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[LimnoTech](http://www.limno.com) is thrilled to have this opportunity to express our interest in supporting the Sewerage and Water Board of New Orleans (SWBNO) develop an innovative approach to create a long-term, integrated master plan for its key business lines. At LimnoTech, our vision is to help our clients make informed decisions based on sound science and real-world constraints, with the goal of restoring and protecting water resources to maximize the benefit to the community and environment. Our clients trust our ingenuity, expertise, and objectivity, and share our passion for clean water and healthy ecosystems.

Since 1975, LimnoTech has built a national reputation for creating lasting and innovative solutions to water-related problems. These include water quantity issues, such as flooding in Washington, DC, Houston, and Toronto; resiliency assessments; and water quality issues, where we have a long history with familiar concerns like nutrients and harmful algal blooms (HABs), as well as being on the front lines with addressing emerging contaminants like per- and poly-fluoroalkyl substances (PFAS/PFOA).

LimnoTech delivers quality technical services and products to municipal governments as well as federal, state, industrial, commercial clients, and non-governmental organizations. With this diversity, we understand what is required to develop successful solutions that work for all parties, including the interests of regulators, regulated entities, and the wide range of impacted stakeholders. As a result, we have built strong relationships with regulators across the country on behalf of our clients. This includes organizations, such as the US Army Corps of Engineers, with whom we work on many projects across the country.

Our approach to projects is to understand the big picture of a client's localized issues, which often include a wide range of economic, social, and technical challenges. As experienced by SWBNO, this includes assessing affordability, improving program branding and building trust, increasing programmatic funding, and planning to address both immediate and long-range infrastructure issues. LimnoTech has worked on numerous projects to build bridges between multiple experts that address these key needs. The following discussion includes our understanding of SWBNO's immediate needs and challenges 50 years from now, and how we have addressed similar issues and projects elsewhere using an Integrated Framework Planning approach.

We welcome additional discussion on our innovative and flexible approach to address real, implementable change for SWBNO and the City of New Orleans and we would love to have an opportunity to participate in any future workshops!



What will be New Orleans' biggest stormwater/drainage, wastewater/sewerage, and drinking water challenges in 50 years and what is the best approach to integrated, long-range planning to address those challenges?

The RFI includes three questions related to what New Orleans' biggest water-related challenges will be in 50 years. Given SWBNO's willingness to consider an integrated planning approach, and the obvious linkages between stormwater, wastewater, and drinking water, our response addresses these topics collectively.

Understanding of Current and Future Challenges

Infrastructure decisions made today will be relied on for the next 50 years, the typical design life of water- and wastewater-related infrastructure. It is imperative to make these decisions based on good science and engineering judgement – there are no do-overs when the stakes are this high. The level of investment over the next 50 years is likely to run into the hundreds of millions of dollars across the three programs.

Over this 50-year planning horizon, not considering integrating the planning efforts across these three programs (water, wastewater, stormwater) and within the larger City management would be a lost opportunity. Such an integrated approach allows the City to coordinate across projects and departments to achieve synergistic benefits, manage the utility more effectively and responsively to community interests, and achieve the resiliency necessary for long-term stability and success.

LimnoTech comes to the table with a unique skill set well suited to support this endeavor. Our technical qualifications include water resource-related planning services, including monitoring and modeling, green infrastructure design, and regulatory negotiations. We have also served as a bridge between the highly technical side of planning and the management challenges of building trust with the public and others within the City. Our approach, as presented in this response, reflects the unique space we occupy in a broad integrated planning effort such as that described in SWBNO's RFI.

LimnoTech understands that SWBNO's challenges and opportunities are similar to other cities where we are actively working. However, SWBNO's challenges are bigger, more urgent, and more complex. These challenges include balancing the need for continued daily operations, which can require a reactive or even emergency mode, with the need to plan for the future. Based on our experience working with communities across the country, the approach we present below will help to enable more proactive management and minimization of reactive or emergency operations. Other challenges currently facing SWBNO include: organizational issues related to staff departures and vacancies; financial issues related to lack of sufficient funding to make the necessary infrastructure and personnel investments; public perception issues of mistrust and misunderstanding of SWBNO leading to billing delinquencies; and the technical challenges related to being located in a low lying delta area and relying on aging infrastructure.



On top of that is the continually evolving regulatory landscape. Finally, and potentially most challenging, are the current and future environmental issues in this area, including:

- Rising sea levels and more intense rain events that lead to flooding;
- Warming water temperatures;
- Increased nutrient loadings, which result in harmful algal blooms, and hypoxic conditions in the Gulf of Mexico; and
- A growing list of emerging contaminants including per- and poly-fluoroalkyl substances (PFAS/PFOA).

Some of these challenges are currently playing out, while others will develop more fully in the coming years and decades. What the challenges will specifically look like in 50 years are hard to determine, but likely they will be the same fundamentally, but greatly exacerbated by a host of factors that are getting worse with time. These include rising sea levels, climate change, increased storm intensity, a flashier Mississippi River, and land subsidence. Identifying solutions to these issues will become more challenging if not addressed soon. Whether SWBNO will also still have organizational and public perception issues will depend in large part on the success of the transformations SWBNO institutes in the coming years.

