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Governance and Management of Small Rural Water Supplies: A Comparative Study

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Key research questions

How do other countries manage the problems associated with the delivery of small rural water supplies?

Are there governance frameworks, management tools or regulatory approaches that could help Scotland deliver a better service to small rural communities?

Main findings

This research clearly demonstrated that there are similar problems with small supplies all over the world; and that governance frameworks are relevant regardless of the form of ownership or type of management. It also showed that there are still many issues around definitions and terminology which can confuse the debate, as well as difficulties with consistency of data.

Risk assessment, for example through Water Safety Plans, is a focus for service delivery at every scale, but for small and very small supplies, it is especially important to provide clear, user-friendly information and support, which is easily accessible to users. It is also important that obligations for suppliers and users, who may be the same people, are clear and understandable. 'Education for empowerment' was a key theme.

The report concluded with a series of governance and regulatory policy recommendations (Section 6, Conclusions) which are reproduced in full in this summary.

Background

This research was necessary because small water supplies suffer from the 'three lows' – low revenue; lack of investment; and low quality of service. Small supplies are much more likely to deliver a service that does not meet drinking water standards, presenting risks to public health; this is demonstrably the case in Scotland. Small supplies are also much more likely to be the responsibility of communities or individuals who may need support and assistance in the management of their supply.

Research undertaken

This project began with an extensive literature review, which formed the basis of our analysis of definitions and terminology; good governance of water services; approaches to risk assessment; and our comparative study across a large number of EU and non-EU states. A set of countries were then selected for more detailed analysis as case studies, and in-depth interviews carried out with practitioners, regulators, and NGOs. The results of the interviews fed back into those case studies and the main report. A workshop was held to which key actors in Scotland as well as the interviewees were invited, and the findings of the workshop enhanced the overall project recommendations.

Recommendations

Overall:

1. A stronger focus on household-centred management and treatment options available to individual householders could be helpful, both for Type B supplies (whether serving just one, or a number of households) and for domestic users on a Type A supply.

2. Continued work on catchment protection, and on rural wastewater management, within the wider legal regimes for managing land-and-water. Although the former is currently focused on sources of public supply, and the latter on environmental compliance, both are likely to also benefit the quality of private supplies.

Governance initiatives:

3. Better, 'consumer-friendly', advice and training for both relevant persons and users of supplies. The current guidance is more appropriate for regulatory authorities.

4. In particular, advice regarding risk assessment / water safety planning, and / or point of entry (POE) / point of use (POU) technologies; there is extensive material available on making these appropriate to very small systems.

5. Advice and assistance currently offered through public authorities could be delivered via Health Boards, Local Authority Environmental Health Departments, or by giving a greater role to the Drinking Water Quality Regulator (DWQR). Staff in these organisations might also benefit from increased training and support, e.g. from DWRQ or perhaps Scottish Water. In many countries a trade association for water suppliers provides this training.

6. Better guidance support and advice to communities who wish to join together in some formal legal arrangement (such as a cooperative or a company limited by guarantee) to upgrade and / or better manage an existing private supply. Lessons learned in relation to community energy supplies may be useful here.

7. Potentially, some sort of umbrella organisation such as the Irish NFGWS could play a useful role, as a non-governmental 'trusted intermediary'.

8. Increased use of health data (e.g. from reports by local authorities and the DWQR, as well as by Health Boards and the outputs of research work), to provide evidence to communities as to the desirability of either connection to a public supply, or, improved maintenance and operational activity for private supplies. Means to achieve this (and provision of other guidance and advice) might include web pages, leaflets, presentations at community council meetings or other local forums; as well as direct contact with occupiers of properties registered as having private supply.

9. Consider the possibility of using something like the self-assessment action plans under the Water and Health Protocol, tailored for Scotland to measure the current situation against international criteria, but also to ensure that country-specific problems are being assessed against country-specific criteria and targets.

Regulatory measures:

10. The benefits of stable and consistent law enforcement was a theme of the comparative study. Several of these regulatory measures would work with the corresponding governance initiatives below.

11. One option would be to resource the DWQR to play a greater role, to ensure greater consistency, rather than the separate local authorities.

12. Further clarity in the regulations (and accompanying guidance

and advice) as to the need for all private supply to be on a register; and, on the identification and responsibilities of relevant persons, responsible persons, and users of private supplies.

13. A specific duty on an appropriate public authority to provide advice to users of private systems of different types and scales.

14. Making some form of risk assessment / Water Safety Planning mandatory – at least for Type A systems, and for all new private supplies.

15. Ensuring that incidents of disease linked to water quality, are noted on a register and publicly available.

16. Scottish Water could be enabled and required to provide more assistance to private schemes, perhaps through Scottish Water Horizons to avoid blurring the distinction between public and private supply.

17. Strengthening compulsory powers (or encouraging their use), e.g. in relation to declaring dwellings uninhabitable, or otherwise using the powers of local authorities to prevent unsafe or non-compliant supplies being used for consumption; mandatory powers might be seen as negative, but are an essential back-stop.

18. Alterations to the grant scheme, e.g. to allow 'pooling' to move to improved community schemes and / or public connections; and ideally, increased levels of grant support. The grant aid provided in Ireland for example, although discretionary, is significantly greater than that in Scotland.

19. Regulations to provide for increased monitoring to address known risks, e.g. at times when pesticides are being applied.

20. Bringing in some mandatory requirements for private supply (e.g. testing, certification) on sale of a property, as is done, e.g., in New Zealand. Whilst it would be possible to work with the Law Society of Scotland (and lenders) towards greater uniformity on a voluntary basis, a mandatory provision would be more effective.

1.0 Introduction

This project was commissioned through CREW on behalf of the Scottish Government as a partnership between the University of Dundee and the James Hutton Institute. It was commissioned by the Scottish Government. The project looked at options for management, regulation and governance, especially the monitoring and enforcement of drinking water quality standards and the advice and support given to communities and users. The project was designed to complement other recent and ongoing research into rural water services in Scotland, including an in-depth analysis of the Scottish frameworks for regulation and governance of drinking water (ICF Consulting 2016), an epidemiological study, a study of community perceptions, as well as work on rural wastewater services and on innovation in all aspects of rural supply. Much of this work is in furtherance of, and all is related to, the Scottish Government's 'Hydro Nation' strategy, an initiative to maximise the different values of Scotland's abundant water resource (Scotland the Hydro Nation, 2016).

Small scale and rural water supply present well-recognised problems to policymakers, regulators, service providers, communities and water users, all over the world. Small supplies across the European Union (EU) and internationally have been associated with inconsistent, or lower than required, frequency of monitoring and reporting of their status; non-compliances with microbiological and chemical quality standards; and unclear legal responsibilities for both operators and regulators in the case of a disease outbreak or non-compliances (Sinisi & Aertgeerts 2011; Rickert & Schmoll 2011; Eureau 2011; WHO 2012; European Commission 2014a; 2014b).
This study was designed to make a wider comparative analysis of the governance, regulation and management of small rural water supplies across Member States of the European Union and other jurisdictions, and then make an in-depth analysis of selected case studies, supplemented by interviews and a stakeholder workshop.

1.1 Water Supply in Scotland

The approach to service delivery in Scotland, and the regulation and governance of small rural supply, is set out in detail in Annex 1. By way of introduction and context, we would note here that in Scotland, most people (more than 95% of the population) are served by a single public supplier, and the quality of water supplied is generally very high (Drinking Water Quality Regulator, DWQR 2015a). Charges are banded relative to property values and they are also cross-subsidised to protect rural consumers from diseconomies of scale. However, mainly in rural areas and mainly where there is no network to which connections can be made at reasonable cost, the remainder of the population is served by what are here termed 'private supplies' (see Annex 1; and generally, Section 3 below for definitions). These may serve single dwellings or communities of different sizes and may or may not include properties with public and commercial use. Here the quality of the water supplied is much more variable, with potential health consequences (DWQR 2015b). Where a public supply is available there may still be reluctance to connect, on economic grounds, for reasons of autonomy or otherwise. In Scotland, there is a well-established political consensus around the management and regulation of public supply. The distinction between 'private' and 'public' (and see Annex 1) was entrenched when public water services were removed from municipal control in the 1990s and restructured into first three regional authorities, and then a single national supplier. The municipal history led to some regional differences in terms of the retention of private supplies, where some rural authorities adopted significantly more supplies than others prior to restructuring.

Although the management models, regulatory and governance approaches, and the terminology, may vary considerably, similar problems were identified in almost every jurisdiction that we reviewed. Section 3 below analyses the different terminologies in use and explores some of the resulting inconsistencies.

2.0 Material and Methods

This project is designed to identify management practices and governance arrangements for small-scale rural water supplies, particularly in the European Union (EU), which might be of use in Scotland. In Section 3 we discuss some terminology and definitions. In Section 4 we briefly present theories of governance, the types of management models applying specifically to small water supplies, and how these models may be related to governance arrangements. Then we describe major practices towards the proactive and preventive management of small water supplies, especially around risk assessment.

In the next part (Section 5), we provide the legislative background which is the context of this review. We specifically focus on the key instruments of drinking water policy and governance in the EU, i.e. Directive 98/83/EC on the quality of water intended for human consumption, (Drinking Water Quality Directive, DWQ Directive) and Directive 2000/60/EC establishing a framework for Community action in the field of water policy, (Water Framework Directive, WFD). We also describe international guidance and practice around drinking water standards, and the principles of the human right to water. In Section 6 we present some key findings from our comparative review of practices in different EU member states (Annex 2), from our detailed case studies (Annex 3), and from the workshop (Annex 6) before drawing conclusions and making recommendations for Scotland. The Scottish situation is also presented (Annex 1).

Annex 2 provides an extensive comparative analysis of national legislative frameworks with respect to provisions for small water supplies; and then an analysis of examples from each type of management arrangement. This accounts for country-specific approaches towards safe water, by means of monitoring, treatment, risk assessment and enforcement, within legislative and governance frameworks. As a result of this work, we identified criteria for the selection of five case study countries for further detailed analysis, including the size of jurisdiction, the use of different water sources, the types of risk assessment adopted, and the availability of information. Section 6.1 presents some analysis and overall findings from this work.

Evidence was extracted from both peer-reviewed and grey literature. Computerised searches were performed using web-based search engines such as Google Scholar, Web of Science and ScienceDirect. The legislation and regulations were sourced from government websites and through the FAOLEX legislative database of the Food and Agriculture Organisation (Faolex n.d.), the online database of treaties, laws, and regulations on food, agriculture and renewable natural resources from all over the world. Finally, relevant dissertations, conference and workshop papers, and newspaper articles were consulted.

Searches for 'small-scale drinking water supplies' generated 78 results. The majority of these articles dealt with failures in microbiological parameters, technological advances in the treatment of specific contaminants, and land use or climate change pressures. We therefore modified our searches to capture terms used in policy and socio-economic fields, such as regulation, governance, management, decentralised, rural, community, municipal, cooperative, water safety plans and water framework directive. Reference lists of these articles were also reviewed to identify additional relevant documents. Overall, more than 500 articles, chapters from books, reports and dissertations were retrieved but many of them were analyses of performance, or

referred to small supplies but did not fit the European Union definition or the Scottish context. Documents in the websites of Ministries or associations of water experts or practitioners proved most relevant.

As well as issues of terminology (Section 3), literature searches revealed discrepancies and inconsistencies in the evidence reported by authorities and experts, including between official EU and national documents about policy implementation and regulation; academic research-based literature; and policy documents, including from the United Nations Commission for Human Rights (UNCHR), World Health Organisation (WHO) ,the United Nations Economic Commission for Europe (UNECE), as well as national bodies, especially Environmental Protection Agencies and Ministries. These discrepancies reflect (variously) gradual and ongoing policy and governance changes in the management of small supplies in Europe and internationally, and difficulties with data, as well as different reporting purposes and different agencies responsible for reporting, rather than conflict among the various experts.

The main discrepancies are related to:

(i) The definition of small water supplies. The defining criteria vary by country and authorship and may depend on population served, volume of water supplied, number of household connections, technical properties, and regulations, thus making comparisons difficult.

(ii) The number of small water supplies, which not only depends on the country-specific definition of small supplies but also on the context and purpose (research paper or policy report) of a document.

(iii) The terminology describing the management of small supplies. Terms referring to the same concept, type of supply or management vary not only by country but also by context and author. Notable examples include the use of the terms (i) 'private' and 'public' which may refer to management models or to ownership of assets; and (ii) 'individual self-supply', 'self-provision', 'private wells', 'individual wells', 'independent wells', 'household-centred management' and 'informal water services', which may describe the model of supply management, or refer to technical properties of a supply; and does not necessarily indicate that the supply is for a single dwelling.

With regard to these discrepancies and caveats, this report, and especially the comparative analysis in Annex 2, uses the terms and evidence as reported in the various original documents. The specific national legal and regulatory circumstances are explained on a case by case basis, where possible, to enable the variety of management practices to be better understood. Finally, only the legislation and national reports in English and French could be extensively covered in this review, the reports in the remainder of languages being accessed, where possible, through brief summaries and abstracts.

2.1 Interviews and Case Studies

The project specification identified five detailed case studies as one of the outputs, and these were chosen after the wider country comparisons had been undertaken. The case studies are presented in Annex 3, and summarised in Section 6.2. Interviews with specialists were also carried out, to confirm the material in the country case studies and to add depth to the findings. Interviewees were identified from amongst the academics, practitioners and NGO's active in this general area; and from regulators, practitioners and NGO's in the jurisdictions selected as potential case studies. The interview schedules are provided in Annex 4; we are grateful for the inputs of our interviewees. Ethical approval for the interviews was obtained from the University of Dundee Research Ethics Committee, who approved our participant information sheets, consent forms, interview schedules and preliminary emails.

The interviewees were provided with the reports of their interviews, and drafts of their specific case studies, for comment and review. They were then invited to the project workshop, and (whether or not able to attend) sent the draft report for comment. The draft report was also sent to other workshop attendees from relevant Scottish stakeholders. Following the workshop the report will be further reviewed to take account of the discussions (and comments received from those unable to attend, both our external participants and other Scottish stakeholders). We would like to thank all the participants for their engagement and hope they find the report useful.

3.0 Terminology and Definitions

There is no standard definition for small water supplies in the peer-reviewed and grey literature. 'Small' may be relevant to a range of concepts such as:

- Size, which may apply to population served, volume of water produced, or number of connections.
- Regulations, which may exempt (or apply different requirements to) certain types of supplies, based on size or other criteria.
- Technical properties, which mainly apply to the scale of treatment and protection measures and the use of piped network, or not; including concepts of improved and unimproved supply, and access to safe water, which may be limited because of location, cost, regulatory frameworks, and lack of awareness of public health risks.
- Resources, especially staff, expertise and budget, which may be limited and generate management and governance problems.
- Water supply models, including the group of people operating and using the supply.
- Terms such as 'public', 'private', 'community' and 'individual' supply are especially problematic and may mean different things in different contexts.

3.1 Size-based definitions

Size-based definitions as such classify water supplies mainly on the basis of population served or the volume of water provided per day or year. However, size-based definitions of small water supplies vary widely around the world. The Canadian National Collaborating Center for Public Health (2013) reports that around the world a water system may be defined as small on the basis of the number of connections to the system; the amount of water distributed (flow rate); the length of time the system is in use during the year; or the complexity of the system ranging from a simple well and pump to a system consisting of coagulation, filtration and disinfection.

The EU uses 'small supplies' for reporting purposes to refer to those serving up to 5000 people (Section 5) although there is no consistency across Member States (Annex 2). Table 1 shows some examples of this diversity.

Table 1. Size-based definitions of small water supplies around the world.	
Country	**Size based specifications** Population (volume/day)
EU	Small supplies: serving < 5000 people (< 1000 m^3/day) (European Commission 2015a) Very small: serving < 50 people (< 10 m3 /day) (Hulsmann 2005)
US	Small supplies: serving: serving < 3,300 people (US EPA 2016); < 10,000 (Ford et al 2005). Very small supplies: serving 25 to 500 people (US EPA 2016)
Canada	Small supplies are those serving (Pons et al 2015): <100 people at Prince Edward Island; <500 in Alberta and British Columbia; <1000 in Quebec <1500 people at Newfoundland
New Zealand	Neighbourhood supplies: serving 25-100 people. Small supplies: serving 101-500 people (NZ Ministry of Health 2016). (See also New Zealand case study, Annex 3.)

3.2 Regulatory Definitions

Regulation (legislation) establishes specific requirements for compliance with water quality standards, monitoring, reporting, remedial action and certain other provisions, and these may be variably applied to different classes of supply. Regulations may use size-based definitions to determine whether these requirements apply, or their frequency. For example, small supplies may be exempt or monitored less frequently, typically between one and four analyses per year. This may not be sufficient to enable potential non-compliance with microbiological standards to be detected and treated to minimise risks to public health. Annex 2 describes on a country-by-country basis rates of compliance with monitoring and quality standards across EU Member States, and types of remedial action taken to remove causes of non-compliance.

However, in some countries size has no bearing on such regulations, for example there may instead be different requirements for municipal and other supplies (see Section 3.2 below for 'municipal', and Annex 2 for examples) or for 'networked' and other supplies (see e.g. New Zealand case study, Annex 3).

3.3 Technical properties of a supply system

Definitions based on the **technical properties of a supply system** classify water supplies as 'centralised', generally referring to urban systems or rural supplies with the capacity to supply large volumes of treated piped water; and 'decentralised' systems, which usually refer to rural systems with the capacity for small-scale purification and distribution of water (Peter-Varbanets et al 2008). The UN has defined 'improved' and 'unimproved' water supply systems (UN 2006). Improved systems include piped water, water from public standpipes, protected wells and springs, rainwater and bottled water. Unimproved sources would be unprotected wells and springs, water from vendors and tankers, and from surface waters. Although many urban dwellers also suffer from unimproved water sources, decentralised rural systems may be inadequately protected at source, relying on ineffective treatment systems and poorly maintained infrastructure and exposing users to the effects of livestock, farmland runoff, sewage overflows and any other sources of contamination. Systems that are improved and more likely to provide safe water from source to tap, include centralised systems and small supplies using groundwater, such as boreholes and wells; having a protection zone around them; and distributing water through a well maintained piped network. An indirect way of assessing the state and number of small water supplies is by measuring access of the rural population to **improved, mainly piped, water systems** (Rickert & Schmoll 2011; Brown et al 2013; Shaheed et al 2014). The percentage of population with access to improved water supply sources was used for tracking progress towards the drinking water target of the Millennium Development Goals (MDG), to halve, by 2015, the proportion of people without access to safe water (WHO/UNICEF 2010).[1] The latest report shows that on a global scale, only 16% of the rural population and 4% of the urban population had no access to improved drinking water supplies (WHO/UNICEF 2015). As of studies completed by 2010 the proportion of the rural population without access to improved drinking water sources ranges from 0% to 4% in EU Member States and countries in the European Free Trade Area, and from 0% to 29% in South East Europe and the Eastern European, Caucasus and Central Asian countries (Rickert & Schmoll 2011).

With respect to **access to safe water**, problems may be greater. Shasheed et al (2014) warned that international metrics such as access to improved water systems 'should be interpreted with great caution' because awareness of risks and measures to protect public health from source to tap are limited, especially in many rural areas. The UN Human Rights Council (2013) estimated that twice as many people may not have access to 'safe' water, as an improved supply source may not be maintained properly over time. In addition, access of the rural population to information and participation in decisions applying to water services may be limited; Section 4.1 outlines governance approaches to tackle such challenges. Section 5.5 explains that access to safe water for all is a State obligation under international law and the human right to water.

3.4 Availability of resources.

Availability of resources - technical, human and financial – required to operate a water supply sustainably and ensure safe water, has been considered to be the defining problem distinguishing small from large supplies by international groups of experts, regulators and practitioners (Ford et al 2005; Sinisi and

[1] Indicators for the new Sustainable Development Goals (UN General Assembly 2015, 'Agenda 2030') are currently being developed (and see Section 5.5). Access to water and sanitation remains a priority for the 'water goal'; Target 6.1 requires states to 'achieve universal and equitable access to safe and affordable drinking water for all'.

Aertgeerts 2011). Eureau (2011) outlined a range of problems that may apply to water supplies in the European context and include low awareness of public health risks, greater vulnerability to contamination, inadequate treatment technologies, outdated infrastructure, non-compliance with water quality standards, inadequate or infrequent monitoring and reporting, lack of risk assessment and management, and limited political attention and financial support. These problems may apply to all water supplies regardless of population or volume or water served, regulations, and technical properties (Ford et al 2005; Sinisi and Aertgeerts 2011, Eureau 2011).

Population base may be critical. The principle of economy of scale (i.e. the greater the number of connections, the lower the per-unit cost) favours centralised and standardised solutions for the operation and management of water supplies. Large, centralised systems have higher revenues from their consumers/customers, who may number in the many thousands in each supply zone; thus can afford to put integrated protection measures in place, such as multistep treatment systems, back-up measures, strategic planning and frequent monitoring practices; and invest in the best possible infrastructure and staff. On the other hand, public and community supplies with a small population base and private/individual water supplies may get trapped in the circle of the 'three lows' (Box 1).

Box 1. The circle of the 'three lows' for small supplies

Small supplies may get trapped into the circle of the 'three lows':

- Low revenue / income.
- Low investment e.g. on infrastructure, monitoring, expertise.
- Low quality of service.

Public or community supplies with a small population base receive low levels of revenue relative to costs and thus typically struggle to break even and under-invest. The resulting low quality of service cannot justify raising water rates, or investing in 'invisible' tasks for consumers, such as:

- Upgrading infrastructure (from source to tap).
- Monitoring and reporting in compliance with regulations.
- Improving sampling equipment and analytical methods. Transport of samples to a certified laboratory may be an extra cost and difficulty, especially if there is no certified laboratory in the vicinity of a supply.
- Funding staff training.
- Conducting risk assessments.

At a single-household level the low revenue may refer to low household income, which may result in low investment for treatment, monitoring, and maintenance and, subsequently in poor drinking water quality. In some cases, increased water pricing applying to those connected to piped water systems is leading poor people, especially in small communities and rural areas, to use old, unsafe wells. The cost for treatment, maintenance, monitoring, and risk assessment depends on local hazards, users' awareness and the regulations applying to individual supplies (e.g. exemptions, subsidies, and registration requirements).

