



A Framework for Permitting Innovation in the Wastewater Sector

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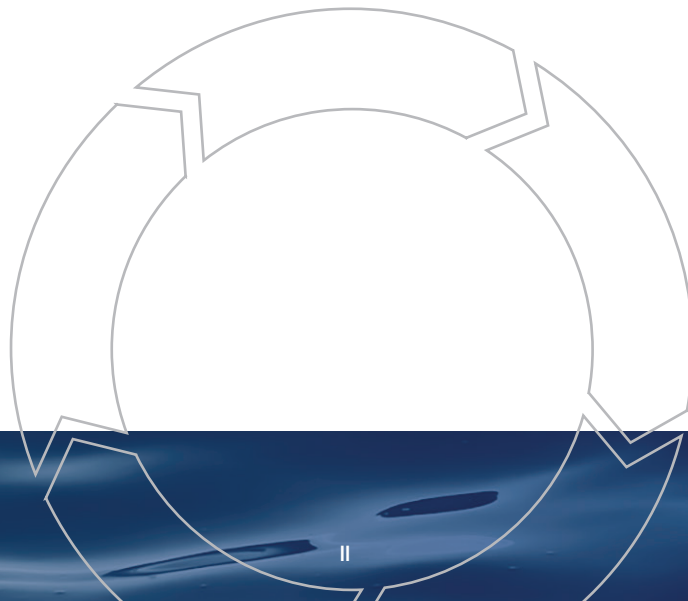
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Workshop participants helped to test, improve, and validate our framework for innovation and permitting, shown here at Wingspread in Racine, WI, August 2023.

This report is an output of Action 2.19 (Advance Strategies for Permitting Innovative Wastewater Management Practices and Water Reuse) under the National Water Reuse Action Plan (WRAP). Additional outputs of WRAP Action 2.19 can be accessed within the WRAP Online Platform.

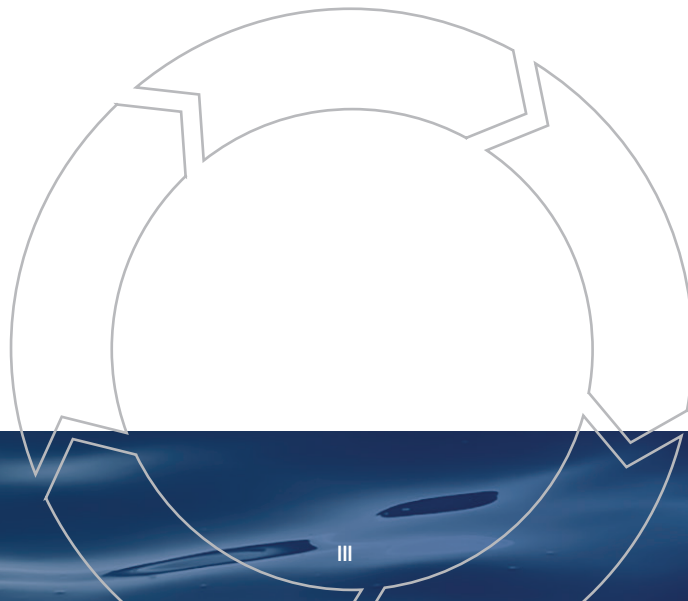
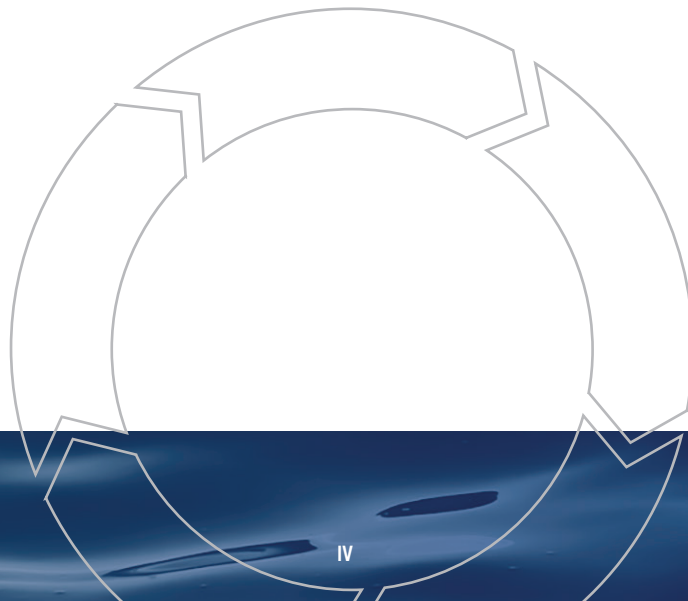




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From Agencies to People: Notes from the Organizers

We envision a future in which an efficient and effective wastewater permitting process can ensure environmental protection while embracing creative solutions leading to innovation.

This report is a step towards realizing this vision. It is the product of years of effort by dozens of people throughout the country. While the report marks the culmination of an initial phase of work, it is most appropriately viewed as the beginning of a more important effort.



The extensive research portfolio underpinning this report started with a simple question: *Why is it so hard to innovate in the wastewater sector, when there are so many opportunities to innovate, recover valuable resources, lower the cost of treatment, and maximize sustainability?*

Our research has found that a lack of technical capability is rarely seen as the leading barrier to innovation. In fact, a multitude of innovative and viable engineered solutions, natural infrastructure approaches, and management strategies are available for deployment today, and many dedicated professionals at utilities, consultancies, regulatory agencies, and universities

already have the skills and creativity needed to implement them. Rather, the key bottlenecks to innovation often arise from the institutions and processes that collectively shape decisions about how wastewater systems are managed. These institutions consist of people, many of whom want to help advance the state of practice in the sector. However, institutional inertia on the part of permitting authorities and permittees can make it difficult for them to take bold steps forward.

This inertia can stem from permit writers' uncertainty about the degree of available discretion to tailor permit conditions to address the specific circumstances associated with an innovative project or program. They may not fully grasp the scope and nature of their discretion to tailor permit requirements to projects or programs that differ significantly from those they commonly encounter, or they may not feel empowered to exercise the discretion they know they have.¹ They may lack the bandwidth, resources, or permission to learn about the context in which regulated entities operate by visiting project sites, getting to know permittees, or investigating the factors motivating a particular community to try something new (such as addressing unmet community needs that more traditional management strategies would not address). It can stem from project proponents not being clear about the full scope of an innovative project early in the permitting process, or not understanding where the regulatory agency's discretion in the way requirements are written into permits lies. The parties may not realize they need to actively work to understand one another's objectives and constraints. Or, it can stem from working independently without discussing each other's constraints or objectives. As a result, even relatively straightforward innovations may remain out of reach or take years of concerted effort and additional cost.

Utility managers do not think less protective water standards would spur innovation. On the contrary, permit requirements can motivate utilities to pursue more innovative treatment methods and processes.

Research findings led us to focus in on how regulatory institutions and processes, including permitting, affect innovation. Detailed investigation revealed more nuance within a general perception that regulation often stands in the way of innovation. While regulators and the regulated community alike agree that the permitting process can be a problem, neither group believes that reducing regulatory stringency is a useful pathway to accelerating innovation. More specifically, utility managers do not think less protective water standards would spur innovation. On the contrary, permit requirements can motivate utilities to pursue more innovative treatment methods and processes.

¹ The EPA (2022) paper "Navigating the NPDES Permitting Process for Water Reuse Projects: Strategies to Enable Recycling and Protect Water Quality" illustrates the broad range of NPDES permitting approaches used to address discharges associated with water reuse, explain how NPDES permits accommodate and/or incentivize reuse, and help permitting authorities and permittees to work cooperatively.

Instead, a key insight that emerged from our body of research is that the permitting process itself can pose challenges for innovation. This process consists of multiple sets of interconnected relationships – not just among organizations, but more important, among the individuals that comprise these organizations. These relationships often involve not just permittees and regulators but also members of the engaged public (such as NGO staff, researchers, and local residents).

These characteristics are not magic traits granted to a lucky few. Instead, they are understandable, trainable, and learnable strategies and behaviors.

Shifting the frame – from technology to institutions and from organizations to relationships between groups of individuals – seem obvious in retrospect. But these frame shifts have profound implications for understanding why it can be difficult to implement new technologies with immense benefits for communities and the environment, and how to safely enable more rapid adaptation to climate change and other stressors facing our nation’s wastewater systems.

Through our research, and in collaboration with a dedicated and growing group of leaders from the regulated and regulator communities, a recipe for innovation is becoming clear. The key lies in approaching the permitting process as an ongoing series of relationships which require greater skill and attention for effective engagement. In particular, the suc-

cessful approaches to innovation we have studied have five interrelated and mutually supporting characteristics in common: They created **clarity** with explicit and mutually understood expectations regarding the parties’ responsibilities and goals. They facilitated active **capacity building** to develop needed knowledge and abilities, including technical competence for both the regulator and the permittee. They maintained sufficient **continuity**, beginning the relationship between regulator and permittee early and continuing it throughout project development and implementation. The relationships also fostered **trust**, and the mutual willingness to take risks in exchange for the other party’s capability and willingness to deliver on commitments, which creates space for innovation and co-generating creative solutions to problems. Finally, all of these enable and are supported by **bounded flexibility**, the ability to learn, adjust, and adapt over time coupled with exploring the appropriate use of regulatory discretion in the way requirements are written into permits.

