Water Pre-Workshop Input Tool Responses

This document is a repository of submissions received through the EHMI input tool for the upcoming workshop, *Quality Water From Every Tap: A Workshop of the Environmental Health Matters Initiative.* The responses are broken down into three large categories: 1. Governance, finance, policy and management at the local and utility levels; 2. Governance, economics, and policy solutions at the national and state levels; 3, Leveraging technology and information. These are further subdivided into actions, actors, and challenges for each. The tables below illustrate individuals' responses on what action(s) should be taken to improve the quality of drinking water, who should take these actions, and what challenges they may face. The National Academies' research staff has discretionarily taken out any personal identifiable information from the table, as well as removed responses that were not related to subject of the workshop.

Governance, Finance, Policy And Management At The Local And Utility Levels

Category of Action	Specific Action(s)	Actors	Challenge(s)
Individual and Community Change	**Increase communities' awareness of the underpricing and undervaluation of water**, to begin address underpricing issue.	- Individuals and Community Organizations - NGOs and Philanthropy - Government and Intergovernmental Organizations	**Difficult to convince consumers** that something that is out-of-sight (underground) is in poor condition and must be replaced. Behavioral change is difficult.
	Provide guidance on the variety of short term and long term solutions available outside of centralized treatment, to local utilities and governance. **Financial support needed at the local and utility levels** to implement those solutions.	- Scientists and Experts -Individuals and Community Organizations - Education and Informal Learning	**Behavioral and budgeting shift needed for households** to accept that centralized treatment is limited in the quality of water that can be provided and that the final water quality is up to the consumer to provide.
Governmental Change	**Access to financial resources** for small communities for implementing drinking water systems.	- Government and Intergovernmental Organizations - Private Sector - Media and Communication	**Not profitable** to invest in small drinking water systems because there are no economies of scale, and source water may be polluted.
	Reforming governance institutions to incentivize investment in drinking water.	- Government and Intergovernmental Organizations - Private Sector - NGOs and Philanthropy	**Governance reform inherently difficult,** need state/federal action to incentivize changes.
	Water infrastructure projects need to **utilize Subsurface Utility Engineering,** in order to make utilities more efficient and cost-effective.	- Government and Intergovernmental Organizations - Private Sector	**Coordinating with many Federal Agencies** can be logistically difficult.

		- Scientists and Experts	
	Voting in leaders at the local level in order to implement environmental infrastructure changes that enact environmental protections for chemical use and non-point pollution sources.	- Individuals and Community Organization - Government and Intergovernmental Organizations - Scientists and Experts	**Disconnect between scientific evidence and action,** lack of the public's collective will and motivation to adapt to climate change and adopt sustainable water infrastructure.
	Create unified water management needed to reduce silos between storm water, wastewater and drinking water management—water systems are more interconnected and need to be managed as such.	- Water utility managers and leaders - Government and Intergovernmental Organizations - Scientists and Experts	**Risk aversion and resource constraints have kept the water industry from innovating** to move beyond the current bounds to improve water management and conserve resources.
	Changing the way public water systems are funded. Small and shrinking cities will never have the funds to address their infrastructures issues without economic restructuring, i.e. private-public partnerships.	- Government and Intergovernmental Organizations - Private Sector - Individuals and Community Organization	**Taxes insufficient** to provide financial support for small cities.
	Pricing water at a more realistic, fair rate. Utilities are constrained by local government water rates. Distribution systems are not maintained because there is not enough funding to maintain them—need to raise the price of water.	- Government and Intergovernmental Organizations - Private Sector - Citizens	**Consumer education needed** to create collective will to increase water rates for treatment and distribution system upgrades
Advocacy	**Advocacy needed to educate public the challenges that small communities face** in terms of deteriorating water infrastructure. This will lead to higher funding to maintain water infrastructure.	- NGOs and Philanthropy - Government and Intergovernmental Organizations - Individuals and Community Organizations	**Insufficient tax revenue** for small communities to address water infrastructure issues.

