

Improving the implementation of water and resource recovery in Canada

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ABSTRACT

Globally there is a need to rethink water use and wastewater disposal. One view is to consider wastewater as a resource via treatment for fit-for-purpose water and resource recovery (WRR). To understand what has worked in Canada according to those directly involved in WRR, we used interviews with individuals involved in various WRR projects. Seventeen semi-structured interviews were completed with participants from regions across Canada. Three main findings pertaining to the question ‘what is needed for WRR project implementation?’ emerged from the interviews: government and institutional support; community engagement, education, and acceptance; and comprehensive planning. Based on the interview findings, WRR projects require foundational guidance, something that is currently lacking in the Canadian context. To improve WRR implementation and success in Canada, guidance on community engagement, technology, costs, and impact assessments should be built into a policy for WRR.

Key words | community engagement, implementation process, implementer experience, resource recovery, water reuse

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HIGHLIGHTS

- Current WRR projects in Canada are managed independently, resulting in mixed experiences and outcomes.
- Implementer experiences with the WRR implementation process vary regionally.
- Community engagement is necessary for WRR implementation, and transparent communication is imperative for building community trust.
- WRR in Canada should be supported by governments through proper guidance and technical support.

INTRODUCTION

Though the water cycle continually renews itself, we use and dispose of water at a faster rate than the natural water cycle regenerates it. This has led to water scarcity, which is compounded by nutrient and pollutant discharges in

wastewater, the need to build and maintain large, centralized water infrastructure, and the financial stresses this generates for communities. Globally there is a need to rethink both water use and wastewater disposal and to identify overlap and opportunities for improvement. These opportunities include water reuse and resource recovery, both of which consider wastewater as a resource. Water reuse and resource recovery can be distinct, and there may

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be different considerations, such as the extraction and treatment process and health and safety related to the use of the reclaimed resource. Although the practices of water reuse and resource recovery can be separated, we take the approach of the combined strategy, known as WRR (water and resource recovery), defined as the treatment of wastewater for fit-for-purpose use of recovered water and nutrients, such as phosphorus and nitrogen for use in thermal/organic carbon energy (Miller 2006; Sengupta *et al.* 2015; Cornejo *et al.* 2019; Kobayashi *et al.* 2020; Prado *et al.* 2020; Noga *et al.* 2021).

WRR as a broader concept must be considered with the caveat that every project comes with its own specific nuances. Although each project differs in aspects regarding engineering and outcome, there are many factors that contribute to the overall success of these projects. These factors include the use of water quality metrics and other public health-focused monitoring (Watson *et al.* 2016), assigned risk and liability (Exall *et al.* 2004; Kosovac *et al.* 2017), accounting and planning for long-term maintenance (Harris-Lovett *et al.* 2015), and public education (Hennessy 2009; Dolnicar *et al.* 2011). Having an identified need and reason for implementing a WRR project contributes to the justification, for example, water scarcity or reducing nutrient loading (Asano 2002). Public trust and buy-in for a project is another factor, as it keeps decision makers more accountable to project goals and the impacted community (Marks *et al.* 2003; Baggett *et al.* 2006; Hartley 2006; Ross *et al.* 2014; Harris-Lovett *et al.* 2015). Arguably the most important factor of a WRR project is working within the context of a given community. A shared understanding of the context and mutually understood language among the implementers, decision makers, and community at large is imperative as this enhances the likelihood that most understand the context for decision-making, which builds trust in the scheme for the community (Morgan & Grant-Smith 2015). Specifically regarding water reuse, there is some hesitancy from the public to use reused water for direct human use such as drinking or washing, commonly known as the 'yuck' factor (Asano 2002). As such, another aspect of building public confidence in a WRR project is to start with noncontact uses of the water and resources that have been recovered, thereby allowing users to experience WRR with perceived minimal risk (DuBose 2009). Although these

factors are not an exhaustive list, they outline some key considerations for developing WRR projects from international experience.

However, with a few notable exceptions (Hennessy 2009; Ogilvie, Ogilvie & Company 2010), much of the research on perceptions of WRR has focused on Australia and the United States. The practices of water reuse and resource recovery are sometimes researched separately because of the potential differences in technical aspects; however, given the current scope of water reuse and resource recovery projects in Canada, we focus on WRR overall, selecting participants with experience in either or both. To understand what has worked in Canada according to those directly involved in WRR projects, we used interviews with individuals involved in various WRR projects across the country. When it comes to understanding the details of WRR, interviews have been used to provide in-depth explanation and understanding (Harris-Lovett *et al.* 2015).