These characteristics are not magic traits granted to a lucky few. Instead, they are understandable, trainable, and learnable strategies and behaviors. We envision the permitting process not as a painful hurdle, but rather as an opportunity to focus the mutual creativity of regulators, regulated entities, and the engaged public around the shared goal of improving beneficial outcomes for society and the environment.

In service of this vision, this report and the engagement behind it also represents something more profound – the development of an emerging community of practice dedicated to these ideas. With the EPA’s support, this community can develop and refine the ideas presented here, develop trainings, tools, and methods and disseminate them broadly, deploy resources in support of visionary efforts to implement innovative solutions, and ultimately catalyze a shift in mindset to enable regulators and regulated entities to work together to foster a new wave of innovation that protects the environment, furthers community interests, lowers costs, and builds resilience to the varied challenges facing our nation.

We invite you to join us.



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Approach and Source Material for this Document

This report presents a synthesis of information derived from published research and extensive engagement. Engagement activities included numerous interviews with and contributions from wastewater managers, regulators, and other experts, a nationwide webinar, and a multi-day workshop that brought together a diverse group of participants for intensive discussion.

As a result, the report is a prospective look at an emerging topic that reflects a mixture of detailed research and expert opinions. It should not be viewed as a reflection of EPA policy or an official EPA position, but part of an ongoing, collaborative exploration of how to better enable innovation through permitting. Unattributed statements should be assumed to be insights from interviewees, webinar attendees, or workshop participants, or informed opinions from the authors regarding this emerging and dynamic field of study.

Our research and this report have focused primarily on how the National Pollutant Discharge Elimination System (NPDES) permitting process implementing the Clean Water Act works for municipal wastewater utilities. However, the issues and potential strategies to improve how the permitting process addresses innovation are also relevant for other water management sectors such as stormwater, drinking water, watershed, wetland, and industrial wastewater management, along with other permitting contexts.

Published Research

This report builds on extensive peer-reviewed research on innovation in the wastewater sector, including recent EPA-sponsored research on the role of regulatory relationships in innovation.

Citations are provided in the text to selected published literature and are listed in the References for those interested in further reading. These references can serve as an entry point to a larger body of literature on innovation.

Case spotlights

Throughout this report, case examples illustrate the need for innovation – and how effective relationships and communication between permitting authorities and permittees can accelerate permitting processes that enable it. These brief project “spotlights” are drawn from a variety of sources. Some are summarized from detailed, peer-reviewed case studies. Others were contributed by experts with knowledge of a particular project. These illustrative descriptions have not been subject to detailed peer review; please see cited sources or contact the report authors to learn more about each project.

Engagement

The organizers of this effort conducted extensive engagement to stress test, improve, and validate the concepts described in this report. We worked with federal and state regulators, water utility managers from both the water and wastewater sectors, non-governmental organization (NGO) representatives engaged in the permitting process, lawyers, and academics. In May 2023, we held a national webinar with over 60 attendees selected for their different roles, experience, and perspectives on the wastewater permitting process. This phase of the engagement culminated in a three-day workshop sponsored by the EPA and the Johnson Foundation at Wingspread in Racine, WI in August 2023. This gathering involved an intensive, facilitated series of meetings, breakout sessions, and informal interactions revolving around the framework described in this report. The group stress-tested and validated the framework, and co-produced recommendations to bring the ideas into action in the real world. Finally, the organizers conducted in-depth interviews with key experts to gain detailed perspectives and identify examples to spotlight.

In all these engagement activities, participants were given anonymity for their responses, which supported the openness with which they shared their perspectives, positive and critical alike. They deserve significant credit for the inspiration and ideas that contributed to this effort. We gratefully acknowledge workshop attendees for generously sharing their time as part of an emerging community of practice.

National Water Reuse Action Plan

The National Water Reuse Action Plan (WRAP) is a collaborative effort of over 150 partner organizations led by the EPA to develop and share tools, information, and other resources to build the technical, financial, and institutional capacity that supports the safe implementation of water reuse. This report supports WRAP Action 2.19, which focuses on the relationships between regulators and the regulated community as well the broader regulatory context under the Clean Water Act and other federal, state, and local laws. This report also builds on work completed under WRAP Action 2.6 (see EPA, 2022), which identified key considerations when permitting wastewater reuse and stormwater capture projects, presented strategies to effectively permit water reuse projects, and provided detailed case studies that illustrate those strategies. WRAP Action 2.16 also created a foundation for this work by analyzing the dynamics for interagency collaboration throughout the permit development process (see Rosenblum et al., 2022 for lessons learned from recycled water projects). These reports contain lessons and examples specific to water reuse that can be applied to other types of innovative wastewater technologies and management strategies.

Acknowledgements

As mentioned above, a workshop at Wingspread provided the authors with crucial ideas and inspiration that are reflected directly in the contents of this report. While our agreement as facilitators to honor the anonymity of these participants precludes us from directly citing or quoting individual contributions, we wish to express gratitude for their participation, and acknowledge that this report would not exist in its current form without them.

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The national webinar described above also laid groundwork for this report through discussions that helped frame the Wingspread workshop. While too numerous to list, we hope many of these contributors will be early members of the emerging community of practice discussed in this report.

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Introduction and Summary

There is a recognized innovation deficit in wastewater management (Kiparsky et al., 2013). As in other areas of resource management, adaptation to climate change and other stressors will require shifting away from traditional solutions and towards novel, multi-benefit, and nature-based solutions. The road to this shift runs directly through permitting, which can be a real and perceived challenge to efficient project implementation. Improving permitting processes to better ensure permitting can direct and support technical advances is possible but will require culture change.

A key research insight is that, broadly speaking, neither regulators nor regulated entities see reducing the stringency of regulatory standards as desirable or important for enabling innovation. Rather, the key to doing things differently lies in changing how permit writers and permittees interact with one another and the engaged public in the permitting process.

Ensuring an effective permitting approach that supports appropriate engagement between permitting authorities, permittees, and the public will require understanding (1) the specific types of permitting approaches available in different permitting programs and (2) the engagement needed to effectively bring practitioners together to address permitting challenges presented by innovative wastewater technologies and management strategies. Then it will require training those involved in the appropriate ideas and skills. The good news is that research points to a clear, generalizable framework for facilitating successful innovation in wastewater management.

This framework can be conceptualized as a set of necessary ingredients in a creative recipe for effective regulatory relationships and processes around innovation that can be adapted to the context of each situation.

This document reports on the potential for this shift, and how it can be realized. We describe a way to help successfully facilitate innovation through the permitting process. This framework can be thought of as a set of ingredients in a creative recipe for effective regulatory relationships and processes. The recipe can then be adapted to the context of each situation.

The ingredients include a focus by all parties involved in permitting on taking action to achieve clarity, build capacity, and foster trust, while doing so with continuity – all of which support the use of bounded flexibility to find creative solutions for permitting new strategies for wastewater management. These strategies will apply to a range of new approaches, including innovative technologies or management strategies such as multi-benefit projects that span jurisdictions or disciplines.

This report aims to call attention to, and increase the priority of, improving permitting processes to better address discharges associated with innovative technologies and management strategies. In addition to providing this synthesis of key characteristics of effective regulatory relationships and processes around innovation, the report includes representative case spotlights, and outlines actions regulators, utilities, and others can take to support innovation. We see great potential to actualize these elements of successful innovation by expanding the community of practice emerging as a result of this work.

In the remainder of this report, we provide an overview of the concept of innovation as it applies in the wastewater sector and summarize the NPDES permitting process and some of the ways it can affect innovation before introducing a framework for permitting discharges resulting from innovation. We then discuss its implications and a vision for creating a culture of innovation. Finally, we offer recommendations for actions that different parties can take to support more effective permitting of discharges associated with innovative wastewater management strategies.

Innovation in Wastewater Management

This report describes a research-based framework for enabling more successful innovation in wastewater management. The framework is geared toward improving the relationships between regulators and regulated entities. Doing so provides an essential but underappreciated gateway to permitting practices that can accelerate the deployment of innovative, cost-effective projects that help communities and ecosystems thrive and adapt to climate change.

This section builds the case for the importance of innovation in the wastewater sector.

What is innovation and why does it matter for wastewater?

In general, innovation is the development, application, diffusion, and utilization of different knowledge, technologies, and approaches (Kiparsky et al., 2013). Crucially, innovation in wastewater management can take many forms and can create many different benefits. It can include a novel application of an existing technology to a new process or to a new waste stream, and it can include the application of new emerging technologies. It can also include innovative partnerships across traditional geographies, organizational, and functional lines that address multiple community needs.