Source: Bakker 2003; Ford et al 2005; Sutton 2009; Sinisi & Aertgeerts 2011; WHO 2012.

Water supply models have been extensively used for classifying water supplies on the basis of ownership, management and use (see Section 4.3). In this respect, the WHO (see Sinisi & Aertgeerts 2011) and the UN (see Rickert & Schmoll 2011) classify small-scale water supplies in three categories: **public, community, and private/individual supplies.** However, these terms bring their own problems (3.5 below). Water supply models are analysed in Section 4.3 in the wider context of water governance, and described on a country-by-country basis in Annex 2, using the terms as they were found in national literature.

3.5 Public, Private, Community-Based, Individual

In the EU and internationally, water services assets are usually publicly owned, and these are often the responsibility of municipal government. Many small supplies are municipally owned and operated. In some countries, the operation of such supplies may be contracted to the private sector in a variety of ways; and municipalities may join together to provide water (and other) services (below, and Annex 2).

Small supplies may alternatively be owned and / or operated by either householders and / or property owners, or collectively by local communities. In such a case the assets may be owned privately, either individually, by several property owners jointly or in common, or owned by a community 'vehicle' such as a cooperative. The terminology will vary according to the legal regime in different jurisdictions. Further, some 'community' schemes in rural areas, although technically involving private ownership, will bear much more resemblance to small municipal schemes.

Finally, there may be properties with an individual supply, such as an individual well, where the infrastructure will be solely owned by that property. Management models (Section 4.3 below) also use these terms, not always with reference to ownership of assets.

Some authors caution that the categories of public (or state), private (or markets), and community, are unhelpful. As Bakker (2010: 45) noted the term 'private' is misleading, as it mistakenly groups under the same category the following:

- Private, as in 'for-profit', large-scale water companies providing centralised water services.
- Small-scale (private) entrepreneurs who build stand-alone micro-treatment systems as water vendors or individuals who own and operate small-scale water supplies for residential developments in peri-urban or rural areas.
- Community groups, religious associations, cooperatives, and non-governmental organizations, active in water supply, particularly to the poor and to rural unserved areas but are not-for-profit.
- Individuals who own a water supply for their own domestic (private) use.

Equally misleading may be to conflate the term 'public' with the piped network provided by the central or local governments (municipalities) - or private companies - as it obscures collective forms of action (such as provision of treatment facilities and piped networks) mediated by community groups and cooperatives (Bakker 2010). In addition, it is unhelpful to conflate community (or communal) water supply operation with community-based water supply governance, the latter referring to the involvement of consumers and community members to decision making about the social, financial and ecological aspects of water supply management (Bakker 2008).

In this context, the system in Scotland is unusual but not unique (Annex 1); there is a single public sector provider, for most of

Scotland. Remaining properties are 'private supplies' and may be served by some form of community system, or there may be individual self-served properties. Scotland is also unusual (but not unique) in that the public supplier is vertically integrated and responsible for the whole cycle, from bulk abstraction to wastewater discharge.

The terminology (and politics) around 'privatisation' is just one area of confusion here; in the wider literature this tends to refer to some form of private sector participation in the delivery of larger urban services.

Further complications arise in relation to England and Wales, where the entire asset base of the public system was divested after 1989; yet that network is still described (and properly understood) as the 'public' system, whereas remote rural communities would be described as having 'private' supply as the term is used in Scotland. This is compounded by literature referring to 'the UK', although the structures are quite different between the constituent jurisdictions. In that context, definitions regarding small supplies as only those provided independently of the public network (e.g. Clapham 2004), are largely misleading.

In this report, we have adopted the approach of the EU, which is to define 'small supplies' to mean supplies serving fewer than 5000 people or less than 1000 m3 of water per day (European Commission 2014a; European Commission 2015a). We will use the term 'very small supplies' to mean supplies serving fewer than 50 people or less than 10 m3 of water per day, and are not related to a commercial or public activity, as there are specific exemptions for supplies of this size in EU law (Section 4.1 and 4.2). Evidence shows that these supplies may not be properly monitored or may not deliver drinking water complying with the quality standards under the DWQ Directive (European Commission 2014a; European Commission 2015a). If we are discussing a jurisdiction that gives different specific meanings to these terms, especially in Annexes 2 and 3, the terms will be defined and used in that context.

4.0 Delivery of water services: governance and management arrangements, and risk assessment

As with any service, there are key elements that are required to deliver water services. In the context of local water services, with a small population base, these elements include (de la Harpe 2009):

- **Creating an enabling environment**, which may include establishing: water tariffs; standards of services; conditions for discontinuing /providing services and connections; subsidies; and how services are installed, operated, protected and inspected.

- **Planning,** which should include addressing: number of users and their location and needs; number of people currently without access to safe water; existing and potential future infrastructure and water resources, and arrangements for monitoring and evaluation.

- **Finance**, which includes mechanisms and decisions that influence financial viability of water services such as tariff structure, subsidies, investment choices, and financial management.

- **Institutional arrangements**, which refers to the range of entities that are involved in the provision of water services.

- **Infrastructure**, which is one of the greatest challenges facing a water supply, and refers to the processes required to maintain and extend existing water (and sanitation) services.

- **Regulation**, which aims to ensure that services comply with minimum national standards and with policies and by-laws.

Governance may include all of these elements. The definition of governance depends on the economic, legal and environmental context. In general, governance relates to decision making at different levels from governments and organisations to individuals through a range of processes and mechanisms. Systems of governance range from centralised, top down approaches to local, decentralised and participatory approaches (Wilde & Nahem 2008). The concept of 'good governance' is also context specific (de Boer et al 2013: 15). In the EU context, the concept of governance assumes, among others, that hierarchical power exercise is increasingly complemented with more involvement of citizens and more effective definition of policies and legislation, as advocated by the White Paper on European Governance (European Commission 2001); and solutions with horizontal effects to adjust government interventions to real social needs (Grzeszczak 2015). In the water services context, Bakker (2010: 45) suggested that a key point to consider is what governance arrangements might more effectively be associated with one form of water supply ownership and management than others.

In this respect, Section 4.1 gives a brief account of governance principles and Section 4.2 outlines ideas of good governance. Section 4.3 then identifies models of water supply management to help understand and compare the water supply governance and management arrangements across the EU and internationally.

4.1 Governance definitions and principles

Governance is essentially a political concept and has been extensively defined (e.g. World Bank 1994; United Nations Development Programme (UNDP) 1997; UNDP 2004). The Global Water Partnership defined water governance as the range of political, social, economic and administrative systems that are in place to develop and manage water resources, and the delivery of water services at different levels of society (Rogers & Hall 2003).

The **Institute on Governance** grouped the UNDP principles of good governance in five broad categories: legitimacy and voice; good performance; strategic vision; accountability and transparency; and fairness (Graham et al 2003). The Institute on Governance linked the good governance principles of legitimacy and fairness with key clauses in the United Nations Declaration of Human Rights adopted in 1948 and international human rights law (see Section 4.4).

de la Harpe (2009) noted that governance shapes the way water services are planned, managed and regulated within a set of political, social and economic systems to ensure sustainability. Local governance for water sanitation and hygiene (WASH), in particular, can filter through day-to-day tasks in a small water supply to ensure that sufficient financial resources are available through pricing and funding; water resources are protected through political decisions on land use; water quality is adequately monitored; infrastructure is audited; and water supply duties and consumer rights are clear to those involved. Local governance for WASH varies from country to country depending on the framework of delivering WASH services. Specific areas to improve governance include:

- **Advocacy and communication.**
- Structures for **participatory strategic planning**
- Assembling, storing and sharing **knowledge and information**
- Financial mechanisms which include cost recovery and

innovative methods of finance Capacity building
- **Transparent, gender sensitive** and **equitable** decisions.
- Ensuring an **enabling environment for service provision,**
- Systems and procedures for **accountability in monitoring, evaluation and reporting,**

Several authors caution that governance is not a synonym for government (Rhodes 1996) and distinguished water governance from government activities, especially, regulatory compliance (Bakker 2010: 47; Wiek and Larson 2012). Ansell and Gash (2008) linked water governance to collective actions from a wide range of stakeholders aimed towards a common goal. Bakker (2008 and literature cited therein) concluded that ownership is less important than institutions (rules, norms, and laws) and the implementation of good governance principles. Bakker (2010: 47) added that 'the institutions we chose for managing water supplies and the principles that support these institutions play a powerful role in shaping the governance process and in determining the likelihood of equitable and sustainable outcomes.'

As regards outcomes, local, decentralized (or devolved) water supply governance has many advantages with respect to good governance principles such as enhancing local expertise, which can improve the quality of decision making; adjusting regulatory processes to local conditions; and offering greater opportunities for information sharing, trust among stakeholders and, therefore, enforceability (Bakker 2008; de la Harpe 2009; Hall and Lobina 2010). However, it is not a panacea. Balancing financial imperatives (i.e. cost recovery) with social needs (i.e. affordability of water tariffs and universal provision of safe water) and environmental sustainability, remains the major goal of water governance. Multilevel governance is unavoidable: as Bakker (2010: 211) suggested 'governments are best able to carry out the coordination required.' In addition, local governance for improved water services requires transformation at local level with the active support of institutions and policy makers at regional / provincial and national level (de Harpe 2009).

4.2 Good Governance

There is also an extensive literature on 'good governance', and the allocation of responsibilities and relationships between stakeholders for tasks and practices required for good governance (Bakker 2003). For 'good water governance', Rogers and Hall (2003) considered features such as inclusiveness, predictability, accountability, transparency, participation, equity and ethics, coherence, efficiency, responsiveness, and sustainability. Garcia-Quesada (2011) analysed how transparency, public participation and access to justice apply in different regulatory frameworks.

Likewise, but in the narrower context of local governance for WASH, de la Harpe (2009) suggested that the basic characteristics of good governance are met when:

- There is **participation** of all stakeholders;
- Decisions are taken in a **transparent manner**, with access to information;
- There is **equity**;
- **Fair legislation** is implemented with full protection of human rights;
- Services are **responsive**;
- Broad **consensus** is achieved about how to achieve sustainable services;
- The needs of society are met **efficiently and effectively**, with sustainable use of national resources where the institutions of government are capable;
- There is **accountability** for decisions.

The next section outlines water supply models and the potential relations between governance and different management models.

4.3 Water supply models

Distinct water supply models must cover both large-scale urban utilities and smaller and rural supplies. In general, the term refers to descriptions of the ownership and organizational structure, and allocation of responsibilities and risks for operational management and/or infrastructure maintenance and improvement of a water supply (Bakker 2003). Garcia-Quesada (2011) identified urban water supply models on the basis of ownership and management for good governance, and described as 'ownership' the possession of rights over water resources, infrastructure and the water assets; and as 'management' the daily activities for the provision of water services – abstraction, transportation, quality control, distribution, collection of water. Von Montfort et al (2014) identified water supply models on the basis of urban socio-political domains (i.e. public, private and community) and legal context to help determine which governance conditions have to be met for a specific water supply model to be successful. Peter-Varbanets et al (2008), Sutton (2009), Sinisi & Aertgeerts (2011) and Rickert & Schmoll (2011) defined specifically small water supply models on the basis of organisational levels in rural societies i.e. the public, private (e.g. individual entrepreneurs), community and household levels.

Water supply can be categorised in four broad models:

- The **public- or government-based model** -Bakker 2003; Techneau 2007; Bakker 2010; Garcia-Quesada 2011; Rickert & Schmoll 2011; Sinisi & Aertgeerts 2011; van Montfort et al 2014).
- The **private or market-based model** (Rogers and Hall 2003; Techneau 2007; Bakker 2010; Garcia-Quesada 2011; van Montfort et al 2014).
- The **community-based model** (Bakker 2003; Bakker 2008; van Montfort et al 2014).
- The **household-centred model** (Sutton 2009).

Not all of these models exist everywhere, and different models may exist at any point in time within the same country (see Annex 2). To define and understand small water supply governance and management arrangements a number of core questions must be explored referring to who has, or should have, the responsibility for policy-making and legislating; implementing regulations about monitoring, reporting and quality standards; and carrying out operational activities from treatment to maintenance, including training for operators. In addition, it is crucial to understand who participates in decision making for strategic plans and daily activities and who evaluates the outcomes. The next paragraphs outline the way these responsibilities and relationships are arranged to form distinct water supply models, with the emphasis being on small water supply arrangements.

The public- (or government-) based model refers to supplies (utilities) that are owned and regulated by central, federal or local government, e.g. a municipality or groups of municipalities. Often, this type of management refers to consumers/users as citizens (Bakker 2016: 198). **Annex 2** describes in detail how certain countries in the EU and internationally have tailored this type of management for small water supplies in the context of their drinking water policy frameworks. This model may refer to the following operational arrangements:

- **Direct public management,** in which water supplies are operated directly by public authorities; this applies to many rural municipal and inter-municipal water supplies in Scandinavian countries (Mattison & Thomasson 2010; Sorensen 2010; Gunnarsdottir 2012); France (Levraut et al 2013); Austria (Klein 2009); and other European countries (DWP-Czech Republic 2015; GWP-Poland n.d.).

- Delegated public management, in which supplies are

operated by not-for-profit entities which are appointed or created by the public authorities to run the supply; this applies to rural municipal and inter-municipal water corporations in Germany (Profile of the Drinking Water Sector 2015); Estonia (EEA 2013), Italy (EEA 2013) and many Balkan countries (DWP-Slovenia 2015; DWP-Serbia 2015; DWP-Bulgaria 2015). In certain countries small rural supply zones are operated by central government corporations, e.g. Scottish Water has the operational responsibility for 140 small supply zones over Scotland (Scottish Water 2015).

- **Delegated private management** (also described as Public-private partnerships, PPPs), in which supplies are operated by private (for-profit) companies, subcontracted by public authorities, often through lease or **concession contracts.** This is more commonly used for the management of larger, usually urban, supplies. For example, PPPs are in place for supplies serving more than 3500 people in France, as reported by Levraut et al (2013a); or in Scotland, for large wastewater treatment plants. In rural areas it may be found in jurisdictions under weak public administration in rural areas of British Commonwealth countries (Kleemeier & Lockwood 2012) and the Midwest states in the US (Dziegielewski & Bik 2004). This type of management **is not further explored in this review.**

The **private-, or market-based model** refers to infrastructure owned and operated by private (for-profit) companies; Government retains its regulatory role. This is also known as direct private management. This may refer to consumers/users as customers (Bakker 2016: 198). This model is more common for large urban networks (utilities) in densely populated areas, as in England, than for small supplies serving small communities in sparsely populated, rural areas. However, in the Midwest US, 38% of small supplies have been fully 'privatised' (CPWS US/WST Board/DELS/ NRC 2002; Dziegielewski & Bik 2004). Given that this type of management is not common in rural areas and for small supplies, direct private management is not further explored in this review.

The **community-based management model** mainly refers to consumers as community members (Bakker 2016: 198). A major prerequisite for a water supply to be managed by community members is the involvement of civil society organisations (grassroots) in the ownership and operation of the water supply (Heivo & Anttiroiko 2014; van Montfort et al 2014). Civil society may include non-governmental organizations (NGOs), community-owned corporations, social movements, volunteer groups and cooperatives. The model will work best where the members of the community owning and operating the supply are linked through common values and principles, such as voluntary and open membership; democratic decision making; economic participation of all members; training and sharing of information among members; cooperation among members within and between communities; and concern for common water-related problems (see for example Heivo & Anttiroiko 2014; van Montfort et al 2010).

Annex 2 describes in detail community-based models in EU Member States and some international comparators. **Civil society** may be involved in the management of a small water supply in a range of ways, as follows:

- **Through claiming ownership of drinking water sources and water supply facilities and operating and monitoring the water supply system using the community's own human, material and financial resources** (Bakker 2003; van Montfort et al 2014). This is practically a form of self-governance and is possible when the source of water is under state ownership as discussed by Montfort et al 2014. Across the EU this management model is found in Finland and Austria.
- **Through partnerships between civil society (e.g. cooperatives) and a public entity (e.g. municipality, central state, public water corporation),** with the public entity facilitating and supporting financially the initiatives taken by the community to build new infrastructure, improve existing infrastructure, or train the operators of the community supply (Montfort et al 2014). Hall et al (2009: 6-9) refer to this type of partnership as a particular type of public-public partnerships (PUPs) and report that in Latin America members of civil society organisations participating in such partnerships see 'PUPs as a technical tool and at the same time a political tool for those working towards effective public water delivery and the universalisation of water services'. Across the EU, civil society-public partnerships can be found in countries including Finland, Austria and Ireland.
- **Through partnerships between** civil society (e.g. NGOs, cooperatives) and a private (for profit) company (van Montfort et al 2014). This type of management refers to small-scale projects in underdeveloped regions with the aim to increase awareness, empower communities and ensure access to safe water through affordable technology.

The **household-centred management model**, also described as 'self-provision', or 'self-supply', refers to simple improvements to water supplies that households or groups of households can finance and execute by using lower-cost technologies (Koppen et al 2007: 67; Sutton 2009). These may include a range of initiatives relating to: simple in-house water treatment; supply construction (e.g. hand-digging of wells, borehole drilling, constructing water intake from rivers or ponds) and upgrading (e.g. deepening or lining wells); rainwater harvesting; and other investments such as storage, source protection and household water treatment and monitoring. In this regard, Peter-Varbanets et al (2009) distinguished two types of household-based water treatment and monitoring: (i) point-of-use (POU) systems, when the treatment and monitoring are applied on the part of water used for drinking purposes (e.g. kitchen tap); and (ii) point-of-entry (POE) systems, when the treatment and monitoring are applied on all the water supplied to a household.

A defining characteristic of the household-centred model is its placing **the household in charge of water provision** and, as such, it is a form of self-governance (Sutton 2009). Self-provision has the potential to support higher levels of treatment, or service in general, than are presently provided by a formal water provider, i.e. a provider under the direct influence of financial and water quality regulations in a specific country (Koppen et al 2007: 67; Sutton 2009). As a result, self-provision has also been identified with the range of informal water services provided out with a utility or community-operated supplies, as for example in the recent report of the Danube Water Programme (DWP) on the state of water and sanitation services in EU member states and other Eastern European countries in the Danube Region (World Bank 2015).

Self-provision is more common in the developing world with more than 20% of the population relying on household-centred services in several countries of Africa, Asia and Latin America (Koppen et al 2007; Smits and Sutton 2015); however, it is not uncommon in the developed world. Again, the terminology is variable – for example the figure for Scotland below refers to all non-public supplies of any scale. It may, or may not, refer only to a supply serving a single household. It may also be used in specific reporting contexts, where it may be differently understood by regulators or policy makers completing such reporting.

- In Hungary 6% of the population relies on private wells (DWP-Hungary 2015).
- In **Germany** approximately 700,000 people use water from about 185,000 private wells (Federal Republic of

Germany submission to OHCHR n.d.).
- In the **US** 15 million households or 14% of the population rely on private wells in rural areas (US EPA 2015).
- In **Scotland** about 3.5% of the permanent population relies on self-provision (DWQR 2015b).

Annex 2 explores how household-centred supplies are operated on a country-by-country basis. Generally, self-provision from source to tap (i.e. intake infrastructure, distribution, treatment) may refer to two contexts of very small supplies (i.e. supplies serving fewer than 50 people):

- **Supplies serving a single (domestic) property;**
- Supplies serving **more than two households or a commercial/ public property** in rural areas where properties are not connected on the public mains or a community-operated water supply. In developing countries, e.g. central Africa, this may refer to family wells shared by a few households (Butterworth et al 2013). In developed countries, a well may be used by neighbouring households that use their own financial resources separately to distribute, treat or store water for their single-household needs, as described by Hulsmann (2005) for very small supplies and Sinisi & Aertgeerts (2011) and Rickert & Schmoll (2011) for private/ individual wells.

Distinguishing between the household-centred model (self-provision) and the community-based model of water supply management may be difficult in certain cultural or regulatory contexts. For example, a very small supply defined as such on the basis of size-based and legal/regulatory criteria, e.g. serving fewer than 50 people, may be managed under the municipal-based model; the community-based model; the household-centred model; or a combination of them, e.g. when water is not centrally treated, a household may be connected to a piped network and rely on household-based treatment.

In the context of small supplies, the public and community-based models have the highest potential to fit the good governance principles reported in Section 4.2 (Bakker 2003; Bakker 2010: Table 1.1 and 1.2).

Finally, Smits and Sutton (2015) asserted that the **household-based model** has the potential to meet these good governance principles, provided that:

- **Governments recognise self-provision as an alternative service delivery** model and incorporate it into rural water supply strategies;
- **Civil society organisations raise awareness of self-provision as an option** and help link governments or potential investors with support services for microfinance, construction, equipment and training
- **Investors recognise self-provision as a valid approach** that requires some degree of **investment in private sector development in rural areas**, to enable affordable technologies to be installed.

4.4 Effective management and risk assessment

The Framework for Action guidance document for the management of small supplies across EU (European Commission 2014b) identified four practices, which have the potential to enable greater accountability, transparency and traceability of the problems that need to be fixed:

1. All small supply locations, owners and operators should be registered with the local and national regulatory authority.
2. The information in this register must be standardised to enable a coordinated management of water services at the local, regional, and national level.
3. Risk assessment and management plans should be implemented to help detect and eliminate the causes of failures in a small supply system.
4. Records should be kept to demonstrate that drinking water is safe for the population served by small supplies.

The range of risk assessment approaches is described in Section 4.5. Annex 2 describes whether and how these practices mentioned above apply to different management models on a country-by-country basis.

Figure 1. Practices to improve the management and governance of small water supplies.

4.5 Risk assessment and management approaches

Over recent years, the water utility sector has increasingly adopted holistic and proactive approaches to assessing and managing risks to public health. A mind-set of producing rather than only testing quality is gradually spreading. Of course end-point monitoring to ensure that water is safe is part of risk assessment, but it is not preventative. Assessment of all potential risk factors will help target available resources (e.g. budget, training) towards tackling the problem and making sure that the supply provides safe water all the time. Treatment and monitoring can be targeted where or when there is higher contamination risk, to help early detection and fixing of problems. The great variety of approaches to risk assessment in the drinking water sector reflects differences in local hazards but also in governance arrangements (Hulsmann & Smeets 2011). Here we briefly discuss four major approaches in the context of small systems:

- The Hazard Analysis and Critical Control Point (HACCP) approach
- The multiple barrier approach
- Water Safety Plans (WSPs)
- The quantitative microbial risk assessment (QMRA).