METHODS

To explore what is needed for successful WRR project implementation in Canada, interview questions pertaining to participants' experience were asked, followed by questions about the processes, perceived challenges, and facilitators to project implementation. The interviews were conducted primarily over the phone (one interview was done in person), lasting approximately 1 h each. Occasionally, two members of the same organization participated together.

Initial participants were identified using known contacts in the Canadian water sector, as well as contacts for known water reuse and resource recovery projects. Snowball sampling was then used to identify further participants, a technique that allows for the identification of prominent individuals involved in WRR (Harris-Lovett *et al.* 2015). Using snowball sampling allowed the researchers to include participants who were not previously identified. The only inclusion criterion was having experience in a WRR project in Canada, regardless of the status of the project, timeframe, or outcome. Thus, participants had a range of experiences, ranging from small municipal projects to academic pilot projects, with both successful and unsuccessful outcomes.

To provide a comprehensive summary with minimal interpretation, a qualitative description approach was chosen (Sandelowski 2000). Content analysis was used as the analysis technique and organized using NVivo 12 Plus (QSR International 2020). The initial coding of the transcripts was completed while working concurrently during the interviews. Further coding and categorizing were completed in order to identify themes (Mayan 2009). Using member checking to establish the reliability of the data (Mayan 2009), a summary of the interviews was sent to the participants for their feedback to ensure that the research assistant accurately understood their responses.

RESULTS

In total, 17 semi-structured interviews were completed with participants from various regions across Canada. Eight participants were from Alberta, four participants were from British Columbia (BC), and five participants were from Ontario (ON). In terms of comparisons of experience between provinces, there appeared to be a difference between what was perceived as the biggest barriers in WRR project implementation. In Alberta, participants spoke most often about a lack of legislation and regulation. In BC, participants discussed having more guidance, but the legislation was not clear nor aligned. ON participants talked predominantly about the importance of community engagement. Additionally, compared to both Alberta and BC, participants in ON discussed having more clear regulations pertaining to WRR projects.

Three main findings pertaining to the question ‘what is needed for WRR project implementation?’ emerged from the interviews: government and institutional support; community engagement, education, and acceptance; and comprehensive planning.

Government support

Government support refers to municipal, provincial, and federal governments or their laws and regulations that may impact WRR projects. Clear, aligned, up-to-date regulations were expressed by almost every participant as a factor that was needed for successful implementation. It was expressed

that clear regulations provided participants with a better understanding of what was required when trying to gain approval for projects: ‘Getting the rules and regulations clear, understandable, and appropriate at the start is the single best thing’ (Participant 1).

A lack of specific regulations in some regions has delayed many projects, either in details that come up after the project has been built or needing to wait for the government to create and publish a policy that would support such projects. One participant described the missed opportunities because of having to wait for a policy to come out, even though the technology required is readily available: ‘We can’t use [the technology] yet because the policy’s not out yet. We started this all in 2008. That’s 12 years of missed opportunities’ (Participant 15). Another participant expressed their concern surrounding the impact that a lack of government support has, stating that ‘it’s costing the environment and the economy’ (Participant 2). For one participant, the lack of regulations was exacerbated because the building is run federally but built on provincial land, causing a ‘regulatory black hole’ (Participant 14). This resulted in the project being completed, but since there was no approval process in this particular situation, the project remains unused.

A lack of clear, aligned regulations has resulted in some people going ahead with the projects regardless of receiving government approval. One participant describes the dangers of doing this, explaining how it will result in numerous projects without a guided plan: ‘It’s like we’re going to wing something, but it’s going to be a hodgepodge of 40 different irrigation systems without a guiding document’ (Participant 11).