Information Dissemination	**Sharing planning information at the local and utility level** to make infrastructure upgrading more efficient and cost-effective. Need to take advantage of modern information systems to integrate all utilities. **Create an emergency funding mechanism** that can provide resources under short notice.	- Government and Intergovernmental Organizations - Private Sector - Scientists and Experts	**Little communication between state mandates/plans and local governments** who carry out the infrastructure upgrades.
Business and Industry Change	**Better utility workforce recruitment/training/placement** for small systems. All levels of government should work with community organizations to develop informational materials to promote water-related jobs as viable job options for young people.	- Government and Intergovernmental Organizations - Individuals and Community Organizations - Education and Informal Learning	**Resource constraints—**1. Public water systems undercharge for water; 2. High turnover rates for water utility workers in small systems—need better pay to retain workers.
Other	**Changing business model of utilities;** Utilities need to be more organic, less political, and more responsive to those they serve. Utilities need to be owned by the people they serve. Goal of water utilities should be to ensure water rights.	- Government and Intergovernmental Organizations - Individuals and Community Organizations - Utilities need new leadership	This change has two challenging aspects: **1. Development of a new water utility business model** (more attention to balance sheets (and the equity position of citizen owners); increasing use of prices for services (moving away from rates); retooling how water services (drinking, storm, non-potable water, water reclamation) are paid for by low-income owners; and, better integration of all water services.); **2. This change will take time.**

Governance, Economics, And Policy Solutions At The National And State Levels

Category of Action	Specific Action(s)	Actors	Challenge(s)
Scientific, Engineering, or Health Advances or Interventions	**Updating regulations to fundamentally change the current centralized water and wastewater infrastructure** (reduce defragmentation, improve water quality at the point of use, increase reuse, and facilitate localized, yet integrated water, storm water and wastewater solutions, but with remote management, and much more stringent water quality standards).	- Private Sector - Individuals and Community Organizations - Scientists and Experts - **Comment:** All actors indicated are relevant (The government orgs are needed to help transition the regs and facilitate innovation through financing. Scientists can help with technology selection and infrastructure design directions. Individual /community orgs are needed to highlight the inequities in access and protection from the current systems and to highlight the price-performance needed. The private sectors sole is critical for service provision/financing and defragmentation)	**Existing policies, reuse regulations, and reliance on traditional water quality testing regimens** make the introduction of new system designs of decentralization harder.
	Developing new water quality monitoring technology.	- Scientists and Experts	**Knowledge and uncertainty,** but will be overcome with time.
	Real-time monitoring of drinking water quality throughout the distribution system to understand level and extent of compliance, and potential health impacts to communities.	- Scientists and Experts - Government and Intergovernmental Organizations - Private Sector	**Resource constraints** play a large role in small and decreasing communities—in terms of **both money and operators**. Monitoring is important to adequately allocate those resources.

	Federal and state assistance to provide clean water to those who have contaminated drinking water (i.e. PFAS).	- Government and Intergovernmental Organizations - Private Sector	**Resource constraints.**
Governmental Change	**Federal government needs to provide local communities with more funding**	- Government and Intergovernmental Organizations - NGOs and Philanthropy - Education and Informal Learning	**Policies and politics,** the federal government prioritizes defense spending over giving it to local communities.
	More research into non-standard solutions. The **federal government should act as a facilitator for conversations act as a clearinghouse for best practices** from various communities. They should also take the lead at **crafting regulations that allow for interpretation at the local level** to determine best solutions for specific local conditions.	- Scientists and Experts - Government and Intergovernmental Organizations - NGOs and Philanthropy	**Disconnect between big government and small government,** regulations in SDWA need to be implemented in a way so that guidelines can be set at a national level and local communities can create location specific rules.
	Federal and state governments need to **create incentives and push for regionalization of water utilities.** **Consolidation of utilities** to improve management and stretch resources.	- Government and Intergovernmental Organizations - Individuals and Community Organizations - NGOs and Philanthropy	**Taking steps to ensure that publicly invested infrastructure stays public and shared** so local communities have a sense of control over their utilities.
	State policies need to be streamlined so local communities have the flexibility to adapt to their unique situations. Local governments are the ones that implement policies and manage utilities. For example, local governments need to be free to create storm water (or better yet, one water) utilities. States need flexibility, but so do	- Government and Intergovernmental Organizations - Scientists and Experts - Media and Communications	**Policy-making and policy reform takes time.**

