MEDIATING WATER:

Trust, Responsibility & Engagement in Public Perceptions of Water Quality in Ireland

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Abstract

This research was carried out to tentatively explore public perceptions of water quality in Ireland. The study carried out focus groups in Dublin and Carlow to access views across rural and urban cohorts. Three key threads tie the findings together: Trust, Responsibility and Engagement. Participants frequently returned to these ideas in their discussions about water quality. In the absence of trust towards organisations currently providing information and knowledge about water quality, participants turned to unsatisfactory "rules of thumb" for assessing quality: vague definitions of organoleptic measures of purity, local reports of problems, or even bodily reactions like sickness. Poor engagement practices were a key reason for mistrust, with participants seeking communication that was transparent, reliable, relevant, and made in the interest of the public. We identify a missing link between state bodies and lay publics which would effectively communicate information about water in a way that is both scientific and impartial and addresses local concerns. We suggest that independent testing companies could act as mediators in this way. It would require responsible engagement that is open and responsive to public concerns about water quality: taking seriously issues of purity, sickness, control, and shared responsibility while providing reliable, objective information.

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Safe2o is an Irish company that provides home water testing services to consumers.

The Water Institute (WI) is a cross-faculty initiative of research and education on water. It aims to work with all stakeholders – a quadruple helix of academia, industry, agency and society in its research and development work. Through research and capacity building, the WI develops solutions to national and global problems in water. We specialize in technology developments across science, engineering and computer science domains with strong communications focus and policy and business drivers. These areas are reflected in our academic members in DCU – across all faculties of the University.

Celsius is an interdisciplinary research cluster at the School of Communications, Dublin City University that researches and facilitates better societal outcomes and impacts for emerging and disruptive technologies, informing and guiding public policy for an engaged science. We bring many social science perspectives to STEM, but our central aim is for more inclusion of publics and stakeholders in responsible, open and socially ethical methods of combining science, technology and society through more effective and purposeful communication and engagement.

Introduction

There is no doubt that a sustainable supply of good quality water is essential to Ireland's health, wellbeing, and prosperity. The country currently has abundant surface water resources, with over 70,000 km of rivers, 12,000 lakes, 850 km^2 of estuaries and 13,000 km^2 of coastal waters (EPA 2018). Groundwater is also in plentiful supply, providing over 20% of water supplies nationally. Despite this abundance, Ireland still faces difficulties in providing a sustainable, high quality supply to its citizens. The eastern and midland regions face future water shortages; infrastructure is in need of repair; contamination exceeds acceptable levels; and wastewater treatment services are underfunded (Irish Water 2015). To deal with these issues, the Irish Government created Irish Water in 2013. A subsidiary of the semi-state utility company, Ervia, Irish Water was tasked with building a new national water utility to provide the country with safe, affordable and environmentally compliant water services. Prior to this, management of water supplies was the responsibility of local authorities.

Irish Water is responsible for providing and developing public water services and ensuring drinking water quality meets the standards in the Drinking Water Regulations. The Environmental Protection Agency (EPA) is responsible for enforcing those regulations while the Commission for Regulation of Utilities is responsible for ensuring Irish Water operate in an efficient manner. The public water infrastructure serves 80% of the population, treating 1,670m litres of drinking water per day and 1,600m litres of wastewater per day (Irish Water 2015, p.11). The EPA have identified six key areas which need to be addressed to protect and improve public drinking water supplies. These are: keeping water free from bacteria, minimising harmful disinfection by-products (from chlorine), eliminating lead from pipes, preventing pesticides from entering the water, managing risks, and ensuring treatment plants are effective (EPA 2018). The EPA's most recent report on the standard of public water supplies found that the quality of drinking water was high but issues with disinfectants, lead, and pesticides were still an issue (ibid 2018). Private supplies were less satisfactory, with the quality of water poorer than in public supplies.

Private supplies account for 20% of water supply in Ireland. They include public group schemes, private group schemes, small private supplies, and household wells. Irish Water and the local community are responsible for the quality of water in public group schemes, local communities alone are responsible for private group schemes, and individual owners are responsible for small private supplies and household wells. The EPA faces difficulties in monitoring the quality of private supplies as not all of these supplies are registered. Local authorities are responsible for ensuring that all regulated private supplies are registered and tested.

Water is a controversial issue in Ireland. It took centre stage in Irish politics during the mid-2010s, when the creation of Irish Water became a key election issue. The government's decision in 2013 to create Irish Water alongside the introduction of pay-per-use water charges, caused widespread resistance and the formation of a national campaign group called 'Right 2 Water'. Public concerns about privatisation, communication, data security, wastefulness and inefficiency resulted in nationwide protests and the eventual backtracking by the government on the decision to introduce water charges. Perceptions about water quality in Ireland have no doubt been impacted by this controversy – everyone had an opinion at one stage about the viability of Irish Water and the impact that water charges would have on public finances. Despite these challenges, Irish Water (2015) have embarked on an ambitious plan to transform outdated infrastructure and to provide a clean, sustainable supply of water for the country.

It is within this context that this research seeks to examine public perceptions of water quality in Ireland. As the study will go on to show, these social contexts play an important role in how people conceive of water quality. Perceptions are understood here in a sociological sense, meaning that they are, in part, shaped by the social contexts in which they are established. This research is not restricting itself to an examination of individuals' perceptions of drinking water in isolation but within the contexts that make them meaningful. This involves examining concerns about public and private institutions, water infrastructures, cultural values, and personal experiences. The literature review section will

provide an outline of how important social contexts are to perceptions of water quality.

It is important to note that the work undertaken here is not a comprehensive study of public perceptions but rather a preliminary investigation of the various ways that people make sense of water quality in Ireland. The sample size is small – two focus groups – and rather than attempt to infer generalisations about all perceptions, the research seeks to explore, in depth, some of the richly detailed ways that water is interpreted and made meaningful in the lives of *these* participants. This will provide us with a snapshot of some of the ways that drinking water and its supply is an object of concern, interest, and action. It will show us how water plays a role in everyday life and how social contexts shape how it is understood.

The study was designed to be quite open; we tried, wherever possible, not to define, for participants, what the areas of importance were in relation to water. Our questions and prompts were open-ended, allowing participants add their own contexts and issues of relevance. While the study focused on water quality, knowledge of testing, responsibility, and conservation, we allowed discussions to flow where participants took them. This resulted in some interesting findings that we had not expected.

Focus groups generate discussion and this discussion becomes the data that is analysed. The findings are therefore shaped by the discursive form in which it comes. Discourse analysis in the social sciences is quite often an interpretative process whereby meaning is sometimes unclear or even contradictory. We view this as a strength of the data in that it more closely resembles the quite complex and sometimes inchoate ways that perceptions are produced. People rarely hold a clear and consistent "view" about something as broad as water quality, precisely because views can change depending on context. Our aim has therefore been to retain these contexts and respect the uncertainty that sometimes accompanies perceptions. This does not mean that perceptions are not analysable. We have employed social science methods which pay attention to the patterns and coherences which emerge through discussion and sense-making. Together with the contexts in which these perceptions are embedded we have been able to develop a picture of how these groups make sense of water in particular circumstances and why this is relevant. The following section will provide an outline of these findings.

Overview and Key Findings

The following are three key findings:

1. Participants had a lack of **TRUST** in public and private assessments of water quality.
2. **RESPONSIBILITY** was viewed as something which should be shared between communities and state agencies.
3. Effective communication by independent testing companies could lead to more satisfactory **ENGAGEMENT** between public and private spheres.

Upon analysing the discussions which took place during these focus groups, we discovered three key threads which participants returned to frequently. These were **Trust**, **Responsibility**, and **Engagement** and we have used them to frame the findings. Trust relates in a general sense to questions about water quality and knowledge about testing while Responsibility relates to questions about responsibility and sustainability. These categories were not entirely separate; responsibility featured in discussions about water quality, while trust cropped up in discussions about sustainability.

We found that **Trust** was established through four key concerns:

- **Purity**
- **Locality**
- **Expertise**
- **Control**

These were the main issues relating to trust which emerged from the discussions. **Purity** was the defining concept used by participants to evaluate water. It had multiple meanings, sometimes being deployed in a scientific sense and sometimes in an aesthetic sense. Purity had the effect of establishing whether water "good" or "bad" – providing a measure of its quality. When not being discussed in a scientific sense, purity was described in reference to the senses; through taste, look, and odour. Many participants recounted instances when they had encountered water that was impure from this perspective. At the same time, they were quick to acknowledge the unreliability of sensorial evaluations of water quality.

Locality was also a key issue in the establishment of trust. Participants described how they felt that local water was more dependable than water which came from more distant sources. This was linked to a perception that information which came local sources was more reliable than information from further afield, particularly that which came from organisations like Irish Water. Community and household knowledge were deemed to be particularly reliable, with the impact of water on participants' own bodies (e.g., through getting sick) viewed as the clearest indication of whether water was safe.

It is important to note that this was not the result of a general scepticism towards science. On the contrary, participants held technical **expertise** in very high regard. There was little criticism of the scientific testing capabilities of public or private organisations; the issue lay in how they were managed and governed and how they communicated information. Independent testing companies were singled out as being particularly trustworthy, if expensive, giving rise to our later conclusion that there might be a unique role for these types of organisations as a mediator between the public and the state. Some participants held that there limits to scientific knowledge in a broad sense, pointing out that "unknown unknowns" and knowing what to test for created challenges for accurately testing water quality.

One of the reasons that participants were distrustful of expertise lay in how these organisations were **controlled**. Some were sceptical of public bodies, fearing they would cover up mistakes or problems, while others were concerned that private companies would be driven by profit rather than public health. These concerns demonstrated that technical capability was only one dimension of trust in establishing whether water was safe and that other issues like locality, control, and aesthetic ideas about purity also had an impact. Participants were generally dissatisfied with their ability to evaluate water quality. Public and private testing was perceived as being hampered by poor management and a lack of transparency. In the absence of quality information, participants looked to local resources – in the community and the home – but these were also unreliable. In the absence of a satisfactory system for reliably evaluating water quality, participants imagined alternatives.

Participants envisioned **Responsibility** in three key areas:

- **Accountability**
- **Personal, Public, Communal Responsibility**
- **Communication**

Accountability was an important issue for participants. They felt that some groups in society – farmers, local authorities, Irish Water, private companies – were unaccountable. They believed an increase in accountability could improve organisation, management, and governance. Some pointed to food labelling as an example of accountability, whereby companies had to ensure the quality of the product matched the label. If this failed, companies were then accountable to the law. For this reason, participants had confidence in bottled water.

Others made distinctions between **personal, public, and communal responsibility**. Participants were clear that responsibility should be attributed across the social field and that householders, government agencies, and private companies should all be responsible for water quality.

Communication between each of these sectors of society was a key aspect of this. Participants described how they wanted to see communication between the government, private companies and the public that was transparent, reliable, relevant, and made in the interest of the public.