Financial support for WRR projects was also mentioned. This included increasing the cost of water to encourage WRR and to provide funding for projects and technology. Participants described that if the cost of water does not increase, many people will not feel any incentive to use or implement WRR projects because the alternative is more cost-effective: ‘So the other factor, I think that’s a little bit problematic in certain parts of the country, especially here in Alberta, is the water’s pretty cheap, like potable water is pretty cheap, so there’s not a huge financial incentive for anybody to do this’ (Participant 14). Many participants said the technology that is needed for WRR projects is available; however, the cost of the technology is still quite high. Participants described how they thought that government

grants or support to implement the projects would be beneficial to the implementation group in addition to being more appealing to communities if the cost is lower: ‘Until you get enough rebates to bring it down to more manageable ... people are always going to choose the cheaper option. So, I think as much as people want to be green, they can’t go bankrupt for it. So, I think it’s giving them opportunities to get there’ (Participant 13).

Community engagement, education, and acceptance

Many participants said that education and awareness for the public was needed for successful WRR implementation. This included constant communication and engagement with each of the groups involved, clearly laying out the goals of the project, and using mutually understood language.

Almost every participant felt that community engagement and consultation was essential in a successful WRR project. This refers to aspects like education about what WRR is and addressing the communities’ concerns about a specific project in their community. Many participants expressed that community engagement was imperative because ultimately it is the community that is using and investing in it: ‘[W]e need to have the consumer, the general public, aware of the steps we’re doing because ultimately, we need their buy in’ (Participant 13). Simply being aware of the steps of reusing water is just the beginning, however. Participants also described the importance of engaging the public on a project to ensure that it is tailored to the specific context of the target community:

“The challenge is finding the right fit for each community and to ensure the proper solutions are implemented. I think a successful means to approach water reuse is to first ascertain what the end user finds palatable and then identify the potential solutions and have a feedback loop that ensures the end user will be comfortable and knowledgeable with the proposed solutions.” (Participant 5)

There were a few participants who said although the public should be involved and aware of the project, community involvement should be minimized. Those who thought the public should not be involved thought that involving the public too much on the technical side was not necessary,

and that public engagement is not needed if the project is not directly going to be used by them: ‘I think it depends on what the water reuse is for. I think you have to have the public on board. But at the same time, if you’re looking at doing industrial reuse, how much time do you really need to spend educating or getting the public on board for that?’ (Participant 7).

The concept of reusing water, whether that be in residential homes or industrial uses, created some concern in communities. In some cases, concerns that communities had about the project were the reason that projects were stalled. Participants described the importance of addressing community concerns early on and that although it may take more time upfront to come to a consensus, ‘you can come up with a solution that’s advantageous for everybody’ (Participant 10). Furthermore, many participants expressed that although technology needed for WRR is available, ‘it doesn’t necessarily mean that people feel like they want to use that’ (Participant 8), emphasizing the importance of framing the project to something the public can understand and view as trustworthy. In terms of increasing the trust that communities have with WRR projects, one participant emphasized the need to be consistent when describing a project to a community, so that the users are not surprised with something unexpected, therefore decreasing trust in future projects. They described the disappointment they felt in the past when stormwater ponds were advertised as recreational areas where residents can surf or boat, but 10 years later, the pond is covered in weeds and has an unpleasant odor: ‘I want to make sure that the marketing message is consistent with ultimately what is implemented, so there isn’t a concern later on saying, you sold me based on this, but I get this? Terrible’ (Participant 4).

When it comes to residential WRR systems, participants felt that engagement and education were imperative in a sustainable project. Property owners cannot be expected to perform the extensive monitoring required of some of the systems, emphasizing the need to consult with different users to ensure that the type of WRR project is appropriate and meets ‘their level of expertise and capability to keep it (water reuse system) in good operating conditions’ (Participant 12). For one participant, a lack of education and engagement in a project resulted in some homeowners removing the water-reuse technology that used shower

water for toilet flushing. The participant described how many of the homeowners were not expecting the amount of maintenance required in their systems, including the removal of hair caught in the system, shampoo buildup, and maintenance costs. They found that there was not enough education about the technology, and ‘people ripped them out based on their experience because they take so much management’ (Participant 13).

When communicating with a community about a project proposal, many participants felt that using examples from previous studies was helpful. The examples could be used to address concerns the community had and understand what the proposed system might look like or provide reassurance that this was not the first project of its kind: ‘The best way to win over the public support for a reuse project is where there is a defined opportunity and where there is a successful example somewhere else that has already been done’ (Participant 1). Another participant explained how with increasing exposure, these types of reuse projects will become normalized and communities will see that ‘it’s being done in a rigorous manner and in a way that is not posing a risk’ (Participant 14).

