDM Smith has been working with the City of Des Moines, Iowa on optimizing their Biosolids management program for over a decade and developed their BioEnergy Master Plan and implemented recommendations from that plan. The goal of this facility was to be the number one choice for hauled waste receiving in the region. For Des Moines this meant not only receiving revenue for the waste received, but more importantly recovering and receiving the monetary benefit of the energy in this hauled waste. CDM Smith worked with the City and developed a tool to assess the cost and benefit of a number of treatment technologies and ultimately recommended digestion with gas cleaning and discharge of RNG into the gas utility's system. This successful project allows the facility to operate close to

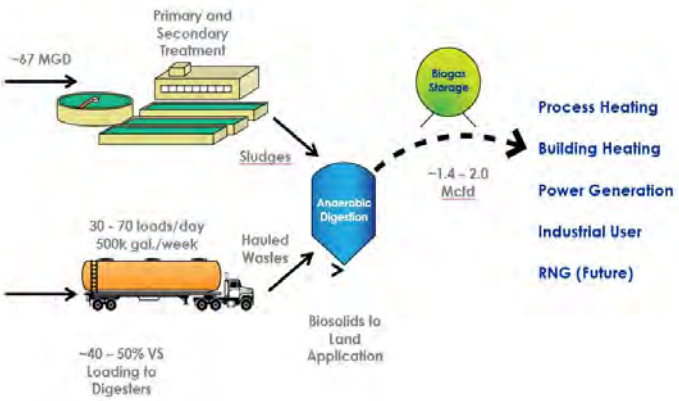
"Net Zero." For the Greater Lawrence Sanitation District in Andover, MA CDM Smith expanded the existing digestion facility and added a combined heat and power system to enable acceptance of food waste into the digesters to increase gas production. Again, not only did the District receive revenue from tipping fees but also received the benefit of the power generation of these wastes. SWBNO currently operates multiple hearth furnaces for biosolids management and although this system may provide the most cost-effective solution for biosolids management today, our master planning will evaluate alternatives that may better capture the resources in the influent stream over time. CDM Smith has significant expertise in sewage sludge incineration including the implementation of flue gas recirculation of multiple hearth furnaces at Upper Blackstone Clean Water, which significantly reduced natural gas use in the facility.

Case Study

NEXT GENERATION RESOURCE RECOVERY

DES MOINES WASTEWATER RECLAMATION AUTHORITY (WRA), DES MOINES, IOWA

DesMoines WRA's primary goal is to improve the performance of the existing anaerobic digesters, reduce maintenance costs, and maximize digester gas utilization. Currently receiving a large portion of the digester load as hauled waste (approximately 40%), WRA receives significant economic benefit from the waste tip fees and the usage of the biogas onsite and the revenue generated by the sale of the biogas to a neighboring industry. CDM Smith evaluated options for waste activated sludge conditioning, processing the primary clarifier scum in the digesters, and methods for controlling struvite formation in digestion and subsequent processes. CDM Smith also performed a Bioenergy Master Plan which included the development of a process/economic model to help WRA evaluate the effects of different outside waste streams on the digestion process and biogas production. The model provides a tool to assess the energy value of waste streams for codigestion and optimize the use of its digestion facilities for energy production. The BioEnergy Master Plan recommendations led to a $19M Digester Improvements Project, which is currently finishing the construction and commissioning phase.



Although New Orleans is water rich, there may be opportunities for targeted water reuse or scalping projects in the system, which could reduce costs when considering the overall water-energy nexus. Consideration will be given to producing a high-quality plant effluent on-site for plant water uses that currently use potable water. Once on-site needs are met, this reclaimed water could also be provided to neighboring industries that currently use potable water for non-potable water uses, e.g. cooling water. For GLWA it was recommended to provide filtration of their secondary effluent for use in their chlorination system, saving the purchase of 3 mgd of potable water this use at a cost of nearly $3 million annually.

As a facility is upgraded, opportunities for use of other renewable energy technologies will be assessed, including heat pumps, solar panels, and wind turbines to further drive Net-Zero at the facilities.

Climate Planning: Today, no Master Plan would be complete without the assessment of climate change on system operation. For the Hampton Roads Sanitation District (HRSD), CDM Smith was recently awarded a contract to assess the impacts of climate change on HRSDs 8 major wastewater treatment facilities and 92 pumping stations. The assessment not only includes the establishment of the projected design flood elevation and future rainfall projections but also an assessment of hardening approaches to protect the District's assets. The evaluation includes the impact of higher intensity more frequent storm events, sea level rise and its impact on infiltration and inflow in the system and the capacity of the effluent outfall. CDM Smith has developed a tool to monetize and normalize capital investments required to protect against these more extreme conditions, that takes into account the age and condition of the existing assets, replacement costs, and population served. With this tool, the investments can be targeted to achieve the greatest value at the lowest cost. Determination will be made when it might make more sense to abandon an existing asset to replace with a more resilient one.