This led us to conclude that **engagement** was an important factor in establishing how the public evaluated water quality. As discussed above, water quality was perceived in relation to a range of social contexts and was dependent upon the relationships between different actors in society. We found that there was a missing link between the local, contextual meanings that people made of water and the impartial scientific knowledge that ensured a safe and healthy society. We believe that independent testing companies could occupy that position as mediators between the state and society. It would involve acting as a hinge between local concerns and the objective analyses required for governance and management. It would require responsible engagement that is open and responsive to public concerns about water quality: taking seriously issues of purity, sickness, control, accountability, knowledge limitations, and shared responsibility. In this scenario, communication becomes a shared enterprise, resembling something closer to dialogue, where perceptions about water quality are shared across science and society. Participants were very clear about their dissatisfaction with their current ability to evaluate water quality. We believe that having independent scientific testing companies act as mediators between the state and society could provide publics with the engagement they desire and help governments to manage water quality more effectively.

Literature Review

Public perceptions of water quality are well-studied across a range of academic disciplines including sociology, economics, cultural studies, public health studies, marketing, environmental management, policy studies, and geography to name a few. Embarking on a systematic literature review of the topic would require far more time and resources than a project of this size could provide. In its place will be a short snapshot of the literature as it exists across these fields. The review is by no means exhaustive or representative of a field and does not attempt to synthesise the findings surveyed. The idea is to get a sense of how the issue of public perceptions of water quality has been broadly defined and understood in a small sample of the literature to help us get a bearing on what might be relevant and what has already been discussed. The review is too small to develop a specific research question about public perceptions of water quality. As the research design section outlines, the approach taken here is an interpretative and inductive one, starting from the already established question: What perceptions do people have of water quality in Ireland? The review focuses on literature published within the past 20 years, with a slight emphasis on material from Science and Technology Studies, the area of expertise of the authors.

Factors Influencing Public Perceptions of Water Quality

One of the most frequently cited papers on public perceptions of water quality comes from Miguel de França Doria (2010). Doria's review article covers many of the themes which will become important later in this report. He begins by arguing that quality standards are no longer the preserve of science but rather, quoting the World Health Organisation, 'a matter in which society as a whole has a role to play' (2010, p.1). His paper charts the various ways in which perceptions of water are shaped, beginning with sensory information, commonly referred to as 'organoleptics' in the literature. Taste, in particular, alongside odour, colour and murkiness are incredibly important for publics in how they rank 'quality perception, service satisfaction, willingness to pay and the selection of water sources' (ibid.). This is supported by Dupont's (2005) analysis of consumer perceptions of drinking water in Canada, where odour, appearance, and taste are reported to be what consumers care about the most. Interestingly, this research also suggests that consumers would be most willing to pay for improvements in taste and smell after safety. This can be connected to a finding by Doria et al (2009, p.5462) that the marketing of water as 'a commodity that must be enjoyed' emphasises the importance of taste for consumers.

Researchers also point out that sensorial factors are not simply aesthetic concerns but are often used by publics as indicators of the safety of tap water (Dupont 2005; Doria et al 2009; Spackman and Burlingame 2018). Doria et al (2009, p.5461) argue that the reason for this might lie in familiarity: 'people seem to become accustomed to the characteristics of a specific water that will serve as a reference standard'. They also suggest that the directness of subjective sensory observation is more influential on perceived quality and risk than abstract second-hand information (2009, p.5462).

Another major influence on perceptions of water quality is the variety of chemical substances which are commonly found in drinking water. This has an impact both on perceptions of the quality of water from an organoleptic perspective and from the perspective of risk. Doria's (2010, p.4) review finds that 'waters with high mineral content were generally preferred over those with low mineral content' and that 'cations (e.g. sulphates) are more likely to produce objectionable flavours than anions (e.g. chlorine)'. The literature indicates that the chemicals most frequently alluded to by publics when discussing water quality are chlorine, limescale/hardness, and lead. Mahler et al (1999) suggest the relevance of other substances such as fluoride, nitrates, pesticides, heavy metals, and industrial chemicals is minute or restricted to specific locations. In contrast, Hynds et al (2013), who studied contamination awareness in Ireland, found high awareness of nitrate and fluoride, alongside *E. coli* and *Cryptosporidium*. Jones et al (2005) also found that bacterial and chemical contamination from agriculture was a large factor in public perceptions of water quality.

Doria (2010) also points to contextual factors that have an influence on water quality perceptions. These include clues derived from taps, pipes, bottles, and characteristics of the

environment where water is consumed. This is an understudied aspect of public perceptions of water quality which tends to focus on responses to the characteristics of water itself. As the literature demonstrates, however, perceptions are connected to broader contexts including physical clues surrounding the water itself, as well as social and subjective contexts such as community information and individual past experiences. Physical indicators include knowledge about water infrastructure – leaking or rusty pipes (Jones et al 2006) – rubbish or the presence of wildlife (Doria 2010), and labelling and container design of bottled water.

Consumption of bottled water has been linked to perceptions of drinking water (Hu et al 2011; Merkel et al 2012; Race 2012; Harvey 2015). Merkel et al (2012) studied parents' perceptions of drinking water, finding that bottled water usage was inversely affected by tap water usage. Further, they discovered that bottled water consumption was influenced by price, convenience, and environmental concerns. Interestingly, Hu et al (2011) found no connection between bottled water consumption and environmental concerns in their study of US consumers. Americans find bottled water more convenient and better tasting than tap water and consumption of bottled water is higher where perception of water quality is lower. In the European context, Harvey (2015) writes that Italians drink four times as much bottled water as UK consumers due to widespread distrust of drinking water quality in Italy. Race's (2012, p.72) study of bottled water marketing traces an increase in consumption to the development of 'the subject of hydration'. The subject of hydration is a person who understands themselves through the medical discourse of hydration, a discourse that encourages 'frequent sipping' (ibid) of a constantly available and convenient source of water.

Perceptions about water quality are also influenced by prior personal experiences. Doria (2010, p.7) states that 'experience sets a standard' and 'people prefer what they are used to'. This is not necessarily a rationally deduced principle but rather a tendency towards familiarity. Colour, odour, taste, and clarity contribute to familiarity satisfaction, a satisfaction linked to lower perceptions of risk (Doria et al 2009). Adverse experiences also influence perceptions, 'leading to an increase in risk judgements' where prior negative experiences correlate with less acceptability of water quality (Doria 2010, p.8). The effectiveness of this common-sense approach to gauging the quality of a water source is not examined. Spackman and Burlingame (2018) suggest that everyday assessments of water quality, using organoleptic information, is undervalued.

Social factors also play an important part in shaping perceptions of water quality. Information about water quality is obtained through various channels: mass media, friends and relatives, local community, environmental groups, social media, and government and have an impact on individuals' views about water quality. Further, trust in water companies, governments, and environmental groups influences how individuals navigate this information (Doria 2010). Control over water supplies is another important social factor that influences public perceptions of water quality. Syme and Williams (1993) found that perceptions of personal control over the water supply was associated with judgements of risk and quality acceptability. Doria (2010) also points to a wide literature on demographic and cultural influences on water quality perceptions. In these studies, findings suggest: women perceive water quality risks to be higher (Griffin and Dunwoody 2000), younger people attribute higher risks to drinking water (Park et al 2001), education and income are inversely associated with risk perception of drinking water (Grondin et al 1995), and cultural myths about the purifying power of water can influence perceptions about pollution (Douglas 1966).

In just a brief glance at the literature we have come across a wide-ranging series of factors that can potentially influence public views on water quality. This indicates that any study of perceptions of water quality requires a nuanced and contextual approach which is open to the myriad ways that these perceptions are produced. The next section will briefly look at research which aims to do just that.

More Than Just the Water – Teasing out the Contexts

Doria's (2010) review of the literature on public perceptions of water quality shows us how difficult it is to generalise the causes of variations in these perceptions, dependent as they are on so many contextual factors. How do we know whether a given individual's views about water are a consequence of their age, their income level, their trust in water suppliers, which news articles they've recently read, who they follow on Twitter, the views of their relatives and friends, or their

previous experiences with drinking water? It also raises questions about what exactly perception of water quality is. Is it restricted to an individual's empirical observations of drinking water? Or does it extend to the entirety of ways that they might evaluate water, including moral, emotive, or aesthetic types of meaning-making (e.g., water that comes from an institution they believe are greedy, a river they are fond of, or water that is clear)? What the literature tells us is that both perceptions and quality are highly dependent on context – what is deemed relevant about water quality changes depending on the situation in which it is discussed. Water quality is not restricted to a rational and empirical analysis of contamination but is connected to wider social and cultural practices.

One of the ways that social science researchers seek to accommodate this is by taking an open approach to the study of public perceptions. Rather than try to control for all the different variables that might determine how certain groups think about water, researchers will instead keep these contexts intact, sifting through them to see what is important in a given situation. This is a move away from generalisation, focusing instead on the ways in which perceptions are produced in a particular context. For those working in the social studies of science, this approach is known as 'co-production' (Jasanoff 2004). Co-productive analysts seek to understand a given natural or social phenomenon in its environment, examining what various factors come together to co-produce it. Understanding perceptions about water in Ireland would involve examining water infrastructures, community attitudes, governing bodies, subjective experiences, and local practices as well as more general views about the quality of drinking water itself. This allows for a more specific and nuanced analysis that might be lost in an approach which seeks to generalise perceptions about water across a small number of variables.

Co-productive analyses of public perceptions of water pay close attention to the ways in which water and the societies in which they flow are connected. Bijker (2012, p.624) goes so far as to make the case that modern societies are 'water cultures' - social groups so dependent on water that it shapes our geography, politics, economics, and everyday ways of living. Barnes (2016) shows how water shapes Egyptian society through its vast irrigation infrastructure. The maintenance of this infrastructure by farmers builds communal relationships between them while shaping their relationship with the state. Water quality is not just about the chemical constitution of the supply, but also about the social networks that are involved in producing it. Carroll (2012, p.490) demonstrates how the very distinctions between public and private are created by 'boundary objects' like water. Examining the development of water management in California, he examines the establishment of important state bodies such as the 'State Water Commission' which impacts the way that politics is done in that jurisdiction. We might consider how the setting up of Irish Water has had a similar impact on politics in Ireland, particularly the controversy surrounding whether utilities should be publicly or privately owned and managed.

This literature suggests that the ways in which people perceive water are closely tied to the ways in which they view the organisations which manage them and also how water impacts their day to day lives (Sultana 2011; Race 2012). Spackman and Burlingame (2018) have explored the importance of public perceptions of water in their study of municipal water testing in the US. They describe how standardised water-testing methods have increasingly excluded aesthetic information derived from organoleptics in favour of the objectivity of analytic scientific information. Spackman and Burlingame point out, however, that in the absence of a testing protocol that would be able to assess all water sources constantly, there will always be the need for organoleptic information. They point to the examples of Toledo and Flint in the United States where contaminated water supplies were organoleptically noticeable but not addressed because 'consumer sensory knowledge' had been marginalised as a reliable form of knowledge (2018, p.350). The authors suggest that improved communication processes might have better aligned these different ways of understanding water quality. Ireland's EPA includes colour, odour, taste, and turbidity in its 'indicator parameters', with the parametric value ascribed to it stating: 'acceptable to consumers and no abnormal change' (EPA 2014). However, it is unclear how the EPA qualifies acceptability and normality in this context.

Understanding public perceptions of water quality requires an analysis of the various contexts within which different groups make sense of water – including the ways that water is governed and managed, and what kinds of shared cultural values are circulating at a particular time. A common thread that runs through analyses of perceptions of water quality is communication: how different perspectives on water are

shared and how his impacts how people view water and its surrounding social contexts.