Changing the perspective of participants’ views on water as a resource was described by many participants. The current price of water is perceived as low, many people do not see water as a resource that can or needs to be reused. This is also related to regulatory needs to increase the value of water but is also deeply connected to changing communities’ perspective on water as a resource rather than ‘just a waste product that needs to be discharged in the environment’ (Participant 2). Some participants felt that part of the reason why communities in Canada are slow to view water as a resource could be due to the perceived abundance of water in Canada compared to more water-stressed regions ‘where there’s a driving force behind it’ (Participant 13).

An imperative aspect of community engagement encompasses effective communication methods. This involves determining appropriate communication avenues for the specific community and using clear and mutually understood language. One participant described that when their city realized not many community members were engaging with the project proposal open houses, they adjusted their communication methods and began sending out monthly updates to community members and addressing new

questions that way. Another participant who has worked extensively with public engagement and energy conservation suggested that workshops and webinars could be tailored toward WRR topics to increase the ‘buy-in from people’ (Participant 9). Regarding mutually understood language, one participant described how during a proposal for a resource recovery program, they ran into some challenges with the different understandings about the term ‘organic’, which created confusion and stalled the project. Another participant spoke about when discussing the project with the community, it was not framed in a way the community could see its importance. It was not obvious to the community why decreasing nutrients in the lake was a good idea, which impacted the public’s confidence and acceptance of the project, emphasizing the importance of ‘having a way to understand for people why this is good and why this will be a benefit to the community and to everybody’ (Participant 7).

For one participant, they described how the community had initial concerns about the project, but once they saw how happy the farmers were about the reused water, they accepted the project: ‘We had a lot of “ick” factor in the beginning, but certainly turned around, once the facility became operational and people saw one, how the facility was run and also the benefits that it really did bring to the community without significant negative aspects. And then when people saw how happy the farmers were. Like it really was a resource that was helping them out and something they valued’ (Participant 10).

Comprehensive planning

Comprehensive planning refers to having clear drivers for pursuing a WRR project, mutually understood goals of the project, and realistic plans for implementation and maintenance. The three most common drivers as discussed by the participants were regulatory/political requirements, long-term cost-savings, and environmental sustainability. It is important to note that these drivers are not mutually exclusive. For example, environmental sustainability concerns may have been the reason for a regulatory requirement to pursue a WRR project. Participants described the benefits of having clearly understood drivers and goals, one being that it helps with more coherent planning and increases

the likelihood the project will be achieved, or 'stay the course' (Participant 1). This includes clearly identifying goals, the motivation, and can be as specific as the location of the project. Vague goals are often abandoned, don't have a clear path, or can be questioned easily: 'When it's just a vague goal, you know, just "use the water for something." We don't know where or what or when, it becomes harder to do proper planning for it' (Participant 1). Some participants referred to the goals as having a clear business case. More than just the money or economical side of things, having a clear business case is used to 'show why this (a WRR project) makes sense for an area to proceed or a region to proceed with it' (Participant 7). Having clear goals also enables the appropriate technology to be chosen: 'But I think unless you can really make the business case, and unless you can demonstrate the benefits, it's going to be hard to select the right technology' (Participant 14).

Comprehensive planning also refers to understanding the uses and impact of the project. To determine the various potential uses for the reused water, some participants completed assessments to identify the various ways the water could be used that had not previously been thought of: 'And really, what we're trying to define is what do we have? We keep focusing on the water, but maybe it's actually the heat or the nutrients or something else in there that may be a benefit' (Participant 7). Completing assessments, or impact assessments as some participants described them, helped understand the purpose and the impact that the WRR project would have on both the economy and environment.

Having a clear understanding of the goals and potential benefits or uses of a WRR project can assist in increasing the appeal to future communities or developers and create 'win-win situations' (Participant 12). If there are multiple benefits of a WRR project outside of saving water, for example, if a newly engineered stormwater pond decreases water stress on a primary water source while looking more aesthetically pleasing than traditional stormwater ponds, and producing cost-savings, all benefits should be emphasized because different benefits may be appealing to different stakeholders. One participant described it as 'having a nexus of values' (Participant 8) that are clear and that can appeal to different stakeholders and decision makers so that a project can be

moved forward with more ease. One participant said that it might not even be to reuse water that was necessarily the best business case, it might be the environment: 'So I think, you know, having that solid business case and you know, putting it to the environment might be the best business case. Really clean water to the environment might be a better business case than just reusing the water. You need to look at the whole picture' (Participant 7).