The challenges we see over the next 50 years can cut across all three programs in different, but important, ways (Table 1 includes some examples). A holistic approach that addresses all three programs together will yield better solutions and investment priorities. Our approach offers a pathway to accomplish this.

Table 1. Challenges and potential impacts to SWBNO and the City of New Orleans

Challenge	Potential Impacts		
	Water	Wastewater	Stormwater
Rising sea levels and more intense rain events	Saltwater intrusion affecting viability of groundwater as a source water supply	Increased wet weather flows stressing treatment plants, uncontrolled discharges, need for more flood-protection infrastructure	Flooding, which could threaten public safety and local property; requiring more investment in flood-protection infrastructure
Warming water temperatures	Creates more favorable conditions for HABs and pathogens, requiring increased monitoring and treatment	More stringent limits for parameters potentially affecting vulnerable biological communities	TMDLs to address the temperature of stormwater runoff
Increased nutrient loadings, HABs and hypoxia in GOM	Increased treatment of surface source water with HABs	New discharge limits, requiring additional treatment technology investments	Need to remove pollutants from stormwater prior to reaching waterways
Emerging contaminants	Additional treatment, infrastructure updates, public concerns	New discharge limits, requiring additional treatment technology investments and/or change in current treatment practices	Presence of emerging contaminants in stormwater may result in additional regulatory requirements to address.



LimnoTech understands that SWBNO wishes to undertake an innovative approach to long-term, integrated master planning for its sewer, water, and drainage-related divisions. To accomplish this, SWBNO will need to build resilience across four critical dimensions: technical and engineering; organizational; financial; and the community. This will allow for adaptation in the future. For example, incremental change in response to climate change is possible when all four dimensions of resilience planning are working.

Our approach to addressing resilience across these four dimensions is designed around community and organizational planning to lay the foundation for comprehensive, lasting resiliency of the SWBNO utility. We first develop a vision for SWBNO, including the role it plays in the lives of their customers and how the city will adapt its infrastructure in light of issues like climate change. This will be followed by the development of a strategic plan, or Road Map, and conducting integrated utility system planning grounded in technically sound planning and engineering practices with measurable outcomes to gauge progress. As part of this process, our approach will achieve the two related outcomes desired for the city, which are to restore the community's trust in SWBNO and to bring financial stability to the organization. The following discusses LimnoTech's approach to achieving these steps, the desired outcomes, considerations to be taken, and its resulting benefits (summarized in Figure 1).