Innovative wastewater management strategies such as nature-based solutions can replace or supplement traditional engineered solutions to reduce costs, create new community amenities, and build climate resilience. For example, Philadelphia, PA, Chicago, IL, Omaha, NE, and other cities have incorporated significant green infrastructure elements in revised combined sewer overflow (CSO) long-term control plans in response to enforcement actions and guidance encouraging use of green infrastructure to address CSOs (see <https://www.epa.gov/green-infrastructure/enforcement> for more details). These green infrastructure investments have helped reduce the frequency of CSO events at lower costs than conventional CSO controls, enabling more efficient allocation of financial resources, while also yielding significant community greening benefits. Other innovative technologies can create opportunities for communities to meet water quality goals more cost-effectively by targeting where infrastructure is most likely to fail versus a traditional replacement by the year it was installed. Sensor technologies can reduce risk by providing real-time data to provide assurances that water quality goals are met or identify problems early.

Climate change will make challenging circumstances for water agencies and the public they serve even more difficult. Whether through increasing water scarcity, flooding, or sea level rise, the impacts of climate change manifest heavily in the water sector. Aging infrastructure requires considerable rehabilitation even without climate change, and the additional stresses to come highlight the need for creative solutions that can be implemented more quickly and economically to meet multiple societal needs. This reality demands that we consider not just new technologies or management strategies, but also optimize our permitting systems to transparently and cost-effectively enable innovations needed to protect public health and the environment.

Real Time Monitoring and Control in Evansville, IN Reduces Sewer Overflows and Reduces Costs

During heavy rainfalls, the aging combined sewers in Evansville, IN, often overflowed. To address the problem, the city built a real-time decision support system (RTDSS) using sensor networks, real-time monitoring, and artificial intelligence. Operators can now see the available capacity at the wastewater treatment plant up to an hour in advance along with recommended pumping rates. Thanks to the RTDSS, Evansville has reduced combined sewer overflows by more than 100 million gallons annually. Evansville estimates that achieving this reduction costs \$0.01 per gallon per year with the smart technology and would have cost \$0.23 per gallon without it—a savings of 95 percent. This demonstrates that, in some cases, it is possible to substitute real-time sanitary sewer monitoring technology for end-of-pipe monitoring. More information can be found here: <https://www.epa.gov/npdes/smart-sewers#casestudies>.



CSOs occur when the flow of wastewater and stormwater overwhelm a combined sewer system.

Improving wastewater infrastructure design and operations using innovative technologies and management strategies is also critical to reducing greenhouse gas (GHG) emissions from wastewater treatment systems and buildings. It can also build community resilience to the impacts of climate change, all while meeting discharge permit requirements. Conventional wastewater management processes contribute to GHG emissions through treatment processes and collection system energy demands, as well as biosolids management practices such as landfill disposal or composting operations. Implementing innovative technologies and management strategies can reduce GHG emissions through less energy intensive treatment or through timing treatment to periods when cleaner energy sources are available

Further, communities can recover valuable resources such as nutrients, energy, and treated water from wastewater through the application of new technologies. For example, the co-digestion of biosolids with diverted organic wastes (e.g., food waste or fats, oil, and grease) can produce additional biogas and reduce the use of fossil fuels while reducing methane emissions from landfills.

Generating Energy from Organic Trucked Wastes

The East Bay Municipal Utility District (EBMUD) in Oakland, CA, employs anaerobic co-digestion of municipal wastewater sludge and high-strength liquid organic wastes trucked in from surrounding commercial and industrial food producers, as well as some solid food waste, to generate enough biogas to meet its treatment plant's energy needs and sell the surplus to other users. The program reduces operating costs for the utility and reduces methane emissions by diverting organic wastes from landfills. EBMUD worked with State regulators both to tailor its NPDES permit to reflect the benefits, risks, and needs of the program and to coordinate wastewater and solid waste permitting to reduce redundancy and better support this innovative management strategy. Source: Green Nylén et al., 2022



Photo credit: East Bay Municipal Utility District

Innovative technologies in wastewater treatment can also reduce service disruptions from climate-related impacts. For example, applying advanced monitoring and control technologies can reduce the risk of sewer overflows during heavy precipitation events by enhancing operational control and flexibility. These technologies and innovative strategies can also incorporate nature-based solutions that can mimic natural processes to mitigate risks from flooding while capturing water for later use, providing green space, and improving water quality. Additionally, water reuse builds climate resilience by reducing the reliance on traditional water supply sources threatened by long-term drought and sea-level rise, and mitigates short-term supply disruptions due to natural or human-caused disasters. Innovation can include a novel application of an existing technology. What is considered a standard practice in one region of the country may be new in another region, and therefore considered innovative.

Finally, innovation in the integrated management of wastewater, stormwater, combined sewers, water supply, and watershed systems can enable more cost-effective “one water” solutions, consistent with the EPA’s NPDES Integrated Planning framework. For more information about Integrated Planning, see <https://www.epa.gov/npdes/integrated-planning-municipal-stormwater-and-wastewater>.

Innovative Strategies: Nature-based Solutions

Nature-based solutions are actions to protect, conserve, restore, and sustainably manage natural or modified ecosystems. These actions use natural features or processes to address public health and environmental challenges while providing multiple benefits to people and nature. These solutions can help combat climate change, reduce flood risk, improve water quality, protect coastal property, restore and protect wetlands, stabilize shorelines, reduce urban heat, and create new recreational spaces.

The Tres Rios Wetlands project is an example of a nature-based solution in practice. The City of Phoenix and federal partners implemented the multi-stage, multi-benefit project to improve water quality in the Salt River, reduce flood risk for adjacent communities, and restore riparian and wetland habitat along the Salt and Gila Rivers. Hundreds of acres of treatment wetlands were constructed adjacent to the Salt River to provide natural treatment to reduce the nutrient load of discharged municipal wastewater effluent, while preserving and regulating flows in the seasonally effluent-dominated river. Meanwhile, the constructed wetlands and restored riparian zone provide vital habitat for wildlife and recreational opportunities for visitors, and a levee incorporated into the project protects local communities from flooding. This project exemplifies the use of recycled water to create multiple co-benefits.

However, there were challenges in permitting this project, which required extensive interactions between the City and permitting staff. To ensure that it would meet the established goals, the project was developed through engagement with regulators and other stakeholders and planned and executed in stages with monitoring to enable learning and adjustment along the way. Initially, the EPA established extensive monitoring requirements for the full-scale treatment wetland, including some the City had difficulty complying with. These requirements were refined over time to better target specific ongoing information needs, while reducing long-term monitoring costs.

Additionally, the City advocated for, and the EPA eventually allowed, measurement of compliance at non-traditional locations to accommodate the natural processes within the wetlands. This is a clear example of bounded flexibility being used to enable innovation while ensuring water quality protection. More detail is found in Green Nylen et al., 2022.



The Tres Rios Wetland Restoration Project restores wetland habitat surrounding the Salt River and ensures sufficient flows while controlling nutrient discharges.

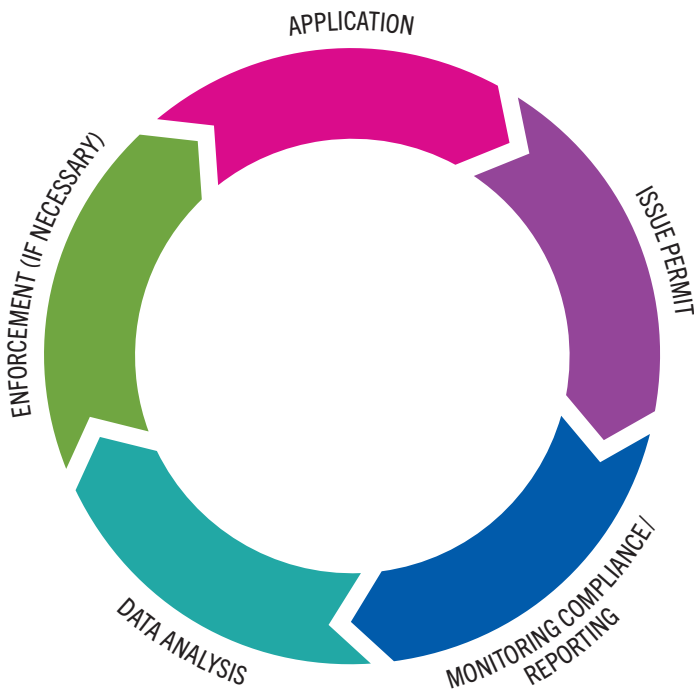
Permitting and Innovation

The permitting process determines how legal requirements and policies are translated to a permittee's particular situation (Green Nylen et al., 2022). This section provides an overview of the NPDES permitting process and summarizes challenges that may arise when developing permits for discharges associated with innovative projects.

The NPDES Permitting Process

The NPDES permit program, established by the CWA, reduces water pollution by regulating point source discharges of pollutants to waters of the United States. To date, 47 states and one territory have been authorized to implement the NPDES program, enabling them to perform many of the permitting, administrative, and enforcement aspects of the program. In addition, some states incorporate state specific provisions into their NPDES permitting process. As such, NPDES permitting is not a "one size fits all" endeavor. The water quality-based provisions of the NPDES permit program require permitting authorities to address site-specific discharge and receiving water conditions. Therefore, over the last 50 years, states have established different implementation rules and procedures to meet NPDES regulations and CWA requirements, resulting in a variety of state-led approaches to permitting.