Comprehensive planning also encompasses the necessity to plan for the long term, thinking through the whole project's life cycle and having plans to address things that may go wrong. It also encompasses knowing what entities/personnel will be responsible for each stage along the way, including operation and maintenance. One of the participants who was involved in an unsuccessful project explained that it was partially due to not fully understanding or planning for the full scale of the project and what would be needed for maintenance. They said that looking back, they would have started a smaller project to really understand the project before scaling up.

DISCUSSION

The purpose of this research was to explore the experience of individuals working on WRR in Canada and to determine what may be needed for successful implementation in Canada. These findings provide original insight into the experience of water professionals and WRR projects in various regions in Canada. The three main findings from this study are that there is a lack of cohesive and supportive regulations in Canada for WRR; comprehensive and appropriate community engagement is essential for WRR; and having a clear understanding of the goals and impacts of the project is imperative for clarity for the implementers, as well as community acceptance. Beyond these concepts, which are discussed below in relation to the current research globally, it is interesting to note that the focus was on social aspects of WRR, rather than technological.

Much of the research focused on WRR has been completed in Australia and the United States, where there is a greater need for WRR due in part to water scarcity, as well as intensive agricultural practices ([Australian Guidelines for Water Recycling 2020](#); [Water Reuse and Recycling](#)

2020). There is comparability that can be made due to the countries' similar political and social structures to Canada.

Government regulations

It is the responsibility of governments in Canada to provide federal guidance (via Health Canada) and in provinces/territories to provide regulations that ensure public health and safety. In the absence of substantial guidance as seen in Australia ([Australian Guidelines for Water Recycling 2020](#)), this has resulted in mixed experiences across Canada regarding cohesive and supportive regulations. Interview participants from BC and ON reported that the current regulations were helpful, but also expressed the need for more aligned regulations, while participants from Alberta expressed that any regulation would be beneficial, finding that a lack of regulations acted as a barrier to implementation which has implications for the environment and the economy. [Hennessey's \(2009\)](#) research in Metro Vancouver (BC) also reported that many participants felt that the lack of legislation in BC was a barrier to implementation. Interestingly, BC has more legislation, regulations, and guidance on WRR projects than other provinces in Canada ([Hennessey 2009](#); [Rossum 2020](#)). In ON, there are no province-wide regulations specific to WRR; however, the regions where WRR is being implemented have guidance from relevant ministries ([Water Reclamation and Reuse 2019](#)). Regarding Alberta WRR legislation, there is a known draft document for water reuse ([Hurley 2017](#)), but it has not been made publicly accessible. The release of this document could have a significant positive impact on WRR implementation in Alberta.

In comparison, Australia is a leader in WRR, having a wealth of resources for those interested in pursuing a WRR project in addition to advocating for such projects due to water scarcity in many parts of the country ([Australian Guidelines for Water Recycling 2020](#)). The same can be said for the United States, where many states have issued their own WRR documents, as well as general federal guidance ([Water Reuse and Recycling 2020](#)). Although the need for WRR in those countries is more immediately apparent, having supportive regulation has provided the necessary resources to implement WRR projects.

One participant described the concern they had regarding a lack of regulations in Alberta that might result in a 'hodgepodge' of different projects. This is cause for concern, particularly due to environmental and public health risks that may arise due to projects not following evidence-based guidelines. Without a uniform guiding document that is grounded in public health protection, there is potential that WRR projects could harm human health if the pathogens found in water are not appropriately treated. Such evidence is echoed by [Paranychianakis *et al.* \(2015\)](#) in their study of European Union countries, finding that without a uniform human health document to address human health risks, countries were left to create their own guidelines.