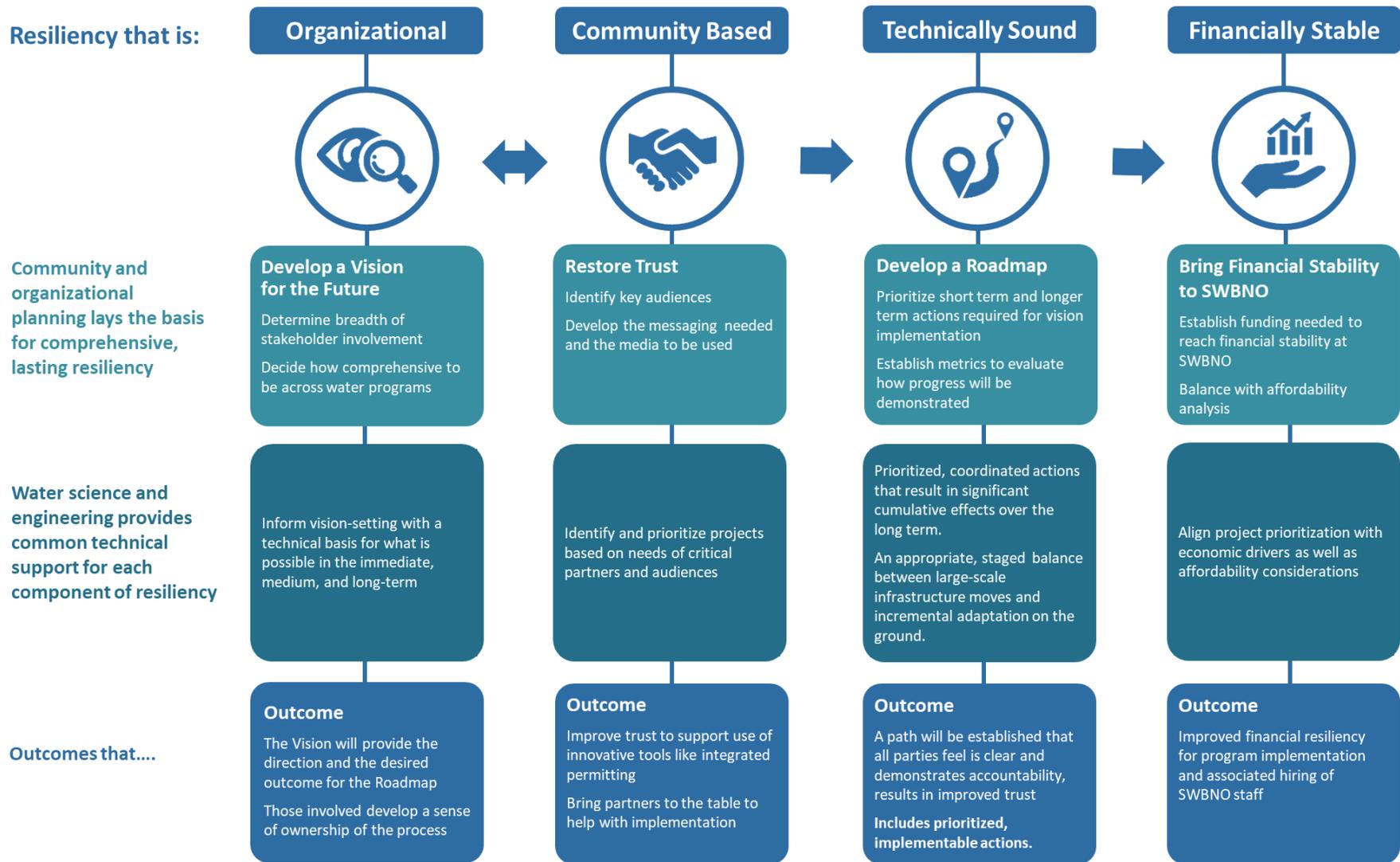


Figure 1. Addressing the needs of SWBNO, the steps, and anticipated outcomes



Opportunities for Positive Change

LimnoTech has worked with other communities, such as Richmond, Virginia, on similar visioning and planning exercises. We believe that SWBNO could employ a similar approach, called Integrated Framework Planning, which we have successfully used elsewhere.

While EPA guidance related to integrated planning and permitting has helped numerous municipalities and organizations across the country, a significant amount of flexibility is still available to achieve more impact within the organization and with the community. Often planning efforts result in a set of strategies that may achieve a program's objectives, but may not be coordinated or connected to other local projects. Alternatively, a larger master planning effort can be more comprehensive in scope, but not tied to actionable projects, which can result in stalled efforts to accomplish goals. Meeting these two planning efforts in the middle is Integrated Framework Planning (Figure 2).

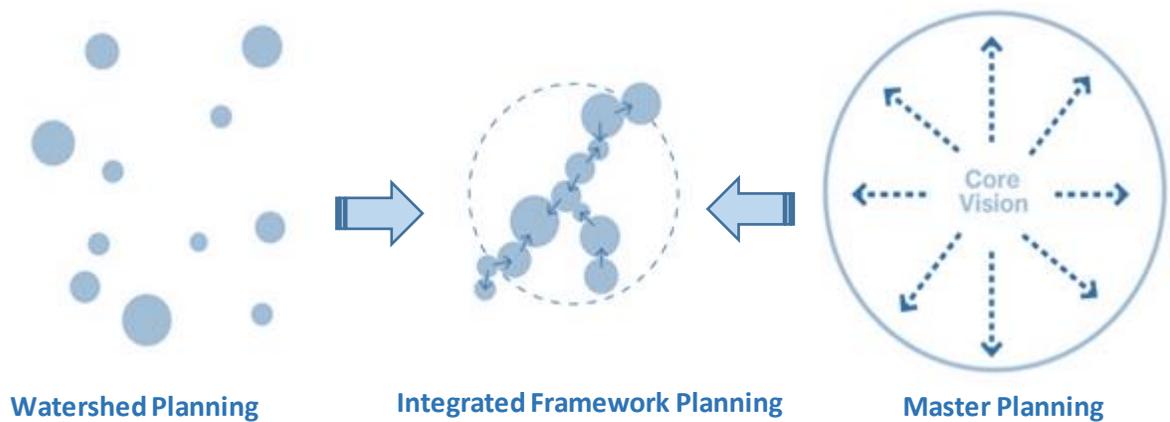


Figure 2. How Integrated Framework Planning relates to watershed and master planning

Integrated Framework Planning is the marriage of EPA's Integrated Planning process and a Framework Planning approach that has traditionally been implemented in urban planning and landscape architecture. The approach connects all the pillars that define the utility, including the organizational, financial, technical, regulatory, and communication pieces, and results in a management and implementation framework that is flexible enough to address current and future challenges.

Benefits of Integrated Framework Planning

This Framework helps to coordinate sometimes disparate planning efforts, such as those driven by NPDES permit requirements with drinking water, flooding, or non-water related drivers, such as habitat, invasive species, pedestrian safety, or socioeconomic issues. The Framework provides the structure for the planning process. This structure is specific to the locality and can range from regulatory drivers and associated requirements to a specific project upon which all related planning hinges.

The Integrated Framework Planning process works to tie together the data and information collected related to the Framework structure as well as continued feedback from internal and external partners. Essentially, this tells a story of what the issues are, what the needs are, and what the constraints are in a particular localized area. This planned, strategic implementation helps to better choreograph implementation activities over time that maximize the benefits of available funding and realize multiple benefits across different partners internal and external to the community. The ultimate goal of this

approach is to achieve more, faster and more efficiently.

It should be noted, again, that flexibility is inherent to this Integrated Framework Planning process. This flexibility allows communities with complex and sometimes competing challenges to work cooperatively and consistently towards a common, shared vision. LimnoTech’s experience with communities such as Detroit, MI, Raleigh, NC, and Austin and Houston, TX, highlighted that these complexities are common. LimnoTech’s approach in such instances is to bring together the right cross-disciplinary pieces (as discussed below in Roles of the IFP Process). Our role is unique in that we have many technical capabilities, but also are comfortable accessing capabilities outside of the typical engineering firm (e.g., urban planning, landscape architecture, technological solutions, and academics).