Communicating About Water

In their study of a public information strategy to promote good practice relating to the operation and maintenance of domestic wastewater treatment systems (DWWTS) in Ireland, Hynds et al (2018, p.205) found that it resulted in 'little or no behavioural engagement'. This finding supported earlier research by Hynds et al (2013) which investigated the level of awareness among private well owners in Ireland relating to groundwater contamination issues. In that study, researchers concluded that 'the level of awareness exhibited by well users did not significantly affect the likelihood of their source being contaminated' (ibid., p.278). What did potentially affect the likelihood of source contamination was protective measures such as water treatment, source maintenance, and regular testing. The 2018 study found that merely providing information about DWWTs was not enough to encourage change. The authors instead suggested producing targeted, contextually relevant material about DWWTs 'to achieve significant knowledge and attitudinal shifts amongst specific population cohorts, and thus bring about significant behavioural change' (ibid.). Others have made similar findings.

Maguire's (2003) study found that stakeholder expectations of water resource management did not match those of regulators. They concluded that regulatory processes were 'defined much too narrowly to encompass stakeholders' wide-ranging concerns for equity, cost effectiveness, and deliberate adjudication of the tradeoffs between costs and benefits of water quality regulation' (2003, p.261). Better communication early on between all involved could have resulted in the development of shared ground rules upon which to establish effective regulation. Stenekes et al (2006), exploring failures in implementing water recycling projects, again found that the issue lay in poor engagement and a consequent misaligning of values. Specifically, they concluded that it was a result of 'inadequate involvement of communities in planning' where issues relating to cost, institutional conservatism, and administrative fragmentation went unaddressed (2006, p.107). What these studies suggest is that neglecting to consider and respond to the specific values and expectations of diverse publics in relation to water quality can result in poor relationships and unsustainable outcomes.

This reflects decades of findings in science communication literature whereby the so-called 'deficit model' of engaging the public has been heavily critiqued (Wynne 1992; Irwin 1995; Williams et al. 2017). Williams et al (2017, p.91) neatly summarise the deficit model, writing that it assumes:

> public unease is caused primarily by a lack of sufficient knowledge (a deficit of understanding) and that the best way to overcome this is through the provision of accurate and didactic communication of scientific knowledge on risks and benefits, which will best engender public support and the acceptance of new technologies.

As the literature described, above, demonstrates, public perceptions about water quality are frequently connected to a range of other social and political factors such as trust, responsibility, and communication. In focusing on knowledge and information, the deficit model fails to grasp the relevance of these other concerns and how they are commonly at the heart of public opposition to new innovations. Felt (2015, p.121) points out that 'public choices are not for or against technology but for or against particularly imagined forms of life'. Engaging with the public around an issue like water or water testing is not simply about providing accurate information but understanding how water testing fits into their social lives (e.g., cost, what counts as purity, trust in the organisations doing the testing, reliable communication). The science communication literature suggests that organisations need to work alongside stakeholders to identify their values, concerns, and expectations (Chilvers and Kearnes 2016).

We can extend this understanding of science communication to how we think about engaging the public with water testing. Rather than assuming what factors shape the public's perceptions of water quality and what they would like tested, we can explore the ways that their conceptions of quality are connected to wider social practices and broader systems of meaning making. This will give us a better view of what exactly is of concern to these publics and how we can engage with them. That is not to say that providing accurate information about the importance of testing water quality is not equally as important. To this end Jones et al (2005, p.1) found that testing of water supplies in Canada was minimal as a result of 'the inconvenience of the testing process', 'having received acceptable test results in the past',

and ‘complacency and lack of knowledge’. People wanted more information on where they could get their water tested, how often they should get it tested, and which tests should be performed (Jones et al 2006). In a similar conclusion to Hynds et al (2018), Jones et al (2006) suggest targeted education and outreach initiatives to tailor information to local contexts. What this research intends to do is explore those contexts, in Ireland, through focus group discussions.

The literature indicates that public perceptions of water quality is a complex and nuanced issue that is firmly anchored in local contexts. From a lay perspective, quality is not restricted to scientific analysis of drinking water, instead encompassing a range of normative values relating to governance, ownership, and responsibility. Normative, in the context it is used here, refers to standards that are deemed to be desirable or good – not simply “normal”. These values are socially informed and depend upon a diverse network of concerns. Combining this social insight with an understanding of how different groups evaluate the organoleptic properties of drinking water and the chemicals and microorganisms commonly found in it, we can provide a richly detailed snapshot of how the public perceives water quality.

Research Design and Methodology

This project has posed the following Research Question: *What perceptions do people have of water quality in Ireland?* To address this question, we sought to explore a nuanced and richly detailed snapshot of public perspectives through two focus groups – one in Dublin and one in Carlow. The idea here was to obtain a range of views across those on public and private drinking water supplies. As discussed in the literature review, perceptions of quality are complex phenomena which need to be understood within local contexts. Focus groups are an ideal method for addressing this requirement for contextuality in their ability to 'draw out complexities, nuances, and contradictions' (Kamberelis and Dimitriadis 2014, p.328). They are also suitable for a small project like this which does not have the resources to develop generalised hypotheses about nationwide public perceptions. A study such as that would require a much bigger dataset. What a small number of focus groups can provide, instead, is a richly detailed picture of 'understandings, perspectives, stories, discourses and experiences' not easily reducible to numbers (Millward 2012, p.416). This section will provide some brief details on the method, the sampling procedure, and how the data was analysed.

Focus Groups

We conducted two focus group discussions with members of the public living in Dublin and Carlow. The sample was neither representative nor comprehensive, acting instead as a point of departure in the analysis of public perceptions of water quality in Ireland. Participants were screened to ensure a representative balance of gender. We did not receive interest from individuals identifying outside of a male/female binary. The focus groups were advertised on local radio, social media, and through community representatives (politicians, councillors, group water scheme affiliates). Participants were treated as "experts" in the area of water quality perceptions given that it was their views which were sought after. Experts in environmental issues or water infrastructures were welcomed as it was felt that they would contribute unique perspectives that would be useful for driving discussion.

This was informed by Irwin and Michael's (2003, p.146) notion of 'ethno-epistemic assemblages'. What this abstruse term refers to is the manner in which lay and expert knowledges come together at different times to make sense of an issue. Irwin and Michael argue that scientific issues (water quality for our purposes) are always co-produced through different types of meaning-making. Expertise is a flexible term for these authors, encompassing both scientific expertise and civic expertise – the level of knowledge required to make judgements relating to everyday life. Water quality is connected to health, business, identity, community and many other aspects of social life. As Irwin and Michael (2003, p.43) point out, in a democracy, the public are best placed to decide what is relevant and meaningful in relation to an issue like water quality. Involving experts in a focus group with lay people opens the analysis to the different ways that knowledge and meaning are co-produced (Felt et al 2015). It allows us to see what aspects of water quality are assigned by lay people to science and what aspects are considered important from a political, aesthetic, or moral perspective.

Focus groups were conducted in impartial locations, moderated by one of the team, with another member of the team looking after recording and note-taking. Eight participants attended the meeting in Dublin, four women and four men. In Carlow, nine participants attended, four women and five men. Discussion was broken into four topic areas – Water Safety and Quality; Knowledge of Water Testing; Responsibility and Trust; and Sustainability and Water Conservation. Discussion prompts were organised through 'activity-oriented questions' designed to make the event more enjoyable and to 'help focus the group's attention on the core study topic' (Colucci 2007, p.1422). Each focus group lasted approximately 2.5 hours.

Analysis was conducted according to an interpretative and inductive discourse analysis, whereby insights emerge from the ground up (Thorne 2014). The validity of interpretivist research is not verified by its correspondence to a universal and objective reality, but by what Denzin terms 'interpretive sufficiency' (2009, p.123). This involves accounts which 'possess depth, detail, emotionality, nuance, and coherence. These qualities assist the reader in forming a critical

interpretive consciousness' (Denzin 2009, p.123). Discourse analysis was conducted according to Wetherell's (with Potter 1987; 1998) social psychological approach which looks for patterns and regularities in the discussions through the repetition of certain ways of talking and how this produces meaning. Through an iterative process, several 'sensitising concepts' (Blumer, cited in Pallett 2018, p.220) were developed which were subsequently 'bridged' to produce meaningful topics in the discussion.

Ethics

The project followed the standard DCU procedures for conducting 'low risk' research. This is research which does not involve vulnerable people, children, or those who may be harmed in some way by the material being discussed. Each participant signed a consent form and plain language statement which described the study and its objectives. Participants were advised that they were under no obligation to take part in the research and that they may end their involvement at any time. Data from all research activity is encrypted and stored in a password-protected location according to university data protection guidelines. Participants were promised full anonymity in any material arising from the research. To this end, their names have been pseudonymised.

Findings and Discussion

This section will outline the main findings which have arisen out of analysis of the data set and what they mean. The findings and discussion are each grouped into two main sections: Trust and Responsibility. These are the two 'interpretative repertoires' (Wetherell 1998) around which the discussions about water quality can be said to take shape. Participants were asked to give survey-type responses to several questions as prompts to wider discussion. These have been included in table form, below. This is done to give a high-level sketch of participants' views rather than a comprehensive account. Many participants provided revised and nuanced versions of these initial answers as outlined in more detail, below.