Figure 1: The NPDES Permit Cycle.



While monitoring compliance/reporting, data analysis, and enforcement are displayed sequentially, this is a simplified visualization of the permitting cycle and all of these steps can occur concurrently in the 5-year term of a permit.

The CWA defines the NPDES permit cycle by limiting the term of permits to five years. The permit cycle includes the permit application process, permit drafting and public input process, permit issuance (or reissuance), and the permit implementation phase including compliance monitoring, analysis, and reporting. Figure 1 presents a typical permitting cycle comprising the stages of the permitting process. The characteristics of successful and innovative permitting practices described in this report are relevant throughout this cycle. In principle, this cycle allows for lessons to be learned throughout each stage and for these lessons to be applied through an iterative process within the permitting cycle and to future permits. In practice, these steps in the permitting process often occur concurrently or iteratively and permitting is rarely a purely sequential process.

The NPDES permitting process can be summarized in three interrelated aspects (1) regulatory requirements incorporated into NPDES permits, along with information collection and analysis supporting permit development; (2) relationships between regulators and the regulated community; and (3) the broader regulatory context under the CWA and other federal, state and local laws (Sherman et al., 2020), all of which are supported by provisions for public comment. Strategies have been discussed to more effectively engage on these elements, in a series of papers developed under the EPA's Water Reuse Action Plan (WRAP), whereby permitting authorities, permittees, and the engaged public can more effectively collaborate throughout the permit development process and on projects themselves (EPA, 2022 and Rosenblum et al., 2022).

Challenges when Permitting Discharges Associated with Innovative Projects

Research shows that permittees do not view the stringency of regulations and permits as the primary roadblock to the adoption and implementation of innovative technologies and management strategies (Sherman et al., 2020 and Cantor et al., 2021). Rather, detailed national surveys suggest that innovation can be better facilitated in the municipal wastewater sector by improving relationships and communication between utility managers and regulators and securing additional funding support to increase the capacity of utilities and regulators to work with and understand each other (Cantor et al., 2021). In essence, regulatory barriers to innovation may be reduced by helping utilities and regulators build capacity to better navigate the processes that influence how and when new technologies are implemented (Sherman et al., 2020 and Green Nylen et al., 2022).

New wastewater technologies and management strategies increase uncertainty in the permitting process, heightening the importance of how permittees and regulatory agencies engage in the process. In general, research has found that the permitting constraints lie less in challenges with complying with existing regulations and more in the limited understanding and use of approaches available when developing permit requirements.

Enhancing collaboration during the permit development process in a manner that enables better communication, cooperation, and trust between permitting authorities, permittees, and the engaged public can overcome these constraints and help lead to successful outcomes. Effective collaboration can support the issuance of permits that authorize discharges associated with innovative technologies and strategies, while ensuring environmental protection. Doing so requires that both regulators and permittees (1) understand federal and state regulations and available options, as well as limitations, and (2) engage and collaborate in ways that effectively manage technical, legal, and institutional considerations.

The challenges emerge individually at the level of permit writers, and institutionally at the level of permitting agencies. This can present challenges for permitting authorities that have high turnover of permit writers, that are understaffed, or where permit writers are not allotted the time to understand the potential water quality impacts of discharges and the context in which an innovative project is being proposed. Novel proposals can generate confusion or concern in the public as well. This can lead to inconsistent results. Entities seeking permits, similarly, may not have or may not choose to spend the time to engage early with regulators to describe their projects, explain the context in which the project is being proposed, or ask what the requirements are that they need to meet.

Filer, Idaho Roadmap for Recycled Water

Filer, ID was challenged to meet existing discharge limits from their wastewater treatment facility. After considering treatment needs, future growth, and potable water demands, their strategy for complying with their permit limits was to beneficially recycle their water for irrigation. Their plan also laid the groundwork for both immediate and long-term needs. Their goals were to be sustainable, produce high quality recycled water, and have the opportunity to develop the uses of the recycled water as the city's needs changed. At the time, they wanted the most advanced treatment, new to Filer and the regulators. Early on they developed a roadmap, vetted technology to find the best fit for their city, identified the stakeholders who needed to be in alignment, and front-loaded the technical information to the city decision makers, site operators, and state regulators before a reuse permit application was submitted. The city's communication strategy and outreach with public stakeholders kept the community learning and supportive of their reuse project, thus helping build capacity that was integral in moving this project forward. The city of Filer's attention to the details in planning for their community helped them be a success story for a small community's needs implementing water reuse and provides a roadmap to successfully permitting an innovative project.

An Illustration: Water Reuse

While innovation can provide substantial benefits, its novelty and related uncertainty can make permitting challenging, and the perception that permitting is a barrier to innovation can, itself, become a barrier. In particular, concerns regarding permitting complexity and delay can discourage permittees from pursuing projects that promise significant benefits for local communities and the environment.

Water reuse helps illustrate these challenges. Many localities are contemplating expanding water reuse to address water scarcity, reduce nutrient discharges, and achieve other goals. However, large scale water reuse poses potential permitting challenges that can affect those communities' perception of its feasibility. For example, existing NPDES discharge permits may potentially need to be adjusted to accommodate an increased concentration of residual contaminants in discharges to local waters, even though the overall mass loading and the full impact upon the environment would decrease. This requires careful review of whether the increased concentrations, albeit with a smaller mass, would have adverse effects on receiving waters. In addition, water reuse projects often span more than one institution. Commonly, a partnership between a drinking water utility and a wastewater utility can require both discharge and reuse permits issued under different permitting regulations, sometimes by different permitting agencies. The need for multiple parallel permits introduces additional complexity into the permitting process as the institutions need to work together to complete successful projects. Similarly, the use of nature-based solutions to manage residuals can involve multiple parties with distinct interests that may result in different operation, maintenance, compliance, and monitoring requirements.

A Framework for Permitting Innovation

Based on the study of real-world attempts at innovation in wastewater management, regulatory relationships that display five characteristics are more effective at permitting innovation in the municipal wastewater sector. As described in more detail below, Green Nysten et al., (2022) created a conceptual framework that described these characteristics—*clarity, capacity building, continuity, trust, and bounded flexibility*—and potential interconnections between them.

Appropriately applied *bounded flexibility*—such as tailoring permits to reflect the risks, benefits, and monitoring needs of a particular technology or management strategy—is key for enabling socially and environmentally beneficial innovation. Research also indicated that *clarity, capacity building, continuity, and trust* help create an environment where *bounded flexibility* is possible. The framework holds promise as a model for affecting positive change in wastewater management and permitting. The use of *bounded flexibility* can assist in developing creative solutions for permitting new wastewater management strategies but requires a recognition that all five characteristics are interrelated and play mutually reinforcing roles in supporting innovation. In other words, one cannot just ask for “bounded flexibility” in the abstract. It is part of a continuous process of engagement through which permit authorities, permittees, and the engaged public develop comfort in that flexibility. In this process, weaknesses in one of the characteristics can impair the others, while strength in another characteristic can help make up for any shortcomings. Depending on the specific project, its drivers, the parties involved, and the relevant regulatory context, the strength and nature of the interconnections between the characteristics and the relative importance of each will vary.

The remainder of this report provides necessary context, details the conceptual framework, and enumerates recommendations for how to achieve progress.



The George W. Shannon Wetlands consist of ponds and wetlands that provide habitat and recreation while treating water prior to reuse. The 2,200-acre wetlands were built as a joint effort with the Tarrant Regional Water District and the Texas Parks and Wildlife Department. Photo credit: Tarrant Regional Water District

San Francisco Bay Nutrient Management Strategy and Watershed Permit

Thirty-seven wastewater treatment plants discharge into the San Francisco Bay, accounting for two thirds of annual nitrogen loadings. Historically, although loadings to the Bay have been high, the waterbody has been resilient due to turbid waters and presence of filter feeders. However, increased chlorophyll levels within the Bay have indicated waning resilience to nitrogen loading due to a combination of declining sediment loads. Due to these concerning signs, regulators, the regulated community, and the scientific community have collaboratively investigated how to respond.



Oro Loma Sanitary District installed of a full-scale Microvi wastewater side-stream treatment system to treat nutrients at their treatment plant in San Lorenzo, CA. The innovative watershed nutrient permit for SF bay facilitated the evaluation and select

In 2012, a Nutrient Management Strategy was formed through a collaborative process by regulators and the regulated community to do joint fact finding and study the problem together. Watershed Permit 1, a product of the Nutrient Management Strategy, was issued to all 37 dischargers to the San Francisco Bay. This did not contain permit limits; rather, the permit required continued monitoring to better understand trends. Funds from all dischargers were coordinated to be used to study the feasibility treatment and optimization upgrades across all facilities and to support continued joint scientific study of the Bay by the San Francisco Estuary Institute, a non-profit science institute overseen by a board of regulators, permittees, and NGOs.