As noted previously, while planning for 50 years from now may prove challenging, Integrated Framework Planning can meet the goals of today while providing a flexible framework to be adaptive to the changing needs and the community 5, 10 and 50 years from now.

Developing a Vision for the Future

Integrated Framework Planning begins with the development of a vision of where a utility wants to be in 2, 5, 10, and 50 years (see Figure 3). These time horizons are intended to create a vision of where the utility should be currently (2-year horizon), where it should be in the next permit cycle (5-year horizon), where it could be within the next decade (10-year horizon), and where it aspires to be (50-year horizon). The vision should define how the utility wants to be structured and managed as an organization, what its relationship with its customers will be, where it wants to be from a regulatory standpoint, where it should be financially, and where it should be from a technical and engineering perspective.

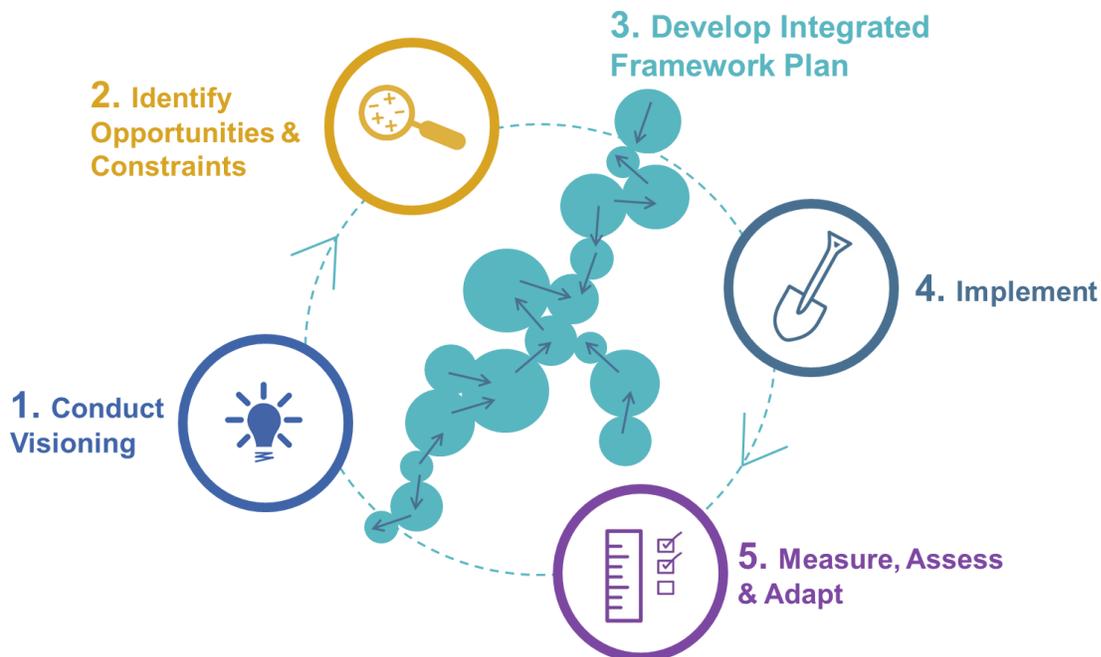


Figure 3. The Integrated Framework Planning Approach

This visioning exercise is typically approached at several levels, including with management, with the utilities’ employees, with technical stakeholders (outside stakeholders with a vested interest in the utility), and with the larger community (the people that SWBNO serves). Ultimately, the City’s path will

be to find a way to provide safe, clean water, reliable and safe wastewater treatment, and protection against changing climate, and then realizing all of the economic and community benefits that come with that. The resulting vision is a Delta City that is clean, safe, beautiful, and closely tied to the water that defines it.

Roles in the IFP Process

In our experience in working on projects such as what SWBNO is planning to initiate, there are a number of experts that are needed to facilitate the implementation of these various steps and desired outcomes. While involving a range of experts is essential, the key role will be the **Champion** of this initiative. The Champion is often a higher-ranking staff member in an organization (but doesn't have to be) that has his/her own vision for the process, but possesses the willingness to modify this vision as needed based on stakeholder feedback. The Champion must also possess the resolve to initiate this process and move it forward despite anticipated push back.

Examples of other important roles ("puzzle pieces", see Figure 4) with which the Champion must interact are discussed below. These, however can be modified, or built upon, based on a community's specific needs.

- **Facilitator/mediator** – Challenges can be experienced as the result of a range of issues, such as negative publicity associated with a natural disaster or resistance to change within an organization. Involving a neutral party from the very beginning can be important to establish trust with various groups (e.g., environmental organizations, the general public, other city departments). Our experience has shown that even skeptical or adversarial participants feel more heard, and, over time, become willing participants in decision making and even subsequent implementation efforts.