4.5.1 The HACCP approach

The food industry has adopted a food quality and risk management approach, known as the **Hazard Analysis and Critical Control Point (HACCP)**. HACCP plans aim to prevent or reduce the health risks from hazards associated with food processing (Box 3). In certain countries drinking water is classified in legislation as a foodstuff, therefore HACCP plans must be developed and implemented. A challenge relating to small supplies may be that HACCPs require additional resources and trained staff, conditions that cannot always be met especially in supplies serving small villages (Gunnarsdottir 2012).

Box 3. What is the Hazard Analysis and Critical Control Point (HACCP)?

HACCP aims to eliminate influences that result in food borne diseases in humans. Based on the Codex Alimentarius Commission there are seven key principles for implementing a HACCP:

1. Identify hazard during the production, handling, treatment, transportation and storage of foods.
2. Determine the critical control points (CCP), i.e. controls required to prevent or reduce a hazard.
3. Establish critical limits, i.e. maximum or minimum values.
4. Establish a system to monitor CCPs.
5. Establish the corrective action to be taken when CCPs are not effective.
6. Establish procedures for verification to confirm that the HACCP system is working effectively.
7. Establish a system of documentation and reporting all HACCP procedures.

A prerequisite for the implementation of the seven HACCP steps in the water industry is to include the so-called Supporting Programs, which ideally should be in place prior to embarking on the HACCP approach, and include:

- Staff training and certification programs.
- Distribution system maintenance programs.
- Standard operating procedures.
- Emergency response programs.
- Quality assurance programs
- Data management systems
- Customer relations programs.
- Calibration of monitoring systems.

According to the EU's Regulation (EC) No 852/2004 on the hygiene of foodstuffs, the application of HACCP in food production is obligatory

Iceland, Slovenia, Sweden, Switzerland, and Georgia regard drinking water as a foodstuff and therefore use the HACCP approach in drinking water regulation, i.e. water treatment plants are run like a food production unit.

Source: FAO / WHO Codex Alimentarius Commission 1997; Girsberger 2003; Slovenia's Act Regulating the Sanitary Suitability of Foodstuff 2003; Martel et al 2006; Gunnarsdottir & Gissurarson 2008; Livsmedelsverket 2015.

4.5.2 The multiple barrier approach

The multiple barrier approach was developed specifically for the drinking water sector. The multiple barrier approach requires a coordinated set of programmes, an appropriate set of requirements as well as technical and managerial barriers between the potential threats and the consumer (Table 2). This approach is implemented at a government level, regional and local, in **Germany** (Profile of the German Water Sector 2015), **Australia** (National Health and Medical Research Council, 2011, last updated 2016), **Canada** (Health Canada, 2013), and the US, (US EPA n.d).

The advantage for small water supplies and especially for the population relying on self-provisioning is that water sources are protected, catchment hazards are addressed, and there is plenty of guidance and information for the citizens. Water quality standards however **must be enforceable for small water supplies** to enable the benefits of the multiple barrier approach to be realised (Boyd 2015: 136).

Table 2. Steps of the multiple barrier approach to risk assessment and management	
Type of Barrier	**Tasks**
1.Risk prevention	The focus is on catchment processes through: • Identifying potential sources of contamination from man-made and natural factors in the catchment area and identify associated risks • Monitoring drinking water resources and pressures in the catchment. • Developing control measures and appropriate protection strategies.
2. Risk management	The focus is on water supply asset management to: • Ensure that treatment facilities meet at least the minimum design and construction standards. • Ensure that treated water meets drinking water quality standards. • Ensure that the water works operators are properly trained. • Develop emergency plans, and response plans and procedures.
3. Monitoring and compliance	The focus is on monitoring the water in consumers' taps in order to: • Detect problems • Demonstrate compliance • Assess the effectiveness of the treatment process.
4. Individual action	The focus is on consumer awareness and participation through: • Quality and performance reports explaining condition of the entire water supply system from catchment to tap. • Early notifications of potential public health risks. • Reports by the general public on identified problems.

4.5.3 Water Safety Plans

In 2004 the WHO outlined the Water Safety Plan (WSP) approach, a comprehensive risk assessment and risk management framework for safe drinking water (now WHO 2011). There are some similarities between the WSP approach and the multiple barrier approach; some formulations of WSPs look and sound very similar. Multiple barrier approaches may focus more on catchment protection, and WSPs may focus more on training the community to manage the supply infrastructure. The WSP approach draws on the HACCP and the multiple barrier approach and therefore encompasses all steps and procedures in water supply from catchment to consumers' point-of-use (tap). A WSP manual (Bartram et al 2009), has identified the short-, medium- or long-term procedures that must be implemented by large water supply operators. WHO (2012) has also provided a manual for the development of the WSP approach in small community-operated supplies (Figure 2).

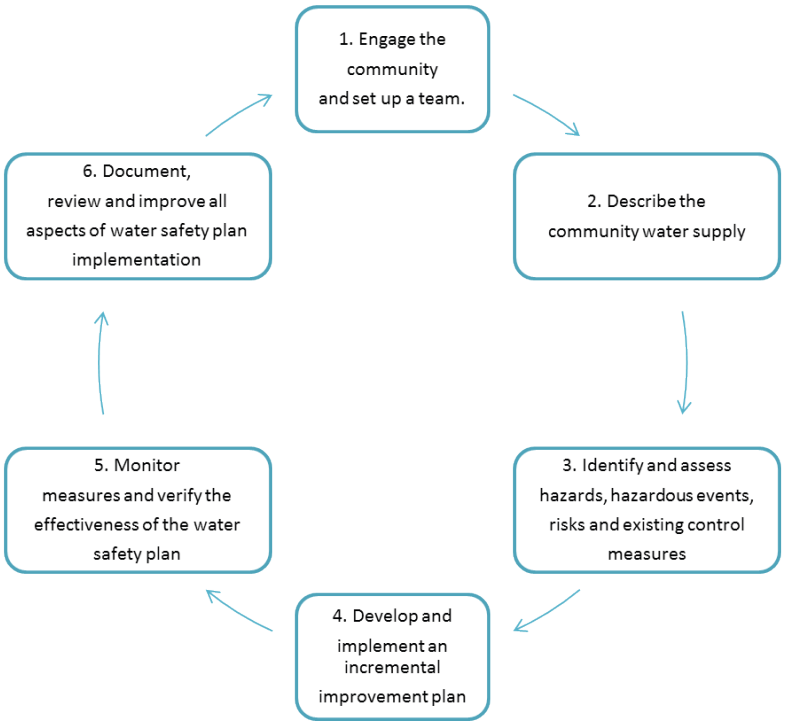

Figure 2. Key steps in developing Water Safety Plans for small communities. Source: WHO (2012).

In New Zealand for example, the WSP approach underpins the whole system for drinking water quality at every scale – see the case study, Annex 3. The EU has also recently adopted the WSP approach, recognising that end-point monitoring may not be needed in cases where risks for public health have been minimised by appropriate operational tasks (Directive 2015/1787, amending Annexes II and III to Directive 98/83/EC on the quality of water intended for human consumption). However, the benefit for very small water supplies is unclear as the general exemptions for monitoring and reporting for very small supplies are still in place; see Section 5 below.

The following recommendations for effective development of the WSP approach in small water supplies have been added by Eureau (2011):

- Health authorities should be actively involved.
- A culture of collaboration among supply managers should be developed.
- Best practices, which are usually low-cost, should be promoted and targeted.
- The budget required should be guaranteed in the outset of planning the WSP approach.
- External auditing should aim to improve, if needed, the WSP approach already in place.
- A common, national policy must be in place, for all involved in the supply of safe water.

A European Strategic Workshop on Water Safety Planning (WHO 2014) provided evidence that regulators and water sector experts regard the WSP approach as a managerial instrument for a day-to-day operation of a water supply rather than a catchment-wide policy instrument, such as WFD, or catchment-wide interventions, such as the multiple barrier approach. The Workshop report noted that there are more obstacles to implementing a WSP in small supplies, mainly lack of resources (human, technical, financial); and therefore small supplies especially need an enabling environment. However their simple structures make the development of WSPs easier, and often the benefits are pronounced.

The UK jurisdictions have embedded the WSP approach in the legislation for small supplies in the form of a requirement for local authorities to carry out a risk assessment (see the Private Water Supplies (England) Regulations 2009 (SI 2009/3101) reg. 6; Private Water Supplies (Wales) Regulations 2010 No. 66 (W.16) reg. 6; Private Water Supplies (Northern Ireland) Regulations 2009 (SI 2009/413) reg. 7; and Private Water Supplies (Scotland) Regulations 2006 (SSI 2006/209); and on Scotland, see also Annex 1.

4.5.4 The Quantitative Microbial Risk Assessment

The Quantitative Microbial Risk Assessment (QMRA) approach applies the principles of risk assessment to estimate the consequences from a planned or actual exposure to infectious microorganisms (Haas et al 1999; Medema et al 2006; Petterson & Ashbolt 2016). A notable example is the Dutch approach to safe drinking water, which includes the five steps described by Haas et al 1999; Smeets et al 2009:

- **Step 1:** Selection of the best sources available, in order of preference:

a. Microbiologically safe groundwater.
b. Surface water with soil passage such as artificial recharge or bank filtration.
c. Direct treatment of surface water in a multiple barrier treatment.

- **Step 2:** Water treatment using physical processes such as sedimentation, filtration and UV disinfection. If it cannot be avoided also oxidation by means of ozone or peroxide can be used, but chlorine is not used.
- **Step 3:** Prevention of microorganisms entering the distribution system.
- **Step 4:** Prevent microbial growth in the distribution system by production and distribution of biologically stable water and the use of biostable materials.
- **Step 5:** Monitor for timely detection of any failure of the system to prevent significant health consequences.

To sum up, the drinking water sector is increasingly adopting risk assessment approaches towards providing safe water. There is great variation between and within countries because of specific hazards and circumstances. In addition, there is a tendency towards integrating elements from different approaches. For example, HACCPs can be combined with the WSP approach, as in Sweden and Latvia, and the QMRA approach can support the WSP and the multiple-barrier approaches, as reported by Petterson and Ashbolt (2016) and WHO (2013). Nevertheless, and despite the benefits of all risk assessment methods, two major approaches are more relevant to the context of small and very small supply management: the HACCP approach and the WSP approach.

5.0 Legislative Frameworks for Drinking Water Quality in the Context of Small Supplies

5.1 The EU Drinking Water Quality Directives

The first EU Drinking Water Quality (DWQ) Directive was made in 1980 (Directive 1980/778/EEC) and was substantially revised in 1998 (Directive 1998/83/EC). It has recently had some minor amendments made (Directive 2015/17 87/EU); these are not yet in force but affect risk assessment and specifically refer to the WSP approach. In this section and this report, the 'DWQ Directive' is used to refer generally to the rules currently in force.

The DWQ Directive applies specific technical parameters for water supply (Annex A) which must be complied with to ensure that the water supplied is 'wholesome and clean' (Art.4). It requires that Member States monitor, relative to the size of supply, the quality of water intended for human consumption (Art.7) and ensure that adequate and up-to-date information for consumers is published every three years (Art.13).

The EU identifies supplies serving fewer than 5000 people or supplying less than 1000 m^3/day as 'small supplies' (European Commission 2014b; European Commission 2015a). This is relevant to monitoring and reporting, but not to the applicable parameters (Art.13). This definition refers to 85,405 supplies (88% of all supplies) and 65 million people (17% of the total EU population) (Hulsmann & Smeets 2011).

Member States may exempt from the provisions of the DWQ Directive 'individual supplies providing less than 10m^3/day as an average or serving fewer than 50 persons, unless the water is supplied as part of a public or commercial activity' (Art.3). Member States utilising that exemption must still ensure that the population so served is informed of this and of any action that should be taken to protect public health; and that if there is a potential danger to human health, the population should be given appropriate advice. Hence not all the technical parameters need to be applied. This report uses the term 'very small supplies' for supplies below these limits (as per Hulsmann 2005).

Article 8 of the DWQ Directive states that Member States also have the obligation to take remedial actions, in case of failure to meet the parametric values set in accordance with Art. 5.

Every three years Member States report to the European Commission on the quality of the water intended for human consumption within their territory in relation to the DWQ Directive. Reporting requirements are regulated in Article 13 of the DWQ Directive and related Decisions. The reports cover information relating to: general water supply arrangements; non-compliances, exemptions, monitoring of supply zones, and alternative methods used by the Member States; and updates on the quality of water in different supply zones at a national level. A reporting format has been agreed upon between the Commission and the Member States. Annex 2 includes the latest information regarding exemptions from and compliance with the monitoring requirements of the DWQ Directive in small supply zones. This information refers to supply zones serving more than 10 m3 of water a day or supporting a commercial activity.

Evidence reported by Hulsmann and Smeets (2011) and the European Commission (2014a) shows that major causes of policy concerns about small systems relate to:

- Low microbiological compliance, as illustrated in Figure 3;
- Inadequate monitoring; incomplete data; inaccessible information;
- Inequalities regarding access to water, i.e. the right to water (see also Section 5.6);
- Unclear accountability in case of a disease outbreak.

A problem specifically relating to small supplies is the sampling frequency for regulatory purposes stipulated in the DWQ Directive: this depends on the volume of water distributed, and at the smallest water supplies (supplies producing 10–50m3/day), the required frequency is once per year. Since the events leading to faecal contaminations of water such as rain runoff or melting of snow usually exist for only a few days, it is evident that the once a year monitoring does not truly guarantee the protection of public health. National regulations would ideally therefore provide for increased monitoring to address known risks, e.g. at times when pesticides are being applied.

5.2 EU Policy Review

The European Commission has been reviewing the legislative and policy frameworks for drinking water. In 2014 the Commission published a response to the Citizens' Initiative 'Water is a Human Right' (European Commission 2014c) where it is recognised that small supplies (i.e. serving fewer than 5000 people) need particular attention, and also that full implementation of existing EU legislation will contribute to wider goals of achieving safe drinking water for all. It also notes relevant reviews of the Priority Substances Directives (Directives 2008/105/EC; 2013/39/EU), the second Groundwater Directive (Directive 2006/118/EC) and (by 2019) the Water Framework Directive (Directive 2000/60/EC).

The response to the Citizens' Initiative has also formed part of the background to the 2015 revisions to the Annexes to the DWQ Directive (Commission Directive 2015/1787/EU). This latter gives some more flexibility to Member States in monitoring drinking water quality, and makes specific reference to a 'risk assessment' to align the DWQ Directive with the water safety plan approach, developed by the WHO (2011) and the EN 15975-2 standard concerning 'security of drinking water supply, guidelines for risk and crisis management' (Preamble). The risk assessment should be based on these guidelines and 'should take into account' the results of monitoring under the WFD Art. 7 (see Section 4. 3). Specifically, the revisions allow further flexibility in deciding not to carry out monitoring following risk assessment. However these revisions do not make any difference to the exemptions for very small-scale supply, nor indeed to the reporting requirements for small supply in the DWQ Directives.

A consultation was held in 2014 with the aim of better understanding citizens' views on the need for and possible range of actions which could be undertaken in order to improve drinking water provision and policy (European Commission 2015b). A draft report was published including an analysis of the consultation (ECORYS 2015). The questionnaire received over 5000 responses, with another 136 emails received, including position papers from national authorities and organisations. Most respondents (70%) professed themselves satisfies with the quality of their drinking water, though less than 20% believed this was true in other parts of Europe.

However there was considerable dissatisfaction expressed over the information provided to citizens on the quality of their drinking water. Although 88% of respondents were 'citizens' rather than other stakeholders, 2/3 of those stating a sector were from the water supply sector. The analysis did not find significant differences in responses from those in larger urban areas and those in smaller rural communities. Responses were very uneven geographically. Although UK and Scottish institutions and organisations responded, UK citizens had one of the lowest rates.

There is recognition throughout all the Commission documentation that small supplies are likely to be less well-monitored, the water subject to less treatment, and much less likely to meet DWQ Directive standards. Work continues to support revisions of the DWQ Directive (ECORYS 2016).

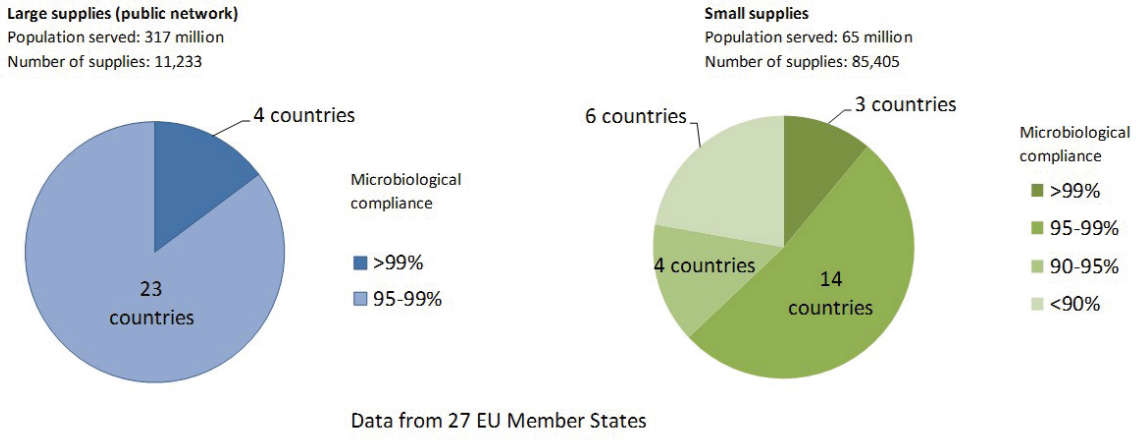

Figure 3. Microbiological compliance with the requirements of the EU DWQ Directive (98/83/EC) in large and small water supplies i.e. serving fewer than 5000 people, in the EU (27 Member States) (Hulsmann & Smeets 2011; European Commission 2014a).

5.3 The Water Framework Directive and small water supplies

The EU's WFD (Directive 2000/60/EC) is widely recognised as the overarching water policy instrument in European Union. It introduced a legal framework to protect and restore the water environment across EU Member States. It requires that all surface waterbodies and bodies of groundwater, including waters intended for human consumption, achieve the objective of 'good status' by means of River Basin Management Plans (RBMPs). RBMPs should be produced with the 'active involvement' of 'interested parties' and are subject to public consultation and reporting (Art. 14).Thus, water management under WFD is implemented at the scale of river catchments (basins), the natural hydrological unit for fresh waters. 'Good status' is based on the overall ecology of water bodies, taking account of biological, chemical and hydro-morphological characteristics.

The Preamble to the WFD recognises the special nature of water: 'Water is not a commercial product like any other but, rather, a heritage which must be protected, defended and treated as such' (Preamble para.1). Nonetheless the WFD requires the use of economic instruments (pricing), as well as regulation and other policy instruments, to guarantee source protection and sustainable water use in the long run, and contribute to the mitigation of the effects of floods and droughts on water resources. The WFD expects states to manage abstractions and discharges, including point and non-point pollution; and to apply EU (and national) quality standards to receiving waters. States should develop programmes of measures in their RBMPs in order to bring waterbodies to 'good status'. Water services providers, especially bulk abstractors, are likely to be key stakeholders in the RBMP process and responsible for parts of the programmes of measures.

Certain WFD goals explicitly refer to drinking water and water services:

- Article 7 prescribes the threshold of 10 m3 / 50 persons above which all abstraction points for drinking water must be identified and mapped as a 'protected area' to enable water treatment to be cost- effectively reduced; it also requires that Member States monitor water bodies that will provide more than 100 m3 / day of drinking water on average.

- Article 9 requires that Member States 'take account of the principle of recovery of the costs of water services, including environmental and resource costs, having regard to the economic analysis and in accordance in particular with the polluter pays principle'. In addition, 'water pricing policies should provide incentives for users to use water resources efficiently and thereby contribute to the environmental objectives of the Directive'.

Article 9 has been a challenge for Member States and this may be especially true for small supplies without economies of scale. As reporting under the WFD is by states and at the scale of large river basins, there are no specific data for small supplies. Full cost recovery is a widely discussed principle for water services globally and involves recovering the capital and operational costs of the system over its whole lifetime. Many states subsidise their water services from general taxation and this is still true in some EU Member States (for example, Estonia; Box 4). Ideally over time tariffs will rise to eventually meet the full costs, allowing the subsidy to be removed. The WFD Art.9 allows some derogation from full cost recovery, as long as the overall objectives of the Directive are not compromised. The cost recovery and pricing provisions relate to all water uses and users, not just drinking water; though in the first River Basin Management Plans, most states only reported with regard to urban services.

Box 4. Estonia: towards cost-recovery for small supplies with external funding

In Estonia, 80% of municipal water supplies are small-scale systems suffering from under-funding and water quality problems. Many of these resource -limited municipalities agreed to establish an inter-municipal public company to attract the required financing (GWP 2012; Dige et al 2013). The new municipally-owned and managed company, Estonian Water Company (EWC), signed a project contract with European Bank for Reconstruction and Development (EBRD) and the Nordic Environment Finance Corporation (NEFCO), while the municipalities signed project contracts with EWC on-lending loans and with EBRD guaranteeing tariff increases. The programme involved a 5-year investment period (1995–2000) followed by 10 years for loan repayment thereafter. 15-year tariff increase was planned and included in the contract, based on assumptions of local affordability.

Source: GWP 2012; Dige et al 2013

In other Member States, such as in Germany, cost recovery levels are 100 % for small supplies; all costs pass to the customers, including connections or construction grants (Box 5).

Box 5. Germany: 100% cost-recovery from small municipal supply charges

The German water sector is one of the most decentralised in Europe and dominated by many small municipally-owned, usually also municipally operated, companies. All supplies in Germany, well-known for their high quality of drinking water, have invested in a high technical standard and good water protection policies, which have increased costs and resulted in rising prices. Under Municipal Charges Law these small supplies can collect user charges and contributions for the creation and renewal of water supply facilities. For example, they can invoice their customers for water prices (volumetric-based), construction grants and house connection costs for the supply of drinking water. This mechanism is very effective, resulting in 100% cost –recovery. Public charges must be approved by local governments under the supervision of the Federal States and although rising, have mainly remained below the inflation index for many years.