Beyond regulations, participants expressed the desire for the government to support WRR projects through rebates and other incentives. Technology costs vary depending on the context and type of project ([Maurya *et al.* 2018](#); [Yerri & Piratla 2019](#)). Due to the high cost of most technology for WRR projects, having financial assistance from the government could decrease implementation costs. Another option could be providing rebates to the consumer or resident of the WRR project for the installation of the project in their home or establishment. This has the potential to increase the likelihood of consumers investing in WRR projects, in addition to making the cost of reused water and resources less than traditional sources ([Marks *et al.* 2003](#); [Garcia-Cuerva *et al.* 2016](#); [Water Reclamation and Reuse 2019](#)). Rebates can also be provided directly to the project developers to cover development and implementation costs. Given the importance of context, government rebates should be general and allow for the choice of WRR technology.

Finally, though the cost of water varies between municipalities, in general, these costs do not reflect the actual cost of extraction, treatment, and distribution, in addition to the cost to maintain infrastructure ([Exall *et al.* 2004](#)). Although more recently some municipalities across Canada, particularly in ON, have increased prices to reflect the full cost of water services, there is still a gap between the current price of water and anticipated future expenses ([Bodimeade 2013](#)). As a nation, Canada's cost recovery for water is low relative to the current cost of providing water, and the anticipated costs of upgrading infrastructure and transitioning to

more sustainable practices are not accounted for (Brandes *et al.* 2010). Many participants felt that because water is inexpensive in Canada, the incentive to pursue WRR remains low. This perception is echoed by other research in Canada (Hennessy 2009; Velasquez & Yanful 2015). Increasing the cost of water, or more consistently charging for the actual cost of water, may incentivize individuals and communities to consider WRR.

It has been reported that many regions of the United States are experiencing cost surges due to water scarcity, the need to pay for failing infrastructure, and treatment costs associated with recovering from severe storms due to climate change (Layne 2019). If the cost of water is not appropriately accounted for, Canadians may be experiencing a similar surge/increase in water pricing.

Community engagement

Community engagement and mutual knowledge sharing and education in WRR projects is arguably one of the most universally agreed upon components for a successful project. Hartley (2006) acknowledges that addressing the human aspects of WRR is often more challenging than the technological or scientific challenges, and Ingram *et al.* (2006) emphasize that building community trust takes time. Developing community trust and support should be included in WRR legislation and built into a WRR project plan.

Participants acknowledged that although appropriately engaging with the community may take more time at the beginning, it will be overall more beneficial in the end. In a report on a water-reuse program in California, the authors describe a water-reuse project that was met by strong opposition by community members after decision makers initially perceiving that there was no opposition to the project. Some of the main lessons learned from this project was that just because initial meetings may have poor attendance, decision makers cannot assume that the community is uninterested or accepts the proposed water-reuse project (Ingram *et al.* 2006). This emphasizes the concepts surrounding effective communication techniques as described by the participants in this study when the project planners decided to change their communication styles to increase participation. Additionally, to ensure that engagement and communication is relevant and useful for the intended audience, the

perspectives and values of each group should be known, and the information being provided should reflect the groups' interests. As Harris-Lovett *et al.* (2015) explain: the technology should 'mesh with the values and social beliefs of a given community' (p. 7553).

Harris-Lovett *et al.* (2015) explain the varying types of legitimacy regarding increasing community buy-in and trust of a water-reuse project. Two types they describe are influence legitimacy (strengthening the decision-making power of the community) and dispositional legitimacy (transparent communication and development of a positive reputation). Dispositional legitimacy is related to the remarks by one of the interview participants who emphasized the importance of providing the consumer with the product that they expect, thus increasing the trust that the consumer has in the technology or concept of water reuse as a whole and increasing the reputation. Developing trust and open communication has been attributed to the success of a variety of water-reuse projects in Australia (Ingram *et al.* 2006).

Some participants explained challenges surrounding a community's misunderstanding of definitions when the WRR project was proposed. Regarding mutually understood terminology, although a WRR project may be technologically sound, if the terminology is not well understood by the community, it can lead to the failure of the project because of a lack of acceptance. Such was the experience in Toowoomba, Australia, when public opposition defeated a proposal for a reuse water infrastructure, in part due to a lack of understanding from the community (Hurlimann & Dolnicar 2010). Frijns *et al.* (2016) suggest that 'except for a few key messages that are always important, such as "water is always reused", there is no silver bullet when it comes to the structure and content of information messages on water reuse' (p. 11).