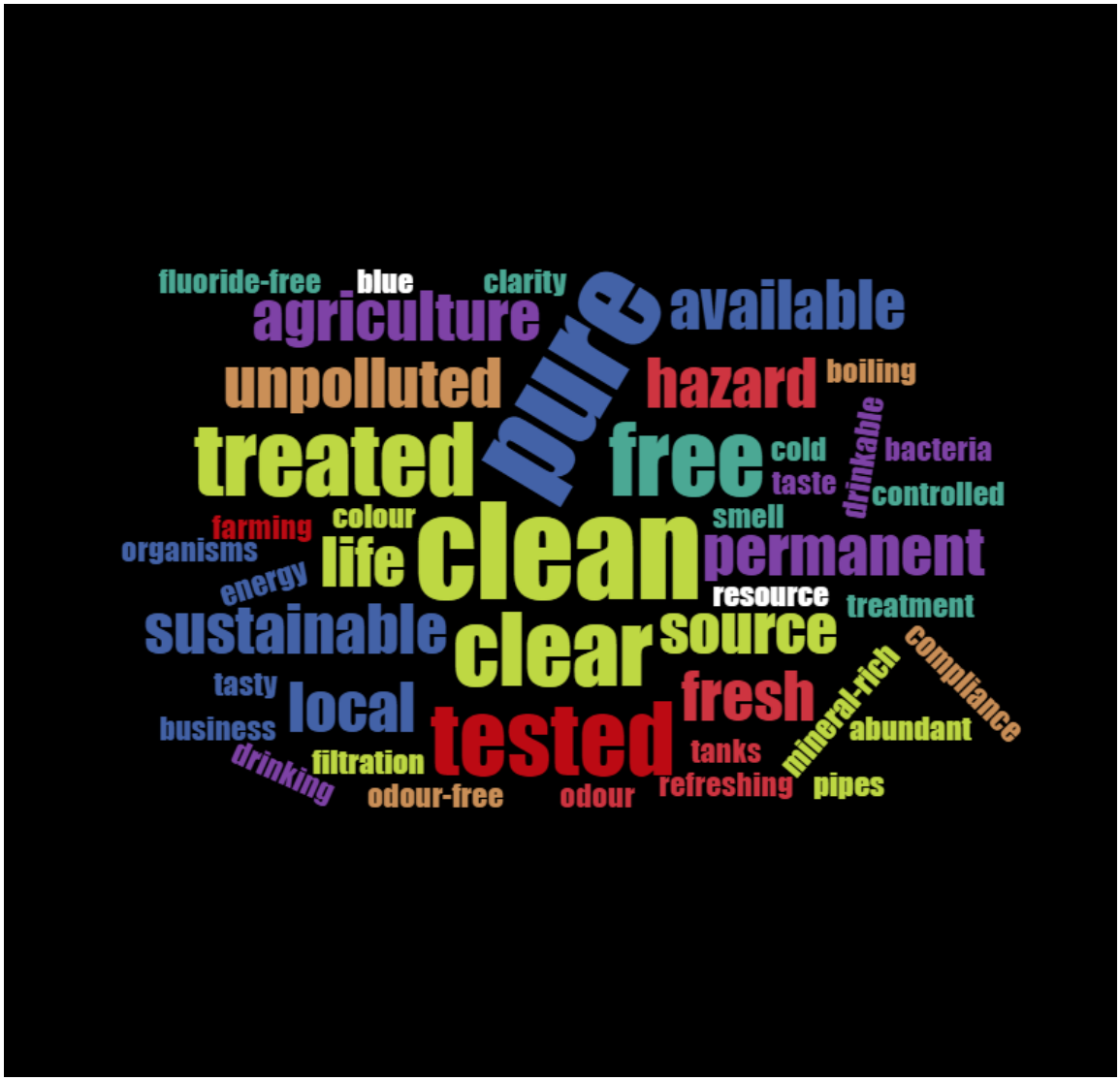

Figure 1 – Participants were asked to list five words that come to mind when they think of 'safe, secure water'.

Trust: Water Quality and Knowledge About Testing

Participant responses to the issue of water safety and quality were broadly shaped by concerns around trust. This was due in part to the framing of the focus groups questions around the issue of confidence, but even before being asked about their confidence in water quality, their answers gravitated in this direction. It is in these group discussions that a richer picture emerges in relation to the issue of trust and water quality. The following sections provide an overview of a number of discussion threads which emerged on this topic. They are: **purity**, **locality**, **expertise**, and **control**.

Purity

When participants spoke about water quality it was frequently described in terms of purity. This term arose several times in word associations and in discussions of water quality in general. Purity is not an entirely coherent or universally defined concept, but an interpretative one, whereby its meaning shifts depending on context (van Dijk 2008). It overflows a strictly analytic definition, spilling into cultural notions of cleanliness, naturalness, and order (Douglas 2001 [1966]). Participants contrasted pure water with 'uncontaminated' water (Mark, 30s, Dublin), largely evaluated through the senses. This was despite practically all participants acknowledging that these senses, particularly vision, were likely to be deceptive. While there was consensus that scientific testing was, objectively, the most valid form of assessing water quality (See 'Expertise'), this kind of testing was problematised by its relationship with other factors (e.g., cost, knowing what to test for, governance, communication, issues with testing parameters). As a result, subjective assessment of water testing was still considered to be valuable. In some instances, intuitive notions of purity powerfully guided perceptions about what was considered "good" or "right" more generally (e.g., associated with life or health). Purity cut across subjective assessments and was most frequently derived organoleptically through taste, odour and the look of water.

In this vein, Josh (40s, Dublin) stated simply that pure water, 'tastes nice'. Vanessa (40s, Dublin) described how 'a lot of people are just concerned about the taste of water'. Sandra (20s, Carlow), a science student, explained, 'I'm from Canada, and this is going to sound funny, but the water tastes different. I have a water bottle that I fill up every day and I would bring it to school, and it smells weird like there's something wrong with the water […] Well, it smells weird and its doesn't taste good'. Often, the taste of water was connected quite specifically to its purity and quality: 'Hard water is the other thing that affects taste. Could be good for your bones so I'm happy to hear that if it's true. It's probably pure water but it doesn't taste nice' (Norah, 60s, Dublin). Vanessa stated that 'tasty' water is also 'fluoride-free'. Only two participants mentioned fluoride. Chlorine was referenced by several participants in relation to taste. Carl (50s, Dublin) said, 'taste is really important […] mains water is heavily chlorinated – it's a pity', Vanessa said that restaurants in her area use Mi Wadi cordial to 'disguise the taste' of chlorine, while Stuart (40s Carlow) said that if his water supply was highly chlorinated 'I wouldn't be happy' and that he would prefer to drink bottled water in that situation. Josh described how taste was a powerful indicator of water quality, despite knowing that water was technically pure. He described an exhibition at Dublin Science Gallery where visitors were encouraged to drink filtered canal water: 'you could drink pure, filtered canal water. It was 100% pure but it still tasted strange because it wasn't what you were used to'. Here, purity is evaluated by taste in a different manner to scientific purity. We might understand it as familiarity (Doria 2010) or naturality.

Familiar or natural purity was described by participants in contrast to artificial purity (derived through treatment or lab-based technical processing) with natural purity in some cases regarded as superior to artificial purity. This was in direct contradiction to the strongly-held view that sensorial assessments of purity were open to error and to being deceptive. Josh evoked this sense of artificial purity with his description of the disconcerting taste of the filtered canal water. June (20s, Dublin) said, 'scientifically, pure water is H2O' but that you 'wouldn't get pure water outside of a lab' and, 'you wouldn't be drinking anything in the lab in the first place'. This was supported by Mark who mentioned deionised water which is also technically pure, but which should not be consumed. Purity, and its positioning as natural or artificial, is a powerful determinant of water quality for these participants. In describing pure water, Mark used the word 'natural'. Vanessa used the evocative phrase 'dead water' when discussing bottled water, stating that 'water should be alive'.

How often do you think about your water supply?	Dublin Responses	Carlow Responses
A few times a day	3	0
A few times a week	1	5
A few times a month	2	3
A few times a year	3	1
I never really think about it	0	0

Table 1 – Participants were asked how often they think about their water supply.

Smell was often referred to in order to mark when water was impure. At no time did participants describe nice-smelling water. Rather, they described 'stagnant water' (Elaine, 20s, Dublin), the smell from raw sewage (Frank, Gavin, Josh, Norah) and the smell of chlorine (Alan and Lucy). In each instance, these smells strongly indicated problems with the quality of water. Lucy (30s, Carlow) went so far as to say that the smell of chlorine she gets from the water while showering, coupled with its poor taste, convinced her to use Britta filters, to boil water, and to buy bottled water for her children.

The visual aspect of water was also an important marker for participants in assessing its overall quality. Josh said he had 'tap water from a GWS that was brown […] it just doesn't look appealing'. Both discussion groups demonstrated an overriding concern with sewage contaminating the drinking water supply, expressed through several anecdotes about disgusting-looking liquids entering a clearer body of water (Thomas, Sandra, Alan, Frank, June, Gavin, Josh, Norah). Norah described 'swampy or stuff bubbling up', Alan (60s, Carlow) described how you can no longer swim in a local lake because sewage has made it 'murky', while Frank (50s, Carlow) described a 'brown, oily, greasy slick' that started flowing from a pipe near to where he was fishing.

Discussion took place in both focus groups about the deceptive nature of visual assessments of water, indicating that while it was a powerful prompt to evaluating water quality, the actual status of water was highly contingent upon other factors (such as the presence of pathogens or metals [Stuart]). Carl described the 'sediment' and 'grit' which was left behind after distilling water, stating that 'you can't see it when you pour a glass of water, but when you distil it you can see it'. Later, Carl spoke of a television episode of Bear Grylls set in Ireland where he came upon a river in Connemara: 'this looked like pure water and [Bear Grylls] said, "you'd be tempted to drink that, but be careful, because not until you get to the source of the water can you really trust it". And so, he walks about a 100m further up and there's a dead sheep lying in the stream'. Frank described getting a test result back on his drinking water supply which reported 250 E. coli per 100mls, to which his wife exclaimed, 'and you couldn't smell it or see it!' (Áine, 50s, Carlow). Both focus groups suggested that visual observation of drought conditions could also have the opposite effect and confirm risks in relation to water. Vanessa stated that 'I think people noticed last year with the drought […] people could physically see', while Stuart said, 'people were very aware after [the drought last summer], particularly in places like Dublin, where they realised it's an organic system'. If water quality is 'a matter in which society as a whole has a role to play' (Doria 2010, p.1) then it is important to understand the various ways that the public interprets and makes sense of it.

How confident are you in the quality of water in your area?	Dublin Responses	Carlow Responses
No confidence whatsoever	0	0
Not very confident	0	3
Neither confident nor unconfident	1	0
Somewhat confident	2	3
Very confident	5	3

How confident are you in the quality of water in Ireland?	Dublin Responses	Carlow Responses
No confidence whatsoever	0	1
Not very confident	3	3
Neither confident nor unconfident	0	2
Somewhat confident	4	3
Very confident	0	0

How confident are you in the quality of bottled water?	Dublin Responses	Carlow
No confidence whatsoever	1	1
Not very confident	1	0
Neither confident nor unconfident	1	2
Somewhat confident	2	5
Very confident	3	1

Table 2 – Participants were asked about confidence in their water supply.

Locality

As the above section indicates, participants valued subjective assessments of water quality. Added to this was a tendency for participants to demonstrate a lower perception of risk if knowledge about water quality was local. Gavin (30s, Dublin) included 'local' as a word which came to mind when they thought about 'safe, secure water'. He elaborated on this selection by stating that, 'I suppose it's probably more readily manageable if it comes from somewhere near to you rather than somewhere on the other side of the country or even further. I suppose we are not as at risk from events that are far away from us if it's a local supply'. June supported this view, saying:

> I live in an estate – I'm confident that if something went wrong with it by the time I came home I'd be notified. Whereas if you live in the country and it was only your own thing and there was nobody else using it you wouldn't realise. The more people that are using that supply the quicker it would be detected, I think.

This extended to a wider sense of uncertainty in relation to confidence in water that was not from home. June explained that 'I'd feel safer drinking the water in our house in Dublin than in the country'. Josh, living in Dublin, was specific in his response that he would be confident enough to drink water from Dublin, later going on to say 'I bring my water down from Dublin to [my house in] Mayo in big drums rather than drink the tap water'. Gloria (20s, Carlow) said that, 'It depends on the place. Here, it's fine. But when I go to Navan my auntie can't really drink the tap water because it tastes really weird'.

As well as there being a lower perception of risk about local water supplies in a general sense, some participants described higher levels of trust when they had some form of control or ownership over it themselves. This was particularly the case amongst those on private supplies in Carlow. Thomas (40s, Carlow) said, 'I'd be pretty confident [in the quality of water in my area] I'm on the committee of our local group water scheme, so I know the system […] I know what way it's treated, we regularly get samples to TelLab and IAS, so we keep on top of it'. Elaine, who has a private well supply at her home in Swords, as well as at her parent's home in Carlow, described how she 'would have more confidence with the well supply in Carlow because I would have more knowledge of what the farmers are doing in the area, I'd have more knowledge of the lay of the land'. She felt that she was less able to determine the effects of human activity in the busy suburb of Swords. Local knowledge can be seen, again, to connect to an increased sense of trust in the water supply. Frank echoed this idea. Together with his wife, Áine, Frank was actively involved in the management of his household's water supply:

> I have to think about it a lot. If I don't go out […] and make sure the UV is still on or hasn't blown or whatever, or needs replacing every 11 months, basically I've got to make sure that everything is there and that the softener has salt and everything so that the water's not going to bung up the whole mechanism of the purification system we have. So, yeah, at least I feel confident that I'm not depending on somebody else to say, "well your water's fine, trust me", you know […] I have control which is comforting.