local governments who do most of the work here. At **a federal level, the Farm Bill's SNAP program should be expanded to include the ability to purchase drinking water**.		
More rigorous and equitable enforcement of existing regulations.	- Government and Intergovernmental Organizations - NGOs and Philanthropy - Media and Communications	**Changing regulations within regulatory organizations** will require a significant overhaul.
Updating regulations to match innovations in technology. **Increased appropriations and funding to address water quality.** **Investing more in technology and state's approving good technologies.**	- Government and Intergovernmental Organizations - Individuals and Community Organizations - Education and Informal Learning	**Time and bureaucracy** related to changing regulations related to how state revolving fund operators and state approval of solutions.
Focus on compliance with existing drinking water regulations.	- Government and Intergovernmental Organizations - Scientists and Experts - Individuals and Community Organizations	**Lack of funding to fix the problem** and **a lack of resources** to solve the technical, social, and governance issues.
National government needs to commit to more funding to support the rebuilding of water infrastructure. **States need to be more accountable for the quality of drinking water and proactively protect water resources.**	- Government and Intergovernmental Organizations - Individuals and Community Organizations - Media and Communications	**Insufficient funding at every level of government.**

Establish and enforce measures that protect public health.	- Education and Informal Learning - Scientists and Experts - Government and Intergovernmental Organizations	**Policies and politics.**
Create collective/political will to develop sustainable natural and built water systems.	- Individuals and Community Organizations - Government and Intergovernmental Organizations - Scientists and Experts	**Collaborating and coordinating with all levels of government to build sustainable water systems.**
Federal government needs to create a framework to help communities beyond issuing SDWA violations.	- Scientists and Experts - Government and Intergovernmental Organizations - NGOs and Philanthropy - **Comment:** We need a think tank of sorts among academics/experts, government, and NGOs on how we might restructure finance/enforcement at a national level that gets clean, safe water to people.	**Bringing together multiple actors from various sectors to brainstorm how water infrastructure can be restructured—**doing this in a mindful way and keeping in mind that our world continuously changes.
Increased funding to encourage consolidation and reform. Federal and state grants programs tend to either: a) favor systems that already have the capacity to apply and qualify for them; or b) prop up failing systems that ought to consolidate. **Federal funding ought to be a lever to drive structural reforms, including consolidation.**	- Government and Intergovernmental Organizations - NGOs and Philanthropy - Private Sector	**Changing current policies and processes at the federal level will take time.**

	Optimize the standard-setting process to be more efficient (time-wise) in addressing emerging contaminants.	- Government and Intergovernmental Organizations - Scientists and Experts - Individuals and Community Experts	**Amending the SDWA will take time.**
Advocacy	**Funding from the SDWA needs to be more flexible to help pay for the operation and maintenance of water treatment equipment** that communities cannot afford to pay for increased water rates. Currently, the SDWA can only be used for infrastructure replacements, improvements and the addition of new water treatment equipment. A **long-term reliable source of funding must be identified** to help these communities qualify for State Revolving Funds to **get new treatment equipment installed.**	- Government and Intergovernmental Organizations - NGOs and Philanthropy	**Consumers have limited income,** so higher water rates are not feasible. **Funding is restricted,** limiting communities' allocation of resources.
	Adequate resources, both money and knowledgeable operators, are needed to help improve the quality of drinking water.	- Private Sector - Government and Intergovernmental Organizations - NGOs and Philanthropy - **Comment:** Fed and state gov. has been the source of funds for SDWA facilities, but money is likely not to increase to amounts needed. **P2 partnerships and other creative financial opportunities ought to be explored** - or reorganizing DW providers to capitalize on economies of scale through perhaps consolidation.	**What is stopping creative financing and the flow of resources are market conditions. Need to make quality drinking water economically feasible.**