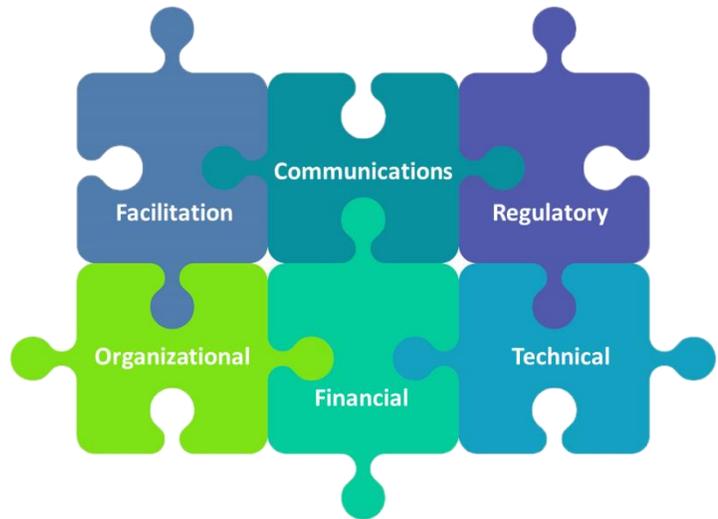


Figure 4. Roles in the Integrated Framework Planning

- **Communications and public relations experts** – Lack of an accurate, consistent, and positive messaging associated with any issue can result in the spread of misinformation and resulting frustration with an organization. Involving those that understand the various audiences, their concerns, and the best media by which to reach these groups is important. It is also important for communication staff to work closely with other experts, such as technical staff, to have accurate information that can be conveyed readily as issues may arise, but in a much more thoughtful, proactive way.
- **Technical experts** – In a community such as New Orleans, where the utility oversees many topic areas (wastewater, stormwater/flooding, drinking water), there are many issues that need to be addressed – sometimes simultaneously. Technical staff need to have a comprehensive

understanding of these issues and the tools (e.g., modeling, design, analysis, etc.) that are needed to tackle issues in a timely manner.

- **Regulatory experts** – Environmental regulations and the associated pressures they may pose on a community can change quickly. Regulatory pressures may relate to changing drivers, such as harmful algal blooms or PFAS contaminant concerns. They may also shift due to changing perceptions, such as increased comfort with integrated planning and permitting. It is important for technical staff to not only be knowledgeable of the current regulatory climate, but be nimble enough to react to changing drivers in the regulatory environment.
- **Financial analysts** – Financial needs and limitations are experienced on both ends of the spectrum in a community – from the municipal end, where there may be limited funds to implement regulatory-driven requirements, to residents, who may face financial challenges in paying utility bills. Involving financial analysts, who have experience in assessing the affordability thresholds of a community and can evaluate and propose creative financing options for the utility, will help address the financial gap and could help set the stage for obtaining regulatory relief.
- **Organizational experts** – A common challenge in implementing municipal programs can be the structure of the department itself. While sometimes overlooked, understanding the roles of various departments and individuals in how decisions are made and how efficient programs are implemented can be important. This can result in restructuring an organization and/or clarifying staff roles and responsibilities.

The assembly of the team can facilitate the initiation of the visioning process. It is important that the visioning and associated planning be intentional. To be most successful, it must include explicit buy-in from stakeholders, which can include environmental groups, developers, and other City departments. The expectations, or rules, of the process should also be clear to all involved. This includes things like the approach toward consensus or which stakeholders will be invited to the table.

In cases where particular regulatory issues must be addressed or where a community may be looking to initiate innovative solutions to regulatory drivers (e.g., integrated NPDES permit), it is essential that the appropriate regulatory authority (e.g., permit writer) be involved immediately upon project initiation. This is important to avoid any road blocks or miscommunication from the beginning or to prevent any promises to stakeholders that are not supported by the regulatory agency. As SWBNO has responsibility for multiple water resources, the desire to pursue integrated planning, and the opportunity to pursue integrated permitting, early communication with the Louisiana Department of Environmental Quality will be essential.

Other Available Tools: [Integrated Permitting](#)

Integrated permitting is another tool that can be used to address regulatory challenges. This approach can be used to synthesize and manage complex permitting requirements across departments and jurisdictions. SWBNO is in the fortunate position to own the stormwater, wastewater, and drinking water systems in the City. Richmond, Virginia is in the same situation, and LimnoTech helped facilitate the issuance of an integrated permit for stormwater, wastewater, and combined sewers in that city.

Our experience working with Clean Water Services in Oregon resulted in the nation's first watershed-based permit. A watershed-based approach allows CWS the ability to shift resources to projects that will



provide the greatest benefit. Rather than focus expenditures on changes at a specific wastewater plant, CWS has flexibility to implement improvements elsewhere in the watershed to maximize benefits. LimnoTech also supported CWS with the development of a comprehensive watershed-based index to prioritize investments considering multiple benefits. Finally, we've also worked with CWS and other entities to evaluate and develop methods for quantifying benefits for specific projects. These assessments include benefits for reducing water footprints, improving water quality, and restoring ecological integrity.

Developing a Roadmap

Once the overarching vision for this effort is identified and associated goals and objectives are established, next steps will include the development a "Roadmap" to achieve this vision. This will include:

- Opportunities and constraints to the process (e.g., is additional sewer system or flood modeling needed; are there opportunities to coordinate with other efforts, such as the Coastal Master Plan or a Nutrient Management Strategy that addresses Gulf of Mexico Hypoxia issues)
- High-level strategies that will achieve the goals/objectives (these will later be translated into associated site-specific projects through the Framework Planning effort;
- A timeline in which they will be implemented; and
- Metrics, by which progress will be measured.