Áine supported this sentiment, stating, 'I'll drink our well water because I know what it's gone through'.

Frank raised the issue of placing trusting in others to keep him informed of the condition of his water supply. The extent to which external information could be relied upon was an important issue that cut across each discussion. Dependability of this information was broadly verified according to proximity: the closer the knowledge to the household, the more reliable that knowledge was. In this matrix, community and personal observations/experiences were more dependable than information which came from the local authority or Irish Water. As the 'Expertise' section will outline, this was less to do with a perception of the reliability of scientific information and more to do with the reliability of distant organisations more generally. While most participants stated that they would seek out Irish Water or their local council in the event of having an issue with their water, many were not satisfied with this situation. Some participants felt that they would not receive useful information contacting these organisations or that they would be ferried back and forth endlessly – 'I guess I'd contact Irish Water but I find it's really hard to contact someone in there who knows what they're talking about' (Josh). This was compounded by a universal uncertainty

across both focus groups about who exactly was the appropriate point of contact, even in Vanessa who works in the water industry and Stuart who works in water services for the County Council. Others spoke of how they would seek or prefer more localised avenues if they had an issue with their water. Gavin said, 'I'd try and take advantage of parochialism and talk to a local councillor', Carl said 'in West Donegal you just call over to the guy's house who works on the council, 'cause you'd know them, [and you'd ask] "what's wrong with the water?"' while Elaine said, 'I'd call my dad'. Irish Water, in particular, were described as being difficult to get through to and perceived, as a result, as being more distant, or further away. The issue of communication will be dealt with more thoroughly in 'Communication' in the 'Responsibility and Sustainability' section.

Community and Household knowledge were deemed to be the most reliable source of information in relation to a problem with water supply. Gavin made the parallel with an electrical outage where you would check with other members of the community if there was a problem with power. Doria (2010, p.8) suggests that adverse experiences lead to 'an increase in risk judgements' where prior negative experiences correlate with less acceptability of water. However, the findings here suggest that reliable information encourages better acceptability of water quality. The householder's own bodies were ultimately regarded as the most reliable source of information about water quality, particularly if someone got sick. This, unsurprisingly, came from those on a private water supply. Tummy bugs were mentioned several times as an indicator of poor water quality (Noel and Frank), while Alan suggested that he would know there was an issue with coliforms in his water 'when Uncle Jim comes down from Australia […] all sick and vomiting'. Gloria linked confidence in her water supply to the absence of sickness in her household – 'so far there is nothing happening to us'. Spackman and Burlingame (2018, p.367) argue that because of this sensitivity to water we should 'try to engage the human body and its sensory knowledge in regulatory efforts to monitor and protect the environment'. This is in the absence of laboratory testing which can provide complete system coverage.

Expertise

Scientific and technical expertise in assessing the quality of water was highly valued, but as mentioned above, was not always the kind of knowledge used to delineate "good" from "bad" water. In addition to local and subjective forms of quality assessment (shared community knowledge, sensory observation), participants were broadly positive about the scientific expertise available in private water testing laboratories. Frank, a private well owner, stated, 'I use IAS in Bagenalstown – they're great there, very helpful'. Thomas, closely involved with the group water scheme he is on, described the confidence he has in his water due to getting it frequently tested: 'I know how it's treated. [We] regularly get samples to labs like IAS so we keep on top'. Participants in the Dublin focus group were clear that they would trust 'accredited' labs (Vanessa, Elaine, Carl). Elaine, who was unique in being on a private well supply in Dublin, described, in detail, her preference for testing facilities that had a 'high level of transparency – a lot of information on their website about the standards that they certify against [for which] I would certainly be happy to pay for'. Some raised concerns about the reliability of privately-owned labs by referencing the government's use of American laboratories to analyse cervical screens. This practice had recently been the subject of controversy in Ireland after several women were discovered to have received incorrect test results. Subsequent cases in Ireland's High Court found that the American labs had negligently read the tests. Participants were concerned that the government would "farm out" scientific testing to distant laboratories that might not be as interested as the state in ensuring a high standard of public health in Ireland. Discussion on this issue was minimal.

Several participants felt that home testing was prohibitively expensive (Stuart, Alan, Vanessa, Carl). Vanessa said she would like to see testing 'readily available at an affordable price to have a true version of what's in the water'. Alan spoke of getting his household's water tested in the past: 'we did get our water tested and it came out clean but it cost a lot of money – £40 – which sounded like a lot of money then and it still does now'. Stuart said: 'I'd be of the belief that people with wells should get them tested at least once a year – the chances of a pollutant – they won't because of cost […] It's because of the cost people aren't going out getting it done every year'. There was general consensus that price was a barrier to getting water tested.

In Dublin, the Council, or Irish Water, appeared to have the confidence of the discussion group to keep water quality to an acceptable standard. This is indicated by the lack of talk about getting city water tested, articulated explicitly by Elaine: 'I would find city water tastes bad but I would never

think to get city water tested'. However, this trust disappears when participants discuss the governance and communication practices of these organisations. When doing so, participants spoke in far more sceptical terms of the Council's or Irish Water's capacity to responsibly manage water quality. But as far as their technical capacity to safely treat water went, local councils and Irish Water had participants' confidence.

In thinking about expertise in a wider sense, participants of both groups discussed limits to scientific assessments of water quality. Elaine described how thinking about her local water supply prompted her to think more broadly in ecological terms about the various environmental factors that could impact its quality. This included activities of farmers, dog-walkers, littering, and broader uses of amenities. This was then extended to unknown determinants: 'I would have said in the beginning that I would have relative level of confidence but when you start talking about unknown factors, I think about the known risk factors – microplastics – who knows yet?' After hearing others talk of risks that she hadn't previously considered, Frank said, 'now I'm beginning to wonder if I should go from very confident to somewhat confident!' Alan, a water scientist, described the highly chlorinated water in Tramore, saying, 'no one's going to get coliforms but I don't know what it's doing to their intestinal tracts'. Vanessa spoke of how it was only after husband got cancer that she began to think about the potential threats caused by water quality. Others pointed out that you needed to know what to test for in order to evaluate water quality effectively, which again, depended on a tension between what was known and unknown. Talking about home testing kits, Norah said 'The other thing about testing is you need to know what to test for […] it's like getting a blood test'. Áine and Frank, a couple who were experienced in getting their water tested, had an exchange about this issue:

> **Áine**: If you're testing for E.coli that's fine but there are other things in the water that will do you just as much harm. If you don't test it, you won't find it.
>
> **Frank**: You've got to do specific tests. You've got to look for it.
>
> **Áine**: It's a specific test for E.coli but are they looking for other things that could be new in the water now with the intense farming and the sprays and all going on.
>
> **Frank**: Glyphosate.
>
> **Áine**: That would be a huge concern of mine. You don't have a test to tell you what's in the water. You have to look for it. If you look for E.coli and you don't get it - it doesn't mean your water is good enough, and are they looking for anything else and that's one of the areas I'd be looking at.

Williams et al (2017, p.99) characterise this kind of public response as a 'humble epistemology'. Epistemology can be understood as an individual or group's understanding of the world, the systematic way that they make sense of things. A humble epistemology, according to Williams et al (2017, p.98), is an approach to knowledge whereby our uncertainty and ignorance is emphasised and 'where experts [tend] to be characterised as naïve (in relation to assumptions about society) and complacent (in relation to an unruly, elusive nature)'. It essentially urges caution and respect for the inherent limits to knowledge. Participants' focus on unknowns and the fallibility of testing parameters (Carl) indicates that they were keen to maintain this attitude of humility towards testing water quality.

Some participants felt that even with reliable expertise in testing water, householders might not be trusted to carry out sampling correctly. Elaine suggested a 'dipstick test' for water testing which would use different colours to indicate issues with the supply. June responded with an idea for an app-based water-testing system:

> I have type 1 diabetes so I have a glucose sensor that I scan my phone with so it will tell me high low whatever - I don't get a doctor, I don't go to the hospital every day to check my bloods. If there's a problem I go to the doctor. That's all app and Bluetooth. For me that would seem very logical […] In my head you have the water, you have a sensor, you have the thing, you just scan it with your phone it gives you a colour gradient or a level or it looks a bit high you might want to get it checked.

However, Gavin questioned whether people could be trusted to read these tests accurately: '[Earlier], we were talking about the level of scientific knowledge that people

have or don't have. When it comes to doing a home testing kit like that how equipped are people to interpret even a coloured stick?' to which June responded:

> colour's so visual – if you're talking to people who have already noticed something is wrong with their water they're going to be inclined to have that level of thinking anyway. If you gave the kit to someone randomly they're not necessarily going to get the best results of it as someone who is already conscious about or they're thinking about water or they've noticed something themselves they've already started thinking about

Those in the Carlow focus group were more confident in the householder's expertise, despite the limitations posed by broader unknown risks.

Here, we see how a range of contextual issues bear upon participants' confidence in water testing. Cost, communication, governance, uncertainty around testing parameters, and potential deficits in householders' ability to use home testing kits all impacted householder trust in expert methods of analysis.

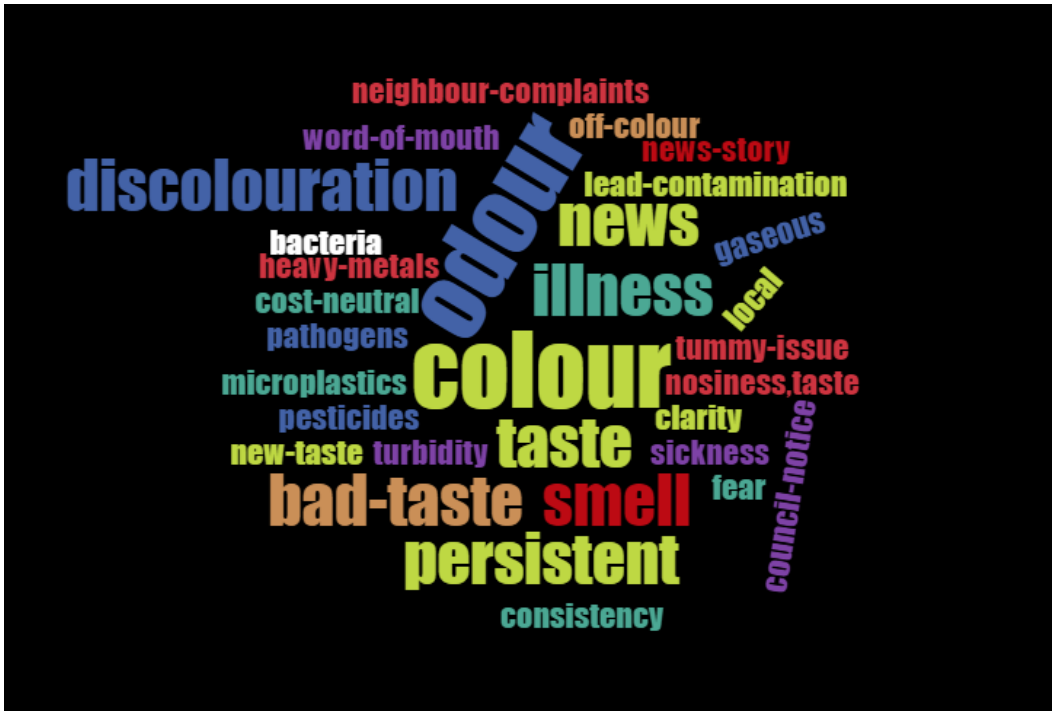

Figure 2 – Participants were asked to list what things would make them get their water tested.