Source: Wackerbauer 2009; Kraemer et al 2009; Profile of the German Water Sector 2015.

For certain Member States, as in Italy, there is neither full cost recovery at municipal level (at least for small supplies) nor a comprehensive system of central subsidy (Box 6 and literature cited therein). This leads to under-investment. The imposition of increased tariffs is often conflated with socio-political debate over ownership and private sector participation in service delivery (Dige et al 2013).

Box 6. Italy: small supplies at a crossroads

Italy's water main network is very heterogeneous. Municipalities served with high-quality water by innovative technologies coexist with poor areas characterized by outdated mains providing low-quality water. There are still about 6000 small municipalities in Italy, each operating supplies serving fewer than 5,000 inhabitants.

Consolidation of small municipal water companies and participation of the private sector have been legislated for since 1994 (Galli Law). Since 2012, return on invested water supply assets cannot be included in water tariffs for water services provided by public-private partnerships. The current arrangement discourages private investments in small-scale water services. But in Italy 75% of operators are small municipalities and mountain communities, which by definition struggle to achieve cost-recovery. In parallel, a strong 'anti-privatisation' civil movement has developed. The compliance of small water supplies with WFD requirements is a pressing challenge for Italy.

Source: EEA 2013; Guerrini and Romano 2014; Moreno 2012.

In both Scotland and England, there is full cost recovery of the service for the public networks, through the charging schemes and systems of economic regulation (Dige et al 2013). In the RBMP reporting under the WFD, the issues of funding of small private supplies are not specifically addressed. The charging regime for public supply does include cross-subsidy; so in Scotland, small rural supplies on the public network are charged at the same rate as an equivalent householder in a dense urban area with economies of scale. The issues for private supplies are not so much whether there is a failure to implement Art.9, but rather how to improve the system in order to ensure that citizens' drinking water is wholesome and safe – issues of governance and management. These problems are shared by small rural systems regardless of their ownership model.

In addition, Art.7 requires the 'protection' of drinking water bodies (above the threshold of 50 persons or 10 m3/day) to avoid deterioration and reduce the level of treatment required. In other words, it encourages a 'catchment management' alternative (or supplement) to 'end-of-pipe' treatment of water, which, however effective in terms of safety, is costly and does not address the causes of contamination. In this line, water suppliers have started initiating cooperative voluntary agreements with farmers across the EU and the world in general, often with the direct support of national, regional or local authorities that have the responsibility of water policy implementation (Heinz 2008).

The approaches most commonly taken by supply operators through these cooperative agreements have been described in a greater extent for large urban supplies than for smaller rural supplies. This reflects the wider scale of policy implications and the multiple benefits arising from the larger number of farmers being involved and the larger parts of land under improved land management within a catchment when the agreements refer to large urban supplies (Heinz 2008; Barataud et al 2014; Viavattene et al 2015). Indeed, cooperative agreements between large supplies and farmers have the potential to benefit the drinking water quality of sources serving small and very small rural supplies located within the same catchment. The benefits relate to the implementation of the catchment-based approach to risk assessment and management of drinking water resources, exactly as prescribed in the multiple barrier approach and the WSP approach (Sections 4.5.2 and 4.5.3).

Nevertheless, smaller rural supplies may also initiate cooperative agreements (Garin & Barraque 2012). For example, the municipal supply of Vanquiere, France, served 2700 people when it entered a cooperative agreement in 2005. This particular agreement involved economic compensation for changing practices through the use of an agricultural label: half the farmers either gave up or reduced their use of chemical herbicides, while at the same time promoting this 'virtuous' practice within the protected designation area. The examples reported by Garin and Baraque (2012) show that cooperative agreements between farmers and small municipal supplies have the potential to increase awareness among farmers and persuade farmers change land management without compensation; less frequently, these agreements can promote mobilisation of the farmers through imitation. However, in the case studies reviewed, small supplies (serving 50 to 5000 people) find it hard to achieve long-term compensation agreements with farmers, mainly because farmers decline the proposals.

As outlined by Garin and Barraque (2012) small supply operators initiate cooperative agreements with farmers with the aim to:

- Raise awareness among local framers of the impacts of agricultural practices on drinking water quality to promote best or better practices.
- Provide advice to farmers.
- Provide prescriptions to farmers for the uptake of certain land management measures that can reduce inputs of pesticides and nutrients and prevent losses to watercourses, such as conversion to organic agriculture.
- Set up a cooperative to collectively integrate the management of composted cattle manure.
- Make communal land available with constraints on production patterns.
- Compensate farmers for changing practices through the use of an agricultural label.[2]

As for very small supplies, i.e. serving 50 or fewer people, it remains unexplored whether and how those supplies managed under the household-centred model can initiate, negotiate and maintain cooperative agreements with farmers. Potential for action exists in the case that the farmer(s) own or use parts of the infrastructure (e.g. borehole, well) for their household needs.

5.5 International Guidelines for Drinking Water Quality

The global debate around the human right to water (and indeed sanitation) is not primarily focused on developed countries, which are expected to have the resources necessary to ensure a safe and adequate supply of services to their citizens. Rather it is about a baseline provision; and it recognises the diversity of national provision, hence it does not involve the setting of specific technical standards. There is guidance on access and availability; the WHO / UNICEF Joint Monitoring Programme uses a measure of 30 minutes collection time (either distance, or waiting time) as a baseline (see e.g. WHO / UNICEF 2010). States are encouraged to maximise availability to the best of their abilities and resources (e.g. de Albuquerque 2014). It is unlikely that these sorts of provisions would be relevant in Scotland, where small rural supplies would be better compared to public provision and to the standards under the DWQ Directive, in order to assess the expected level of state provision.

There is no binding international legal framework for drinking water quality. There is extensive guidance from the WHO around appropriate standards for drinking water (WHO 2011); Volume 3 addresses surveillance and control of community supplies. It also

[2] This was also noted by one of our interviewees. Due to the small numbers of interviewees, we decided not to use any identifiers when reporting on their inputs.

provides separate guidance on small supplies (WHO 2012). This is not binding on states but many States do use it to develop their national standards, as did the EU in its DWQ Directives. Whilst the WHO provides comprehensive indicators for an extensive range of chemical and biological parameters, there is recognition here (as in the UN human rights documentation) that small rural supplies present special problems. The WHO does recommend the use of Water Safety Plans, and risk assessment; and the 4th Edition places more emphasis on upstream catchment protection (WHO 2011).

5.6 International Law and the Human Right to Water

The debate around the human right to water (and to sanitation) has been influential in the development of water laws in the last decade (see, e.g., Winkler 2010; Cullet et al 2010; Smets 2012). The UN's position is that drinking water should be safe and sufficiently available to everyone, in line with the human rights principles of non-discrimination and equality, participation, accountability, access to information, and transparency ('General Comment 15', UN Committee on Economic, Social and Cultural Rights 2002).

General Comment 15 also observes that States should take steps to ensure that rural areas have access to properly maintained water facilities and that access to traditional water sources are protected from pollution, and stipulates the legal obligations of States towards realisation of the human right to water. Such duties include, inter alia, adopting effective legislative and other measures and an effective regulatory system, which includes independent monitoring, genuine public participation and imposition of penalties against those who compromise equal, affordable, and physical access to sufficient, safe and acceptable water. Where there is provision by the private sector, governments must still regulate provision appropriately.

There is no specific convention on the human right to water, but other UN human rights conventions make mention of water in the International Covenant on Economic, Social and Cultural Rights (1966), and the specialist Convention on the Rights of the Child (1990) and Convention on the Elimination of All Forms of Discrimination against Women (1981), linked to adequate standards of living and to other specific human rights, such as housing and health. The human right to water and the primary responsibility of the State to protect it was officially recognized by both the UN General Assembly (2010) and the UN Human Rights Council (2013). Winkler (2010) concluded that although the 'right to sanitation' is not yet fully accepted by states, the 'right to water' had emerged as a customary right of international law. Since then, there have been several resolutions on water and sanitation, and both were recognised in the 'Outcome' document from the UN Conference on Sustainable Development in Rio in 2012 (UN 2012). The right to water substantially underpins Goal 6 in the new 2030 Sustainable Development Goals (UN General Assembly 2015) and the debate over the right to water continues to inform policy development and law reform across the globe.

The UNECE Protocol on Water and Health

The UNECE Convention on the Protection and Use of Transboundary Watercourses and International Lakes (1992, Helsinki Convention) and especially its Protocol on Water and Health (1999) are both relevant to the implementation of the human right to water (and sanitation), and more generally to the protection of water resources for human uses and to human and environmental health. The Convention has recently been opened to accession by states out with the UNECE. The EU has also ratified ('approved') the Convention, which would enable the EU to legislate to implement the Convention in its Member States; indeed much EU water law, especially the WFD, is relevant to the provisions of the Convention. The WFD and the DWQ Directive, amongst other EU instruments, are both also relevant to the Protocol, but the EU has not (yet) approved the Protocol. The UK has signed both instruments but (unlike many EU Member States) has ratified neither independently. Therefore on the face of it, the UK is bound by the Helsinki Convention, and the Protocol, only insofar as its terms reflect either customary international law or other EU (or domestic) law. Signing a Convention indicates a willingness to ratify in the future, and that the state in question will act in good faith (e.g. will not introduce domestic legislation that contradicts the instrument). By contrast, several Member States have independently ratified both the Convention and the Protocol (e.g. France, Germany, Finland, Spain; UNECE, n.d.). The UK has no transboundary waters other than with Ireland, which may be a reason why it has so far chosen not to ratify.

The Protocol has a joint secretariat from the UNECE and the WHO, and is especially relevant to this project in relation to their work in Eastern Europe, including research and working with communities, especially in regard to safe water supply. Research findings were recently presented at a workshop in Geneva (UNECE 2016), including progress on 'action plans for equitable access' which were agreed at the 2013 Meeting of the Parties. The action plans allow self-assessment of baseline services according to international criteria, including the MDGs and now, the SDGs. France, Portugal and Ukraine are amongst countries that have completed the score-card in a pilot exercise, and others are currently doing so (WHO/UNECE 2016). This might be a useful exercise for Scotland, despite the UK not having ratified the Protocol.

European Human Rights Law

At a European level, the Council of Europe, which is broader than the EU and responsible for the (European) Convention for the Protection of Human Rights and Fundamental Freedoms (ECHR), recommended in 2001 that members adopt the European Charter on Water Resources (Council of Europe 2001). Article 2 provides for 'equitable and reasonable use' with special regard to vital human needs; Art.5 states '[e]veryone has the right to a sufficient quantity of water for his or her basic needs'. The European Citizens' Initiative 'Water is a Human Right ' (European Commission 2014c) obtained 1,884,790 signatures and led to a debate in the European Parliament, and a vote in favour of the Commission bringing proposals to recognise the human right to water and sanitation.

The ECHR safeguards property rights, and the jurisprudence of the European Court of Human Rights has given a wide meaning to 'property' (ECHR Art.1 Protocol 1), including licences to extract natural resources which in turn would include water licences, but has not prevented states from infringing property rights if the measures are proportionate and for a public purpose. These arguments essentially address property rights, and are relevant to abstractors for commercial use, rather than the 'human right to water', which is concerned with access to basic services. The linkage could exist if an individual or community losing a 'water right' was dependent on it for drinking water supply. In such a case, the general issue around the 'human right to water' would be seen in terms of the state's duty to ensure that all citizens can access a safe and adequate service. The appropriate response from the state to a deficiency in supply is unlikely to be removal of the right to abstract; or at least, not in isolation from a positive solution.

Until 2012, the UK Government abstained from votes on the human rights to water and sanitation including the Resolutions in 2010. However, prior to the UN Summit in Rio in 2012, the UK government announced that it would recognise both a right to water and a right to sanitation (UK Government 2012)

under Art.11 of the International Covenant on Economic, Social and Cultural Rights (standard of living). Since then the UK has been part of the UN Human Rights Council when four relevant Resolutions were adopted without a vote, and co-sponsored a Resolution by the General Assembly; but it did issue a statement dissociating itself from a detailed Preamble on sanitation in 2014 (Amnesty International 2015). It seems unlikely that the Scottish Government would not support these rights, which are widely accepted by progressive democracies.

The right to water is now widely accepted as a customary right in international law, and many states have enacted this right in domestic legislation, both in Constitutions and in sectoral water laws, (see e.g. Cullet et al 2010: Part 1)) but there is a continuing debate as to the extent of the right and its relationship to other water rights, especially agricultural water use. General Comment 15 recognised the rights of farmers to agricultural water as part of its analysis of the human right to water (para.7). Current discourse would suggest a useful distinction between water for subsistence farming, and for larger-scale commercial farming; the latter would not amount to a human right. As shown in the above analysis, and exemplified in Annexes 2 and 3, deficiencies in providing these services (especially in developed countries) are most likely to emanate in rural and in small-scale supplies.

6.0 Key findings, Conclusions and Recommendations

The Annexes to this report, especially Annex 2 (the comparative review) and Annex 3 (the case studies) report on the detail of the research that was carried out for this project. Given the depth of information collated for the comparative review and the detailed case studies, it was decided to include those in their entirety in the Annexes and to provide here an overview, with some high level analysis and our findings, conclusions and recommendations. The findings from the workshop have been incorporated into the overall conclusions and recommendations (Section 6.4) and a report of the workshop is included as Annex 5.

6.1 Overview and Key Findings from the Comparative Review (Annex 2)

Legislation and governance

Annex 2 examines inter alia national legislative frameworks with respect to mechanisms that have the potential to ensure access to safe water for the users of all supplies. We draw out here six elements: **water rights**, to account for the role of ownership of water resources on the overall governance of water services; **operational responsibility and administrative** responsibility, to represent features of responsiveness and accountability; **obligation and alternatives to connection to water mains,** to represent potential for; **affordability**, to account for mechanisms supporting inclusiveness and equity; and **enforcement mechanisms**, to account for efficiency and implementation of the rule of Law. There is considerable variation in the way several EU Member States and other countries: view drinking water resources; regulate the operation of water supplies; require, or not, connection on the mains; have provisions for alternative and affordable options for those in rural areas or not connected to the water mains; allocate responsibilities for water services; and enforce the legislation. Although not explored at length in the Annex, in most countries, legislation on building codes, planning permissions, local government legislation and housing, is likely to be relevant.

Regarding **water rights,** in many countries water resources are proclaimed clearly as a public good (e.g. Bulgaria, Greece, France) whereas in others water is defined as in WFD (see section 4.2).

Also, constitutional and other legal provisions may allocate both rights of water use to citizens and duties for the state to provide services for everyone (e.g. Netherlands, Belgium) as well as duties for the citizens to connect to the mains, e.g. where the public network is available (e.g. Austria, Greece, Cyprus).

Legal provisions for **operational responsibility** apply to large and small (i.e. 50 to 5000 people) supply zones in almost all countries and to very small supplies, depending on country-specific conditions. Operational accountability for treatment, maintenance, monitoring and reporting as well as tariffs may lie legally with any of the following entities:

- Municipalities (e.g. Austria, France);
- Municipal or inter-municipal water corporations (e.g. Belgium, Bulgaria, Croatia, Greece, Denmark);
- State water corporations (e.g. Ireland, Netherlands, Scotland);
- Private companies (e.g. Czech Republic, France; and England, where the public network is also privately owned);
- Cooperative societies or consumer partnerships (e.g. Denmark, Finland);
- Household (e.g. Denmark, Finland).

In general, and this is also reflected in the case studies, where there is public or municipal supply the public authority bears the costs of risk assessment and monitoring. Where the supply is owned and managed privately by communities or householders, monitoring may be the responsibility of the owners, and some practical or financial support may be available; or lie with the public authority. In the latter case the costs may be recoverable from the owners, and this may be discretionary. There is much more variability regarding support for connection costs, and also for tariffs. Although we have given information on connections and to a lesser extent, tariffs, where available, in the Annexes, a comprehensive comparison of tariffs was out with the scope of this project.

(Political and) Administrative responsibility of the water sector also varies as it depends on degree of decentralisation of water governance and country-specific arrangements. Decentralised decision making requires the responsibility for water price setting, connections, and enforcement mechanisms to lie with municipalities, municipal corporations, cooperative societies or consumer partnerships, as in the majority of countries. However, policy making and integration of the drinking water sector with water resource management and wider policies may involve multi-dimensional governance. Governance arrangements may be relatively simple, as when responsibilities for water management planning lie primarily with the entity that has the operational responsibility for a water supply, but are implemented under the control of and in accordance with regional, national or federal water service and/or public health authorities, as in Austria, Belgium Denmark, England Scotland, Ireland, Iceland and New Zealand. At the other end of the spectrum, decision making and administrative responsibilities are allocated through complex governance structures involving many local, regional and national entities and institutions interconnected horizontally and implemented under parliamentary control (e.g. France, Greece, Italy).

Policies for connection also depend on the administration of the water sector and the degree of decentralisation of decision making. Connections to water mains (state, municipal, company or cooperative) may be:

- required by all households in an area, as long as an area is covered by water mains; distributing treated water, with the cost incurred to the entity responsible for connections, as in Austria, Cyprus and Greece;
- required because assessments of the quality of drinking water in private water has dictated so and there is no feasible

alternative option (e.g. Germany);
- available for those who wish to connect, if feasible (e.g. Scotland).

Enforcement mechanisms are also shaped by local circumstances and in the case of EU Member States, by EU law, especially the DWQ Directive and WFD. Enforcement mechanisms include:

- Notifications to supply operators, as in almost all countries;
- Consultations among all stakeholders affecting quality of drinking water (e.g. Belgium);
- Penalties (e.g. Cyprus) and fines (e.g. Austria);
- Restrictions or prohibitions on land use (e.g. Austria, Denmark);
- Requiring users of individual supplies to submit a signed statement that they are aware that they use unsafe water (e.g. Greece).

Exemptions, Monitoring and Compliance

The DWQ Directive requires Member States to ensure regular monitoring for supplies of more than 10 m^3 of water per day. Information about exemptions is explicitly reported in the synthesis report on drinking water quality covering the period 2005-2007 (European Union, 2011). In the following years, exemptions were deleted from the reporting template because "exemptions were more a question of transposition and were not (any more) of interest for annual reporting" (European Topic Centre, 2014). An additional problem with the available information on exemptions from the period 2005-2007 is that Member States did not always report the reasons of exemptions. Some Member States exempted small supply zones on the ground of not being part of a commercial or public activity; other Member States exempted private and individual wells on the basis of size, i.e. serving fewer than 50 people or providing less than 10 m3 of water per day; finally, other Member States did not report on exemptions being in place either on the basis of the small size or the use of water (European Union, 2011).

On the basis of data from the period 2005-2007, exemptions of the application of the DWQ Directive are as follows:

- Nine Member States used the exemption of 50 people or 10 m^3/day mentioned in Article 3 of the DWQ Directive: Belgium, Estonia, Finland, France, Hungary, Ireland, Sweden, UK and Spain. In Spain, exemptions do not apply when there is a potential risk to human health.

- Four Member States used other types of exemptions:

o Bulgaria exempts from monitoring supplies providing water independently from the public network;
o Czech Republic and Lithuania exempts private wells for one household and not supporting commercial/public use;
o Luxemburg exempts private water supplies (regardless of size) except those supporting a commercial or public activity.

- Eleven Member States reported no exemptions: Austria, Cyprus, Denmark, Germany, Latvia, Malta, Portugal, Romania, Slovak Republic, Slovenia.[3] In certain countries this may refer to large and small public supply zones covering more than 99% of the population, as in Cyprus and Malta (Eurostat, 2016).

- Four Member States gave no information about exemptions, i.e. Greece, the Netherlands, Poland, and Italy. If 100% of the population is covered by the public network, as in the Netherlands (Eurostat, 2016) and Greece (Assimacopoulos, 2012), exemptions are meaningless.

Compliance with regulations.

In addition to exemptions, the synthesis reports for the evaluation of the DWQ Directive demonstrated that small supply zones across EU are inadequately monitored (European Commission, 2014a). The non-compliance with the monitoring requirements under DWQ Directive imply that part of the water supply zones reported as fully compliant with respect to water quality might not have been properly monitored. This caveat is cited in the technical report from each Member State (European Commission, 2014d). Further detail from this report is contained in the country comparisons (Annex 2) and the case studies (Annex 3).

The key findings of the comparative review can be summarised as follows:

- Small supplies serving fewer than 5000 people comprise a large part of the drinking water sector in EU and internationally, but serve a relatively small part of the population.

- Small supplies are characteristic of countries with sparsely populated rural areas with either plenty of fairly good quality groundwater or mountainous terrain (e.g. Finland, Germany).

- In certain countries all types of small supplies must fulfil the same standards according to the regulations, and experience shows that the regulations are enforced towards this end (e.g. Germany, Netherlands, and Switzerland). In other countries, although the State's obligation to connect or provide water as a public good for all residents is in the legislation, resource constraints and the physical conditions limit enforcement (e.g. Greece, Italy, Bulgaria, Slovenia, and Eastern Europe).

- Approaches to risk assessment vary widely and include all of the approaches discussed above (Section 4.5). In the EU, such procedures have been legislated in Scotland, England and Wales, N. Ireland, Germany, Denmark, the Netherlands, Sweden, Slovenia, Switzerland, Malta. In countries like Germany, Netherlands and Switzerland, the overall governance approach to water services, based on both risk assessment and self-regulation, ensures the implementation of the regulations.

- In general, in the EU, US, Canada and New Zealand there is a variety of both top-down and bottom up approaches to the management of small and very small supplies. These different management approaches may or may not involve different regulatory requirements, different parameters, different ownership models, but they all recognise the resource constraints and particular needs of small and / or scattered rural communities.

- Especially where the legislative framework has enabled near-universal access to the public network, functional interfaces between the governments, the private sector, the communities and the farmers can be developed, with multiple benefits for consumers of small community supplies and those relying on self-provision. Such benefits may include e.g. lower treatment costs, less need for monitoring, better accountability of authorities for non-compliance and lower contamination risk at the source.