What we have experienced in implementing this approach in cities like Richmond, Virginia, is that this process establishes a culture of cooperation, engagement, and trust. The time that is taken up front to be clear about defining these steps; the expectations of the stakeholders, as well as thoughtfully addressing their concerns; and clearly describing what the technical data means results in significant benefits in later stages of the project. These benefits can include support of stakeholders during permit issuance (e.g., no significant comments on draft permit, no associated lawsuits); positive engagement, including a sense of ownership and interest in its success; and implementation support, including bringing additional resources, like grants, to the table to implement projects.

As this collaborative approach continues, it can also be adaptive as it is based on a flexible approach established in the Integrated Framework Planning process, discussed above, that can change over time as conditions, such as political pressures or environmental drivers, may change.

Subsequently, the Integrated Framework Planning process helps to address not only regulatory drivers, but provides a framework to simultaneously address other community benefits, such as biker or pedestrian safety, habitat, beautification, environmental justice-related issues, etc. This allows a community to tell a more comprehensive story than that which focuses on something like stormwater, which can be of greater interest to the public, and result in increased support in association with a related projects implementation.

Lastly, the flexibility found within the existing regulatory structure, and the improving perception and support for more innovative approaches, such as trading and integrated permitting, may also serve to provide some regulatory relief. This may also include additional flexibilities associated with EPA allowing to consider affordability within a community's water programs and under the umbrella of integrated planning.



Profile of the Firm

LimnoTech is an environmental engineering and science firm incorporated in Michigan that has been in business for 45 years. During this time, LimnoTech has helped clients across the United States and internationally create lasting solutions to water-related problems that are firmly anchored in the best science and engineering. LimnoTech has a national reputation for providing objective, authoritative consulting services in all areas related to the water environment. LimnoTech delivers quality technical services and products to municipal governments as well as federal, state, industrial, commercial clients, and non-governmental organizations. With this diversity, we understand what is required to develop successful solutions that work for all parties, including the interests of regulators, regulated entities, and the wide range of impacted stakeholders.

The heart of our organization is our people. The company employs 78 engineers, scientists, and support staff. LimnoTech is a 100% employee owned through an Employee Stock Ownership Plan (ESOP). This ownership structure instills and maintains strong employee engagement and commitment to succeed for the company through client service.

This strong staff engagement facilitates our vision to help our clients make informed decisions based on sound science and real-world constraints with the goal of restoring and protecting water resources to maximize the benefit to the community and environment. Our clients trust our ingenuity, expertise, and objectivity, and share our passion for clean water and healthy ecosystems. Our scientists and engineers build on an in-depth understanding of wet weather program-related regulations, the underlying science, modeling, and needs of the regulated community to find innovative solutions to a wide range of water-related problems.

LimnoTech has successfully served clients across 49 of the 50 United States and a number of locations worldwide, from our offices in Ann Arbor, MI, Washington D.C., St. Paul, MN, and El Segundo, CA. We make efficient and effective use of all forms of communication to build and maintain close working relationships with our clients. We also value our teaming relationships with private firms, public entities, research organizations, and universities. Our focus on service and quality has resulted in clients that turn to us repeatedly and refer LimnoTech to others with similar needs.

In addition to our long history supporting wet weather programs, LimnoTech has also been working to take planning further. We are working in communities such as Richmond, VA; Kansas City, MO; Detroit, MI; Austin, TX; and Toronto, Canada to make progress faster and more efficiently while creating multiple benefits across internal and external partners. We have been working with these and other communities to develop and implement a spectrum of Integrated Planning approaches that best achieve the locality's goals. These can range from achieving regulatory drivers to a focus on a specific project (e.g., riverfront plan) that is the foundation for all related planning. The results of LimnoTech's efforts have resulted in a variety of novel outcomes (integrated NPDES permit, Clinton Climate Initiative awarded project to serve as a model for carbon-neutral and sustainable development) that may provide valuable ideas to the Sewerage and Water Board of New Orleans as well.

While LimnoTech may be known more traditionally for its wet weather program and modeling expertise, LimnoTech also has helped many communities develop and implement a broad range of integrated planning approaches (such as Detroit, MI, Raleigh, NC, and Austin and Houston, TX). This combination of expertise allows LimnoTech staff to "dig into the weeds" regarding regulatory and technical water quality issues while understanding the complexities of a community's needs. These needs are often



outside the realm of a traditional water quality program, but may be tied together to incorporate efficiencies and cost savings.

Examples of LimnoTech Experience with Integrated, Long-Range Planning

Clean Water Plan - Richmond, Virginia

The City of Richmond’s Department of Public Utilities (DPU) sought an improved method to manage its stormwater, wastewater, and combined sewer programs, which all include their own regulatory compliance and management requirements, and historically have been addressed separately. In 2014, the agency embarked on an ambitious effort to accomplish this in a coordinated way with an aim to increase efficiency and allow for identification and prioritization of the actions needed to improve and protect water quality. This integrated planning process would then inform an integrated NPDES permit. With almost four years until their next permit would be issued, DPU hired LimnoTech to develop an approach to achieve this goal. LimnoTech developed a methodology for what DPU calls its “[Clean Water Plan](#)” that is intended to streamline and incorporate flexibility into regulatory implementation, improve



Frequent RVA Clean Water Plan stakeholder meetings have built trust and facilitated partnerships for implementation.

collaboration, build trust, focus planning, and direct investments in a way that meets water quality goals as well as achieve other social and environmental benefits affordably.