Case Study

ADDRESSING SEA LEVEL RISE WITH CLIMATE CHANGE PLANNING

HAMPTON ROADS SANITATION DISTRICT, VIRGINIA BEACH, VIRGINIA

The Hampton Roads Sanitation District (HRSD) is actively implementing unprecedented facility improvements to protect the region's environment by reducing effluent discharges and expanding collection system capacity. Over the last decade, federal, regional, and local planning has increased awareness of Hampton Roads' vulnerability to flooding and climate change, which poses a serious threat to HRSD's existing and future facilities.

CDM Smith is looking at ways to ensure the continuing operation of HRSD facilities during recurrent flooding, extreme weather events, and to prepare for sea level rise. From this analysis, we will work with HRSD to determine projects that will prepare HRSD for resiliency today and climate change impacts in the future. Analysis will be conducted on approximately 92 pump stations/pressure reducing stations, eight (8) major treatment plants, and four (4) treatment plants.

Public Education: For many facilities, we have incorporated a new visitor center into the upgraded administration and control buildings to provide a hub for educational tours to help inform the public of the good work utilities do and to educate and captivate the next generation of utility workers. We have found that the education of the students can often more effectively result in changed behavior of the adults. For the Hyperion Wastewater Treatment plant in Los Angeles, CDM Smith designed an innovative facility at the plant site to promote environmental education and sustainability. The learning center located at the plant provides a central location to teach visitors about the urban water cycle (drinking water, stormwater, and wastewater) and the City's solid resources program (reduce, reuse, recycle) and the importance of their individual and aggregate commitment to conservation and environmental stewardship. CDM Smith's skilled architects designed an exterior watershed exhibit as well as an observation deck with a green roof. The intended audience at the learning center is highly diverse. Curriculum and exhibits were designed in multiple languages and at different educational levels to accommodate the city's diverse student population.

Case Study

RESILIENCY IN MIAMI-DADE: DESIGN, FIELD TESTING, AND IMPLEMENTATION

MIAMI-DADE WATER AND SEWER DEPARTMENT, MIAMI, FLORIDA

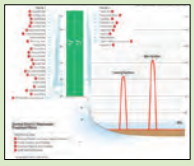
Miami is a coastal area with documented high vulnerability to hurricanes, sea level rise and storm events that pose a high risk to system operations. MDWASD has taken a proactive approach in planning for high-risk events, future sea level rise and climate change by incorporating design guidelines to improve infrastructure resiliency. CDM Smith developed a Hardening Evaluation Tool for the purpose of supporting the evaluation of alternatives and decision making for individual asset hardening at the WWTPs. The overall approach is to evaluate the vulnerability of each individual new or existing asset, determine its priority in terms of mitigation, define and evaluate alternatives and mitigation approaches, and then document the process. The approach to define the hardening criteria is presented below.

DEFINE LEVEL OF SERVICE PRIORITY

RISK-BASED FRAMEWORK
1. Personnel protection
2. Recovery after storm event
3. Hydraulic capacity maintained
4. Primary treatment liquid processes
5. Secondary treatment liquid processes
6. Tertiary treatment liquid processes
7. Solids treatment processes

DEFINE ACTUAL & DESIGN ELEVATIONS AND DEFINE COMPLEXITY

GROUP BY TIER LEVEL



DEFINE HARDENING APPROACH & ALTERNATIVES

VALIDATION & REALITY CHECK

Conceptual Functional Analysis
Impact to Operations & Maintenance
Cost Impact
Meet with WASD and OOL PM for alignment
Finalize Approach to Continue Design

Case Study

A BUILDING THAT INCORPORATES THE PRINCIPLES OF ENVIRONMENTAL STEWARDSHIP AND TEACHES ABOUT PROTECTING OUR RESOURCES

LOS ANGELES ENVIRONMENTAL LEARNING CENTER, PLAYA DEL REY, CALIFORNIA

CDM Smith provided design and construction services for the two-story, 15,000 square foot renovation of an existing administration building into two exhibit halls, an auditorium, and a classroom located at LA Sanitation's Hyperion Water Reclamation Plant.