[3] One of our interviewees told us of questionnaire results for a survey relating to the WHO/UNECE Protocol on Water and Health, indicating that four of these countries (Latvia, Romania, Slovak republic and Slovenia) did exempt supplies serving less than 50 people, with no commercial use. This is a good example of the disparities in information noted in Section 2 and relating to the purpose of information-gathering and the provider of the information.

6.2 Key Findings from the Case Studies (Annex3).

Based on criteria derived from the literature review and the comparative study, five case studies were selected with a variety of relevant characteristics including size of jurisdiction, predominance of different types of water sources, and cultural similarities. The choice of case studies was also partly constrained by language and by availability of participants willing to be involved in the project and provide interviews. As was also apparent from the broader comparative review, all jurisdictions face similar difficulties with small and very small scale supply, including resources and public health issues. There was no obvious 'model solution' presented by any of the case studies. The five jurisdictions chosen were Finland, France, Ireland, Sweden, and New Zealand. At least one interview (or written response to the interview questions) was obtained to enrich the literature review, with the exception of France; but the French case study was cross-checked with a national expert.

In all the case studies, municipalities have a role in rural supply. In Finland, France, Sweden and New Zealand, municipalities have a general role in providing water services, although they may not provide those services to very small communities and / or to individual dwellings. In Ireland, as in Scotland, local authorities have a regulatory function. In all the EU Member States, there is an exemption under the DWQ Directive for supply below 50 persons 10m3/day, unless there is public or commercial use, but this is applied differently.

Ireland

In Ireland, as in Scotland, there is a single public supplier but where there is private supply (see the case study in Annex 3 for terminology), local authorities (and local health boards) have a role in monitoring that supply.

Ireland has well-established Group Water Schemes (GWS) for community-owned and managed supplies at different scales, and an active 'umbrella' NGO (the National Federation for GWS). These are (now) often organised as cooperatives and there are model articles of association provided by the Federation. In addition, Ireland has many private wells which serve single dwellings and here, the Irish EPA provides user-friendly tools and guidance to assist householders. The Federation also provides advice and assistance to any users of private supplies and directs them to further support. Ireland has experience of contracting out the management of larger group schemes to private for-profit firms. Ireland has also supported paid (not necessarily full-time) technical staff to support GWS and this has also been successful.

Funding is mainly from the Department of Housing, Planning, Community and Local Government's Rural Water Programme, through local authorities. There are small annual payments to all householders on GWS and the proper management of a Scheme (in general and including the articles of association) can be made a condition of funding and thereby used to improve practice. There was a (short-term) non-means tested water conservation grant to all registered households from Irish Water. This was regardless of the type of supply and could be a means to encourage registration. Central government funding to GWS is discretionary (based on local authorities' Strategic Plans) but significantly higher than that in Scotland. Current policy is to encourage rationalisation of Group Schemes.

Recommendations / lessons for Scotland:

- Powers of Regulator to issue 'binding guidance' to authorities (and specific duties on local authorities to identify, and provide information to, supplies below the Directive limits);
- Significantly higher levels of funding (albeit not automatic);
- Group Schemes – although not mandatory, tools to encourage these (and their proper management) including the subsidy programme (i.e. proper management required to access subsidy) and support and encouragement for cooperatives as a management vehicle;
- The NFGWS itself – non-regulatory, neutral, advice and good practice umbrella organisation;
- Encouragement (and medium-term financial support for) paid technical staff for larger schemes.

Finland

In **Finland** municipal authorities have responsibilities for water supply, regulated by the Ministry of Social Affairs and Health. There are separate decrees for water quality for supply above and below Directive limits. In recent years there has been a reduction in the numbers of authorities and increased cooperation between authorities. There is no register of supplies below the Directive limits, though municipalities may have their own registers and there is discussion of a national database. Operating licences are required for supplies above the Directive limit (including public or commercial use) and recommended for others.

There are large numbers of cooperatives in rural areas, which may serve fewer than 10 people or more than 4000, and large numbers of remote dwellings with self-supply. Due to the generally high quality of groundwater, little treatment may be required. Finland takes a WSP approach and is also developing a Building Water Safety Plan for individual households. Larger cooperatives function similarly to municipal supply (see the general discussion in Section 3.5). Cooperatives can join municipal supply if this is available and funding for infrastructure improvements larger cooperatives (from central and local government) is designed to ensure that if the supply transitions, the quality will be assured.

If a property is within the operational area of a municipality, the owner can be required to connect to the network. There is financial support for connections, usually for larger systems, which covers part of the costs and depends on both household income and the population served. There is also a possibility of support for individual households, from the municipalities, but this is quite rare.

Recommendations / lessons for Scotland:

- Power to require connection, with financial support;
- Cooperatives as a well-established mechanism (here in Scotland, would need support);
- Considering a national database of all supplies and improved WSP support.

New Zealand

In New Zealand the primary service provider is the municipality and regulation is through the Ministry of Health. New Zealand has a size-based classification system; supplies of less than 25 persons are not regulated though they may be registered. An important distinction is between networked supplies and supplies on a single property, which are defined as 'self-suppliers' regardless of how many individual units may be on that property or whether there is any commercial use. Most duties under the Act apply to 'suppliers' (and not to self-supply).

The Register includes (for supplies above 500pp) information on the grading of the water quality – this is voluntary but has been a driver for improvement. There is an excellent map-based system where users can identify the quality of a particular supply.

New Zealand has been very proactive in promoting a WSP approach for systems of all sizes. The same standards apply to

all supplies, but the monitoring and sampling varies. For 'small' supplies (below 500 pp, and smaller), 'participating suppliers' may use a 'water safety plan compliance criteria approach' for deemed compliance with the Standards.

There is extensive technical guidance for suppliers, some of which is also useful for users, and including guidance for individual households using rainwater harvesting. The Building Codes also apply. It is illegal to let or sell a house unless there is a supply of potable water.

The Drinking-water Assistance Programme provided capital assistance for connections from 2005-2015, and continues to provide technical assistance and support for networked supplies, but does not assist with self-supply as such. There is no prescribed legal form for private supplies, but there must be either an individual owner or a legal entity that can meet supplier obligations under the Act. There are no specific requirements for operators of private systems or for self-suppliers, but extensive guidance.

There is no mechanism to force connections to a public system, but in some very small communities where the population has dropped to a level where the infrastructure cannot be maintained, communities have taken a decision to abandon the networks and move to rainwater tanks. It is recognised that this shifts the costs of provision to the householder.

Recommendations / Lessons for Scotland

- New Zealand is very focused on the use of Water Safety Plans, and on using these to provide support and assistance to communities to achieve safe drinking water. This is considered to be a much more productive and proactive approach than seeking to regulate for compliance for very small systems;
- There is extensive guidance and advice both for very small supplies (neighbourhood supplies, and supplies below the 25pp limit) and for self-supply;
- Map-based user-friendly system to check water quality (though not for supplies below 500pp).

Sweden

In Sweden municipalities are responsible for water services and the principal regulator is the National Food Agency. In recent years there has been a significant reduction in the number of municipalities. Drinking water is regulated as foodstuff and therefore HACCPs should be developed and implemented for each water supply. WSPs may also be used, especially for small and very small supplies; the important thing is to ensure risk assessment, but HACCP is the most common and best understood. Some 15% of the population depend on municipal supplies of less than 1000pp. The National Food Agency can provide emergency support to communities where there is a quality failure.

Very small supplies (below the Directive limit) in Sweden are not monitored. Owners of very small supplies can voluntarily send in their results for analysis, and these results are maintained in a register but it is incomplete. The DWQ Directive requirements are not applied to very small supplies. Advice is provided, and some parameters are the same, but there are fewer parameters. Although all commercial and public suppliers should come within the Directive, small tourist accommodation (up to eight beds) is not monitored.

In rural areas, supplies can be owned by private companies, or other private associations or by cooperatives or individuals. There is no requirement for any particular legal form. If the supply is above the Directive limit then the staff and / or the owner must have the required education to be able to run the supply.

There is no power to require a connection to a public or municipal supply if one is available, but, there may be some financial support for connection costs (depending on the population served or the number of properties to be connected). If the supply is covered by the DWQ Directive, then a local authority can 'close' the supply and prohibit its use.

Recommendations for Scotland:

- Focus on risk assessment, including but not restricted to HACCP;
- A national agency with powers and duties regarding private supply.

France

France is the only large jurisdiction (66m population) amongst the case studies. It has very large numbers of very small municipalities - 36,000 communes overall, and over 30,000 with less than 2000 inhabitants; with 18,363 small supplies. Some three quarters of the communes join together to provide services with some 14,000 inter-municipal agencies.

France has a very long-established administrative structure for water management generally and a globally recognised model for delivery of services through concessions and affermage contracts, i.e., delegated private management (see Section 4.3 above). However for supplies serving less than 3000 inhabitants direct public management by the municipality is the norm.

The law has a strong underpinning of principles, including 'water pays for water' (a presumption of cost recovery) and the 'polluter pays'. The human right to water is recognised in French law. In addition, a strong tradition of social cohesion between urban and rural areas has driven policy including connections policy, and in the second half of the twentieth century almost everyone (more than 99%) was connected to a public supply. Hence even the smallest systems are municipal, and there is ongoing financial support in the common interest. There is also a focus on catchment protection, recognising agricultural pollution, and a new risk management tool has been developed to assist managers of small supplies (below 5000 pp).

Recommendations for Scotland:

- Online tool for managers of small supplies;
- Cohesive approach to national solidarity justifying investment to improve services to rural communities;
- Long term policy of ensuring public (municipal) connections for almost all users;
- Support for catchment measures and engagement of farmers (and see also Section 5.3, where much relevant literature referred to France).

6.3 Key Findings from the interviews.

The two interview schedules (Annex 4) were designed to apply to EU Member States and to other jurisdictions. In the event, we were also able to interview three practitioners whose input was not restricted to a jurisdiction, and we used the 'non-EU' schedule with slight amendments. Where the interviewees were commenting on their own jurisdiction, that data has been incorporated into the relevant case study; but in addition any general information from those interviews has been incorporated into this section. This section is structured according to the structure of the interview schedules (Annex 4.) Due to the small number of interviewees we have not used any identifiers for the quotations in this section.

All interviewees agreed that the state's regulatory function could be implemented through a central or local government department or a public agency. Most often, water services are the responsibility of municipalities and most often, monitoring and enforcement lies under departments of public health / local health authorities. One interviewee noted '[t]he State authorities…. have the responsibility for safe water regardless of who operates a supply'.

On surveillance and monitoring, interviewees agreed that operators could be expected to report; and that there was usually a mixture of self-monitoring and monitoring by authorities or agencies. There was always an issue of what would happen with the data and whether there would be follow up. In many places there is no requirement to monitor or report on very small supplies (however defined), and / or self-serve; and if required, would be less frequent. Mobile labs / sampling kits are one suggestion for remote areas.

Ideally, there would be a register of all supplies, though in many countries, the register only applies to larger supplies and / or municipal or public supplies. 'The Register is the basis of all subsequent action' stated one interviewee; but even where all properties should be on a register, that may not happen.

In some places the same parameters and standards apply, but there might be different means of securing compliance, and recognition that the balance between risk and cost is different. In other places there might be a reduced set of parameters for very small supply. Arguably threshold values for microbiological parameters should always be the same. Chemical parameters may vary according to occurrence. A short set of the most relevant parameters can be expanded based on a risk assessment, e.g. for pesticide use, in a locality (or at a specific time of year).

In terms of management options, cooperatives were often used, especially in some cultural and social settings, but a specific legal form is rarely mandatory. It is useful is to have support and guidance about setting up a community vehicle such as a cooperative, with model articles etc., and actively encouraging community vehicles where such are not in common use. One interviewee recommended cooperatives, where every household has an equal say, to other corporate forms with shares or trustees. For larger communities, there could be mandatory training requirements for operators but this is difficult to mandate for smaller community systems and for private wells. One jurisdiction has experimented with providing a paid staff member to work on behalf of a number of community supplies, as a value-adding investment that was also a vehicle to provide education and training.

There were mixed views on how to manage enforcement against very small supplies including single dwellings. Whilst it may be useful to have mandatory powers, e.g. to prohibit the use of the supply or declare the house uninhabitable, that would always be a last resort. 'Building trust and cooperation' was seen as key, although if there was a serious health risk, e.g. from regular microbial failures, then action might be needed. Similarly, even if there were powers to require connections to the public system, in some places householders might continue to use an unsafe private supply in preference, for reasons of cost or otherwise. One interviewee commented: '[the question is…] Why is the supply unsafe? It is because of state activities, a natural disaster or industry? The Government has to provide alternatives, as it has the responsibility to ensure that everyone has access to safe water.'

Practice around financial assistance for connections varies widely and is often partial; if available it may be based on household income, population served or a potential health impact. Most interviewees supported financial assistance regardless of whether there was a power to require connection. Some jurisdictions provided financial support to owners of private supplies to improve their supply instead; whereas others provided advice, but expected owners of systems to meet their own costs and if appropriate charge users (for larger systems).

Advice, education and information were always needed, e.g. (especially) with Water Safety Planning; other methods of risk assessment; PoE and PoU technologies at household level. This should include both detailed information for operators and practitioners at different scales, and user-friendly guidance in appropriate formats.

In summary:

- States have responsibility for ensuring services are provided (regardless of who provides them) and for regulation;
- Monitoring and reporting are essential and registers are the basis of all subsequent action;
- Parameters should be the same, if health-based, but the actions towards compliance may vary in offsetting risk against costs;
- Support on creating and operating community entities to improve supply is useful;
- Advice, education and building trust are essential.

6.4 Workshop Findings

The Workshop is reported in Annex 5. We would like to thank all the workshop participants for their time and contributions. 'Golden themes' emerging included: **levels of funding; engagement and support; and WSP / risk assessment.**

The variety of views held by different users of private supplies was also noted, and the need to work with people. The 'household centred model' was seen as relevant to Scotland.

General discussion identified the following as issues:

- Importance / relevance of cultural issues e.g. community pride in 'our water';
- Reluctance to recognise problems that were not 'visible' (colour / odour / taste);
- Poor construction and maintenance of facilities; need for treatment especially of surface water; need for good long term data on water quality to support treatment options;
- Staged process of engagement to get buy-in for solutions; simple and appropriate guidance and support;
- Need for training on operation and maintenance of different sized systems and at householder level;
- How testing can be made available, and in turn support engagement; usefulness of health-based data;
- The need to provide for succession planning at the end of projects (but also to ensure ongoing help and support);

We asked the participants to identify solutions, both before and after the workshop. Many of these reflected the need to educate and empower communities; training and support; the role of government and of governance. Specific points included:

- Connect all to the public network (if money was no object!);
- Full compliance with Regulations and Directives;
- A centralised body / agency which can coordinate knowledge / expertise and advise communities on options; a 'water centre' with experts to support communities; a 'one-stop' shop;
- Strategy for improvement; programme of community engagement and capacity-building; clear, developed solution models; educate and involve school children;
- Testing end-to-end community solutions – different issues, different communities; clear understanding of actions /

outcomes;
- Clear structure for community schemes – robust register as starting point;
- Improve construction; e.g. properly constructed boreholes / appropriate treatment; enable larger suppliers to support operators of small systems;
- Continued research – community pilot schemes; trained facilitators to implement WSPs;
- Clear processes for testing supplies of different scales; get beyond taste, colour being used to determine quality;
- HACCP / WSP models – tangible and engaging tools / guide for getting communities involved; clear planning and outcomes;
- Recognising a governance crisis and responding appropriately;
- Water is part of intrinsic culture; water is life; incentives to protect water.

6.5 Overall Recommendations

The report provides twenty recommendations, listed below.

Definitions and structural issues:

The literature distinguishes between supplies serving a single dwelling and every other form of self-supply or community scheme, but most jurisdictions do not provide differently in terms of enforcement compared to other very small supplies. It would be possible to make such a distinction here by distinguishing single dwellings in the regulations, but, there was no evidence or support for this as a desirable proposition. The current 'size' threshold, as well as being found in EU law, is comparable to that used in other jurisdictions e.g. New Zealand.

Overall:

1. A stronger focus on household-centred management and treatment options available to individual householders could be helpful, both for Type B supplies (whether serving just one, or a number of households) and for domestic users on a Type A supply.

2. Continued work on catchment protection, and on rural wastewater management, within the wider legal regimes for managing land-and-water, especially the WFD. Although the former is currently focused on sources of public supply, and the latter on environmental compliance, both are likely to also benefit the quality of private supplies.

Improvements in service levels will entail increased costs somewhere. Different measures suggested below will allocate those costs in different ways.

Governance initiatives:

Education for empowerment was a key theme of the workshop, and all the comparative work.

3. Better, 'consumer-friendly', advice and training for both relevant persons and users of supplies. The current guidance is more appropriate for regulatory authorities.

4. In particular, advice regarding risk assessment / water safety planning, and / or POE / POU technologies; there is extensive material available on making these appropriate to very small systems.

5. Advice and assistance offered through public authorities could be done via Health Boards, Local Authority Environmental Health Departments, or by giving a greater role to DWQR. Staff in these organisations might also benefit from increased training and support, e.g. from DWRQ or perhaps Scottish Water. In many countries a trade association for water suppliers provides this training.

6. Better guidance support and advice to communities who wish to join together in some formal legal arrangement (such as a cooperative or a company limited by guarantee) to upgrade and / or better manage an existing private supply. Lessons learned in relation to community energy supplies may be useful here.

7. Potentially, some sort of umbrella organisation such as the Irish NFGWS could play a useful role, as a non-governmental 'trusted intermediary'.

8. Increased use of health data (e.g. from reports by local authorities and the DWQR, as well as by Health Boards and the outputs of research work), to provide evidence to communities as to the desirability of either connection to a public supply, or, improved maintenance and operational activity for private supplies. Means to achieve this (and provision of other guidance and advice) might include web pages, leaflets, presentations at community council meetings or other local forums; as well as direct contact with occupiers of properties registered as having private supply.

9. Consider the possibility of using something like the self-assessment action plans under the Water and Health Protocol, tailored for Scotland to measure the current situation against international criteria, but also to ensure that country-specific problems are being assessed against country-specific criteria and targets.

Regulatory measures:

10. The benefits of stable and consistent law enforcement was a theme of the comparative study. Several of these regulatory measures would work with the corresponding governance initiatives below.

11. One option would be to resource the DWQR to play a greater role, to ensure greater consistency, rather than the separate local authorities.

12. Further clarity in the regulations (and accompanying guidance and advice) as to the need for all private supply to be on a register; and, on the identification and responsibilities of relevant persons, responsible persons, and users of private supplies.

13. A specific duty on an appropriate public authority to provide advice to users of private systems of different types and scales.

14. Making some form of risk assessment / WSP mandatory – at least for Type A systems, and for all new private supplies.

15. Ensuring that incidents of disease linked to water quality, are noted on a register and publicly available.

16. Scottish Water could be enabled and required to provide more assistance to private schemes, perhaps through SW Horizons to avoid blurring the distinction between public and private supply.

17. Strengthening compulsory powers (or encouraging their use), e.g. in relation to declaring dwellings uninhabitable, or otherwise using the powers of local authorities to prevent unsafe or non-compliant supplies being used for consumption; mandatory powers might be seen as negative, but are an essential back-stop.

18. Alterations to the grant scheme, e.g. to allow 'pooling' to move to improved community schemes and / or public connections; and ideally, increased levels of grant support. The grant aid provided in Ireland for example, although discretionary, is significantly greater than that in Scotland.

19. Regulations to provide for increased monitoring to address known risks, e.g. at times when pesticides are being applied.

20. Bringing in some mandatory requirements for private supply (e.g. testing, certification) on sale of a property, as is done, e.g., in New Zealand. Whilst it would be possible to work with the Law Society of Scotland (and lenders) towards greater uniformity on a voluntary basis, a mandatory provision would be more effective.

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Annex 1 Private Water Supplies in Scotland

In Scotland, water (both water resources and water services, along with the environment, property rights and private law, and implementation of related EU legislation) are devolved under the Scotland Acts (1998, 2012, 2016). The Scottish Parliament is the primary legislature and the Ministers (collectively) exercise administrative control. Under the current administration, water services are within the portfolio of the Cabinet Secretary for Environment, Climate Change and Land Reform.

Some 95% of premises, household and non-household, are served by Scottish Water on a 'mains' or 'public' supply (Water (Scotland) Act 1980, Water Industry (Scotland) Act 2002). This includes water for domestic and commercial purposes. For customers on a mains supply, in business, commercial and other non-domestic premises, Scottish Water is the wholesaler and retail services are provided by a Licensed Provider, licensed under the Water Services (Scotland) Act 2005. **The remainder is served by what in Scotland is termed a private supply, i.e. where assets are not owned and maintained by Scottish Water**.

Scottish Water has four regulators (the Water Industry Commission for Scotland, the Scottish Environment Protection Agency, the Drinking Water Quality Regulator and Citizens' Advice Scotland) within the context of policy objectives and principles of charging set by the Ministers (Scottish Government 2014a, 2014b; see generally, Hendry 2016). Charges are set by the economic regulator under a 'broad' approach to economic regulation (see e.g. Groom et al 2006, table 1.1) where charges must be sufficient to meet all mandatory requirements (under EU and domestic law) as well as the policy objectives, i.e. including environmental and social objectives. Scottish Water does provide some small rural supply, and charges are banded relative to property values and cross-subsidised to equilibrate charges between rural and urban customers in the same band. Scottish Water's supplies are almost always compliant (DWQR 2015a).

Private Supplies

Private water supplies may be a supply to communities of different sizes, or an individual dwelling. Usually private supplies are found in sparsely populated, rural Scotland, where it has not been cost-effective to provide a mains supply. There is however significant variability across rural local authorities as to whether small and very small supplies are in public ownership, for historical reasons when delivery was first moved from local authorities to first regional, and then a single national, supplier. Under the Water (Scotland) Act 1980 (s.6), Scottish Water must connect properties where this can be done at 'reasonable cost'. There is both regulation and guidance to determine what is 'reasonable cost' (Provision of Water and Sewerage Services (Reasonable Cost) (Scotland) Regulations SSI 2015/79; Scottish Executive 2006). These address both situations where premises are too distant from a public supply, and also where existing infrastructure does not have capacity for new developments. They cannot however address a situation where there is a public supply nearby, but where a householder does not wish to connect. That could only be addressed by some power of compulsion.