Watershed Permit 2 was issued in 2019 and included additional requirements for monitoring both influent and effluent, investigating trends, and increasing funding for the joint science program. The permit also required two studies investigating water recycling and nature-based solutions to reduce nutrient loads and create innovative multi-benefit solutions.

In 2022, a major algal bloom within the San Francisco Bay shifted the nutrients problem from a chronic to an acute issue. The algal bloom raised the level of political and public attention, highlighting the need for stakeholders to move faster to address the problem. Watershed Permit 3, issued in July 2024, requires a 40% reduction in dry season nitrogen loading. To facilitate innovative solutions, the permit states that the Regional Water Board will identify regulatory mechanisms to provide more time to comply for agencies that wish to pilot new technologies or multi-benefit projects including water recycling and nature-based solutions. The permit also requires dischargers to develop a regional plan that includes consideration of a nutrient trading program.

The collaborative foundation established over the last decade has fostered a level of trust integral to addressing this complex and expensive challenge. The engaged parties recognize that facing a challenge of this magnitude would have been much more difficult without the collaborative framework. Additionally, the process has avoided a piecemeal, individual discharger-by-discharger approach, focusing on the collective problem in an economical and transparent process. Finally, the process has created a constructive dialogue around how to achieve regional nutrient reductions while still acting strategically to identify and implement multi-benefit projects that optimize the use of limited public infrastructure funds.

Building More Effective Regulatory Relationships and Practices Around Innovation

As described in peer reviewed research (Green Nylén et al., 2022) and validated through extensive expert engagement, lessons learned from successful and unsuccessful case studies indicate that regulatory relationships that display five characteristics may be important for enabling innovation in the municipal wastewater sector. Those characteristics are *clarity*, *capacity building*, *continuity*, *trust*, and *bounded flexibility*.



Clarity is the establishment of explicit and mutually understood expectations regarding the permittee's and the regulator's respective responsibilities, goals, and concerns, including the intended benefits and potential risks of an innovative project or a new permit term. Cultivating clarity requires effective communication between the permittee and the regulator, within each of their respective organizations, and with other potential stakeholders.



Capacity building is the progressive development of knowledge and abilities needed to engage effectively around an innovative project and implement it successfully.



Continuity is sufficient engagement between the parties throughout project development and implementation. Continuity requires the permittee and the regulator to interact with one another (and with other stakeholders) early enough, frequently enough, and about the right topics to ensure effective engagement and project success.



Trust is the willingness to take risks in exchange for another party's ability and willingness to deliver on commitments, as well as public confidence in both the permitting process and the project's intended outcomes. Trust can be built over time through a pattern of good-faith interactions that acknowledge capacity limitations, problems, and concerns while supporting effective problem solving and capacity building.



Bounded flexibility is the ability to adjust and adapt over time to ensure that an innovative project actually achieves mandatory and intended outcomes (such as protecting public and environmental health while meeting other community needs and goals). Bounded flexibility has two interconnected components: 1) supporting project refinement, learning, and adjustment and 2) exploring the appropriate use of available regulatory tools and discretion in the way that permit conditions are written.

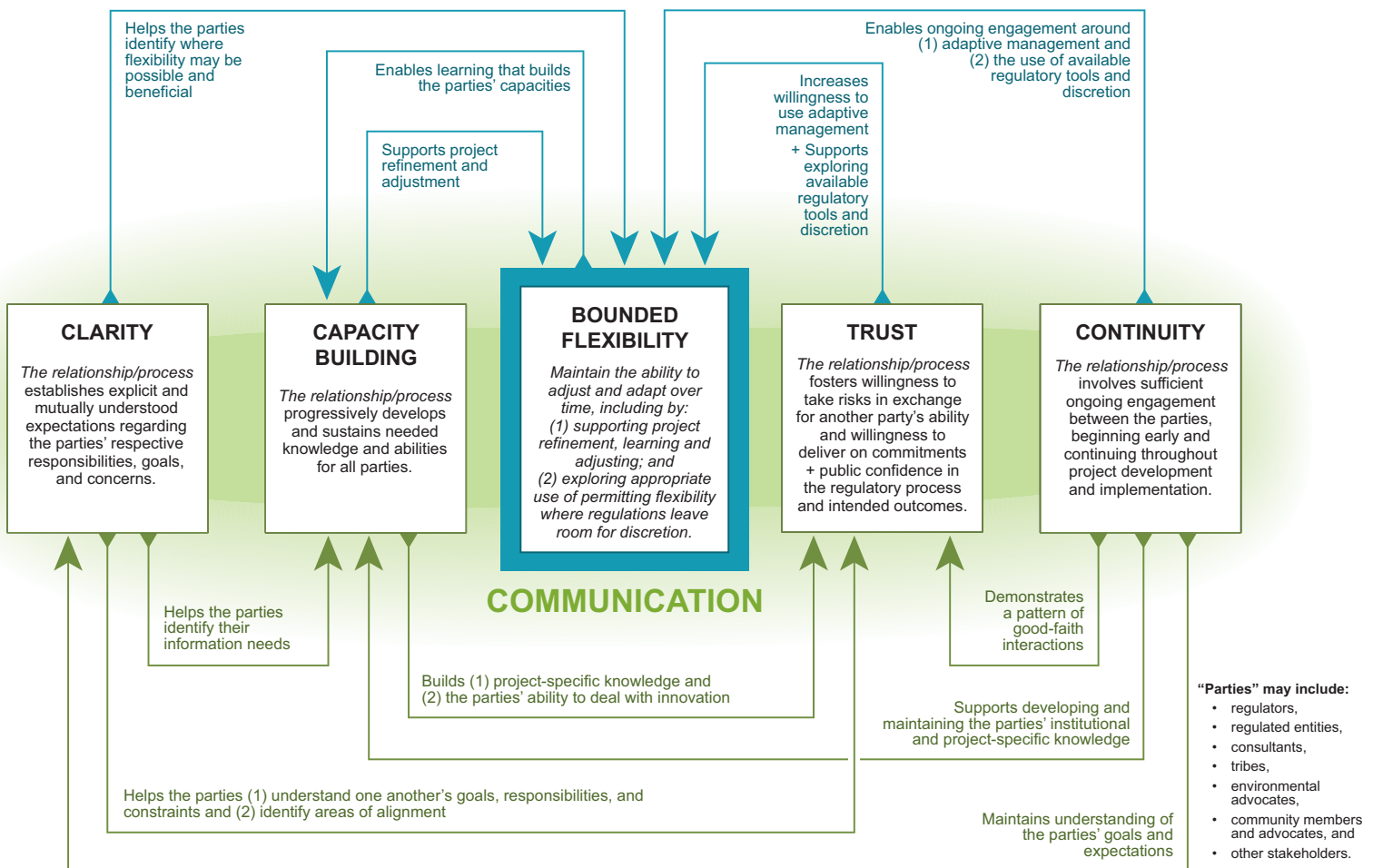
Green Nylén et al., (2022) created a conceptual framework that described the five characteristics and potential interconnections between them. Appropriately applied *bounded flexibility*—such as applying available discretion to tailor permits to reflect the risks and monitoring needs of a particular technology or management strategy—is key for enabling socially and environmentally beneficial innovation. Their research also indicates that *clarity*, *capacity building*, *continuity*, and *trust* help create an environment where *bounded flexibility* is possible.

During the workshop, attendees drew on their own experiences with navigating permitting processes to consider the utility of the conceptual framework in the context of permitting for innovative projects; the relevance of *clarity*, *capacity building*, *continuity*, and *trust*; and their relationships between these characteristics and *bounded flexibility*. Attendees agreed that the framework was potentially quite useful, that the use of *bounded flexibility* can assist in developing creative solutions for permitting new wastewater management strategies, and that all five characteristics are interrelated and mutually reinforcing. In addition, weaknesses in one of the characteristics can impair the others, while strength in one characteristic can mitigate a deficit in another. Depending on the specific project, its drivers, the parties involved, and the relevant regulatory context, the strength and nature of the interconnections between the characteristics and the relative importance of each will vary. Therefore, the framework is meant to reflect a dynamic and iterative set of practices, not a linear progression from one characteristic to the next.

Figure 2 depicts the five characteristics and some key ways they relate to one another (Green Nysten et al., 2022). The figure illustrates the framework’s potential relevance to both regulatory relationships and regulatory processes around innovation, emphasizes the non-linear nature of the interactions between the five characteristics, and highlights the global importance of communication. Connections involving bounded flexibility are shown in aqua, while other connections are shown in green.

Although the framework and the five characteristics were developed descriptively, these concepts can also be applied prospectively to provide insights and inform guidance going forward (Green Nysten et al., 2022).