Control

As touched on in the previous section, the technical capacity of water providers was not in much doubt. There were, however, broader trust issues in relation to control and ownership of water (both public and private) and how this impacted on water quality. This was largely expressed through notions of institutional ineptness and corporate greed. These issues connect to the broader concerns around responsibility, dealt with in the next section, but here, we will focus more narrowly on trust and its relationship with control and ownership.

Participants were conflicted in their confidence for public bodies in ensuring safe, good-quality water supplies. Gavin stated simply: 'maybe I naively trust the state agencies and state bodies not to provide me with poison or things that will harm me'. Noel (40s, Carlow) described himself as somewhat confident in Irish water supplies in a broad sense: 'there are lots of issues of pollution with surface water of rivers and lakes but most of us have fairly reliable drinking water and I suppose in a kind of global context that's something we shouldn't take for granted'. Vanessa, currently working in the water industry, said, 'I'm confident of where we're going to be in 10 or 15 years' time […] I don't drink tap water'. Some participants referred to highly publicised controversies such as the water crisis in the American town of Flint, Michigan, or the CervicalCheck screening test issue in Ireland, as evidence to not trust public bodies with control of something as important as water quality. In these instances, public bodies were seen to cover up problems in order to protect themselves, rather than putting the interests of people first.

Importantly, the issue was not with the technical capacities of these organisations but with their governance and communications practices. Frank put it bluntly: 'I'd have no confidence whatsoever […] I think the governing bodies in Ireland, really, are completely incompetent'. Several participants shared anecdotes where Irish Water or the local authority were poor at communication or in dealing with straightforward problems. This was frequently put down to a lack of care or even laziness on behalf of those working in these organisations, reflective, it was assumed, of a broader culture there or a lack of effective management.

Many participants were also vocal in their mistrust of private bodies controlling or owning water infrastructures, particularly in the Dublin focus group. Norah, when associating words with 'safe, secure water', said, 'secure – what goes into securing water? I guess I heard owning water – and then it's sort of controlled. If supply is secure, then we're into paying for it'. Josh referred to Irish Water: 'because they privatised it and people were making huge amounts of money and it was all mis-managed and when people see there's that kind of corruption going on'. June mentioned the public perception of businessman Denis O'Brien's involvement, describing how people were opposed to water charges when 'these guys are clearly getting paid way more than they should'. Mark stated that the 'privatisation thing is a worry' which would lead to 'under-investment to make profits for shareholders'. Josh brought up the brand, Fiji Water, making the point that the business's success has led to a situation where 'people can't drink their own water that's there'. The consensus appeared to be that water infrastructure should remain in public ownership, but that the agencies tasked with its management ought to be closely monitored. Private organisations were viewed sceptically because their primary motivation was the accumulation of profit rather than providing safe and secure water for the public. Frank, the only vocal critic of private organisations in the Carlow focus group, stated that water management was 'capitalist-driven: a small number of people make a huge amount of money off this'.

This section has described how trust in water safety and quality, as discussed in these focus groups, involves more than subjective or technical assessment of water. There was little doubt about the technical capabilities of water testing laboratories. Confidence was shaped and patterned through talk of purity, locality, expertise, and control. Each of these factors was determined by a range of influences, emerging throughout each discussion. Within assessments of water quality, purity was highly valued. While participants acknowledged that this was not a scientific measurement, it was still strongly regarded as a powerful determinant of quality. The "localness" of knowledge about water quality had an impact on trust. The closer the knowledge came to the household, the more the knowledge was trusted. Hence, community information, or information from the participant's own senses was prioritised. Expertise was still highly valued, but this value was constrained by barriers such as locality, cost, and a broadly conceived limit to scientific knowledge itself. Further, expertise was perceived as being hampered by poor management and communication, reducing trust in both public and private organisations. Having to make do without continual access

to scientific testing, purity – determined either through taste, smell, or look – was the desired quality. The next section will explore how participants attributed responsibility in this context – across public and private spheres – indicating how they would like to see water services being provided.

Responsibility: Governance and Sustainability

Responsibility was a core issue in the development of the focus group questions, prompting participants to consider who ought to be responsible for ensuring water quality in their homes. Before even being asked questions of this nature, however, participants were quick to bring up responsibility, demonstrating its close relation to their overall perceptions of water quality. For participants, the dependability of water quality assessments extends beyond scientific validity to encompass issues around purity, control, expertise, and management – as the last section on trust indicated – as well as to issues of accountability, transparency, and the split between personal and public responsibility. This section will examine each of these perspectives, providing an analysis of how responsibility impacts on public perceptions of water quality. The main areas explored are: **accountability**, **personal**, **public**, **communal responsibility**, and **communication**.

Dublin	No. of Responses	Carlow	No. of Responses
The State	3	Irish Water	4
Irish Water	2	The State	3
Everyone	2	Single Entity	1
Local Government	1	Frank	1
Group Scheme	1	Man of the House	1
House Owner	1		
Irish Water	2		
Everyone	2		
The State	3		
Community	1		

Table 3 – Participant were asked: 'Who should be responsible for ensuring a household has clean and safe drinking water'.

Accountability

Participants were largely in agreement that developing responsibility through some kind of accountability would improve water quality standards. It was contrasted with a lack of accountability which was attributed to state bodies, farmers, and private companies. Participants were critical of wasteful operational practices such as '[flushing] your toilet with treated water' (Frank) that were deemed to be the result of poor management practices. These management practices were attributed to a lack of accountability with 'no clear chain of command' (June) within organisations managing water infrastructures. Carl identified the problem in a lack of clearly defined institutional boundaries, a consequence of Irish Water's transition from 34 'autonomous' local authorities. Irish Water were now, he suggested, working on the 'big picture' without boundaries, leading to a confusion of quality standards. His argument was that without clear standards, responsibility is hard to police. Carroll (2012) describes how water is a boundary object that shapes the societies which govern it. By the same token, those societies shape our perception of water. A lack of clearly defined governance boundaries leads to a "muddying of the waters". Transparency is sought in water itself as well as the organisations which govern it.

Several participants were particularly critical of farmers. They were perceived as lacking the accountability which would prevent them from engaging in what were thought to be polluting practices. Frank frequently referred to this issue, bringing up: 'dumping slurry', 'dumping out milk churns [that] poisoned the river', and the spraying of 'herbicides, fungicides, Insecticides, growth retardant, growth emergence stuff […] and granular fertiliser'. Áine described 'intensive farming' with 'no regulation' which is 'destroying the rivers'. She spoke of how these practices meant she 'wouldn't have confidence in the river water'. Elaine stated that she had low confidence in the quality of the water in her well in Swords because of the 'high-frequency broadcasting' by farmers who were not as accountable to the community as the farmers in Carlow. Participants did not suggest any particular accountability measures for farmers, although Stuart suggested a change in policies aimed at increasing 'aquaculture and more high end products', which, he felt, would boost Ireland's 'green image' and discourage 'agriculture that is polluting the ground'. However, we can see elsewhere – in the labelling of plastic bottles – where participants were more satisfied with levels of accountability.

Both focus groups were largely confident in the quality of bottled water. Some had concerns about the length of time the water was left to sit in plastic bottles (Vanessa and Norah), but mostly participants were confident in its quality. One key reason cited for this was the accountability attributable to private companies, making them clearly responsible for its quality. This was indicated, most clearly, in labelling. Mark said, 'it's the label thing. That's where my confidence comes from'. Stuart stated, 'the fact that you open something that's been in a package you kind of expect it to be of a standard', while Elaine remarked that 'there's a feeling you can take legal action'. In contrast, Gavin stated, 'when you talk about food there's laws to compel food producers to tell you what goes into the food. When I turn on my tap, I don't get told exactly what's in it'. For participants, labelling acts as a medium for accountability, producing transparency and responsibility. The next section will examine how participants envisaged the allocation of responsibility in other areas of the management of water quality.

Personal, Public, Communal Responsibility

The prompts used to elicit discussion about responsibility were deliberately left open enough to allow participants to interpret for themselves what responsibility meant and who it should be attributed to. We have already seen how it was configured through the notion of accountability – making farmers or bottled water producers accountable for their practices. Another way that participants spoke of responsibility was through the distinction between personal and public responsibility (and in one discussion, communal responsibility). Here, responsibility for the quality of water was parsed between these vaguely defined agencies. Personal was broadly conceived as belonging to the individual or to the household, while public related to the state, its agencies, or the local authority. Communal, here, refers more to collections of local individuals.

June, from the Dublin focus group, said that home testing allows homeowners 'take more control over their houses' while increasing critical thinking. She explained, 'I'd be an advocate of more people doing their own thing and thinking critically about stuff […] There are the larger bodies and organisations but ultimately not anyone's going to know

something's wrong if it's not you picking it up in the first place by smell or by taste or by colour'. Those in the Carlow focus group who were supplied by a private well felt differently. They spoke of having no option but to be responsible for their water quality while lacking state assistance in carrying out their testing. Frank stated:

> we have to test our own water, there was the council thing alright which we used to avail of many years ago, but now we have to go to the likes of IAS, which we do from time to time just to test both the treated water and the raw water just to see for peace of mind. But we have no back-up, we have to do our own testing and improve our own issues.

He went on to explain that they would like the government to 'take responsibility to help us to be responsible' by providing subsidised yearly testing kits. Áine echoed the idea that this responsibility was a burden in comparison to the 'luxury' of the urban water situation: 'in the rural areas we all pay and maintain our water but in the city you turn the tap on'. Stuart agreed: 'even in rural towns you are connected but you are well aware that there are wells everywhere where you pay for that to maintain it – pumps and electricity'.

Both groups brought up the issue of payment for water at different points during the discussion. Most were in favour of water charges. Gloria, originally from the Democratic Republic of Congo, said, 'back home we pay for water, so when I heard that [people here do not] I was really surprised. I wouldn't mind paying for water'. Sandra stated, 'if you want clean water that's safe to drink you have to pay for it'. However, several had caveats. For example, Thomas was in favour of water charges so long as the funds were ringfenced for specific purposes and that Irish Water remained in public ownership. It was felt that water charges involved a sharing of responsibility – tax payers would fund the water infrastructure which would be managed and operated by a reliable public organisation.

Personal responsibility was also interpreted in a wider sense, taking in broader social activities that impacted on water quality such as littering, recycling, plastic usage, and conservation practices. 'It's everything', said June. 'Do you vote for the Green Party? It's how you act and how you contribute to the environment. Does the water need to be treated because people are throwing cans into the canal? It's multi-layered'. Gloria stated, 'it's up to us to take action now. Whatever activities will prevent water pollution'. Frank suggested it would take a wholesale change in people's lifestyles to combat water shortages connected to wider environmental threats like climate change: 'we've got to turn ourselves around. Basically make differences by not buying corporate stuff […] You decide whether you eat foreign stuff, organic stuff or GMO'. Thomas saw the solution in the 'polluter pays principle' while Alan suggested, 'we need to pay more taxes'. Participants went back and forth on solutions which existed at both a personal and a public level, indicating their awareness of the wider social contexts of water quality. Neither personal nor public responsibility on their own were deemed effective. For these groups, the complex relationship between water and society requires action at both the personal and public level to ensure a quality supply.