Private supplies are covered by a separate regulatory regime, mainly through Local Authority Environmental Health Officers, and the principal regulations are the Private Water Supplies (Scotland) Regulations SSI 2006/209 as amended (the 2006 Regulations). There are also relevant provisions in other regulations especially the Water Quality (Scotland) Regulations SSI 2010/95, the Public Water Supplies (Scotland) Regulations SSI 2014/364, and most recently the Private and Public Water Supplies (Miscellaneous Amendments) (Scotland) Regulations SSI 2015/346 (establishing limits for radon). There is limited provision for grant aid (up to £800) from local authorities to assist householders in improving the quality of their private supplies, provided certain qualifying conditions are met (the Private Water Supply (Grants) (Scotland) Regulations SSI 2006/210).

Although the Building Codes are always applicable, as are rules regarding fitness for habitation under housing legislation, there is no mandatory requirement in Scotland around private supply when property is sold (e.g. to require testing or certification). Currently, the type of supply would be a standard question in solicitors' property inquiry letters in rural areas, but practice varies and to some extent is driven by the requirements of different lenders. Purchasers may require testing, but there is no obligation for this to happen. When compulsory registration of septic tanks on sale was introduced, conveyancing practice adapted accordingly.

Regulation of Private Supply

The regulatory arrangements differ according to whether the supply is above or below the limit in the DWQ Directive; there are a reduced set of parameters, and different monitoring requirements, for supply below 10 m3/day and serving less than 50 persons, and with no commercial or public use. If a private supply is above that limit, it is termed a 'Type A supply'. If it is below the limit, it is a 'Type B' supply. Local authorities undertake this classification (2006 Regs, R.6).

For both types, there must be a 'relevant person', determined by the local authority, including those persons who provide the supply; occupy the land from which the supply is obtained; or exercise powers of management and control over the supply (2006 Regs, R.4). Relevant persons should be notified in writing, and may appeal the decision to the Sheriff. There is a specific duty re disinfection (if this is being done, the relevant person must undertake any necessary preliminary treatment and also keep disinfection by-products 'as low as possible'; Reg.5A). Recent work by ICF Consulting (2016) for Scottish Government, analysing the regulatory process, suggested that the responsibilities of relevant persons are not always well-understood, and could be clarified in the regulations; along with the requirement to register all supplies.

The 2010 Regulations also provide for 'responsible persons' who are owners or otherwise responsible' for 'domestic distribution systems', i.e., the pipes, fittings etc. internal to a building. In a domestic context, these would be householders and users of the supply. 'Domestic distribution systems' may be found in public or commercial buildings as well as houses. Most obligations on responsible persons apply in relation to such public or commercial buildings.

The 2006 Regulations also require that local authorities risk assess type A supplies from 'source to tap' as part of an effective drinking water surveillance programme (Part VI, R.16). Local authorities **may** also risk assess type B supplies, whether or not on the request of a relevant person or consumer, taking into account the potential health risks associated with any Type B supply in their area (Part VIII, R.27).

Definitions in the 2006 Regulations of Type A and B supplies, relevant persons, responsible persons, and domestic distribution systems, are inserted into relevant provisions of the Water (Scotland) Act 1980.

The Role and Powers of the Drinking Water Quality Regulator

The Drinking Water Quality Regulator (DWQR) was established under Part 2 of the Water Industry (Scotland) Act 2002. It has enforcement powers in relation to Scottish Water ('public water

supplies') and supervisory powers in relation to local authorities' drinking water quality duties (s.7). Local authorities have some general responsibilities in relation to public supply as well as their powers and duties over private supply. Ministers may direct the DWQR. The DWQR has extensive powers in relation to public supply: to obtain information, to enter and inspect premises, to serve enforcement notices, and to act in emergencies. Under s.16 DWQR has a bare power to require information from local authorities, and they must provide information which is reasonably requested. If there is a disagreement as to reasonableness, the Ministers' decision will be final.

By s.17 the DWQR must make an annual report. In the past, this report has included information on private supply from the DWQR's supervisory function, but in 2015 a decision was taken to report separately on private supply (DWQR 2015b). This has a number of advantages: it enables the reporting on the public supply to be made as soon as possible after the end of the calendar year (as required by s.17) whilst then allowing fuller consideration of the issues around private supply.

The statutory powers give no guidance or detail of any kind as to how reports should be provided, data collected and maintained, etc. The DWQR does provide guidance to local authorities on reporting (DWQR 2011) and this contains useful explanations of their obligations relating to monitoring. However, as with many of the countries surveyed in this project, data collected may be incomplete and enforcement action may be inconsistent across the 32 authorities.

Powers, Duties and Functions under the Water (Scotland) Act 1980

All water supplied for human consumption in Scotland must be 'wholesome' under Part VIA of the Water (Scotland) Act 1980 (the 1980 Act). Part VI was initially inserted to ensure compliance with the first Directive on the quality of drinking water (1980/777/EEC). This Part includes provisions relevant to private supply and the duties of local authorities.

Local authorities have general duties to: keep themselves informed about 'wholesomeness and sufficiency' including for private supplies; comply with any Ministerial directions as to their powers re private supply (s.76F). There is a regulation-making power for Ministers.

A new provision under the 2010 Regulations addresses private supplies used by the public – in commercial or public premises (s.76F). If there is a 'relevant water quality issue' LA's must investigate, and report to the Ministers. The may recover costs from the 'responsible person'. 'Relevant water quality issues' are attributable to the distribution system and would require notification to the Ministers under the 2006 Regulations.

Local authorities have powers to serve a notice on the responsible person, containing details and steps to be taken, and time periods; for purposes of ensuring a wholesome supply and protecting human health (s.76FB). If the relevant quality issue or failure constitutes a potential risk to human health, the authority must notify the required steps and require advice to be given to consumers, and also consider the potential risks to health caused by an interruption to supply. After the time for taking any required steps, the authority must notify the Ministers as to what has been done; and unless the issue / failure is trivial, should notify consumers of any remedial action. Failure to comply with a notice will be an offence.

There are general remedial powers for private supply (s.76G). If water for human consumption is (or is likely) not to be wholesome; or the supply has failed, is failing or is likely to fail to provide a sufficient supply of wholesome water, the authority may serve a notice; If a Type A supply, it shall serve a notice (s.76HA). If a Type A supply is failing, including re an indicator parameter, and this constitutes a health risk, the local authority must exercise remedial powers and serve a notice. Local authorities have powers to serve notices requiring information (s.76I) as well as powers of entry for enforcement purposes.

Regulation and Enforcement Provisions in the 2006 Regulations

Part V provides for temporary departures from these standards for Type A supplies. These can be requested by the relevant person on application to the local authority and are intended to provide for the derogations in the DWQ Directive (Art.9).
Part VI provides for risk assessments, investigations and remedial actions for Type A supplies. The monitoring local authority (in whose area the supply is located) carries out risk assessments (Sch.4 applies) for new supplies (within 6 months), or if the supply may no longer be wholesome (as soon as reasonably practicable) (R.16).

Regulation 17 provides for investigations where a Type A supply is failing or likely to fail the microbiological and chemical parameters. The local authority shall notify the relevant persons, the Ministers and any other 'appropriate' local authority (where the source is located), specifying whether there is any supply to the public. The relevant person should notify consumers of the supply. If the failure is attributable to a domestic distribution system the 'responsible person' for the operation and maintenance of that system should also be notified, after consultation with the health board, and advised of steps that they should take, and inform consumers and the public. Regulation 18 makes similar provision for failures relating to the indicator parameters, where there is a potential immediate risk to human health. Local authorities must to notify consumers of (non-trivial) failures, and of any remedial actions under notices under the 1980 Act.

Part VII and Sch.2 provide for monitoring of Type A supplies, including check and audit monitoring. Check monitoring is more frequent and applies to parameters likely to cause immediate risk. Audit monitoring is less frequent, for a wider set of parameters at levels that could cause harm to health over time. Both sets of samples are reported to the European Commission annually under the DWQ Directive.

Regulations 21-26 provide for monitoring. Local authorities must take samples to determine compliance. These should be representative throughout the year and (if serving a number of premises) from a random selection of premises unless otherwise directed by the Ministers. The tables to the Schedules set out the prescribed substances and the parameters and the sampling frequencies, and the frequencies of monitoring may be reduced where there has been no adverse indication for that parameter or substance for two years. There can be additional monitoring for any substances, elements, parasites or micro-organisms not contained in Sch.1 but which might nonetheless cause the water fail to be wholesome; alternatively, the authority need not carry out audit monitoring of certain parameters where they are not present, or are not likely to be present.

Part VIII applies to Part B supplies. Local authorities shall provide information to relevant persons to enable them to undertake risk assessments; and may carry out risk assessments themselves, whether or not at the request of a relevant person or a consumer. Local authorities may undertake investigations regarding failures or likely failures of the parameters for Type B supplies (schedule 2), and notify the relevant person and any other appropriate local authority, including any steps that should be taken. The relevant person should notify consumers.

Local authorities have powers to take samples to establish if

water is wholesome, and samples to confirm or clarify previous test results, and to identify the effectiveness of remedial actions. They may at any time sample for the specified parameters in ('routine monitoring', for example, of E-coli or coliforms); and for parameters not listed in schedule 2 if they believe such parameters may cause the supply to fail.

Part IX applies to sampling, analysis and charging. Charges may be levied for visits to premises and for analysis of samples, but there is variety of practice across authorities (ICF Consulting 2016). Part X applies to records and information. Local authorities should maintain registers of private supplies in their area, including whether it is Type A or B; the details of every relevant person; the addresses of every premises served; a description of the supply, including location; the average volume and number of persons supplied; any treatment; any departures authorised; the results of sampling; any enforcement notices under the 1980 Act; a copy of any risk assessment; and this should be updated each year and be available to the public. Local authorities shall provide information reasonably requested to the Ministers, the Scottish Environment Protection Agency, and the local Health Board; and to neighbouring authorities. The register should be provided annually to SEPA; and each year a completed Annual Return made to the Drinking Water Quality Regulator, SEPA and the Health Board. (In practice the DWQR will forward reports to SEPA and the Health Boards.) Public and commercial premises with private supply shall display a notice provided by the local authority. Scottish Government provides technical guidance on private supply and the 2006 Regulations, especially on risk assessment and water safety planning (Scottish Government 2006).

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Annex 2 Comparative review of governance and management of small water supplies

Introduction

In materials and methods (Section 2) we explained the process we used for the literature review, identifying the sources used and the constraints and discrepancies. This annex presents the findings of our country-by-country comparison. We look at legislation and regulation, but also at guidance and policy (where available) as well as academic literature. All countries have on-line information explaining the regulations and providing guidance for best practices for the lay audience. In some countries however, action has been taken either at a top-down or bottom-up level (or sometimes both). In some EU states, stricter standards are applied than the DWQ Directives require; for example applying the Directive to very small supplies. In others, very small supplies are fully exempted within the law. Here we focus on monitoring, treatment and risk assessment procedures as well as enforcement; but also address management models and (where possible) wider issues of governance. We also report what, despite the legislation, has not been done because of other constraints.

We cover firstly, the Member States of the EU, in alphabetical order, with (very) variable levels of detail. We have endeavoured to be as complete as possible, especially for the EU states, subject to language barriers but also to availability of data. Where there is data, we report: an overview; any results from the 2014 synthesis report (European Commission 2014d); arrangements for national public management; for community-based management; and for household level management. Where data is inconsistent but we were unable to verify, we report the findings. The absence of comment, especially regarding household level management, is unlikely to indicate that there are no such supplies in most jurisdictions, and this is also likely to be the case for very small community-based models. We then look at a small number of non-EU states, also in alphabetical order. We do not include here the five countries for which there is a case study in Annex 3 (Finland, France, Ireland, New Zealand and Sweden). References to Sections are references to the main report.

EU Member States

Austria

In Austria, water law is shaped by the Austrian federal legal system and the 'polluter pays' principle (Schmelz & Rajal 2012). The Water Rights Act (1959, consolidated as of 54/2014) enacts provisions relating to **water rights**. Accordingly, water is either public or private. Article 2 defines public waters: rivers, streams, brooks, canals, lakes and their arms; private waters are inter alia groundwater existing on the territory of a private owner. The Lower Austria Water Connection Law (1978, consolidated as of 96/13) stipulates in Article 1 that all public buildings have to be connected to public water supplies. The Upper Austria Water Supply Law (2013) establishes that buildings and water plants including the land surrounding them shall have to be connected to a public water supply plant. In general, **connection and usage of the municipal network is compulsory in Federal Austria**, provided that an area is covered by the public network (Klein 2009). This means that, by law, households cannot choose a provider but are obliged to connect to the local network and use only the respective service.

Given that **municipalities are responsible for water supply services**, water supply in Austria is characterised by (local) municipal monopolies (Klein 2009). The Austrian Water sector has been included in the Environmental Subsidies Act, No. 185 (1993 consolidated as of 52/2009) under the Federal Ministry of Agriculture, Forestry, Environment and Water Management. Accordingly, regional and municipal authorities are responsible for strategic planning for all water resources management (DWP-Austria 2015).

The Water Rights Act (1959 consolidated as 54/2014, and relating to more than 35 regulations on water) is the most important legal basis for authorities to require remediation measures. As described by Schmelz and Rajal (2012), municipal authorities may require the polluter to take proper preventive or remediation measures or to bear the costs of measures taken, as long as a polluter can be traced. If no polluter can be traced by the competent authorities and the property owner knowingly agreed with the circumstances or measures that caused the thread or tolerated them by neglecting any reasonable defence, the property owner may be held secondarily liable to take preventive or remedial action, or bear the costs, or both.

The synthesis report on the quality of drinking water across European Union states there are no exemptions on the basis of supply size in Austria (European Union 2011). It remains uncertain whether supplies providing less than 10 m^3 of water a day are monitored. Small supplies may be managed by municipalities or cooperatives. However, 8% of the water sector reported to rely on self-provision (DWP- Austria 2015), which possibly includes the 'private water supplies' regulated under the Lower Austria Water Connection Law (1978 consolidated as of 96/13).

In the 2014 synthesis report (European Commission 2014d), in Austria all small water supplies are stated to use groundwater sources. As of 2008-2010, there were 4750 small water supplies supplying 503,994 m^3 of water per day to 2.7 million people (32% of the population). This figure includes all supplies serving 10 to 1000 m3 of water per day. Overall, 1123 small water supplies (24.7%) were not monitored in accordance with the requirements corresponding to 681,458 people (8.7% of the population). Overall, 14.1% of the total number of water supply zones that have been monitored (i.e. municipal and cooperative supply networks) was not in compliance with the drinking water standards. The highest level of non-compliance was observed in supplies serving 10 to 100 m3 of water per day. Non-compliances were related to microbiological parameters, indicating inadequate treatment, and pesticides and nitrates, indicating inadequate agricultural practices. In the case of non-compliances, notifications were sent to consumers. Remedial actions required to meet microbiological standards entailed removal of cause, improved treatment and actions in the public and domestic network, and, in some cases, offer of an alternative water supply. Remedial actions for the non-compliance related to agricultural pollutants were mostly scheduled for the long term and included removal of the source of nitrates and pesticides and better treatment.

National public management in Austria includes about 1870 small municipal supplies serving fewer than 5000 people (DWP-Austria 2015). About 93% of all drinking water in Austria is not treated (DWP-Austria 2015); the same source reports that compliance is at 99.8% for microbiological parameters and 100% for chemical parameters as of 2014-15 (DWP-Austria 2015). However, according to the 'Austrian Drinking Water Report' (BMG 2015, cited in DWP-Austria 2015), in 2010 a relatively high number of small operators (municipalities and water cooperatives) serving fewer than 5,000 inhabitants asked for 118 exceptional derogations under Art.9 of the DWQ Directive due to high values of nitrate or pesticides.

[1] Details on the regulations pertaining to self –provision and 'private water supplies' in Austria (definitions, registration, enforcement) could not be extracted because the documents are in German.

Community-based management is found in Austrian water cooperatives. These are under the same regulatory control as municipal water supplies to meet the requirements of both the DWQ Directive and WFD (Klein 2009; DWP-Austria 2015. Almost all cooperatives use water meters, excepting only in rural areas, some single or very small water cooperatives (up to 10 connections) (DWP-Austria 2015). There are about 3400 cooperatives serving fewer than 5000 people, but many of the 1870 municipalities also serve small towns with fewer than 5000 people (DWP-Austria 2015). In general, a high number of cooperatives are self-supporting, based on revenues from the services (water and waste-water) provided, but all of them are eligible to apply for public and EU finding (Klein 2009). Most cooperatives have on average 100 members, i.e. 100 households on average (Hatchfeld et al 2009).

Table A2.1 illustrates the Austrian cooperative paradigm.

Table A2.1. An example of community-operated small water supply in Austria

Name of cooperative	Wassergenossenschaft Gramastetten, Austria
Membership	It has 569 members (2008) and serves about 2000 people. Membership is related to ownership of real estate and apartments. A connection fee (1820 in 2008) has to be paid.
Decision making	All relevant information is available to everyone and important decisions are taken by the general assembly of all members. The administrative work is on a voluntary basis.
Water sources	Local groundwater, thus reducing infrastructure cost.
Risks	As all water supplies in Austria, this cooperative faces the risk of elevated levels of nitrate and pesticides from agricultural land use.
Treatment and monitoring	Most of the technical work is done on a voluntary basis. The regional association of water cooperatives provides expertise, quality control, and training for the volunteers.
Charges	Tariffs are well below average because: • Groundwater is generally at good status so treatment is not costly • Administrative costs are low due to voluntary work • The cooperative's purpose is not-for-profit
References	Hachfeld et al 2009.

Belgium

Very little information could be extracted about water rights, responsibility, connections, enforcement and types of small water supply management in the different federal regions of Belgium, because the majority of documents were in Flemish. Unless otherwise stated, the information summarised here comes from the Contribution of the to the study on human rights and the access to water undertaken by the High Commissioner for Human Rights in accordance with the Human Rights Council (2006) Decision 2/104 (Government of Belgium n.d.).

Article 23 of the Belgian Constitution states that all citizens should be able to live in a dignified manner and therefore have the right to a safe environment and health. Decision-making power is shared by the federal government and the three regions (Flanders, Wallonia and Brussels).[2] Municipalities have responsibility for drinking water supply (since 1907) and have established 'inter-municipal drinking water companies'. Coordination of municipal and inter-municipal companies was assigned to the National Water Distribution Company (SNDE), a public corporation. The SNDE is split into three sections: in Flanders, the Flemish Water Distribution Company; in Wallonia, the Walloon Water Distribution Company; and the Brussels Water Distribution Company.

All three regions have laws establishing the right of access to drinking water and have introduced social tariffs in relation to water supply and sanitation. Brussels region refers to large urban supplies, and will not be further examined in this report. In Flanders, legislation recognises the every person is entitled to receive a minimal amount of water free of charge per year (15 m^3), as recommended by WHO. In Wallonia, the Environment Code (2004, cited in Government of Belgium n.d.) states that: 'Water is part of the common heritage of the Walloon region… each person has the right to dispose of drinking water of quality and in sufficient quantity for its nutrition, its household need and its health'. Progressive water pricing is also used with a first block of 30 m^3 per household per year; this is provided at a lower price than other blocks to facilitate access to water to small users and is financed by cross-subsidies from large users. In Brussels disconnection in case of non-payment is subject to court approval.

In addition, in Flanders and Wallonia drinking water municipal companies are also responsible for the clean-up of the water they deliver to customers, mainly through agreements about the required services with the company responsible for building and operating the waste water treatment. Flanders has also established a Consultation Committee gathering all the different stakeholders, whereas Wallonia has set up a specific Committee to monitor the fulfilment of the Environment Code (2004) pertaining to drinking water.

According to Eurostat's recent data, in Belgium 100% of the population is covered by the municipal or inter-municipal network (Eurostat 2016). Sources of water and compliance with the water quality, monitoring and remedial action provisions of the DWQ Directive for small supply zones are examined in section 5.2.2.

In the 2014 synthesis report (European Commission 2014d), only public small water supply zones are reported and these exist only in the Walloon Region. It remains unknown whether there are any 'private water supplies', providing water independently of the public network to households in sparsely populated rural areas. In Wallonia, small water supplies mostly used groundwater

[2] Belgium is also composed of three 'communities': the Flemish community, the French Community and the German-speaking community.

sources (more than 80%). There were 522 publicly owned small water supplies supplying 85,648 m^3 of water per day to 0.58 million inhabitants (representing 5.3 % of the total population in Belgium). Overall, 1.3 % of the total number of small water supply zones in Wallonia were failing to meet the monitoring requirements of the DWQ Directive (Art. 7), corresponding to 4,157 people or 0.04 % of the Belgian population. Only half (50.2%) of the small supply zones were in full compliance with the water quality standards of the DWQ Directive, with only 40% of small supplies serving 10 to 100 m3 of water compliant.

The most serious non-compliances related to microbiological parameters, indicating poor treatment; chemical parameters, mainly heavy metals, reflecting problems in the distribution infrastructure; and indicators such as pH, turbidity, iron, manganese and coliforms, also indicating poor treatment and maintenance of the public distribution system. Most remedial actions were either short term or medium term. Remedial actions for microbiological non-compliance were, after notification of the users, improved treatment and actions in the public and domestic distribution network. Actions for iron, manganese and related turbidity also included improved treatment and actions in the public distribution system.

Bulgaria

In **Bulgaria,** the Water Act (Bulgaria) 2011 stipulates that all waters, including those under or crossing a private property, are considered as a national indivisible natural resource. The primary aim of the Water Act is to ensure a sufficient supply and good quality of surface waters and groundwater for sustainable, balanced and equitable water use (Art. 2). A water supply and related facilities can be under either state, municipal or private ownership (e.g. private wells); however, the State may also 'own or acquire ownership rights to waters, water sites and water development systems and facilities which, under the law, may be subject of private ownership', to satisfy the primary aim of the Water Act. Responsibility for drinking water services is assigned to municipal and 'intercity' (inter-municipal) corporations (DWP-Bulgaria 2015). The Sofia (capital city) water service is the only water concession awarded to a private company for 25 years (EWRC 2015 cited in DWP-Bulgaria 2015). Bulgaria is a highly centralised state; while municipal corporations are under the control of elected mayors and elected councils, regions are administered by governors directly appointed by the Council of Ministers, with both inter-municipal and municipal water corporations relying on the central government for funding (Local authorities in Bulgaria 2014).