Figure 2: Five characteristics of effective regulatory relationships and processes around innovation and potential interconnections between them



Source: Figure updated from Green Nysten et al., 2022

The framework is constructed around the concept of building cooperative and effective relationships between regulators and regulated entities and is not solely focused on permitting agencies improving their processes and regulatory structures to enable more innovative projects. The framework also considers the importance of permittees providing regulators with the appropriate technical information needed to make informed decisions. As such, the concepts presented in the framework can be thought of as a “two-way street,” with regulators and the regulated community sharing responsibility for fostering collaborative relationships to facilitate innovation. Engaging the interested public may be especially important for more novel and potentially controversial projects.

When is this framework relevant?

Many aspects of the framework—specifically those related to cultivating *clarity*, *capacity building*, *continuity*, and *trust*—could be broadly helpful for all regulatory relationships and permitting processes. However, where standard practices can be applied in a straightforward way, a conventional approach to permitting can be efficient and effective. *Bounded flexibility* is a powerful tool that is often crucial for innovation but is appropriate mainly in the subset of contexts in which permittees are pursuing socially and environmentally beneficial innovative wastewater management strategies that may not be a good fit for traditional permit terms.

California’s Industrial Stormwater General Permit (IGP) Incentivizes Stormwater Capture and Use

To tackle water supply shortages in California with the goal of replenishing groundwater aquifers, the California State Water Resources Control Board (State Water Board) sought adding new compliance options to the 2020 IGP to incentivize stormwater reuse, including significant capture and infiltration projects that augment water supplies while using the soil’s natural ability to filter pollutants. The State Water Board engaged non-governmental organizations early in the permit development process and worked collaboratively to develop a new compliance model. The new IGP which includes alternate pathways for permittees to demonstrate compliance through implementation of large-scale stormwater capture and the use of BMPs was ultimately issued in July 2020.

For some wastewater projects, innovative solutions will either be necessary to meet different goals under changing conditions or promise to deliver benefits that justify the additional effort and uncertainty. In these cases, special attention to the permitting process and a more customized approach may be warranted. Relevant projects needing this special attention will frequently be outsized in their importance to a community and may create benefits beyond what conventional projects are capable of. Innovative projects tend to be larger, involving multiple benefits and partners, or novel technologies that have not yet been implemented at scale or under conditions to those the permittee faces. Each of these factors increases uncertainty and may heighten the need for *clarity*, *capacity building*, *continuity*, *trust*, and, ultimately, the appropriate use of *bounded flexibility*.

When those with specific needs, motivations, and circumstances demonstrate that a new approach to wastewater management (or a related permitting innovation) works, they can catalyze future iterations in other places or under other conditions and inform the development of models and guidance that can help transition proven options into common practice. Conversely, without these attempts at innovation, essential progress in the wastewater sector will be far slower than it could and should be.

Bringing the Framework to Life: Developing and Transferring New Knowledge, Skills, and Habits

A thorough understanding of NPDES federal and state regulations and their application is critical to defining *bounded flexibility* and improving *clarity* in understanding the limitations and possibilities of a NPDES permit. Knowledge about NPDES permitting can also enable more productive regulatory engagement, which can facilitate innovation in wastewater management. Specific examples of varied permitting practices for municipal wastewater treatment facilities to implement water reuse projects, including facilities in Wichita Falls, TX, California’s Central Valley, and Orange County, CA have already been documented (see EPA, 2022 for more details).

Furthermore, knowledge about innovative wastewater technologies and management strategies is critical for ensuring that implementation addresses community needs while protecting water quality and public health. Regulators, practitioners, and the engaged public often need additional support to build enough capacity to understand a new wastewater management strategy or technology. Understanding the challenges and tradeoffs associated with an innovative technology across its full life cycle (e.g., energy use, air quality, solid waste, zoning, and land use) is critical for understanding how the technology can be applied to maximize co-benefits while complying with a permit.

Developing communication and relationship-building skills is necessary to collaborate in new ways as permitting authorities, permittees, and other engaged public participants navigate new technical, legal, and institutional territory. Successfully implementing new approaches often requires iterative and adaptive management that may be difficult to reconcile with discrete permit decision-making and the desire for regulatory certainty. Developing effective permitting practices that enable better communication, cooperation, and trust between all parties increases the mutual understanding of participant responsibilities, goals, and capabilities, thereby helping to lead to successful outcomes. Building these skills will help establish greater *continuity* and *trust* in regulator and permittee relationships. However, they also require time and resources to implement, time and resources that permitting authorities and project proponents do not routinely budget for.

Changing how NPDES permit writers, permittees, and other stakeholders interact with each other may necessitate a shift in workplace culture to ensure employees feel empowered to seek creative solutions and have the time to do so. Such changes will likely need to come from upper management and be conveyed through mid-management, as individual employees are often under pressure to meet daily workload demands and must be explicitly empowered to spend time with permittees or apply alternative permitting approaches. Adjustments to job descriptions, performance evaluation methods, and resource allotments (e.g., augmented staffing, time for site visits, briefings, leadership and listening training) will likely be necessary to achieve this shift towards innovative permit development and execution. Further, prioritizing organizational commitments to support ongoing collaboration among permit writers and utility representatives along with the engaged public can better support opportunities for interactive education on innovation opportunities. These commitments will enable relevant parties to better understand each other's roles, priorities, and constraints to build *capacity*, *trust*, and other characteristics.



Photo credit: Eastern Municipal Water District

Implications and Vision

Understanding the theory and framework described above is a first step to improving collaboration during the permitting process. In practice, implementing the framework requires actions by multiple parties at multiple levels in multiple institutions. Such actions in concert would benefit from a cultural shift towards a supportive environment. This environment would reward the skills needed to do this work and give both permittees and regulators the time to develop the knowledge and relationships it takes to innovate together.

Specific actions and practices can enable better communication, cooperation, and trust between permitting authorities, permittees, and other relevant parties. All parties can and should work to integrate these practices throughout permitting authorities and permitted utilities. A multi-level approach is essential to consider the needs, capacities, and motivations of those working at the high levels in an organization (e.g., leadership and upper management) and those working closer to the ground (e.g., permit writers and permittee staff). Developing conceptual knowledge, alignment of understanding of mission and needs, and some of level of permission and incentive for supporting creative solutions within these two broadly defined groups can go a long way to establishing a culture of innovation.

The goal of NPDES permitting is delivering less pollutants to receiving waters, but the pathway for getting there is not set in stone.

To create a culture of innovation from the top-down, organizational leaders can commit to empowering permit writers and agency lawyers to develop creative solutions alongside permitted entities and other engaged public parties. Creating clear and achievable expectations to support innovative projects at the upper level of an organization along with permission to support innovation at the staff level will help create this culture of innovation while maintaining accountability to ensure that water quality standards are being met. Management can reinforce a culture of innovation by supporting staff-level efforts to resolve issues between a permittee and permit writer or through direct engagement in certain cases.

One specific step towards a broader culture of innovation will involve the expansion of an emerging community of practice. This community consists of a core group of experts collaborating on collectively improving the effectiveness of regulatory relationships for innovation in wastewater management. This community of practice stands apart for its diverse expertise and thought leadership. It is and will be comprised of engineers and technical experts representing permit holders, permit writers, and non-governmental organization (NGO) representatives, collaborating with the understanding that all these voices are essential in conversation. The unifying theme is building and maintaining relationships to support the development of overlapping skills and knowledge with a common interest in improving innovation. The goal is to empower innovation from the bottom up, complementing top-down efforts from the EPA and state regulatory agencies. The core of this cross-sectoral group already exists and includes many of the participants in our webinar and workshop.

The recommended actions in the next section are a few of the potential initiatives that can help facilitate permitting of innovative or complex projects. This list of recommendations is not exhaustive, but instead is meant to start an ongoing discussion.



Photo Credit: Salt Lake City Department of Public Utilities

Actions Recommended by Wingspread Workshop Attendees

This section summarizes a set of key actions that workshop attendees recommended that water industry leaders from the private and public sectors, utilities, state permitting agencies, and the EPA can implement, with engaged public participation, to accelerate the adoption of innovative technologies and strategies for wastewater management. Attendees identified many of these recommended actions through discussions at the webinar and workshop. The recommendations, distilled from these proceedings, published literature, and other sources, are intended to improve understanding of NPDES permitting regulations and areas of available discretion in the way certain permit conditions are written, develop and apply communication and engagement skills for both permittees and regulatory authorities, and build and maintain organizational commitments to support this work.

These recommendations are designed to begin an ongoing process to facilitate implementation of innovative wastewater management technologies and strategies within the existing NPDES permitting regulations. The recommendations are a starting point, and permittees and regulatory authorities, along with the interested public, can identify areas of mutual interest and work together to find innovative solutions to permit projects, helping the NPDES process better facilitate innovation without changes to NPDES regulations.

Recommended actions for all parties

Regulators (both federal and state), permittees, and communities all share an interest in benefits that can accrue through innovation, including reduced cost, increased efficiency, more effective treatment, or other benefits such as reduced greenhouse gas emissions or new habitat. All parties will need to act thoughtfully to advance innovation.

Each of the following recommendations are intended to advance one or more of the characteristics of the framework, as indicated by the icons.