Gavin stated, 'the state needs to be accountable as well […] it's difficult to be responsible sometimes'. Suggestions for public responses to water conversation and sustainability issues included universal water collection systems for homes (Alan, Frank, June), proactive water maintenance (Thomas), election of people to create better policies (Stuart), and collection of surface water from large areas like roads and public buildings (Áine). Institutionally, public responsibility for water quality was envisioned as having 'one authority looking after [standards] that you could depend on and trust' (Carl) which would itself have oversight (Mark). Elaine suggested a communal scheme which would mediate the attribution of responsibility between the personal and public spheres by creating local groups which would manage the supply and quality of water: 'In making sure a given household has clean and safe water the community is responsible'. This would involve community pressure through 'community-elected water boards' that were answerable to community peers and 'community bank schemes' where communities would get certain amounts of water that is portioned out. This was looked upon favourably by others in the group. Mark responded by saying,

> In that scenario it's really good because you can allocate […] set amounts to communities or small agglomerations and let people collaborate together to manage their own water rather than one Irish Water type thing […] it's a good way to manage it – basically

> through working together you can appreciate the resource.

The benefits of this approach, according to Elaine, would include transparency and empowerment: '[water boards are] elected in local communities so they're not as hazy as how county councils operate. You get to have a say on how the community water is managed, for example with leaking pipes'. Other incentives for encouraging communal responsibility for a sustainable water supply included tax credits for those who remained in surplus.

Who was made responsible for water quality and sustainability was a vibrant topic of discussion with a wide variety of views. They seemed to converge around a distinction between personal, public, and communal responsibility, with some mediation between the three deemed most desirable. The last section we will examine relates to the important issue of communication, and how each of the topics encountered so far are filtered through it.

Communication

We have seen how participants have emphasised the importance of effective communication for building trust and ensuring that water is managed responsibly. In this section we will examine how participants desire communication which is transparent, relevant, reliable, and made in the interest of the public..

Participants spoke of difficulties getting through to people who knew what they were talking about (Frank, Alan, June, Josh, Mark) or responses that reflected an attitude of 'it's more than my job is worth' (Alan). It appears that this has a significant impact on participants' willingness to trust the broader management capabilities of these organisations. Frank relayed an event where he reported pollution in a river to a number of state agencies and whose response he characterised as '"ah no, it's not my problem"'. He described it as 'no help, no feedback at all' which he found 'heart-breaking'. Exasperated, he summed up his situation as follows: 'all I wanted was can you tell me who to contact?'

This is a powerful reaction and should not be overlooked. Trust in public bodies to manage and provide safe, good-quality water supplies is not restricted to technical capacities but is strongly connected to an organisation's ability to *show* they are technically capable through feedback and communication. The absence of this feedback appears to erode trust. Elaine spoke about this directly:

> On that point about the trust, the point you [Norah] raised about the cervical smear controversies is really interesting. To me it highlights that there's two levels, there's getting the testing done, and that the testing is done to an appropriate standard, and that the standards are transparent […] but then there's the communication, when the information's received, about what the test results are, and that's where I would have, really, such little faith in the Irish government.

Many participants singled out Irish Water and their poor communication practices in this regard (Thomas, Stuart, Sandra, Frank, Vanessa, June, Carl, Josh, Mark). Both discussion groups referred to an incident where raw sewage was pumped into the sea without notifying the public (Sandra, Frank, Vanessa, Josh, Norah). Josh suggested that the reason Irish Water did not let the public know about it was because 'it was sludge and partially treated' and therefore they technically didn't have to let people know. This idea of "technically the truth" was critiqued by participants on other occasions, a sense that information is factual but does not correspond to the expectation that information given be relevant and in the interest of the public. June referred to an aerial photograph taken by a member of the public of the brown, partially-treated sludge, suggesting that this piece of information was more relevant and meaningful for people.

The sewage example illustrated how participants were critical of information that was presented without reference to relevant context. Josh used a UK website as an example of good communication in this regard. On this website, E. coli levels in a glass of water were conveyed using the visual scale analogy of a piece of faeces in a swimming pool. Participants 12 and 14 agreed that this was a useful device, helping people to connect abstract information to their daily lives, hence embedding it with practical meaning. Several participants asserted that a communications approach which was relevant to their daily lives would increase trust in water suppliers: 'It's such a pity, [Irish Water] could have come in like a knight in shining armour, saying, "this country's infrastructure for water is so fucked - but we're going to fix

it". Instead they were very oblique about what the problems were' (Mark).

From these findings we can see quite clearly the contextual nature of perceptions of water quality. Quality is rarely described independently of the social contexts it is connected to. Participants' describe the importance of trust in establishing the veracity of information about water, assessing the communication, management, and governance practices of the organisations providing that information. In the absence of a dependable water infrastructure, participants outline the kinds of accountable, responsible, and responsive practices they would like to see. In the following section we will discuss how trust, responsibility, and effective communication shape public perceptions of water quality, as inferred from these focus groups.

Engagement: Bridging Science and Society

The findings indicate that participants' perception of water quality is 'sociotechnical' in nature (Bakker 2012). That is to say, quality is understood in both social and technical terms. In the technical sense, participants evaluate water quality by referencing scientific standards of observation and the use of technical instruments. Socially, water quality is evaluated through subjective observations and standards as well as through shared norms and communal interactions. This makes it difficult to assess on a single scale how the public perceives water quality in Ireland. As outlined already, the focus group discussions indicate that it is a complex issue which depends heavily on context. Despite this complexity, three distinct patterns emerged in the way water quality was conceptualised, namely: **trust** and **responsibility**, and **engagement**.

Trust

Participants spoke frequently of confidence and trust in their discussion of water quality: trust in the purity of water, trust in the veracity of information about water, and trust in the actions of public and private bodies supplying water. Purity stands as a powerful determinant of quality on the evidence of these focus groups. Despite there being no real agreement on what purity referred to, it was frequently used as the indicator of good quality water. Trustworthy water was pure water. Purity was determined by a mix scientific and heuristic measurements including subjective assessments through the senses of sight, smell, and taste. While participants were largely in agreement that subjective determinations of water quality were highly prone to error, discussion about purity frequently returned to water that tasted, looked, and smelled good. Rather than seeing this as an outright contradiction, however, it is helpful to understand it as shedding light on the way knowledge is often utilised in an everyday manner (Jasanoff 2010). Studies of the everyday usage of knowledge suggest that it is frequently deployed in a pragmatic way – different kinds of knowledge are used in accordance with the problem at hand. For example, participants will refer to laboratory-based testing when seeking to discover the quality of water in relation to pathogens (Alan and Noel) but turn to visual quality when deciding if a test for pathogens is required in the first place (Josh). As discussed in the literature review, perceptions of quality are 'co-produced' (Jasanoff 2004), meaning that they are always embedded in some kind of context. Here, purity was connected to public and private water suppliers and mediated through complex relations of trust. While those on private water supplies were more concerned about the quality of their water than those on public supply, the former trusted the purity of the water because they had a certain degree of control over it and access to local and immediate information.

Trust was also established through expert scientific analysis. Independent water testing laboratories, in particular, had participants' confidence. Verifiable standards, regulatory accountability, and technical expertise convinced participants of the credibility of scientific testing. Some had reservations about the sufficiency of laboratory analysis, citing the potential for "unknown unknowns" and the difficulty of knowing what to test for. This was described in the findings section as a 'humble epistemology' (Williams et al 2017), a cautious approach to knowledge which resists the naïve belief that we can know everything. Participants sought to fill in these gaps through recourse to local knowledge – talk of problems in the area, observations of local activities (e.g., farmers spraying), aesthetic characteristics of their water, and instances of sickness in the home. Jasanoff uses the term 'civic epistemology' (2007) to describe these processes of 'public knowledge-making and argumentation' (Jasanoff 2010, p.239). She argues that lay approaches to understanding the world are as important as scientific ways of understanding the world as they are always embedded in context. Where laboratories seek to

remove or control for contextual noise, public knowledge-making is always immersed in it. Jasanoff makes the point that in order to truly be able to deal with technical issues like water quality we need to be able to 'bridge' together civic epistemology with science (2010). This will bring about the 'ethno-epistemic assemblages' (Irwin and Michael 2003, p.146) which we encountered in the 'Methodology and Research Design' section. For these scholars, social progress is made more possible when lay and expert knowledge comes together to make sense of an issue. Science brings impartial and universal facts to the table while public knowledge provides context, meaning, and relevance.

In the absence of a testing protocol which could provide total system coverage, participants turned to local forms of knowledge in their assessments of water quality. Trust was placed in community knowledge, from farmers' reports on what they are spraying, to neighbours' reports on the quality of their water. Perhaps the most trusted test of water quality was the wellbeing of householders' own bodies. Sickness, 'tummy bugs', or the absence of any health problems, were frequently cited as key indicators of the status of the water supply. This supports Spackman and Burlingame's (2018, p.350) argument about the importance of consumer 'sensory knowledge'. They argue that subjective assessments of water quality, while unreliable, have value in determining when water should get tested, as even the most comprehensive testing infrastructures cannot screen against all contamination. They write that 'the human body and, unfortunately, its hospitalization, mark instances of toxicity in ways that even the most robust of testing programs cannot' (2018, p.367). Discussion amongst participants suggests that instances of sickness were a sign that these infrastructures were not working adequately and that other approaches were required such as government provision of regular and frequent testing.

Another key concern for participants related to the control and ownership of water supplies and infrastructures. Public bodies were deemed to be technically capable of managing water infrastructures but were criticised for being uncaring and poor at communication. Private bottled water companies were regarded by some as being more interested in generating profit than taking care of public needs but were at least accountable to consumer law. Private testing laboratories were largely trusted to provide satisfactory services. No issues were raised about communication or governance with these organisations in the same way that they were raised with public bodies like Irish Water or commercial entities like Fiji water. The preference seemed to be for public ownership and control of water supplies, but with vastly improved transparency and accountability. Private testing labs had the confidence of participants to act as mediators between the local and national. Viewed purely as impartial scientific analysts, participants had no direct issue with them, however it is possible that their role could be expanded. As mediators between the local and the national, independent testing laboratories could provide the 'bridging' that Jasanoff suggests is crucial for producing successful relationships between science and society. Before we investigate this idea further in the section on 'Engagement', let us look first at how the sharing of responsibility influences public perceptions of water quality.

Responsibility

We have so far discussed how a deficit in trust in public and private organisations to reliably supply good quality water has encouraged participants to seek local methods of validating the condition of their water supply. How, then, in an ideal world, would they like to see water managed?

Accountability was an important issue across both discussion groups. Several participants mentioned the labelling of food and bottled water as one way in which entities could be held responsible for the quality of their products. Accountability can be understood as the processes of tracing and tracking responsibility in a clear and transparent way. This is responsibility understood as 'answerability and liability, as consequentialism' (Owen et al 2012, p.xix). Consequential actions such as lawsuits attribute responsibility after the fact. Participants were also interested in other, more future-orientated, ways of enacting responsibility. These included policy, legislation, and community and work practices that would ensure sustainable supplies of good quality water. Felt et al (2013, p.20) make the distinction between accountability and responsibility, where the latter focuses on 'a more personal engagement with values and practices and how this relates to societal preferences and expectations'. In this iteration, rather than simply being accountable, responsible organisations genuinely care about public interests and work them into their day to day practices. Participants were sceptical about whether private and public entities were responsible in this way.