The Los Angeles Environmental Learning Center at Hyperion (ELC) was developed to bring textbook and classroom learning to life while showcasing the City's commitment to protecting public health and the environment. Visitors explore their role in Clean Water Treatment and Conservation, Watershed Protection and Solids Resources Management. Located at LA Sanitation's Hyperion Water Reclamation Plant, and offered free to the community, the ELC's engaging, interactive features aim to inspire future generations to protect the environment through sustainable practices and transform their neighborhoods into cleaner and greener places to live.

CDM Smith designed the facility using environmentally sensitive engineering and sustainable design features, including a green roof, solar panels, and reclaimed water use. Design and construction of the ELC-W meets the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED) Gold standards for certification.

CDM Smith Profile

- 72 years of strategic planning for infrastructure design and improvements
- Holistic, integrated solutions focused on full spectrum of water, wastewater, and stormwater
- 300+ master planning projects/41 states/populations up to 17 million
- Top ENR 2019 ranked design firm: 4th in Water, 7th in Sewer and Waste, and 4th in Sanitary and Storm Sewers
- Expertise in resilient green infrastructure, planning and design, sustainability initiatives, and engaging communities/stakeholders

CDM Smith is a national leader in sewerage, water, and drainage/stormwater management with hundreds of completed integrated and/or strategic planning projects for municipalities across the US. With a staff of over 5,000 employees in more than 125 offices around the globe, CDM Smith has an enormous capacity to deliver the full range of planning, engineering, and related services to create and implement comprehensive, sustainable solutions. We offer clients a 72-year long, rich history of providing master planning services ranging from large communities to comprehensive master plans and integrated water management programs for major urban areas. CDM Smith has led more than 300 master plans and planning studies ranging from service populations of 0.5 million to over 17 million in the last 5-10 years. These plans analyze data, prepare dynamic models, facilitate public and stakeholder programs, and prepare CIPs, and life cycle O&M programs that serve varying needs of metropolitan service areas.

CDM Smith's master planning expertise covers all aspects of planning, design, construction, and operations of water related facilities and infrastructure and their funding. Our technical understanding of all layers of the water environment allows our national experts, together with our local teams, to take a holistic approach to the master planning process, to develop robust, sustainable, and resilient infrastructure solutions that meet the demands of today, maintain flexibility for the future, all while minimizing costs and maximizing resources. An added value of the CDM Smith team is that because we work on projects from inception through construction we have the ability to accurately forecast costs thereby enabling fair comparisons between alternatives, a sound basis for projected rate impacts and equity, and credible rate cases. We take a thoughtful and collaborative approach, engaging our clients and staff, local stakeholders. Our experts include planners, designers, strategists, economists, engineers and community representatives. By understanding the client's unique needs, we are able to provide innovative, sustainable solutions to their individual infrastructure challenges.

GLOBAL LEADERSHIP—EXPERT ADVISORS IN SUSTAINABLE MASTER PLANS

Our team of interdisciplinary experts have a thorough understanding of all project stages involved from concept to completion—from architectural and infrastructure design, environmental and geotechnical assessment, fiscal, regulatory requirements, climate change vulnerability, sustainability and resiliency, and socioeconomic implications, to planning strategy, phasing, and delivery.

Michael Schmidt, PE, BCEE, D.WRE

Stormwater/Drainage and Water Resources

Mike offers 36 years of experience on more than 200 master plans and 380+ programs in 31 states in stormwater, water resource and watershed master planning, flood control, green infrastructure, coastal, ecosystem restoration, modeling, research, facilities evaluations and design, permitting, operations, asset and data management, implementation, training, public information, and funding; He was technical advisor for the post Katrina-Rita FEMA review for SWBNO, the 2011 New Orleans Stormwater Drainage Master Plan for DPW and the Green Infrastructure Toolkit; Has guided planning, design and operations innovations that have saved $365M on more than $1B of green stormwater, flood control, water supply, and environmental restoration projects; Directed civil works projects for Louisiana CPRA, four USACE Districts, NRCS, and $15M/$50M Pontilly and Broadmoor Stormwater Drainage and Green Infrastructure Improvements Design for NORA and DPW for Pontilly and DPW and SWBNO for Broadmoor.