Clarity



Capacity Building



Continuity



Trust



Bounded Flexibility



Recommended Action: Use this framework.

The approach and framework summarized in this report to develop effective permitting relationships can support innovation in wastewater management. It is ready to apply now and, where warranted, all parties involved in the permitting process can implement these ideas in support of innovative projects. Regulators, regulated entities, and the engaged public each have a role to play where innovation is concerned, and this document points the way to do so. To support the use of this framework, the EPA plans to soon publish a series of concept sheets based on the conceptual framework to provide permittees and permitting agencies with actionable information on how to better engage and work towards the common goal of supporting water quality and other resilience priorities.



Recommended Action: Adapt the framework to specific contexts.

A key step in advancing permitting methods is to recognize the permitting challenges presented by specific wastewater innovation opportunities. Advanced nutrient controls, real-time monitoring technologies, source control through pretreatment, and other processes each have their own set of permitting issues. Relating the innovation framework presented in this report to specific wastewater sector needs will increase recognition of tangible opportunities to overcome perceived permitting challenges. There are important opportunities to apply these principles to address a range of emerging water management challenges including management of emerging contaminants like PFAS, improving outcomes in communities affected by environmental justice issues, and anticipating new water management issues caused by climate change impacts. The EPA and others can support this increased specificity by funding research and generating materials on a range of wastewater opportunities, permitting practices, and how the framework does and does not apply. Engaging all sectors in developing these materials will create the most robust and useful tools. Furthermore, we recommend investing in complementary research and tools to extend these permitting strategies and tools to other regulatory settings addressing stormwater, drinking

water, combined sewer overflows, and watershed and wetlands management. Evaluating and fine-tuning application of the framework to other water permitting settings will help advance innovative solutions and more efficient, cost-effective permitting across the water management landscape.



Recommended Action: Support research on bounded flexibility.

Further research is necessary to clarify the extent of bounded flexibility and communicate these findings to permit writers and permittees. Funding this legal research can help all parties better understand what is possible – within the existing regulations and requirements – in an NPDES permit. At present, the lack of clarity can lead to overly conservative approaches or expectations on the part of permitting authorities, potential permittees, and the engaged public. Clarifying available flexibility establishes a more level playing field and helps permit writers better understand and more proactively utilize available permitting discretion while maintaining robust water quality protections. This research will highlight options for writing permits that can better facilitate innovation while maintaining the core goal of water quality protection and improvement. Ensuring that research results are disseminated through varied channels will increase the penetration of new permitting insights within the wastewater community of practice. Universities, research organizations like the Water Research Foundation and Water Environment Federation, regulatory agency associations like Association of Clean Water Administrators (ACWA) and the Environmental Council Of the States (ECOS), water utility associations like the National Association of Clean Water Agencies (NACWA), National Municipal Stormwater Alliance (NMSA), and WateReuse Association (WRA), and environmental NGOs should collaborate in framing and carrying out this type of research.



Recommended Action: Develop and disseminate best practices, success stories and case studies.

All involved parties should support the ongoing development of case studies that demonstrate the environmental benefits and other co-benefits of innovative programs, processes, or technologies. As illustrated by the present framework, case studies can serve as vehicles for learning about the approaches that have worked, and ultimately producing generalized guidance. These case studies could be used to identify best permitting practices and support knowledge transfer across staff and across states. Many of these case studies will constitute success stories that can be used to motivate and inspire all involved parties in a collective movement towards culture and practice changes that will improve results for all.



Recommended Action: Develop communication materials.

All involved parties should support efforts to develop materials to help communicate the concepts and approaches described here. Materials such as fact sheets, “How To” guides, presentations, infographics, and case studies could be used by members of the community of practice as part of an effort to broaden understanding, and ultimately acceptance, of these ideas and practices within the wastewater sector. Sharing these materials at meetings and conferences where large numbers of regulators, wastewater managers, consultants, researchers, and NGOs participate provides an efficient way to share the framework and the associated skills and capabilities it requires.



Recommended Action: Encourage and reward diverse skillsets amongst employees.

Innovative initiatives emerge from a utility workforce with diverse skillsets. Hiring initiatives by utilities, consultancies, and regulators can target different backgrounds and areas of expertise, performance evaluations can value creativity and initiative, cross-training can engage staff in different roles within the same organization, and awards and promotions can recognize staff who lead innovative projects and effective strategies for promoting innovation.



Recommended Action: Give staff sufficient time and resources to engage with others to implement innovative practices.

As noted above, implementing the framework requires permit writers, water agency or industry personnel, and the engaged public to spend the time to understand each other’s working context, available resources and discretion, and the details of their complex or innovative project entails and goals. Senior leaders need to give their staff the resources, time, and authorization to engage thoughtfully with each other. They need to reward initiative and accomplishment in fostering innovation while maintaining environmental and public health protections. Similarly, more senior leaders need to create incentives for supervisors to encourage and support this work with their staff.



Recommended actions for the EPA

The EPA has an important role to play in oversight and guidance and has also played a leading role in convening the parties to try to facilitate improvements in innovative permitting and programs and is singularly well-placed to provide leadership and assistance. EPA Headquarters and the Regional Offices could and should work together on these actions.



Recommended Action: Support and expand this emerging community of practice.

As described above, developing a community of practice is a key avenue to developing and disseminating the framework. The EPA has a nationwide vantage point from which to observe actions, share materials and insights, and convene people. This community of practice can take inspiration from and build on the WRAP. The WRAP has enabled relationships and produced materials that advance new ways of thinking, acting, and relating in the environmental and public health protection arena. As one participant said, “EPA, the states, and agencies may speak the same language, but they speak different dialects.” Developing the community and the vehicle to work on these issues together will yield long lasting results and better products. Bringing this group together can also yield benefits by collectively creating a vision, identifying problems and emerging issues, and developing creative and workable solutions. It will be advantageous to discuss this framework at national and regional state-EPA meetings and conferences of water sector associations, and to involve permittees and interested NGOs in these discussions.



Recommended Action: Educate and support permit writers.

Working effectively with innovative technologies and management strategies requires learning new things. To support the necessary training for permit writers, the EPA can convene efforts to develop educational resources in coordination with state permitting agencies and the regulated community. These resources will illustrate how to develop permits for new technologies and management strategies in accordance with relevant federal regulations. The goal will be to highlight options for developing permits to support innovation while meeting Clean Water Act requirements. These resources and training opportunities should emphasize the framework elements, specific areas of available regulatory discretion, and specific interpersonal and process-building skills that enable productive cooperative relationships. Building this knowledge base will enable permit writers to understand their available discretion and more effectively and efficiently develop permits that employ innovative strategies. Multiple education methods will likely be needed, including new training classes and modules, guidance and best practices documents, and compendia of permitting practices used to address different types of innovative technologies and strategies.



Recommended Action: Educate permittees and wastewater practitioners.

Better understanding of NPDES permitting can help permittees work more effectively with regulators, especially on innovative projects. Education will cover the core elements of NPDES permitting, including outlining the permitting cycle, identifying relevant regulations, and where to find additional information on innovative permitting practices. Educational outreach should specifically discuss key framework elements and the skills and organizational support necessary to effectively apply them. The goal will be to ensure a basic understanding of the NPDES permitting program and process by wastewater practitioners, including a foundational knowledge of the responsibilities of the permitting authority, and of this framework for implementing permitting of innovative technologies and practices. Wastewater practitioners, such as applicants and consultants, equipped with this knowledge could then navigate the permitting process with clearer expectations of what is possible.



Recommended Action: Develop centralized permitting assistance and support a broader innovation task force effort.

As recommended for states below, the EPA should develop high-level permit assistance to identify and help with permit issues overseen by the EPA, and it should assist with developing a larger technical assistance effort. This initiative could identify senior managers who can help guide more junior permit writers and could take on particularly complex permitting processes and guide the creation of the materials suggested in these recommendations.

We envision the creation of an Innovation Task Force to build collective capacity for innovative permitting approaches nationwide. This action will concentrate and make widely available some of the collective knowledge and experience of permitting innovation that is currently dispersed among the entities that have had success.

Most successful attempts at innovative permitting have included aspects of the key elements described in this report. However, few utilities will have the resources and motivation to do so from scratch, especially with limited knowledge of what is possible and permissible.

An Innovation Task Force would consist of key experts based on their track records of working with these ideas, ideally convened at the state level. These teams would consist of experienced thought leaders from the regulatory, utility, consulting, legal, and non-governmental organization (NGO) communities. The teams would be available on an as-needed basis to consult and support communities navigating permitting issues around innovative projects. The Innovation Task Force could help communities avoid “reinventing the wheel,” and help clarify boundaries of what can and cannot be done. In addition, it could and should increase the equitable access to these practices, especially for smaller communities and those without significant resources.

The Innovation Task Force could work in tandem with or complement the efforts by the EPA’s Water Technical Assistance initiative to provide technical assistance for communities seeking funding. The Innovation Task Force has precedent in the TMDL Surface Water Assessment Technical Team, assembled in the early days of the TMDL program, which had great success culminating in the creation of foundational TMDL guidance, as described in the 1992 TMDL Framework for Action published by the EPA.