The development of the [Clean Water Plan](#) began with establishing an extensive public involvement process. A Technical Advisory group was established that included approximately two dozen representatives from state and local agencies and a variety of local watershed and neighborhood associations. A meeting facilitator was also brought in to the process to serve as an impartial third party that brought a sense of trust and to ensure all sides were heard. An extensive public outreach effort was simultaneously implemented to convey related information to the non-technical audience (see RVAH2O.org for more information).

Through meetings with City and non-City partners with interest in the priority areas, a series of nine projects were identified that had the potential for meeting Clean Water Plan goals, meeting partner goals (e.g., traffic calming, pedestrian safety, restoration of impoverished neighborhoods, etc.), and identifying opportunities for cost sharing between DPU and these partner agencies. This effort will result in implementation of these and other projects over the next two years. This focused and coordinated implementation planning process will occur in additional watersheds over the course of the five year NPDES permit cycle. The ultimate goal of this effort is to direct investment of Richmond’s stormwater and wastewater systems while providing the greatest community value by addressing other social



benefits simultaneously. Taking this multifaceted approach to implementation is intended to help cultivate financial, intellectual, and technical partnerships that will support the City in the equitable and affordable implementation of the Clean Water Plan.

While the City has tried to identify goals and drivers as comprehensively as possible through the stakeholder process as well as put forth effort to comprehensively understand the issues being faced within the City's various watersheds and systems, the City also understood that these drivers may change over time. To account for this, the Clean Water Plan implementation approach incorporates flexibility in several ways that will allow the City to adapt to any changes and continue to implement efforts that best address the most pressing issues. Flexibility is obtained through an integrated NPDES permit that addresses stormwater, wastewater and CSOs. The permit was issued in October of 2018 and allows the City to collectively evaluate where it can most cost effectively address pollutant sources. Additionally, the Watershed Framework Planning process is designed in a way that accounts for needs across various City departments. This prevents multiple departments from working in silos or at odds with one another, and removes barriers for implementation. Adaptive management is also achieved through quarterly discussions with partners and annual review of goals and strategies, facilitating refinements and modifications in the planning approach. At the end of the day, this approach allows DPU to continue to make progress toward the most pressing issues addressing stormwater and wastewater systems. For more on LimnoTech's support of Richmond's integrated planning effort, visit the RVAH2O [website](#).

Significant strides were made with the environmental and regulatory communities to build trust, which has resulted in a number of partners for implementation projects that have brought hundreds of thousands of grant dollars to the table. DPU, however, recognizes that there are other key groups, including developers, that still have a sense of mistrust toward the utility. LimnoTech is continuing to work with the City to develop a communication strategy to continue to build trust with these key groups.

[Don River Naturalization, Toronto, Ontario](#)

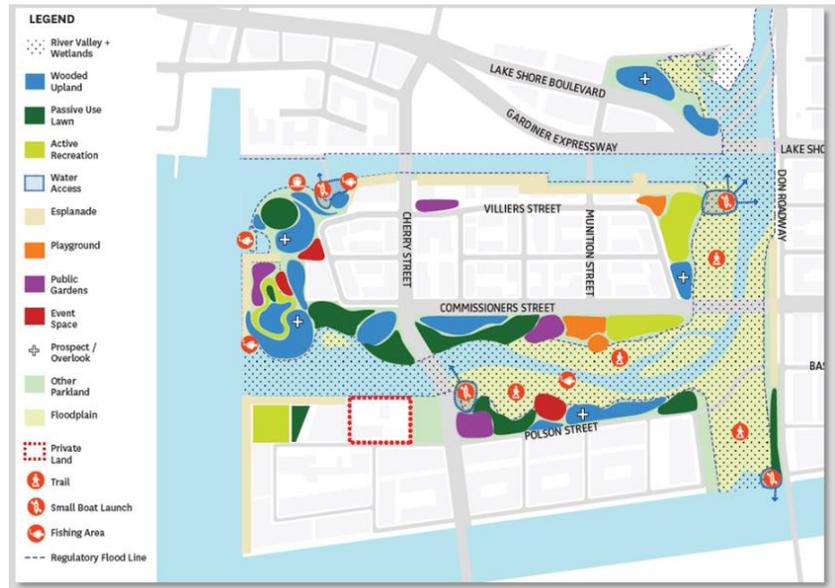
The Lower Don River in Toronto suffers from the neglect and urban decay typical of many older cities. While various ideas had been advanced to address the problems of the Lower Don, no comprehensive solutions could be found that met all the requirements of a river mouth in the middle of an active city. Finding a solution for the Lower Don mouth required simultaneously meeting the City's needs for floodwater conveyance and residential, commercial, and industrial uses in the Don Lands area, while also addressing the community's strong desire to restore ecological function and recreation along the river.