Jessica Watts, PE, CFM, D.WRE

Drainage Management

Based in New Orleans, Jessica has 21 years of experience in civil engineering design, modeling, and planning for stormwater/drainage; Extensive modeling experience including HEC-HMS, HEC-RAS, StormCAD and multiple programs utilizing the SWMM engine; GIS expertise and coordination associated with infrastructure database development and management; Resume includes 11 New Orleans stormwater projects including 2012 City-Wide Drainage Master Plan - managed technical completion of the work associated with multiple tasks including modeling and improvement suggestions for entire city drainage system, (16 major drainage basins that are each served by large stormwater pumping stations and over 1 million miles storm drain); Master plan documentation: System Understanding, Hydraulic Model Development, Design Standards and Guideline Development, and a Rate Study.

Mark Maimone, PhD, PE, D.WRE, BCEE

Green Infrastructure

Dr. Maimone is a water resource specialist experienced in groundwater and surface water studies, source water protection and stormwater studies, water quality studies, wetlands remediation, and mathematical modeling of ground and surface water; Project manager for the Philadelphia Water Department, supporting them in developing and implementing Green City Clean Waters, the innovative Combined Sewer Overflow Program that leads with Green Infrastructure. This groundbreaking program has taken a comprehensive look at urban impervious cover, identified program elements that will reduce runoff, and is tying it into a major CSO Long Term Control Plan; Hundreds of projects for street greening, stream restoration, infiltration beds, and other Low Impact Development techniques have been planned, design, and implemented; Sophisticated hydraulic and water quality models have been developed, and research on Green Stormwater Infrastructure is being carried out in conjunction with several local universities.

Michael Zafer, PE Drinking Water

In 33 years with CDM Smith, Michael has served in a leadership position for more than 20 years on 50+ large, multi-discipline, multi-team drinking water projects to resolve complex regulatory compliance issues, meet stringent water quality standards, and efficiently and reliably meet production objectives; Expertise focuses on water master planning, water quality and treatment processes, design of water treatment facilities, pilot plant and treatability studies, reservoir management, innovative and advanced treatment; research on DBPs, PFAS, biologic filtration, and CECs; plant upgrades and expansions, and startup/commissioning; Michael is a licensed operator and served as an instructor for water operator education and certification programs.

Dan Rodrigo Integrated Planning

Dan brings 30 years of experience in water resources management and economic analysis; Expertise includes water supply planning, integrated water resources management, water demand forecasting, decision science, and resource economics: National expert in preparation of 30+ IWRPs in North America and globally using proven planning techniques and decision models that successfully led to implementation of potable reuse and other alternative water supplies; Led award-winning Los Angeles Water IRP, which expanded water conservation and water reuse, resulting in City water demands for potable water being the same as they were in 1980, despite over one million new residents; Led City of San Diego award-winning 2013 Long-Range Water Resources Plan, ultimately developing a new CIP prioritization process for that client, and brought increased awareness of water supply issues to that community.

Tim Cox, PE, PHD Climate Change

Tim is a 19 year water resources engineer who specializes in water quality and quantity modeling, and the development and maintenance of surface water quality and quantity computer models; Expert in evaluating and using downscaled GCM data, hydrological and systems modeling, water quality analysis, reservoir studies, stream ecology, and software development and tool design for water resources projects; Company-wide expert in applying and developing methods for water supply planning and incorporating climate change projections into water resources planning studies; Served as principal investigator or technical lead for over a dozen climate vulnerability assessments, climate studies, and hydrological modeling projects across the U.S.; Co-authored a handbook on incorporating climate change into water resources planning; Contributions focused on the areas of quantifying uncertainty, applying stochastic methods, and incorporating hydrologic modeling.

Jane Madden, PE, BCEE Wastewater

Since joining CDM Smith in 1984, Jane has been involved in the planning, design and construction of some of the most challenging wastewater treatment projects in the U.S.; Expert in wastewater engineering, nutrient removal, solids handling, sustainability, and planning; regulatory and business issues; and multi-million dollar wastewater treatment facility upgrades for improved effluent quality; With over 100 completed wastewater projects, serves as technical strategy leader for water reclamation, specializes in best practices and sustainable treatment processes; Led master planning of GLWA's 1,700-mgd treatment facilities in Detroit; Successfully led planning, design and construction of a multi-phased, multi-million dollar wastewater treatment facility upgrade and expansion for Upper Blackstone Clean Water serving Worcester, MA; Currently part of the team to assess the impact of climate change on wastewater conveyance and treatment facilities for the Hampton Roads Sanitary District.

Peter Loomis, PE Biosolids

Peter has 30 years of experience with project tasks ranging from wastewater and biosolids treatment plant planning to design, construction management and operations. He has contributed to the success of some of the firm's most impactful wastewater projects; As the project manager and commissioning manager for CDM Smith's DC Water project, Peter led the design and start-up teams to deliver a $215M facility that lowered operating costs, reduced the facility's carbon footprint and improved energy efficiency.