	Regulators and providers need to do a better job at providing communities with the knowledge and tools they need to understand their water quality, and the systems that provide them the water - so they know what they can and cannot do to promote change and improvements.	- Individuals and Community Organizations - NGOS and Philanthropy - Government and Intergovernmental Organizations	This is a competing demands issue - on the part of the community members, but more so on the part of the providers of the information. **It takes time and effort to share information and to respond to community concerns.**
	Technological innovation and acceptance.	- Scientists and Experts - Government and Intergovernmental Organizations - Private Sector - **Comment:** NGOs could be added as well. The National Sanitation Foundation develops standards for materials used in drinking water treatment and delivery, however, there is no similar system for treatment technologies and processes. Any system that could be developed that would streamline testing and evaluation would help states and utilities in their decisions on improving water treatment.	**There are no formal networks in place where evaluations of innovative technology can be shared among states for acceptance and implementation.** **Challenge could be overcome through increased cooperation among individual states--** This could be done through organizations such as the Environmental Council of the States and the Association of Drinking Water Administrators.
Business and Industry Change	**Standardization of building plumbing codes.**	- NGOs and Philanthropy - Scientists and Experts - Government and Intergovernmental Organizations - **Comment: The private sector can play an important role here as well**. Water consumption patterns are changing	**Plumbing codes are not uniform--**plumbing codes vary from state to state and locality to locality. **No clear leader addressing this issue—lack of collective will.**

		throughout communities in the US. Conservation measures at multiple scales (i.e. from large city distribution systems to household premise plumbing) changes flow regimes in water distribution networks which can impact water quality at the tap. Issues involving lead, Legionella, and disinfection by-products are often occurring in the distribution systems. Updated, standardized plumbing codes that take into account water quality can help to improve water quality at the tap.	
	Better training and capacity building. **Access to scientific information and transparency on how services are provided.**	- Scientists and Experts - Government and Intergovernmental Organizations - Private Sector	**Small communities cannot afford to build and maintain adequate drinking water systems.** As a result, they cannot afford training, capacity building and provide transparency information.

Leveraging Technology And Information

Category of Action	Specific Action(s)	Actors	Challenge(s)
Scientific, Engineering, or Health Advances or Interventions	**More attention needs to be given to preventing and identifying pathogens in water systems.**	- Scientists and Experts - Government and Intergovernmental Organizations	**Policies and politics** as well as **Knowledge and uncertainty** pose as large challenges.
	Improve sensors so they could provide information on water quality and use at the point of use—**Encourage decentralized systems** (treatment would be conducted near the point of use to facilitate assurance of quality with or without reuse would emerge thus avoiding /reducing issues related to lead in service lines, disinfection byproducts and other contaminants). This could also make wastewater reuse a lot more technically and economically feasible since sensors assure performance, capital and operating costs.	- Scientists and Experts - Private Sector - Government and Intergovernmental Organizations	**Existing reuse regulations and reliance on traditional water quality testing regimens make the introduction of new system designs harder.** Decentralized water and wastewater reuse systems with direct potable reuse or nonpotable reuse represent the direction for the future.
	Increase water resiliency. This may be more of a water quantity issue, however, if there is no water for a community, water quality hardly matters. Many communities face water shortages. **Increasing viable water supplies through alternative sources and water reuse may be viable options for increasing water resiliency.**	- Scientists and Experts - Government and Intergovernmental Organizations -Education and Informal Learning	The engineering and technology exists to meet existing challenges. **One of the most difficult aspects of implementing water reuse is public perception.** It can be overcome. Many states (e.g. CA, TX, CO, FL, AZ) have implemented water reuse plans to bolster viable water supplies.
	Promote relevant innovation and provide an environment to encourage innovative solutions.	- Scientists and Experts - Private Sector - Government and Intergovernmental Organizations	**Fixed and conservative nature of regulators and utilities.**
	Industry & Academia must come together to rebut and overcome actions by the EPA endangering our water supply, especially with regards to heavy metal contamination.	- Scientists and Experts - Media and Communications - Private Sector	**EPA rolling back regulations in the Clean Water Act.**
	Developing new water quality monitoring technology.	- Scientists and Experts	**It will take time to develop new technologies.**