To find a solution, [WATERFRONToronto](#), a local development authority, sponsored an international design competition in 2006, with four teams representing landscape architects, urban planners, and river hydrologists and geomorphologists from around the world. As part of the winning team, LimnoTech worked with the landscape architecture firm of Michael Van Valkenburgh Associates (New York) and other team members to develop a plan for creating a new river channel with natural meanders, wetlands margins, and abundant recreational opportunities. LimnoTech was able to bring its extensive knowledge of how rivers flow and move sediments to a collaborative working relationship with the ecologists and architects working on the project. The team of scientists, engineers, and architects has developed [a plan for development of the Don Lands](#) that is exceptionally well-integrated



with a revitalized riverine ecology, flood management, management of sediment and debris, and recreational opportunities.

LimnoTech and the rest of the team are continuing to refine the design and develop the basic engineering and science required to implement construction. Ongoing activities include detailed hydrologic, hydrodynamic and sediment transport modeling of the system; support for planning of project phasing and management of contaminated soil and sediment; and technical planning for project sustainability, including minimization of the development's impact on the water environment through water footprinting analysis. The highly integrative project is closely focused on the sustainability of the development and its surrounding ecological setting. This resulted in the project being selected as one of 16 projects in the world by the Clinton Climate Initiative to be studied as a model for carbon-neutral, highly sustainable city building.



Numerous community benefits and drivers, including flooding, were taken into consideration in designing options for the project area.

Hydrologic and Hydraulic Modeling to Support Combined Sewer Overflow and Sewer System Master Plans for Washington, DC

DC Water operates a wastewater collection system that includes an MS4 storm sewer system, a separate sanitary sewer system, and a combined sewer system. The DC Water sewer system includes a substantial number of pump stations and hydraulic control structures, and hundreds of miles of sewer pipes. A detailed understanding of the sewer system is needed as the infrastructure ages and sewer capacity demand increases. In addition, DC Water is building new facilities as part of its CSO Control Program, and these facilities need to be designed to convey, store and treat wet weather flows from within the City and contributing suburban areas. DC Water, like most utilities, has substantial capital and O&M costs to support its water and wastewater services. Sound technical analysis is needed to prioritize projects and implement cost-effective solutions.

LimnoTech has provided hydrologic, hydraulic, flooding, and water quality modeling for DC Water since 1999 to support development of a Sewer System Master Plan, and to assist with implementation of requirements that stem from NPDES permits and a CSO control consent decree.

Meeting DC Water's needs required development of a geodatabase for the sewer system and construction of GIS coverages to support hydrologic and hydraulic modeling. The geodatabase was developed by digitizing all of the sewer system maps for the City. The geodatabase enabled LimnoTech to assemble and utilize key GIS information for the storm, sanitary, and combined sewer systems, sewer outfalls, manholes, catch basins, pump stations, and key hydraulic control points. Access to attribute

data for pipe diameter, material, type, and invert elevations enabled advanced interpretation of system performance and needs.

Meeting DC Water's needs also required development of the hydrologic and hydraulic model used to evaluate and prepare the CSO Long Term Control Plan. LimnoTech moved the model used to develop the CSO Long Term Control Plan to the Mike Urban modeling platform in 2005 to take advantage of advanced GIS capabilities and DHI's asset management system. The upgrade allowed LimnoTech to re-delineate the model's sewersheds and redefine sewershed parameters based on the latest GIS data.

For the past several years, LimnoTech has applied the conducted modeling to support facility planning and design efforts for the nearly \$3 billion DC Clean Rivers program for CSO control and nutrient reduction. This work is targeting pump station capacity, design of deep tunnels for temporary storage of combined sewage, and other improvements to reduce the frequency and volume of CSO discharges. As part of the tunnel design work, LimnoTech has developed and applied a separate hydraulic transient analysis model to investigate the potential surge and geysering in the planned tunnel system that may be caused by rapid filling of the tunnel during extremely heavy rainfall events.

In 2011, LimnoTech also performed a major flooding study of the Federal Triangle area of Washington, DC. During a two-day rain event in 2006, 7 to 12 inches of rain fell in the Washington area. Constitution Avenue was flooded with up to 2.5 feet of water. Many of the federal office buildings and museums along Constitution Avenue experienced serious basement flooding that caused tens of millions of dollars in damages. Working in conjunction with the Federal Emergency Management Agency (FEMA) and DC Water, LimnoTech developed a two-dimensional hydrodynamic flow model, to simulate surface flow, ponding levels on streets and sidewalks, and interaction with the existing hydraulic model. The 2-D model was used to examine the causes of the flooding and to formulate potential alternatives to reduce or eliminate such flooding in the future.

LimnoTech has also been working with DC Water under the DC Clean Rivers program to evaluate the potential for green infrastructure retrofits in the Potomac River and Piney Branch sewer areas to reduce the size of two of the prescribed CSO storage tunnels. LimnoTech's green infrastructure modeling includes pre- and post-construction assessments of built green infrastructure efficacy. In addition to modeling to support the green infrastructure, LimnoTech has worked with DC Water to develop an integrated mobile platform to survey, store, and analyze data related to implementation of a downspout disconnection program.



Flooding addressed in Federal Triangle in Washington, DC