Ahmad Habibian, PhD, PE Conveyance

Ahmad, CDM Smith's technical strategy leader for conveyance, specializes in infrastructure management, pipeline rehabilitation and trenchless technology; Through 31 years of engineering practice, education and research at the local, national and international level, his work has helped shape rehabilitation solutions and formulate assessment methodologies for water and wastewater utilities; As the recipient of the 2015 American Water Works Association Distribution & Plant Operations Division Peak Performance Award, Ahmad was recognized by his peers for his sustained service as well as his creativity, initiative and dedication.

- **Dave Sousa RLA, AICP Planner** - 40 years experience in master planning, urban design, transportation planning, environmental studies and public involvement; manages planning, design of large-scale transportation, urban redevelopment, park, and street enhancement projects
- **Joe Ridge Economist** - 42 years of extensive experience in assessing the fiscal and economic impacts of capital projects on municipal governments and authorities; develops financing plans, assessed financial capability, and conducted financial feasibility and marketing analyses
- **Jayson Brennen Senior GIS Specialist** - Leads CDM Smith Management & Technology Consulting group; 30 years of experience in the design and implementation of GIS and technology solutions for governmental agencies, utilities, airports, and private organizations
- **Amymarie R. Corriveau, PMP, CBAP** - With 21 years of experience, Amy is a program management and business technologies expert who helps utilities improve their operational performance; also manages business-process modeling and strategic planning sessions/workshops
- **Lauren Miller Environmental Scientist** - A 16-year environmental scientist and resiliency expert with extensive knowledge in the area of climate change services, including climate change vulnerability assessments, resiliency and adaptation plans, and greenhouse gas mitigation

PROJECT 1: WATER AND WASTEWATER LONG RANGE REGIONAL MASTER PLANS

GREAT LAKES WATER AUTHORITY (GLWA), DETROIT, MI

CDM Smith delivered the last four master planning efforts for the Detroit metropolitan area with the 2003 and 2019 Wastewater Master Plan, 2004 Water System Master Plan, and 2015 Update. For each, we developed comprehensive asset evaluations, modeling tools, and stakeholder participation programs that compiled information on accurate system conditions and interests of technical work groups, regulatory agencies, and customer communities.

VALUE TO THE SWBNO PLANNING PROCESS: CDM Smith will provide SWBNO with our perspective, best practices, and lessoned learned from our development of GLWA's 40-year wastewater and 20-year water master plans. This expertise and information will support SWBNO's decision-making and strategy as you work to integrate system and strategic planning to efficiently and sustainably operate, manage, and improve New Orleans' drainage, water, and wastewater systems.

INFRASTRUCTURE

Water System: 3.8 million served; 127 member partners; 1,069 sq. mi service area
Wastewater System: 3 million served, 87 member partners; 988 sq. mi. service area

KEY SCOPE ELEMENTS

- Information Gathering
- Asset Evaluation
- Rehabilitation and Rehabilitation
- Hydraulic Modeling
- Customer Steering Committees Specialty Working Groups
- Stakeholder Participation Programs Employee Reach-In /Community Outreach
- Workshops and Presentations
- Water Quality Model Analyses
- Development of Performance Measures
- Source Projection/Water Quality Plan
- Market Plan
- Product Plan/Life Cycle Cost Evaluation
- Water Supply Plan
- Service Management Plan
- Program for Regulatory Compliance
- System Consolidation
- Wastewater Metering
- Lead Pipe Services
- WRRF Modeling and Assessment
- Financial Analysis/Plan
- Developed Future Growth Scenarios Customer Service
- Water-Quality-Based Strategies
- Biosolids and Energy Symposium
- Proposed CIP
- Resolve Legacy Issues
- Strategies to Reduce O&M Costs Green Infrastructure Opportunities Energy Management

KEY STAFF PARTICIPATION

Jane Madden, Mike Schmidt, Peter Loomis, Michael Zafer

COMMUNITY OUTREACH AND EMPLOYEE IN-REACH: With a myriad of customer and stakeholder groups, CDM Smith achieved success through employee reach-in and community and stakeholder outreach. We heard varied stakeholders voice their concerns, needs, and impressions—all helping to shape the master plans. We provided transparency via distribution of all study materials and interim reports on the GLWA Outreach Portal. Our efforts to be transparent were reinforced by meeting with many constituent groups and incorporating these voices into our work, as appropriate.