	Policy should be expanded to measure and adapt to outcomes. We currently do not measure outcomes. It's hard to know if anything is actually working (unless people's health or the environment get compromised). As a starting point, it could be good to **use recent advances in technology to increase the number of water measurements.**	- Government and Intergovernmental Organizations - Scientists and Experts - Private Sector	**Water policy is rarely outcome based. It's more prescribed** (e.g. "if you do this, then we will assume water is good").
	Better monitoring of water quality, including in the distribution systems and, where appropriate, in homes, to better identify problem spots. The SDWA recommends limited monitoring and requires a great deal of funding and resources**. Perhaps this funding could be better spent on "smarter" monitoring.**	- Scientists and Experts - Government and Intergovernmental Organizations - Private Sector	**Developing new technology takes time--** Such technologies need to be identified and then pilot- tested so that there are agreed upon standards and protocols. We do have to be careful to **avoid the "wild west" of water quality monitoring** in an attempt to embrace more precise, accurate and real time monitoring of the future.
	Increasing trust and transparency through modernization of our water systems. Trusted transparency, even radical transparency, is essential to a well-functioning modern democracy. Technology integration in context is far more important now than developing new technology itself.	- Government and Intergovernmental Organizations - Scientists and Experts - Private Sector	The availability of technology to dramatically improve just about every aspect of water quality and supply is largely available, **the challenge is the perceived personal and institutional risk stemming from a lack of depth of expertise in the field.**
	Increased monitoring of water distribution systems. This does not imply increased regulatory monitoring. Many issues involving water quality at the tap are caused by reactions and/or events in the distribution system. **We need better data on the interactions among disinfectants, biofilms, organic matter, and pipe materials to gain a better understanding** on managing opportunistic pathogens, DBP formation, scale build-up (and release), and maintenance of disinfectant residuals.	- Scientists and Experts - Government and Intergovernmental Organizations - Individuals and Community Organizations	**Advances in monitoring technologies are necessary** to help facilitate more research on water quality in distribution systems. **Resource constraints** could also pose a challenge.
Individual and Community Change	All actions are important; **Understanding the formal and informal regulatory environment, as well as how the consumer interact with systems**	- Individuals and Community Organizations - Scientists and Experts	**The regulatory environment and trust in those who is overcoming this will be a large hurdle in many vulnerable communities.**

	is critical for not only improving water quality but also the use of water at the tap.	- Government and Intergovernmental Organizations	
	Use true cost pricing and recognize the value of water.	- Individuals and Community Organizations - Government and Intergovernmental Organizations - Media and Communications	**Educating the public.**
Governmental Change	We are at the limits of what current water systems can do for us. **Our systems need to be more flexible and more adaptable.** To do that, they need to be smarter. Our **distribution and collection systems need real-time controls** so that the built capacity is more completely used. We need **to manage for a range of desired outcomes that transcend today's regulatory scheme** (receiving water hydrology, thermal regimes, groundwater recharge (and related chemistry), in addition to pollutants). We need **to drive adoption of new IOT enabled management systems, better share what's working and work to upgrade the advice our local governments** are getting from consultants who will earn more from more expensive, outdated, approaches.	- Government and Intergovernmental Organizations - Private Sector - Scientists and Experts	The top challenge is **inertia and that is driven by demographics. It takes guts and leadership to bring radical new tech into this space.** That doesn't happen just before large scale retirements in a sector.
	Need to change how state revolving funds work, the process of state regulatory approval, and certain EPA rules.	- Government and Intergovernmental Organizations - Private Sector - Scientists and Experts	**Politics poses a large challenge in conducting this action.**
	Removal and replacement of lead service lines and lead pipes.	- Government and Intergovernmental Organizations	**Difficult to conduct this at a national level.**