Lacking confidence in public and private organisations to reliably supply good quality water, participants placed looked to personal and communal domains to take responsibility. Both discussion groups imagined scenarios where the government would support individuals and communities in improving the standard of water supplies, 'taking responsibility to help us to be responsible' (Frank). This involved a range of activities including home testing of water, water conservation, reducing pollution, and the setting up of community-level organisations for allocating water and maintaining its quality. Private testing organisations could fit into these visions, acting as responsible mediators between communities and the state, bridging the gap between the local and the national. In this guise, independent water testing organisations could take on the kind of responsibility described by Felt et al, above, which would be open to societal expectations and preferences. This would involve practicing the forms of engagement which participants were at pains to communicate were sorely lacking in the current set up. The next section will examine what this kind of engagement might look like.

Engagement

Communication was central both to issues of trust and issues of responsibility. Participants clearly stated that they expected communication that was transparent, relevant, reliable, and made in the interest of the public. Participants lost confidence in organisations like Irish Water and local authorities who they believed did not communicate in this manner. They felt that, at the very least, public bodies should communicate clearly about relevant issues in a way that had public interests at heart. This ties into the point made, above, about responsibility which weaves 'societal preferences and expectations' into work practices. Participants suggest that their preference is for a kind of communication that takes into account the practical relevance of water quality. This makes sense. As the previous sections have made clear, perceptions of water quality are not solely based on scientific analysis. They are connected to a range of social contexts where control, locality, expertise, governance, and responsibility emerge as critical factors. This is particularly the case when the institutions providing expertise are not trusted. Resolving this issue requires bridging the impartial knowledge of science with the local context of the public. This necessitates engagement.

Independent testing laboratories could occupy the position of mediators between local communities and the state by providing scientific expertise alongside a consumer-facing system of engagement. This would involve acting as a "hinge" between local concerns and objective analysis and governance. It would require responsible engagement that is open and responsive to public concerns about water quality: taking seriously issues of purity, sickness, control, accountability, knowledge limitations, and shared responsibility. This type of engagement would not be restricted to the deficit model outlined in the literature review. Instead, it would be open to the 'imagined forms of life' (Felt 2015, p.121) and ways of living which provide the meaning and context for public perceptions of water quality. Improving the relationship between the public and the state would allow for the better management of public health as more people get their wells tested (Hynds et al 2018). It would also empower individuals and communities by having their expectations and concerns engaged with (Stenekes 2006; Felt et al 2013).

In this scenario, communication is a shared enterprise, not a top-down affair. It resembles something closer to dialogue, where perceptions about water quality are shared across science and society. Participants were clear that the current situation is inadequate. As a result, they find themselves resorting to subjective and communal methods of assessing water quality. The problem with this is the lack of objective scientific analysis. As others have rightly pointed out, access to accurate information is crucial (Jones et al 2006; Hynds et al 2018). Bridging scientific analysis with local concerns would involve engaging with the public through openness and sensitivity alongside transparency and a willingness to explore innovative approaches to issues of quality and sustainability. Water quality does not begin and end at the tap for these participants, it extends throughout society. As a result, relationship-building requires a careful and nuanced approach which does not narrow quality or sustainability to "just" a technical or cultural issue.

Conclusions

This research asked the question: What perceptions do people have of water quality in Ireland? We addressed this by holding two focus groups with members of the public, some of whom had expert knowledge of water management and water quality. Our analysis generated rich insights into how perceptions of water quality are connected to a range of social contexts. We found that public perceptions are not restricted to conceptions about water itself but are linked to the many places where water flows through our daily lives. This includes households, communities, and public and private organisations. Water quality was rarely described outside of these contexts.

Three overarching frames through which water quality was made sense of were trust, responsibility, and engagement. It was through these contexts that water was attributed normative value. Trust was established through a vaguely defined but strongly held notion of purity. A mix of scientific and aesthetic types of understanding, purity shifted depended on the context of use. In the absence of analytic testing, subjective assessments of water purity were utilised by participants, despite general agreement that they were highly prone to error. Expert technical analysis was viewed as the best indicator of water quality but factors such as cost, governance, and poor management and communication diminished trust. Where reliable information was not accessible, or not trusted, participants looked to themselves and their communities to assess the quality of their water.

Responsibility was the second overarching frame through which water quality was made meaningful. The attribution and sharing of responsibility structured participants' views on how they would like to see water quality managed and sustained. Through accountability (e.g., information labelling, legal action) water providers were responsible via consequences to their actions. In contrast, a more future-oriented conception of responsibility allowed participants to imagine more positive community-level approaches to water supply. Through changes in policy, legislation and an increase in activities such as home testing of water, reducing pollution, and setting up community water boards, participants identified new forms of responsible water management. Both discussion groups expressed a desire for mediation between the private and public spheres to help them in these efforts. Seeing as communication and engagement were identified as critical issues for participants, we identified a role for independent water testing companies as mediators between communities and the state.

In this role, private water testing companies would act as a hinge between the local and the national, engaging with communities while providing independent scientific analysis for the government. For the state, these companies could mediate open, transparent, and responsive dialogue with the public, engaging with 'societal preferences and expectations' (Felt et al 2013, p.20). Private testers could bridge scientific objectivity with social progress by increasing the number of private water supplies tested. This could potentially improve the government's management of water and improve public health. For the public, benefits could include empowerment, reductions in cost, having concerns about purity, aesthetics, and household sickness taken seriously, and better relationships with the state.

Engaging with the public could drive innovation and reduce risk. As these focus groups demonstrate, members of the public have their own ideas about how water quality can be improved. Introducing a low-cost "dipstick test" could alert households and communities to potential risks while addressing other concerns. Dialogue might reveal other parameters publics believe worth testing for, such as what makes their water taste bad or why it looks off colour. This could expand reach beyond those on private water supplies to include people on public supplies. While aesthetic concerns may not relate to risky pathogens or other dangerous contaminants, publics would feel listened to, potentially increasing trust and awareness of their water supply. Having "aesthetic" concerns taken seriously could also result in the detection of issues testers had not thought to sample for as Spackman and Burlingame (2018) noted in relation to Flint and Toledo in the US.

<u>Limitations and Future Research Directions</u>

The sample size for this research project is undoubtedly small, however there is a strong case to be made for a deeply qualitative analysis in the richness and nuance it provides.

The purpose of the work is not to provide a definitive outline of public perceptions of water quality in Ireland but rather to sketch an outline of some of the contexts in which water quality is made meaningful for people in their everyday lives. To this end, we have achieved our goal. The findings here suggest that trust and responsibility are key factors shaping the perceptions of *these* two groups of people in Ireland. It offers a point of departure for further studies on this topic. This research might investigate whether the issues identified here are present in other groups around the country.

One issue which was touched on at the beginning of each focus group but that did not make it into the final analysis was participants' emotional responses to water quality. As an icebreaker, we asked each person to describe their favourite holiday spot situated near water. Almost everyone shared quite emotive memories about holidays or experiences around water touching on their sense of identity and relationship with family and friends. This made for fascinating listening and could have been explored further. Future studies might pay closer attention to the role that emotions play in public perceptions of water.

Finally, future research might flesh out how independent water testing companies might act as mediators between state and society. We have identified a few possible directions that this could take, but further research, with more data, could certainly reveal more.

KEY FINDINGS

1. Participants had a lack of **TRUST** in public and private assessments of water quality.
2. **RESPONSIBILITY** was viewed as something which should be shared between communities and state agencies.
3. Effective communication by independent testing companies could lead to more satisfactory **ENGAGEMENT** between public and private spheres.

RECOMMENDATIONS

1. Independent testing companies become stewards of responsible engagement around water as mediators between publics and the state.
2. Engagement should involve two-way dialogue where contexts surrounding water quality are taken seriously. These issues include responsibility, accountability, ownership, expertise, and diverse understandings of purity.
3. Conduct further research to experiment and model different modes of responsible engagement.

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Appendix

i. Focus Group Protocol

Time	Activity
16:30	• Researchers arrive. • Set up tables and chairs, name tents, refreshments, flipchart, recording equipment.
17:45	• Greet participants. • Tea and coffee. • Consent forms/information (age range, gender, location, drinking water source)
18:15	**Introduction (see below table)**
18:30	**Ice breaker**: Starting with moderator, go around the table and ask each person to say their name and their favourite holiday spot that is near water – can be a river, lake or by the sea.
	Topic Area 1: Water safety and quality
18.40	• **Free Listing**: List on your cards what five words come to mind when you think about 'safe, secure water'.
18.45	• **Discussion**: Gather cards and ask participants to explain their choices.

19.05	• **Rating Statements out of 5**: Look at the statements on the flipchart and write on a post-it which number matches with your experience. Then place the post-it beside that statement.
	• **Discussion**: Ask participants to expand on their choices or to comment on differences or consistencies amongst the group.
	  ○ *Why are you not confident about the quality of water in your area?*
	  ○ *What gives you the confidence that the quality of your water is high?*
	  ○ *Why are you confident/not confident about the quality of bottled water?*

19.35	• **Discussion:** Ask participants who they would contact if they had a problem with their water supply.
	  ○ *Where would you go to find out more information about the drinking water in your area?*
	  ○ *Where would you go to find out about the quality of your own drinking water?*
	  ○ *Are you aware of any funding for domestic water improvements?*

19:50	**Topic Area 2: Knowledge of Water Testing**
	
	• **Free Listing**: Write down on a post-it what would make you get your water tested. Then place the post it up on the flipchart.
	  ○ *Taste, odour, colour, debris?*
	  ○ *What would you like to test your water for? Fluoride, pharmaceuticals, heavy metals, micro-organisms?*
	• **Discussion**: Invite participants to discuss each other's responses. Is there anything surprising? Are we all in agreement?
	  ○ *Would you have any concerns about getting your water tested?*
	  ○ *Who would you trust to do this testing?*

20:10	**Coffee Break**

20:25	**Topic Area 3: Responsibility and Trust**
	
	• **Sentence Completion**: Write out the missing word on a post-it and stick it onto the flipchart.
	• **Discussion**: Moderator invites participants to discuss their answers. Are there any surprises or recurring answers?
	  ○ *Who is responsible for water quality in your area?*
	  ○ *Are they doing a good job?*
	  ○ *Where does public responsibility end and household responsibility begin?*

20:50
 	
20:55
	Topic Area 4 Begins: Sustainability and Water Conservation
	
	• Roleplaying fantasy: Imagine you are in charge of the Department of Communications, Climate Action and Environment. In response to climate change you have been asked to come up with one law that will improve water conservation in Ireland. What law would you introduce? Write out your answer answer on a blank card and blu tack it onto the flipchart.
	• **Discussion**: Invite participants to discuss their laws.
	  ○ *Is water conservation an important issue in Ireland?*
	  ○ *What are the biggest challenges facing water sustainability?*
	  ○ *What impact might climate change have on Ireland's water supply?*
	  ○ *How effective have advertising campaigns about water usage been?*

21:20	**Wrap up and thanks**