- **WMP:** Outreach to 76 suburban wholesale customers, and 48 communities, with an extensive stakeholder participation program with wholesale customer and retail customer steering committees, technical work groups of customers and regulatory agencies, local neighborhood meetings to communicate with retail customers, and presentations and workshops with Board of Water Commissioners/GLWA Board;
  WWMP: Extensive stakeholder participation program for customer steering committee, technical work groups of customers and regulatory agencies, local precinct groups to communicate with retail customers, and presentations and workshops.

WATER FACILITIES: Master Plan: 2015 to 2034; System includes five water treatment plants (treatment capacity 1.72 bgd), 803 miles of transmission and distribution mains; 3 intakes, 19 booster pump stations.

- In 2004, evaluated entire water system; In 2015, updated the Water System Master Plan: Evaluated source water, treatment processes, and distribution system (Detroit and 87 wholesale customers); Developed short- and long-term capital planning, providing for regulatory compliance and to ensure sustainability; System sustainability and financial plan were critical components of overall analysis.

WASTEWATER FACILITIES: Master Plan: 2020 to 2060; Largest single-site wastewater treatment facility in US (1,700 mgd primary/930 mgd secondary) w/ ADF of 630 mgd, 8 CSO/ screening facilities, 183 miles of trunk sewers, interceptors and outfalls, 6 pumping stations.

- 2019 master planning recommendations designed to move GLWA forward in a logical fashion with an eye towards maintaining a "Utility of the Future" status, while master plan outcomes were achieved.
- Assets assessed to present long-term vision of capital needs to improve level of service and receiving water quality in the region; Developed adaptive, integrated CSO Control Plan; Modeled collection system including 4,500 sub-catchments and 13,000 modeled pipe, hydraulic structure, and control elements; Implemented a metering program to provide data for model calibration to supplement data available from existing flow meters and level sensors within the regional system; Developed water quality models to simulate dissolved oxygen, phosphorus and *E. coli* concentrations; Regional Operating Plan was developed to optimize the regional performance of facilities managed by GLWA and its member utilities; A 4-phase strategy for integrated water quality protection was developed to prioritize required improvements within the limits of affordability of the region.
- Water Resource Recovery Facility: Master Planning effort to help GLWA invest wisely and move towards a "build-it-best" rather than "replace-in-kind" as a Utility of the Future; Developed Near-term, high return on investment projects and studies, Ongoing asset management including necessary repairs and replace-in-kind projects, and New-Function/Transformative Projects including upgrading existing unit processes with more state-of-the-art technologies and/or projects which significantly change how flow is treated; Developed and calibrated plant-wide BioWin process model and full-plant hydraulic model using Visual Hydraulics; Evaluated existing and emerging technologies, and alternative treatment process trains to further resource recovery and sustainability.

PROJECT 2: WATER, WASTEWATER, AND STORMWATER MASTER PLANS

MIAMI-DADE, FL

Since 1989, CDM Smith has developed long-term water, wastewater (biosolids), and stormwater/drainage facilities master plans for the citizens of Miami-Dade, Florida. All encompassing services included modeling, engineering design; best management practices; water quality evaluations; permitting; stakeholder workshops, master planning updates; and facility planning.

VALUE TO THE SWBNO PLANNING PROCESS: For over 20 years, CDM Smith has provided the Miami-Dade area with comprehensive master planning services. CDM Smith will leverage this knowledge and experience that will provide the SWBNO with an overall perspective of lessoned learned, project implementation, and effective solutions of to support SWBNO's strategy as you work to integrate system and strategic planning to efficiently and sustainably operate, manage, and improve New Orleans' stormwater, water, and wastewater systems.

COMMUNITY OUTREACH AND EMPLOYEE IN-REACH: As an example of the on-going City of Miami Stormwater Master Plan, CDM Smith is conducting community outreach throughout the City to explain the planning effort and gather input on needs. Citizens are encouraged to send pictures from their phones of local problems, which are captured on the GIS database. An industry forum and charrette was held to gather input on four areas of interest that covered technical, as well as financial/funding discussions.

WATER FACILITIES: **Master Plan**: 2006 to 2010; System includes 3 water treatment plants (**total treatment capacity of 473 mgd**)

- CDM Smith prepared the most recent update for Miami-Dade County's Water Facilities Master Plan to provide a "road map" for scheduling capital improvements on the County's water supply, treatment, storage, and transmission system and assisting the county in obtaining Water Use Permit over a 20-year timeline. Tasks included: alternative water supply investigation, climate change analysis, integrated resources planning, water treatment residuals evaluation, and groundwater modeling.