The highly centralised structure of the drinking water sector is also reflected in the responsibilities assigned to national institutions. The Ministry of Regional Development and Public Works (central state) has responsibility for intercity corporations (MRRB 2015, cited in DWP-Bulgaria 2015). The Ministry of Environment and Waters is responsible for water resource management (MoEW 2015 cited in DWP-Bulgaria 2015). The Ministry of Health is responsible for monitoring drinking water quality (MoH 2015 cited in DWP-Bulgaria 2015). In case of insufficient monitoring by municipal corporations, the Ministry of Health, instead of the municipality, may perform monitoring, as a temporary measure, (DWP-Bulgaria 2015). The Energy and Water Regulatory Commission (EWRC) is an independent regulatory authority, whose members are appointed by the parliament for 5 years, tasked with approving plans, water tariffs, monitoring performance indicators, and reviewing complaints by customers (EWRC 2015 cited in DWP-Bulgaria 2015).

Only municipal supplies are regulated under the DWQ Directive (European Union 2011). Small water supplies are mainly under public-municipal management but about 2% of supplies provide water independently from the public network (DWP-Bulgaria 2015). No further details on the small supplies managed either under the municipal model or self-provision could be found.

Under the 2014 synthesis report (European Commission 2014d), in **Bulgaria**, small water supplies mostly used groundwater sources (more than 84 %). As of 2008-2010, there were 2226 small water supplies (i.e. provided under the public network) supplying 365,653 m3 of water per day to 1.8 million inhabitants (representing 24% of the total population). Overall, 2223 or nearly all small water supplies (99.9 %) were not properly monitored. Remedial actions were generally scheduled for the short term. To achieve compliance with standards for nitrogen-parameters actions targeted the source or involved changing the sources. Microbiological non-compliance was addressed through treatment, actions at source and in the public distribution system.

There is **national public management** of water services in Bulgaria, with 98% of supplies managed under the public/municipal model (DWP-Bulgaria 2015). Drinking water quality is generally good. Deviation from the norm is characteristic of small supply zones that do not have well maintained or upgraded treatment facilities and thus release water to the rural population after simple chlorination.

Cyprus

In **Cyprus,** water supply regulations prohibit use of water from a water supply other than the municipality's (Regulations (Cyprus) 2004 (P.I. 876/2004). In addition, the Decree No. 2640, Supplement III, Part I 1991 on Saving Water (Special Measures) Regulations provide for written notice of penalties to those who use public water in an inappropriate manner. This is to tackle water scarcity issues due to local climate and the dramatic rise in water demand during the tourist season. There are no exemptions for small systems (European Union 2011) because, in line with the Regulations (Cyprus), 2004 (P.I. 876/2004), all supplies are under public-municipal management.

According to the 2014 synthesis report (European Commission 2014d), in **Cyprus**, small water supplies use both groundwater and surface water sources, including coastal water sources through desalination processes. As of 2010, there were 268 small water supplies supplying 36,927 m^3 of water per day to 0.15 million inhabitants (representing 18 % of the total population). Overall, 47.0% of the total number of small water supply zones were not monitored in accordance with the requirements of the DWQ Directive (Art. 7) corresponding to 90,771 people or 11 % of the population. A rather low percentage 53.4 % (143) of reported small water supply zones was in full compliance with the water quality requirements in the DWQ Directive, with the highest levels of non-compliance being observed in supplies serving 10 to 100 m3 of water per day. The highest level of non-compliance was related to coliform bacteria (75.7 % of all non-compliances, but with marginal infringements of legal limits), reflecting possible poor treatment of the water. Chemical compliance was high. The remedial actions required to meet compliance with the microbiological parameters entailed both short-term and medium term actions, which have effectively lifted non-compliances, such as:

- Integrated cause investigation followed by repeated samplings.
- Actions to terminate or mitigate the cause.
- Actions to replace or repair defective components of the infrastructure.
- Actions to clean and/or disinfect contaminated components.
- General improvement and maintenance of the distribution network and domestic distribution systems.
- Better treatment and actions at the source.

[3] Documents on Ministry websites are in Bulgarian.

Croatia

In **Croatia,** local governments are responsible for water services and provide them through 140 water and sanitation service utilities (DWP-Croatia 2015). The same source reports that the drinking water sector is controlled at the national level by a constellation of actors, the most important of which are the National Water Council, tasked with proposing new policies; the Ministry of Agriculture, responsible for water policies including water services; Croatian Waters, the national water management agency appointed by the Government and responsible for granting water use rights and charging fees; the Water Services Council, established by the Water Laws (Croatia) 2009, 2011, 2013) (cited in DWP-Croatia), is responsible for economic and service quality regulation; and the National Institute of Public Health, which monitors water quality.

The Regulation on Health Suitability of Drinking Water (2008), which implements the Food Law (2007), applies to all public water supplies, i.e. supplies serving more than 50 people and supporting a public or commercial activity. It specifies that Departments of Public Health have the responsibility for monitoring and enforcing the regulation and must be accredited according to DIN EN ISO /IEC 170125 standard. In addition, all public supplies must apply HACCPs as a self-control/ risk assessment approach. Art. 17 stipulates that in the case of non-compliance with water quality standards, the local public health institutes should restrict or interrupt the delivery of water, inform consumers, investigate the cause and take action to remover the public health risks, and inform the experts of the Water Services Council.

Approximately 70% of public water supplies recover their operational costs from tariffs (DWP-Croatia 2015), but it remains uncertain whether small municipal corporations are faced with the greatest problems. In Croatia there is no national operational subsidy scheme except for specific cases, such as small islands without local water supply (DWP-Croatia 2015). Also, significant cross-subsidies between residential and industry exist, with industrial tariffs being up to 50% above residential tariffs (WB&DE 2012, cited in World Bank 2015). However, residential tariffs have increased since 2005 and will continue to increase, given the significant investments and subsequent operating costs linked to Croatia meeting the European environmental acquis. In 2012 the average water bill had risen to 3.6% of household income for the bottom 40% of the population, which is above the designated Croatian affordability level of 2.5% (WB&DE 2012). This situation has potential implications for small supply zones and especially low-income households in rural areas.

The Water Law (Croatia), and a separate Water Financing Act (cited in DWP-Croatia 2015), initiated a significant sector consolidation and modernisation process as part of harmonisation with WFD and to allow more effective European Funds absorption (DWP-Croatia 2015). This process will culminate in the local water utilities being aggregated into about 20 regional providers by 2016. This will also result in the small water supply zones being managed under larger municipal providers (DWP-Croatia 2015). Approximately 24% of the population relies on small water supplies and 19% of the total population relies on self-provision (DWP-Croatia 2015).

In Croatia, utilising **national public management**, approximately 5% of the total population relies on 55 small municipal corporations and (DWP-Croatia 2015). The Regulation on Health Suitability of Drinking Water (2008) requires the implementation of self-control systems such as the HACCP procedure for all public supplies (i.e. those serving more than 50 people and supporting a commercial or public activity). Also, in case of non-compliance detected in a small public water supply, the municipal corporation must maintain records and keep it for five years. In the case of accidental pollution or any cause of non-compliance with water quality standards after natural disasters (e.g. floods), and if treatment is unable to eliminate the problem and there is no backup source, the municipal corporation must request permission to depart from the exposure limits from the Water Services Council and the Ministry of Health.

In Croatia large utilities are key players in staff capacity building (DWP-Croatia 2015). They attract qualified and highly educated employees and play a key role in developing staff training and can be considered a driving force for staff capacity enhancement appointed by municipal representatives. However, staff are often replaced according to political cycles, with management staff turnover much higher than technical staff turnover.

Czech Republic

Municipal corporations are responsible for the provision of water services through the public network (DWP-Czech-Republic 2015). As regards large supplies, PPPs (delegated private management, see Section 3) are the most dominant management model, which is estimated to provide water for 46% of the population. As regards small supplies, there are more than 2300 village administrations (departments of public services) that provide public water services in rural areas to about 11% of the total population. No provisions could be found for very small supplies. The water sector is controlled at the national level by the Ministry of Agriculture, which is in charge of the regulation of water supply; the Ministry of Environment, which is responsible for preventing pollution of water resources; the Ministry of Finance, tasked with regulation and control of fees and water tariffs; and the National Institute of Public Health, which is responsible for drinking water quality control (DWP-Czech Republic 2015). The same source reports that there is only one tariff for households and industries, and cross-subsidies are not permitted. Also, the social affordability threshold is set at 2%, and is reviewed by the State Environmental Fund under projects co-financed by EU funds.

Under the 2014 synthesis report (European Commission 2014d), in the **Czech Republic** in the period 2008-2010, most drinking water in small water supply zones was produced from groundwater sources, some from surface water and the remainder from a mix of groundwater and surface water. Czech Republic reported 3870 small water supplies, i.e. 95.4% of all supplies, subject to normal reporting procedures. However, the volume supplied by small supplies was not reported, therefore it remains uncertain as to what it refers. Small supplies serve 2.0 million people or 19% of the total population. Also, information on causes of insufficient monitoring, non-compliance with standards and remedial action was not reported, but all small water supplies were monitored.

In the Czech Republic, using **national public management**, some villages or small municipalities support their utility operations with funding from their municipal budgets in order to keep tariffs affordable. Such subsidies are currently estimated to represent up to 5% to 10% of total utility operational expenditures (DWP-Czech Republic 2015). Generally, utilities receive no subsidies or additional taxes or fees to cover their operations and maintenance costs. Fees for water discharge and extraction are redistributed through the State Environmental Fund with the aim to be invested in infrastructure.

Denmark

In Denmark, drinking water has traditionally been provided by small user-owned enterprises or the municipalities, with most of the responsibilities for the management of water resources and regulation of drinking water being integrated at the level of the municipalities (Sorensen 2010).

Reform in 2009 introduced mandatory corporatisation of water utilities (i.e. municipal corporations) and a new state office to regulate the utilities, using performance benchmarking and incentive-based price regulation (Sorensen 2010). However, municipalities also regulate the rights and obligations of consumers and property owners in relation to water supply. For instance, they define the areas to be connected to public supply networks and they regulate the abstractions of properties outside public networks (Anker 2006, cited in Sorensen 2010). They also regulate the tariffs, which are financed by water supply-specific user fees, separately from the tax-financed municipal budget. Following the 2009 water sector reform, municipal water price setting is combined with a centralised price ceiling to account for environmental and other obligations imposed at local and national levels (Sorensen 2010). There is a centralised competition authority in Denmark with responsibility for economic regulation of all utilities including water supply, but for very small scale operators below 10 m3/day there is a very limited economic regulation. However, these supplies are regulated by the Danish Nature Agency, and that agency sets some requirements for human health and environmental issues.[4]

The principal Act now is the Water Supply Act (Denmark) (No.1199 of 2013). This includes rules on abstraction and discharge of water resources and also implements European rules on nature conservation and biodiversity. The Act aims to ensure the utilization and protection of water by implementing comprehensive planning and following a comprehensive assessment; to coordinate the existing water supply for prudent use; provide adequate and satisfactory quality of water supply; and to ensure quality of drinking water to protect human health. The Act aims to ensure compliance with the principle of cost recovery, including environmental and resource costs, and pricing with incentive effect. It is significantly broader than previous legislation. Amendments in 2015 (Water Supply Amendment Act, Denmark, No. 538 of 2015) made further provision for groundwater mapping and for a contribution from water tariffs to drinking water protection until 2020.

Order No. 1310 on water quality and supervision of water supply systems (Denmark) 2015 implements some parts of the 2013 Act and the DWQ Directive. It establishes quality requirements for drinking water, including water used for medicine and for human consumption, and regulates control and monitoring of water supply systems. The municipalities provide information on drinking water quality to a public database.

For public supply, Order No. 132 on quality assurance of public water supply facilities requires that a public water system supplying more than 750 000 m^3 of water each year (or more than 2055 m^3 of water per day) shall comply with the requirement of introducing ISO22000, or systems based on HACCP principles, such as Documented Drinking Water Safety or equivalent systems. Supplies providing more than 17 000 m3 per year (or more than 50 m^3 of water per day) shall introduce quality assurance procedures by mapping the entire water supply and the quality thereof by management procedures, e.g. cleaning, sampling, repair and new construction, risk assessment for contamination from individual components, removal of inappropriate structures, and sufficient maintenance, as well as operational processes for prioritising high risks of contamination of water.

Municipalities must also implement environmental laws in accordance with regional resource plans and nature management plans (Sorensen 2010). For this reason they develop water supply and waste water management plans to implement regional and national policies. Such plans, which are financed by a general tax, can guide administrative decisions concerning permits, or they can require actions such as agreements with farmers to restrict their use of pesticides or nutrients (Anker 2006, cited in Sorensen 2010).

Under the 2014 synthesis report (European Commission 2014d), in **Denmark**, all small water supplies use exclusively groundwater sources. As of 2010, 2071 small water supplies supplying 379,063 m^3 of water per day were reported. The population supplied by the small water supply zones was unknown. Overall, 14.1 % of the small water supplies were not monitored in accordance with the requirements of the DWQ Directive (Art. 7). Approximately, 34% of small supplies were non-compliant with the water quality standards of the DWQ Directive. Denmark reported non-compliance in relation to its national limits which vary from the ones set out in the DWQ Directive. The highest number of non-compliances was related to nitrates, with 9.5% of small supply zones being non-compliant, indicating agricultural effects. Microbiological parameters were compliant with standards in more than 99% of supply zones. Non-compliance in ammonium, iron, manganese, were related to the nature of the source water. Denmark did not provide information on remedial actions, as these are taken by municipalities and the related information could not be accessed by the Danish Nature Agency.

Denmark uses **national public management**. A review of the Danish water sector following the 2009 reforms reported 75 municipal utilities that service 65% of Denmark's six million people (Hvilshøj & Klee 2013); however it remains unknown how many of these utilities refer to small supply zones. In any case, small municipal supplies are regulated as large municipal supplies for Denmark. Therefore, there are no reporting exemptions; small supply zones must be risk-assessed under HACCP or a similar procedure; and municipalities regulate tariffs to meet their operational expenses, which are water supply-specific. Also, the government's (Ministry of the Environment and Food) official position is that drinking water should be based on pure groundwater which only needs simple treatment with aeration, pH adjustment and filtration before it is distributed to the consumers (Stockmar and Thomsen 2008; Naturestyrelsen n.d). Except for Copenhagen, water in the municipal network is not chlorinated (Neimann et al 2003; Stockmar & Thomsen 2008). Hvilshøj and Klee (2013) also mention that a challenge addressed by the performance benchmarking and tackled through sharing best practices and technologies related to 'ensuring that waterworks are sufficiently large to meet demand for high-quality water at low-prices'.

Denmark also makes extensive use of **community-based management**, especially cooperatives. There are about 2,400 water consumer-owned waterworks cooperatives serving 35% of Denmark's six million people (Hvilshøj & Klee 2013). The Association of Waterworks in Denmark (n.d.), which is an organisation promoting the views and interests of these cooperatives to the public, the authorities and politicians, report the following facts about cooperatives in Denmark:

- They account for 40% of total abstractions;
- Half of all properties receive water from a cooperative;
- Each cooperative serves on average 400 to 600 people;
- Cooperatives may cover a village, a minor township, or a number of households.

[4] Pers. Comm., Eske Benn Thomsen, Head of Section, Danish Competition and Consumer Authority.

Experience from cooperative provided water services for small supplies in Denmark is summarised in Table A2.2.

Table A2.2. Community-based management of small water supplies in Denmark	
Country	Denmark
Number	There are 2,400 cooperatives in Denmark accounting for 40% of total abstractions and serving 2 million people (A cooperative may serve 10 to 20,000 households, but 400-600 on average).
Risks	The main types of threats to be managed are: -Nitrates and pesticides; -Groundwater over-exploitation.
Planning	The Planning Act (1992) and the Water Resource Plan, drawn up to deliver WFD objectives, require regional and local integration of economic and spatial plans in order to provide a framework for groundwater protection.
Governance Scale	-Decentralised integrated regulation of water utilities, water resources and the aquatic environment by municipalities. -Centralised price regulation. -Treatment, monitoring and compliance with the regulations are enforced by the municipalities.
Risk assessment	Supplies serving more than 17 000 m3 of water every year (about 50 m3/day) shall introduce quality assurance. They must prioritise risk reduction by operational processes and management procedures, e.g. cleaning, sampling, repair and new construction, risk assessment for contamination from individual components, removal of inappropriate structures, and sufficient maintenance.
Regulation and Enforcement	Regional councils and municipalities authorise abstractions and supervise water quality.
References	**Waterworks in Denmark n.d.**, Sorensen 2010; Stockmarr & Thomsen 2008, European Commission 2014d.

In Denmark, there is also **household-based management**. About 50, 000 households rely on self-provision for water, by dug wells or shallow boreholes (Stockmar & Thomsen 2008). Municipalities regulate connection of one or more properties to an existing public network if the connection is found desirable, based on an overall assessment of the conditions in an area or based on the conditions of the individual properties (e.g. if wells are contaminated). Private wells must provide safe drinking water; if not, municipalities take action.

Estonia

In **Estonia**, the Consolidated Water Act (Estonia) 1996 provides that ownership of surface water bodies located on private land vests in the owner of the land (Art.4). Permits are required for abstractions above 30 m^3 per day for surface water and 5 m^3 per day for groundwater for domestic use and shall be refused if the intake affects public health, if groundwater will be polluted or when the abstraction deteriorates the quality of drinking water (Decree on Issuing Water Permits 1994, s.10). Supplies serving fewer than 50 people are exempt from monitoring (European Commission 2011).

Germany

In the **Federal Republic of Germany**, water services, including water quality, environmental requirements and water abstraction rights, are subject to strict control by the State (Consolidated General Water Supply Ordinance (Germany) 2014). Further environmental requirements are stipulated by the Federal Government, and price aspects are addressed at the municipal level.[5] Provision of wholesome water to all, regardless of governance model (municipal or small-scale), is not only legally guaranteed but also 'technologically consolidated' (i.e. using similar technology) at national, regional and local levels; this applies to private wells, too (Federal Republic of Germany submission to OHCHR n.d.).

Supplies serving fewer than 50 people are not exempt from monitoring (European Union 2011). Under the German Drinking Water Ordinance, the requirements governing drinking water quality must be met by all drinking water supplies, regardless of their size, the quantity supplied, the number of persons served, or organizational and ownership structures. Therefore, the minimum requirements cited in the Ordinance also apply to private wells.

According to the 2014 synthesis report (European Commission 2014d), in Germany, small water supplies mostly used groundwater sources (more than 87 %). For the reporting period, there were 5873 small water supplies supplying water to 7.3 million inhabitants (representing 10 % of the total population). A relatively high percentage (87.3 %) of the small water supply zones was in full compliance with the drinking water quality requirements in the DWD Directive.

As a worst case, this may imply that for the remaining percentages of water supplies the population were subjected to a potential health risk for a limited period of time because remedial actions were carried out immediately to meet the parametric values. Chemical parameters were in non-compliance in a very small percentage of small water supply zones e.g. nitrate in 0.2% of water supply zone. Overall, 3.5% of the small water supply zones were not monitored in accordance with the DWD Directive (Art. 7). Some of the small supplies were indeed monitored by local health authorities, but the respective federal state government was not informed. Remedial actions to achieve compliance were mostly reported as improved treatment, actions in the public distribution system and actions in the domestic distribution system. In some cases also actions at the source were reported.

[5] Pers. Comm., Bettina Rickert. We are grateful to Dr Rickert for her inputs to this section.

In Germany, under **national (Federal) public management**, 33% of all water supplies serve less than 275 m^3 of water per day and about 20% of the population is served by small municipally owned water supplies (Federal Republic of Germany submission to OHCHR 2013; Profile of the German Water Sector 2015). These systems are regulated under the same standards as the large public network and display similar levels of performance (Profile of the German Water Sector 2015). The effectiveness of water services sector is largely the result of nation-wide coordination of local regulatory action across Federal States (Profile of the German Water Sector 2015). Cooperative agreements (see Section 3.4.2) among water suppliers and several stakeholders, such as farmers, land owners, regulators, and technical experts, to protect water source and provide affordable and state-of-the-art treatment at a local scale, are also part of the German paradigm for the management of small water supplies (Federal Republic of Germany submission to OHCHR n.d.; Kraemer et al 2009). A summary of the treatment, monitoring practices, approaches to risk assessment and enforcement is given in Table A2.3.

Table A2.3. Public management of small water supplies in Germany

Country	Germany
Management -Governance	State coordination of municipal water services and regulation. Municipalities in most states have the core duty of providing this (and other) public services; delivery is often contracted to the private sector under various legal forms.
Treatment	The German Law requires minimisation of chemical substances in the water, including the disinfectants used for water treatment. In many places disinfectants can be foregone without reducing the high hygienic drinking water standard in Germany.
Monitoring	In the cases of certain parameters, stricter than required in DWQ Directive.
Risk assessment	The multiple barrier approach to risk assessment and prevention is in place in all Federal States, in conjunction with RBMPs to deliver WFD objectives
Enforcement	Water sector experts and professionals who operate water supplies follow technical rules and transparent procedures generally recognised rules of technology and referred to in the laws and regulations through so-termed technology clauses. In this way, the State is relieved of tasks, which the sector develops and applies within the scope of technical self-administration and on the basis of a large consensus.
Reporting	Reporting obligation applies to all municipal supplies, regardless of system size.
Charges	Costs pass to the customers, including connections or construction grants and all steps of the multiple barrier approach.
References	Profile of the German Water Sector 2015; Federal Republic of Germany submission to OHCHR 2010; Dige et al 2013.

Germany also uses **household based management**. About 700,000 citizens rely on 185,000 private wells assigned to private houses or villages (Federal Republic of Germany submission to OHCHR 2010). A joint working group from all Federal States and authorities is set to review all available evidence with regard to safety and protection of drinking water and improve access to information and advice for private well owners and users, thus enabling them to continuously supply drinking water that meets the legal requirements.