To help establish and demonstrate the utility of an Innovation Task Force, we recommend that 3-5 initial pilot projects be funded where a Task Force would work closely with NPDES regulatory authorities, permit applicants, and the engaged public to craft permitting approaches to enable use of promising, innovative wastewater technologies and strategies.



Recommended Action: Create fact sheets geared to specific permitting issues.

Identify a series of permitting topics that have been challenging for some permittees and permitting authorities (e.g., reverse osmosis concentrate, nature-based solutions, contaminants of emerging concern, etc.) and develop fact sheets to help project proponents and permitting personnel at the federal and state levels navigate issues to issue permits faster. The EPA should engage the recommended community of practice to identify these issues collectively.

Recommended actions for state permitting agencies

When states have been authorized to administer the NPDES program, state permitting agencies are responsible for directly issuing NPDES permits within the state. In those cases, the EPA plays a role in oversight and guidance in the NPDES process. Supplementing state leadership, the EPA could help advance these recommendations in each state and provide support to help states carry them out.



Recommended Action: Designate state agency teams to steward innovative permitting practices.

Developing a permit to address an innovative technology or management strategy can be challenging, particularly for less-experienced permit writers. States should identify primary points of contact for permitting innovative projects and support their training. Permit writing staff who have drafted permits that include innovative wastewater management strategies or have been involved in innovative permitting processes can assist other staff who are less familiar with permitting discretion or who may not have encountered similar scenarios. This initial point of contact can serve as a starting place for permit writers within a regulatory agency to provide peer-to-peer guidance, help plan and facilitate the permitting process, or help engage more senior-level or management staff if necessary. If many states designate these key points of contact on innovation permitting, this can foster development of an interstate community of permitting experts who can learn from and support each other in addressing new permitting challenges presented by proposed innovative wastewater management strategies. When established, the Innovation Task Force (see recommendations to the EPA above) can support state agency teams in building their capacity.



Recommended Action: Create forums for discussion between regulators and permittees.

State agencies can create opportunities for sharing operational challenges and how regulators and permittees can work together to overcome perceived barriers to permitting innovation. Communicating the needs and duties of state regulatory agencies, including challenges (e.g., resources, permitting backlog, travel time, etc.) and the context in which they work (e.g., politics, economics) can help permittees better understand permitting

priorities and practical operational constraints in which a permit writer operates. Similarly, permitting agency staff will benefit from better understanding permittee challenges, drivers, and constraints. Enabling permittees to better understand the challenges that regulatory agencies face in issuing permits that are protective of water quality and public health while avoiding a backlog can assist in building clarity and trust in the relationship between the regulatory agency and the permittee. At the same time, state agencies should give staff time to understand the context, needs, and plans of permittees (which are often informed by needs and demands that go beyond water quality protection) to better aid communication and development of the appropriate permitting process.

Many states have wastewater utility organizations that hold regular meetings, which may provide excellent opportunities to arrange discussion sessions with permitting agency colleagues. The EPA, national regulatory agency associations (like ACWA and ECOS), and national permittee associations (like NACWA, NMSA, WRA, WEF and their state affiliates) may be able to assist in supporting such meetings, either on a state-by-state basis or at a regional level, which will afford additional opportunities to learn about permitting challenges and opportunities in different states.



Recommended Action: Develop training and information on the essential elements of a NPDES permit.

It is important for permittees and other engaged public parties to understand the fundamental requirements of an NPDES permitting program and the rationale behind the development of NPDES permit effluent limits and conditions. Building this basic understanding of the structure of NPDES permitting should assist states in discussing potential variations on the base permitting approaches that could be applicable to innovative technologies and methods. Since states with an approved NPDES program may establish additional regulations and implementation procedures, guidance and training specific to the state program may be necessary in addition to more generalized educational materials provided by the EPA or other national organizations.



Recommended Action: Develop fact sheets on state specific issues.

As noted above, some innovative projects or programs are state- or community-specific, and some recur with some frequency across jurisdictions. Identifying those tough issues specific to a state and giving guidance to permittees, permit writers, and the public can lend clarity and speed to the permitting process. The information developed here can be developed in tandem with EPA and others.

Recommended actions for water agency and industry leaders, along with the engaged public

While water agencies and other industries are the permittees in the NPDES permitting process, the engaged public (e.g., non-governmental organizations, other public agencies, private parties) can also be critical players in the process and have an important role to play in permitting. Water agencies and industry also have nationwide and state-wide associations that can help transfer knowledge and broaden a helpful community of practice.



Recommended Action: Proactively engage regulators and the public in understanding organization and community priorities and plans.

While protecting water quality and meeting permit requirements is the principal priority of permittees, there are other community priorities that wastewater agencies and other permittees must also address. These other priorities can be a direct driver for pursuing innovation opportunities. Permitting relationships will be improved when all involved parties have a better understanding of the context in which local entities operate. In addition, this engagement can serve as the basis for an integrated planning process that can be used to balance different water quality and community needs and set priorities for project investments. Wastewater agency staff can begin to share that knowledge and share their plans well before permit applications are submitted. General and inclusive engagement about important issues in the community is likely to yield productive information for all and lay a strong foundation for future permitting.





Recommended Action: Proactively engage regulators and the public early in the permitting process in understanding innovative projects or programs.



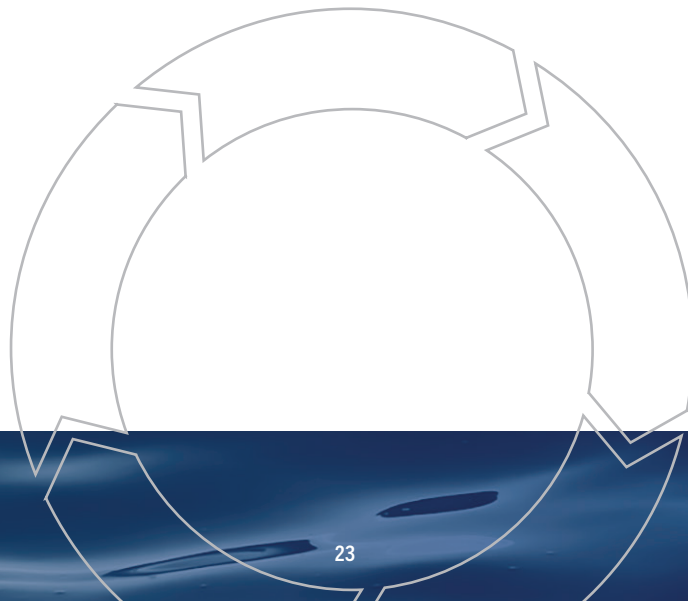
Frequently, project proponents invest considerable time and money into projects and seek permits on complex projects expecting quick resolution. Meeting with regulators early in the process to describe what the community is trying to achieve and seeking insight into what the regulators need to approve such a project is a better approach. Similarly, sharing needs, project ideas, and alternatives considered in a project with the public can develop relationships and engagement to create better projects that can be approved more quickly. Investing time early and often with regulators and the public can yield overall better and faster project approval.



Recommended Action: Support engagement with the community of practice and dissemination of the ideas in this framework.



As noted above, there are a substantial number of utility, industry, and regulatory associations organized at the national and local level to assist their members in joint learning, technology transfer, organizational, and other shared interests. Agency and industry leaders along with the engaged public can encourage those associations to assist in developing the case studies and principles described in this report efficiently and effectively.





Conclusion

In some ways, this report can be summarized in two main results: First, despite reports about permitting as a barrier to innovation, there is little desire among utility managers for relief from stringent permit terms. Rather, the permitting process itself is identified as the primary challenge to initiating innovative projects in a timely manner. Second, there is a clear path forward to improving this process. The clear, research-based framework presented in this report highlights the ingredients for a recipe that has been used with success in many places, and a successful recipe, which we believe can be replicated across the nation.

On its face, the framework for permitting innovation may seem simple. Simple, but not easy. Achieving permitting success will require hard work and a commitment of time and energy on the part of all involved. Perhaps initially more difficult, it will require an openness to seeing things differently, and acting accordingly. Instead of a stance of opposition, building positive relationships, with clear boundaries and attention to appropriate roles, can unlock the secret hiding in plain sight: everyone working in the wastewater sector shares the same core interests – achieving environmental protections as efficiently as possible, while unlocking additional benefits that may be difficult to achieve through standard methods. By building more effective regulatory relationships that support a more effective permitting process, we can accelerate together towards a future that embraces innovation for a more sustainable nation.

References

As noted above, these selected references to EPA-supported work are intended to serve as an entry point to a much larger body of literature on innovation.

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Acronyms

- BMP: Best management practice
- CWA: Clean Water Act
- EPA: U.S. Environmental Protection Agency
- GHG: Greenhouse gas
- NGO: Non-governmental organization
- NPDES: National Pollutant Discharge Elimination System
- SDWA: Safe Drinking Water Act
- TA: Technical Assistance