		- Individuals and Community Organizations - Scientists and Experts	
	Government needs to provide financial incentives and grant funding to move innovation forward.	- Government and Intergovernmental Organizations - Private Sector - NGOs and Philanthropy	**Market forces are a large challenge here, because of the time required to see the returns on investment.**
Information Dissemination	**Need more awareness of regional test cases of implementation and of product certification.** **A willingness to run pilot studies on decentralized drinking water treatment options.** **Create a robust platform (and awareness of that platform by its intended beneficiaries) for sharing information on the various pilot studies**. Scientists and consulting engineers also need better familiarity with decentralized treatment options.	- Scientists and Experts - NGOs and Philanthropy - Education and Informal Learning	**Communication is always difficult in this "noisy" environment.** All sorts of great pilot studies can be conducted, but **if the results are not reaching the intended audience**, nothing will change.
	"What's in your water?" days/events that are coordinated with K-16 schools, libraries, science centers/museums, scouts, public entities**--that disseminate information, but also provide opportunity for water testing--**it's one thing to read about water quality and another to physically take your water and test it/see it tested PS-Education should be added to your section E in "Actions"	- Education and Informal Learning - Scientists and Experts - Media and**)** Communications	**Money is needed to offer tests for free or reduced for citizens** **Support is needed for people who want to organize such events/get supplies for such events** or prepare curriculum materials for K-12 and funding for K-12 teachers to participate in related professional development
Business and Industry Change	**Technological improvements to point-of-use and point-of-entry treatment** can potentially provide a reliable, semi-permanent method, to provide water treatment at smaller public water systems. Point-of-use and point-of-entry treatment are technically capable of treating water to meet drinking water standards for many contaminants.	- Private Sector - Government and Intergovernmental Organizations - Individuals and Community Organizations	**Treatment performance is dependent on local water quality and operating conditions and the routine maintenance** and testing requirements inside customers' homes make them difficult to implement. **Due to the uncertainty and relatively small market demand for Point-of-Use and Point-of-Entry treatment equipment** used to achieve compliance with drinking water

			standard**, equipment manufacturer seems hesitant to invest in the development of more sophisticated point-of-use and point-of-entry treatment equipment** that are more efficient and suitable for use by water systems to achieve compliance with drinking water standards. The technical challenge can be overcome but it is difficult to determine the size and scope of the long-term demand for such equipment across the country.
Other	**Hire new professors that change environmental engineering curriculums, engineering departments, and the conversation surrounding engineering goals** (i.e. in order to focus more on public engagement and infrastructure, and less on defense- and corporation-led research). **Ask the public directly what they need or want,** instead of creating demand for new corporate technologies and gadgets that people didn't know they wanted and probably won't ever need.	- Education and Informal Learning - Individuals and Community Organizations - Scientists and Experts	Such an overhaul of engineering education will be incredibly difficult. **The limitation is ethical knowledge, not technical knowledge**. There are still many widespread, yet dangerous, beliefs among engineers. To name a few, **engineers routinely believe that technology is inherently good** (although it can be "misused," they say), that technology is apolitical, and that by planning to travel to Mars we are not actually sacrificing other opportunities, such as caring for human communities here.
	Research on water quality at the local level paired with Information dissemination is critical--if the general public learns of the quality of water that they are personally drinking/using, they are more motivated to advocate demand the policy changes, etc.; as a result, there is pressure for the government to change level, which would potentially result in business and industry change. Perhaps **undergraduate and citizen science efforts could be created/leveraged in partnership with a network of university faculty conducting research on these investigations** (this would require funding for these projects); including undergraduate researchers also builds	- Education and Informal Learning - Scientists and Experts - Media and Communications	**Public perception, consumer demand and consumption patterns are difficult to change.** However, they can all be positively influenced through intentional education and information dissemination efforts that are built on social science/psychology frameworks.

	long-term support and capacity for improved water quality and public perceptions of value. Also, **education in the K-12 realms is critical**. Aside from long term capacity building by educating/disseminating information through K-12 and informal settings; many parents learn information through the K-12 curriculum, so focusing efforts there has a wider reach (similar to recycling information dissemination/ adoption)		
	Gain understand of the privately owned portion of drinking water distribution systems, and help the public and utilities work together to proactively improve water quality (in this context, I'm thinking of leaded plumbing).	- Individuals and Community Organizations - Scientists and Experts - Water Utilities	**The public lacks scientific literacy surrounding water infrastructure/quality.** A citizen science solution requires that members of the public have a particular science literacy, in this case a certain level of understanding of drinking water systems.