One participant explained the negative outcomes when communication is not adequate, specifically having consumers remove the technology from their home because they did not realize the extent of maintenance required from them. Providing even simple visual explanations of the process used increases understanding and acceptability (Dolnicar *et al.* 2010; Fielding & Roiko 2014). In the case the participant described, consumers should have been provided with details on long-term maintenance and what they

are responsible for. Ideally, the consumers would have been included in developing an information package with the details they wanted along with what is needed. Stakeholder perspectives and understanding must be accounted for when developing communication that is relevant and understandable for each stakeholder group. These social aspects of WRR implementation must be included in WRR legislation and project planning.

Comprehensive planning

Participants discussed the importance of exploring the overall impact of a WRR project, including the potential effects on the environment and aesthetic qualities. Understanding the overall impact of a project is essential and requires engagement with the different groups involved and the surrounding communities. [Watson *et al.* \(2016\)](#) discuss the need to consider how the project will impact different stakeholders, and how various aspects, such as distribution, timing, and scale, will determine how different stakeholders are impacted. This information will help inform the communication strategies when engaging with communities.

Interview participants from this study explain the importance of emphasizing the many benefits of a water project, so that it appeals to a variety of stakeholders. [Hartley \(2006\)](#) describes that nurturing the motives of the water project and highlighting the benefits enable both individuals and communities to better engage with a water project. This is related to the discussion about communication and education, demonstrating the connection between understanding the full impact of a WRR project and sharing it with the community.

In the long term, accounting for indirect benefits such as environmental protection through reduced nutrient offloading, WRR projects will have a positive economic impact ([Exall *et al.* 2004](#)). [Exall *et al.* \(2004\)](#) explain that without accounting for nonmonetary benefits such as reduced environmental impact and improved public health, projects appear to be unable to recover full costs. This is demonstrated by [Yerri & Piratla \(2019\)](#) in their calculation of capital and operational costs of both onsite and satellite greywater systems; the overall economic cost of implementing water reuse is currently much higher than cost-savings for the consumer. However, the long-term benefits of

having alternative sources of water may outweigh the costs ([Yerri & Piratla 2019](#)). The long-term impacts must be researched and understood to the greatest extent possible at the beginning of the project to guide decision-making throughout. Specific information about the impacts of the proposed WRR project – environmental, economic, and social – should be required by legislation to be measured during an initial impact assessment.

Implications and limitations

The various aspects discussed in this paper can be used to create guidance for WRR. [Harris-Lovett *et al.* \(2015\)](#) have created a legitimacy framework for water reuse, focusing on aspects that enhance the legitimacy of a project through public engagement, risk assessment, overall benefit for consumers, open communication, and trust, among other aspects that reflect the findings from the interviews. The legitimacy framework was also developed from interviews with water experts in California, and offers insight for a Canadian-focused guidance document, something the authors of this paper are currently developing ([Ashbolt *et al.* 2012](#)).

While this research offers a novel demonstration of views of WRR in Canada, several limitations exist. Regional representation was limited to three provinces, although they are the three provinces most involved in WRR, there are other regions where WRR projects are being discussed and implemented. A better understanding of perspectives across Canada will better inform the development of federal guidance. Related, currently there is minimal intention to create federal guidance for WRR beyond that already in place for toilet and urine flushing ([Health Canada 2010](#)), and provincial/territorial legislation varies greatly. As such, the utility of this research is limited by the government support of WRR. As well, future research could provide a comparison between water reuse and resource recovery projects in Canada to understand the differences and unique opportunities.

CONCLUSION

Based on the interview findings, WRR projects require foundational guidance documents, something that is currently lacking in the Canadian context. Additionally, transparent,

effective, and appropriate communication is imperative for community engagement and increasing community trust in any WRR project. This upfront community engagement process should be built into a policy for WRR in Canada. Finally, having a sound understanding of the goals, impacts, and operations of a WRR project is critical in ensuring that a project achieves its intentions and is sustainable. The concepts discussed in this research reflect findings from Australia and the United States, as well as research in other countries on WRR. In future research, we should strive to better understand what success means to those directly involved throughout the life cycle of a WRR project.

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CONFLICT OF INTEREST

We declare there is no conflicting interest for any author and affiliation.

DATA AVAILABILITY STATEMENT

All relevant data are included in the paper or its Supplementary Information.

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