WASTEWATER/BIOSOLIDS FACILITIES: **Master Plan**: 2005 to 2007; System includes 3 wastewater treatment plants (**total treatment capacity of 375.5 mgd**)

- **For Miami-Dade County Water and Sewer Department:** CDM Smith completed a biosolids master planning to develop a road map for scheduling capital improvements at the Central District and the South District WWTPs over a **projected 20-year time line**. Services included: flow and load projections for the WWTPs; condition assessment of existing processes; evaluation of stabilization and other processes per classification; biosolids product market assessment; review of potential improvements; and stakeholder workshops.
- **Wastewater Facility Resiliency:** CDM Smith designed improvements to Miami-Dade 112.5 mgd SDWWTP and 143 mgd CDWWTP to improve resiliency to sea level rise and peak flow events; Design encompassed: Hardening of existing and proposed structures; Hydraulic improvements to plant bypass; Modeling and improvements to plant effluent deep injection well disposal system; Improvements to treatment reliability and resiliency during high flow events; Analyzed potential vulnerability of structures, defined alternatives to mitigate the risk, evaluated alternatives using a multivariate analysis and reached stakeholders' consensus to finalize decisions.

STORMWATER FACILITIES: Since 1989, CDM Smith has provided the following stormwater plans for the region: City of Miami (2018-ongoing); Stormwater Management Plans for Various Miami-Dade Airports, FL (1989-ongoing); 20-Year Stormwater Management Master Plan - Miami Beach, FL (2010-2012).

- **City of Miami Stormwater Master Plan:** Stormwater Master Plan services to date include: GIS conversion of 100-years of paper records; hydrologic/hydraulic modeling and mapping to identify flooding risks and water quality problem areas; update digital terrain model; update delineation maps for the sub-basins; develop pollutant load estimates; identify, rank, and prioritize stormwater problems and current/future risks; and conducted systemwide modeling runs in a continuous simulation mode to obtain seasonal stages for the primary and secondary canals. Other planning efforts are on-going.
- **Stormwater Management Plans - Miami Airports:** CDM Smith has provided various services at **Miami International Airport (MIA)** including stormwater modeling and drainage design engineering services; stormwater master planning; best management practices, etc. CDM Smith developed the stormwater master plan updates for both the **Miami-Opa Locka Executive Airport (OPF) and the Miami Executive Airport (TMB)**. Services included: updated SWMPs for each airport; development plans; stormwater atlases; capital improvement planning; permitting support; and exploring sea level rise conditions.
- **Stormwater Management 20-year Master Plan & Sea Level Rise Projects - Miami Beach, FL:** Developed stormwater master plan for next 20 years, recommended stormwater infrastructure and a 50-year planning horizon for sea wall heights; system inventory, and model; and alternatives for flood control, water quality, and aquifer recharge. Capital costs were also presented.

INFRASTRUCTURE

Water System: MDWASD 2.3 million served; includes 3 WTPs; 7,700 miles of water lines
Wastewater System: MDWASD includes three WWTPs, 336,000+ retail sewer accounts, 15 volume sewer customers, 1,035 pumping stations, 3,071 miles of gravity collection system, and 910 miles of force mains
Stormwater: Master planning - 36 square miles/471,000 population

KEY SCOPE ELEMENTS

- Feasibility Study
- H&H modeling
- Utility Strategic planning
- Stakeholder workshops
- Community Visioning/Outreach
- Coastal Wetlands Reuse Rehydration
- Water use permitting support and assistance services
- Alternative Water Supply investigation
- Water treatment residuals evaluation
- Coastal Wetlands Rehydration
- Water Facilities Master Plan Update
- Water demand forecast revisions/update
- Climate change/sea level rise analysis
- Integrated resources plan assistance
- Collecting and reviewing as-built data
- Field verifying as built conditions
- Updating the existing modeling scenario
- Reestablishing the future modeling scenarios
- Updating the master plan documents
- Reviewing and updating the design guidelines
- Assisting with environmental and permitting issues
- Biosolids management master plan, study, and market assessment

KEY STAFF PARTICIPATION

Mike Schmidt, Jane Madden, Jayson Brennen, Mark Maimone, Peter Loomis

PROJECT 3: PHILADELPHIA GREEN CITY, CLEAN WATERS PROGRAM

PHILADELPHIA WATER DEPARTMENT, PA

Since 1994, CDM Smith has helped the Philadelphia Water Department (PWD) develop and implement a comprehensive combined sewer overflow (CSO) program, a stormwater permit compliance program, comprehensive watershed assessments and evaluations, and a source water protection program. CDM Smith has served as PWDs primary program assistant and advisor since the inception of the program. The culmination of this work led to the approval in June 2011 of a Long Term Control Plan Update (LTCPU) for Philadelphia known as the Green City, Clean Waters plan, as amended through negotiations with the Pennsylvania Department of Environmental Protection and U.S. EPA. This program represents the City of Philadelphia's commitments to meeting their regulatory obligations for CSO control while helping to revitalize the City.

VALUE TO THE SWBNO PLANNING PROCESS: CDM Smith will leverage our experience gained from our work with Philadelphia on stormwater master planning and the design of green infrastructure programs to provide SWBNO with additional knowledge on climate adaptation solutions, share best practices, and to identify the types of resources and tools available to support SWBNO in developing your strategies for increased resilience of the city, manage water, and provide other environmental and community benefits.

COMMUNITY OUTREACH AND EMPLOYEE IN-REACH: Supported by CDM Smith, PWD brought together engineers, landscape architects, city planners, biologists and a diverse list of stakeholders to implement this project, developing a plan that would transform the city/ CDM Smith helped PWD by facilitating negotiation and decision making among stakeholders, and presenting our findings to the city's municipal officials. We also assisted in developing the Philadelphia Stormwater Management Guidance Manual, which helps explain program requirements and new design guidelines for area developers.

STORMWATER AND WASTEWATER:

Green City, Clean Waters Program will green 1/2 of Philadelphia's combined sewer area and 25% of the City; applies a one water approach, managing stormwater through green infrastructure while also revitalizing the City

- Services include planning, program management, design criteria development, planning, design, and construction of projects for PWD throughout the City's green infrastructure endeavors; Supports all aspects of the program, triple-bottom-line analysis of green infrastructure, including H&H modeling, stream and estuary modeling, policy development, green infrastructure permitting, planning and design, innovative public and private sector funding, regulatory negotiations and reporting, and process development
- Developed long-term CSO control plan, which brought stakeholders together to help Philadelphia meet regulatory obligations for CSO, both improving stormwater management and water quality while benefiting the environment and containing costs
- Implementation approach was developed to integrate management of Philadelphia's watersheds into a larger context such that the program is designed to provide multiple benefits and provide a maximum return in benefits to the public and the environment
- Through evaluation of a number of alternative implementation approaches, it was determined that a Green Infrastructure (GI)-based approach would provide maximum return in environmental, economic, and social benefits within the most efficient time frame, making it the best approach for the City; one of the largest green infrastructure programs in the country
- Effort included $260M effort stream restoration and wetlands creation program, requirements and incentives for green infrastructure on private lands, large-scale street tree plantings, increased recreational opportunities, and preserved open space to manage stormwater at the source.
- Several design projects involved high school properties where the students were involved with the plantings of the GI, and courses were developed to teach them about the GI
- Implemented new regulations to manage stormwater for development anticipated in regional, watershed-based stormwater management planning
- Developed parcel based stormwater fees
- Hydrology and hydraulics of tributary watersheds and sewer catchments and hydraulic operation of sewer collection and transmission system
- Developed an inventory of hydraulic and physical characteristics of watersheds and sewer systems
- Data collection, compilation, quality assurance, mapping, and data management for all CSO facilities
- Piloting Green Stormwater Infrastructure citywide
- Designed and implemented GI demonstration projects on vacant properties, city schools, recreation

INFRASTRUCTURE

150 sq.mi, and 1.5 million served

KEY SCOPE ELEMENTS

- Coordination with multiple agencies
- GI implementation
- Adjusting traditional organizational practices to new types of infrastructure
- Developed GI standards
- Hydrologic and hydraulic modeling studies Operational analyses
- Triple Bottom Line economic analysis of the benefits of green stormwater infrastructure
- Community Visioning/Outreach and Stakeholder Involvement
- Information Gathering
- Public and Private Sector Funding
- Green Infrastructure Permitting
- Watershed Assessment
- Stream and Estuary Modeling
- Hydrologic and Hydraulic Modeling
- Information Gathering
- Stormwater Management
- Water Quality
- Stream Restoration and Wetlands Creation Program
- Climate Change Effects of Rainfall, Sea Level Rise and Joint Rainfall,and Tidal Surge Events

KEY STAFF PARTICIPATION

Mark Maimone, Jayson Brennen, Mike Schmidt, Tim Cox, Dave Sousa


CDM
Smith®
cdmsmith.com