Small supplies also benefit from the multiple barrier approach to risk assessment implemented in Germany (Federal Republic of Germany submission to OHCHR 2010). In addition to enforcement of groundwater protection on a nation-wide scale in line with the WFD, in many areas water suppliers (e.g. municipalities, cooperatives, small companies) contract with farmers to ensure that land use is low impact for drinking water wells, boreholes and springs. These contracts provide farmers with fixed-rate compensation for the loss of earnings associated with livestock, pesticide or fertilisation restrictions. Regulators have allowed water suppliers to pass on to water consumers the costs of compensating farmers for the required changes in management practices (Kraemer et al 2009; Profile of the German Drinking Water Sector 2015).

The result is that more than 99% of all the water supplies meet the requirements of the DWQ Directive, with exceedances of limits on coliform bacteria often referring to sporadic cases not repeated by further analyses. Overall, 100% of the population is served by improved water supplies (Federal Republic of Germany submission to OHCHR 2010).

Greece

In **Greece**, the protection of the environment including water resources for human consumption is the State's obligation and citizens' right (Article 24 of the Greek Constitution). Free flowing waters are in public ownership (Article 967 of the Greek Civil Law). Regulation of water supply services, approval of connections, issuing of permits for abstraction and the allocation of water uses are decentralised and under the control of municipalities, which can proceed or collaborate to create a public water utility (Law 1069/1980). Municipalities must supply water to all households in their jurisdiction by means of connection to the water mains or unconventional approaches, e.g. transfer via water tankers, construction of desalination plants (Greece's letter to OHCHR 2010).

According to the 2014 synthesis report (European Commission 2014d), in **Greece**, small water supplies mostly used groundwater sources (more than 95%). There were 713 small water supplies supplying water to 0.53 million inhabitants (representing 5 % of the total population). A relatively high percentage 70.1 %) of the small water supply zones was in full compliance with the drinking water quality requirements in the DWD Directive. Microbiological parameters (E.coli and Enterococci) were non-compliant in a high percentage, 13.7 % and 14.2 % respectively, of small water supply zones. Chemical parameters in compliance were nitrate in 2.8 % of water supply zones and arsenic in 1.7% of water supply zones. The nitrate concentrations in water from small supplies were caused by agricultural activities and poor treatment of the water. Overall, 32.0 % small water supply zones were not monitored in accordance with the Directive (Art. 7). As most

non-compliance was caused by a combination of contamination of sources (natural causes and man-made) combined with poor treatment of the water, remedial actions to achieve compliance were mostly reported as actions at the source and improved treatment.

In **Greece** there is national public management; 100% of the population is served by municipally treated water (Greece's Letter to OHCHR 2010). The most notable challenges for small municipal supplies, some of which serve fewer than 2000 people in sparsely populated mountainous areas and semi-arid islands, are the overexploitation and contamination of water by agriculture; the salinization of the aquifers; and the pressure for amalgamation and re-centralisation with the prospect of 'full privatisation' (divestiture) of the assets (waterworks, networks) under the market-based management model (Assimacopoulos 2012; Douvitsa & Kassavetis 2014). The population served by small supplies may be exposed to long and frequent water interruptions mainly due to lack of investment for infrastructure and lack of contingency plans for areas vulnerable to drought (Assimacopoulos 2012). In addition, the traditional cost-effective ways of community- managed supplies and self-provision (e.g. rain collection) have been abandoned (Assimacopoulos 2008). Sinisi and Aertgeerts (2011) report that transfer of drinking water by specially constructed ships (tankers) by the Navy or certified private tankers is a practice that has been followed (at least) in the past 30 years in the islands of the Aegean. This approach tackles the increasing demand for water during the summer period due to tourism influx in combination with the rainfall shortage and inadequate infrastructure for local water collection. The quality of the transported water comes from large urban drinking water treatment plants and it is tested under the DWQ Directive (i) at every voyage for microbiological parameters; (ii) at the water tanker once a year for chemical parameters; and (iii) at the point of the final supplier for microbiological parameters (Sinisi & Aertgeerts 2011).

Hungary

In **Hungary**, Act No. CCIX (Hungary) 2011 on water public utility service stipulates that ownership rights of water utilities may be exercised only by the State or by municipalities. It rules that the integration of water utilities is a goal of principle, setting a minimum size requirement of 150,000 population equivalent (p.e.) to be reached by December 31, 2016. This will result in the integration of all small providers. The Governmental Decree No. 123 of 1997 (VII. 18.) on the protection of freshwater stocks and water works for drinking water distribution, sets out rules of the designation of protected areas when water is served 'to at least an average of 50 persons'. Yet 6% of the population relies on self-provision (DWP-Hungary 2015).

Italy

In **Italy**, the Galli Law 1994 ruled on the integration of water services (drinking water supply and wastewater collection and treatment) and amalgamation of utilities in order to exploit economies of scale and scope. Italy uses both direct public management and delegated private management, usually through municipalities (Garcia-Quesada 2011). Although there have been efforts to rationalise the large numbers of municipalities (and other authorities active in water management), this remains a problem in Italy, as do recent constitutional court cases that led to reform of the law. A national economic regulator has recently been established.

Lithuania

In **Lithuania**, according to the Law (Lithuania) No. VIII-474 on Water 1999 all groundwater is public. All water users shall supply statistical data on water use to an institution authorized by the Ministry of Environmental Protection. There shall be a Public Cadastre of Water Resources, a Public Cadastre of Rivers, Lakes and Reservoirs, a Cadastre of Groundwater, and a public Water Resources Register (Art. 39). Supplies serving fewer than 50 people are exempt from monitoring (European Union 2011).

Malta

In **Malta** the Water Intended for Human Consumption Regulations (Malta) 2009 provides that private water supplies are those supplying potable water which is not distributed through a distribution network; (b) water intended for human consumption from any individual supply providing less than I0 m^3 a day as an average or serving fewer than 50 persons, unless the water is supplied as part of a commercial or public activity. The Registration of Private Water Supplies Intended for Human Consumption Regulations (Malta) L.N. 357 2004 rules that owners of private supplies[6] shall be responsible for verifying the quality of the water and its use. No person shall supply, distribute or make use of water from a private supply unless such supply is registered with the Health Authority. The latter shall keep a register of all private water supplies. The Health Authority shall request a private water supplier to provide water quality analysis results prior to the registration of any source, as to confirm the wholesomeness of that water source.

The Health Authority shall refuse to register any water source unless all the relevant provisions of these regulations and of other related regulations are complied with. The Health Authority may at any time remove from the register any water source if the relevant provisions of these regulations and of other related regulations are not complied with. When the Health Authority grants an exemption under the preceding sub-regulation, it shall ensure that the population concerned is informed of such exemption and of any action that can be taken to protect human health from the adverse effects resulting from any contamination of water intended for human consumption. In addition, when the Health Authority becomes aware of the possibility of potential danger to human health arising out of the quality of such water, the Health Authority shall ensure that such exemption is withdrawn.

Netherlands

In the **Netherlands** the water sector is centralised. The Drinking Water Act (1994, revised 2009) provides that drinking water may only be supplied by publicly-owned drinking water companies appointed as such by the Minister. The Minister allocates to each water company a distribution area, in which the appointed company has the exclusive right and duty to supply potable water; water prices are determined by the company but have to be agreed by the municipal and regional governments. The Dutch Drinking Water Decree (Staatsblad 2001, cited in Smeets et al 2009) rules that drinking water should fulfil the same requirements regardless of system size, thus being stricter than the DWQ Directive and WFD. It also includes no requirements for primary or secondary disinfection but requires the implementation of quantitative microbiological risks assessments (QMRA).

Under the 2014 synthesis report (European Commission 2014d), in the **Netherlands**, there were approximately 250 small water supplies (mostly recreational camp sites). However, information was only submitted for 39 small water supplies. In January 2012, information was electronically available for these 39 small supplies. For all the others (around 210) data was only available on paper, and not reported. Population (not permanent) served (predominantly tourists) was estimated at

[6] Private water supply' means any potable water which is not distributed through a distribution network.

0,006 million inhabitants (less than 1% of the population). A low percentage (15.6%) of the 39 small water supply zones was in full compliance with the drinking water quality requirements in the DWD Directive. Indicator parameters caused non-compliance in some small water supply zones; causes included inefficient treatment and geo-hydrological circumstances (ammonium). Non-compliance was due to natural compounds present in the source and insufficient treatment of the water. Remedial actions reported to achieve compliance were scheduled for the short term and involved improvement of the treatment.

In the Netherlands there is **national public management**. Drinking water should fulfil the same requirements regardless of system size. Almost 100% of the population is connected to a municipally owned network. Hulsmann (2005) reported 175 small supply zones serving 8000 people in total, but no supplies serving fewer than 50 people as of 2005. More recent data could not be found. But given the legal framework it is likely that these supplies are owned and operated by many small or larger amalgamated municipal companies, in a similar way that small (public) supply zones in Scotland are operated by Scottish Water. Chlorine is not used at all, either for primary disinfection or to maintain a residual disinfectant in the distribution network to prevent regrowth (Smeets et al 2009). Instead, a quantitative microbial risk assessment (QMRA) is a statutory requirement for all systems (and see Section 4.5.4).

The **Dutch approach** has been criticised in favour of disinfection as an essential barrier to pathogenic microorganisms entering or growing in the distribution system and for effectively preventing outbreaks. But as Smeets et al (2009) observe Netherlands has higher rates of microbiological compliance than the UK, where water is chlorinated. In addition, a EU wide study of 61 outbreaks found that backflow in the network and cross-connections were the leading causes, while chlorine residual was not sufficient to prevent these outbreaks (Risebro et al 2007). The Dutch management paradigm is summarised in Table A2.4.

Table A2.4. Public management of small water supplies in the Netherlands

Country	Netherlands
Threats	Farming and flooding
Management -Governance	The regulation of drinking water quality and planning of preventive measures is under State coordination and control but water service provision is via decentralised municipal companies.
Exemptions	The DWQ Directive exemptions are not in place. Drinking water should fulfil the same requirements regardless of system size.
Treatment	Water is not chlorinated
Monitoring	All small supplies are monitored by municipal water companies.
Risk assessment	The Dutch approach of QMRA
Enforcement	It is prevention-oriented,
Information-Reporting	Recordkeeping applies to all supplies
Charges	Water prices are determined by the company but have to be agreed by the municipal and regional governments
References	Hulsmann 2005; Drinking Water Act 2009; Smeets et al 2009

Portugal

In **Portugal**, the Decree-Law No. 194/2009 on the legal regime of municipal services for the public water supply establishes that municipal services are responsible for: management of municipal collection systems for handling, storage and distribution of water for public consumption, as well as management of pipes not connected to the public water distribution, which are source of water for human consumption. The exemptions prescribed by DWQ Directive are not in place (European Union 2011). The water sector is undergoing deep reforms since 1990s, in pursuit of higher levels of performance with gradual amalgamations and increasing contracting of water services to private companies.

Romania

Romania is a unique case across EU Member States in terms of water services and the implementation of the right-to-water, as 38% of its population relies on self-provisioning for drinking water (DWP-Romania 2015). In addition, according to a survey by UNDP World Bank and European Commission (European Union Agency for Fundamental Rights - EUFRA 2012), 72% of the Roma population does not have access to an improved water source (and 83% does not have access to improved sanitation). Local authorities provide water and sanitation services through 226 publicly owned utilities (DWP-Romania 2015). But there are no exemptions from monitoring for very small water supplies (European Union 2011).

Slovakia

In **Slovakia**, the self-governing municipalities as asset owners are responsible for provision of water services (MinV 2015). Any surface water or groundwater abstractor must obtain a permit from the water authorities. Payments and charges for surface water extraction, including the payment mechanism, are determined by law. 400 village administrations provide water to 5% of inhabitants living in rural areas. The remaining inhabitants rely on self-provision (13%). The Ministry of Health (through the Public Health Authority), and the Ministry of the Environment, is responsible for drinking water quality control. There are no exemptions from monitoring for very small water supplies (European Union 2011).

Slovenia

In **Slovenia** the Decree on Drinking Water Supply 2012 lays down the responsibilities of municipalities for the provision of water services. Monitoring applies to supplies serving more than 50 people. Recordkeeping applies only to large supplies serving more than 5000 people. The internal monitoring conducted by the administrator of a supply is based on the HACCP and was

established in 2003 (Art. 17 of the Act Regulating the Sanitary Suitability of Foodstuff, Products and Materials Coming into Contact with Foodstuffs (Slovenia) OG RS 52/2000 (cited in USDA 2004). HACCPs must be implemented for all supplies serving more than 50 people (Hulsmann & Smeets 2011).

In Slovenia there is n**ational public management.** There are 80 medium and small municipal water utilities serving about 26% of the population (DWP Slovenia 2015). HACCPs must be developed and implemented for small supplies serving between 50 and 5000 people. Small public systems supplying up to 1000 citizens are facing pressing challenges with respect to the effectiveness of HACCPs because usually they have no administrator (who has responsibility for HACCPs) and they are not properly fitted out (University of Nova Gorica 2005). In particular, facilities and equipment are poorly maintained; the distribution network needs rehabilitation; and protection measures are not carried out in protection zones, which are not designated everywhere. In addition, the lack of well-trained technical and financial staff has further exacerbated already existing technical problems and management inefficiencies in some utilities (DWP Slovenia 2015). The national water association does not currently provide training or technical assistance to water sector professionals. These problems have a greater impact on small supply zones in rural areas but due to wider social change and urbanisation, there is a general decreasing trend in the population served by those small supplies; for example this population declined dramatically from 112,498 in 1995 to fewer than 2000 people in 2000 (University of Nova Gorica 2005). The Slovenian practices are summarised in Table A2.5.

Table A2.5. Public management of small water supplies in Slovenia

Country	Slovenia
Problems	Coliforms, nitrates and pesticides
Management -Governance	Municipalities own and operate the small public supply zones. The regulation of the drinking water quality is centralized at the national level
Exemptions	The DWQ Directive exemptions are in place.
Treatment	Depending on local circumstances, water may be disinfected (e.g. chlorination) or undergo conditioning, i.e. removing or altering minerals, chemicals and contaminants from a water source to improve the taste and potability of drinking water using magnetic, electrolytic, electromagnetic, electrochemical, or electrostatic methods.
Monitoring	Public small supplies are monitored as stipulated in DWQ Directive.
Risk assessment	HACCPS must be implemented to supplies serving more than 50 people or foodstuff preparation activities.
Enforcement	Implementation of DWQ Directive, HACCPs and protected area designations are constrained by budget and state of infrastructure.
Information-Reporting	Recordkeeping does not apply to small supplies (<5000 people).
Charges	Municipalities are responsible for tariff setting.
References	DWP Slovenia 2015; University of Nova Gorica 2005; Hulsmann & Smeets 2011.

Spain

In **Spain** water resources are a public natural resource under the Constitution. The responsibility for water provision rests with the municipalities who own the infrastructure. Municipal water companies operate and manage the water supplies. Spain has adopted the exemptions stipulated in the DWQ Directive for the monitoring of supplies serving fewer than 50 people, except when there is a potential risk to human health (European Union 2011). Hulsmann (2005) reported no supplies serving fewer than 50 people in Spain, although evidence from other work suggests that there are numerous farms, for example, in rural Spain, who would have private wells and household-based management. The exact population served by small supplies zones is unknown because of the seasonal influx of tourists especially in areas served by small municipalities (European Union 2011). In addition, a number of local authorities or water sector practitioners report a relatively large number of very small supplies and individual wells. For example, the municipality of Abegondo, Galicia, has estimated that 650 000 people consume water through uncontrolled autonomous solutions such as wells.

Water suppliers in Spain are required to prepare a Self Control and Supply Management Protocol as a proactive and risk management approach towards safe water (European Commission 2014c). Data from all supplies serving more than 50 people are recorded in the national information system SINAC and provide the basis for the annual reports compiled by municipalities and health authorities. Registration is compulsory for supplies serving more than 50 people but less than 5,000 and for all supplies regardless of size providing water as part of a commercial or public activity (European Commission 2014d).

UK

In **England, Wales, and N. Ireland** the private water supply regulations are very similar to those legislated in Scotland. In **Scotland**, local authorities exempt from monitoring those supplies that serve fewer than 50 people, but monitor and risk assess supplies serving more than 50 people or a public activity. Scotland's private water supply regulations are presented in more detail in Annex 1. In England and Wales, single properties are exempt, but there is a requirement to risk assess and monitor (within a 5 year period) supplies below the Directive limit serving more than one house.

As the UK is the Member State, reporting under the DWQ Directive is at UK level. Under the 2014 synthesis report (European Commission 2014d), in **the UK**, small water supplies are classified by type, public and private,[7] both of which

[7] And private supplies can be Type A or B; see Annex 1 on Scotland. Type A supplies include water above the Directive limit including for commercial or public use and it is not clear from the Report whether these were classed as public or private schemes.

use both surface water and groundwater sources in varying amounts. There were 4,691 small water supply zones (435 public and 4256 private) supplying water to 1.26 million people (0.62 million people from public, and 0.64 million people from private supplies), representing 2% of the total population. The percentage of the small water supply zones in full compliance with the drinking water quality requirements in the Drinking Water Directive is 51.7%. An 11.5 % of the private-domestic supplies were non-compliant for E. Coli compared with a 0.5 % for supplies with a public activity. The metals copper and lead causing non-compliance were recorded as being a result of treatment inefficiency and not (as expected) due to condition of pipes and mains.[8] Also for nitrate, sufficient treatment (or lack) was reported as the main cause of non-compliance. Overall, 32.4 % of the small water supply zones were not monitored in accordance with the Directive. The percentage of small water supplies zones not monitored at the required frequencies were for supplies with public activity, 13.6 % and for domestic supplies, 34.4 %. This is again due to differences in the two types of supplies and how and by whom they are monitored. Remedial actions were reported to achieve compliance and focused on both changes at the sources and improvement of the treatment processes.

Non-EU States

Out with Europe, as discussed in Section 5, water supply regulations often use the guidance issued by WHO (2011), adapted as appropriate, to ensure that the water provided by small supplies is safe for all.

Australia

In **Australia**, the Federal Drinking Water Quality Guidelines (National Health and Medical Research Council 2011, last updated 2016) draw on WHO Guidelines. States are responsible for water under the Constitution of Australia (s.100), and for water services. The Federal Guidelines, although not formally legally binding, should be implemented by each state, where water supply may be the responsibility of municipalities or other entities. States apply the Federal Guidelines in state law, for example in New South Wales, under the Public Health Act 2010 and the Public Health Regulation 2012. The Act and Regulation require drinking water suppliers to develop and adhere to a quality assurance program (or drinking water management system) by 1 September 2014. This requirement applies to water suppliers defined in the Act, which includes private water suppliers.

Small, remote water supplies, in particular, are typically managed by a community group or a small private operator, and some are managed by water utilities (National Health and Medical Research Council 2011: 153). Although the Federal Guidelines are comprehensive, Chapter 4 recognises the issues for small supplies, defined as serving less than 1000 people and including some commercial supplies. The recommendation is that small supplies should adopt a risk management framework and take a preventive approach; 'the focus in small supplies should be on regular inspection of the system to check for any direct or potential sources of contamination, and on the use of a clean and unpolluted water source' (para.4.2). It is accepted that a reduced set of parameters may be applicable and that informed communities are able to make relevant trade-offs.

As for 'private operators', this term should be used with caution. For example The New South Wales Private Water Supply Guidelines (NSW Government 2015), not to be confused with the Federal Drinking Water Quality Guidelines, aim to assist small private operators of supplies using water from an 'independent water supply' to comply with the requirements of the Federal Drinking Water Guidelines and the Public Health Act 2010 and Public Health Regulation 2012. Facilities with a private water supply can include: caravan parks, recreational and sporting facilities, schools, food manufacturing premises, cafes and restaurants, marinas, mines and worksites (NSW Government 2015: section One). However, the facility included in this definition '**does not** [our emphasis] include supplies provided by water utilities (i.e. town water) or individual household supplies' (NSW Government 2015: section One). Across the states, private entities in different legal forms (including cooperatives, irrigation boards, as well as corporatised entities providing municipal services) may have a role in owning and maintaining infrastructure and managing supply.

Iceland

Iceland is not a member of the EU, but is a member of the European Economic Area through membership of The European Free Trade Association (EFTA) and as such is obliged to implement EU directives into national legislation to ensure that minimal water quality requirements are fulfilled; to conduct regular monitoring of water quality; and to report to the public and to the EU (Gunnarsdottir et al 2015). The EFTA Surveillance Authority (ESA) has the role of monitoring compliance with European Economic Area rules in the EFTA countries. Regulation of drinking water quality in Iceland is according to the Drinking Water Regulation (Iceland) SI 536/2001 introduced in 2001, in accordance with the European DWQ Directive. In 1995 the Foodstuffs Act (93/1995) was introduced, where drinking water was defined as food, with a legal requirement for water supply to have HACCP or similar preventive management (e.g. WSPs) in place. It has now been implemented into 31 water supplies serving 81% of the population.[9]

The service of providing drinking water is according to the Municipal Water Supply Act (32/2004). Municipalities are obliged to supply water and sanitation to their densely populated areas, which are defined as areas with 50 inhabitants or more and distance between houses of not more than 200 meters (Gunnarsdottir et al 2015). In rural areas water supply is most often consumer owned.

Responsibility for surveillance of drinking water quality is at the municipal government level with the ten Local Competent Authorities (LCAs) operating in the country, and at the central governmental level with the Icelandic Food and Veterinary Authority (IFVA) acting on behalf of the Ministry of Industries and Innovation. Each LCA is usually run by several neighboring municipalities and managed by a politically appointed health committee. Regulated water utilities are defined in the IDWR as all water utilities serving more than 50 individuals or 20 dwellings /summerhouses, or with food processing activity regardless of ownership.

Source protection centres on three protection zones; well zone, near-zone, and distance zone, all with different stringent requirements and local authorities can also implement legal requirements to restrict access, land use and use of chemicals inside catchment areas to prevent contamination of drinking water (Icelandic Drinking Water Regulation, 536/2001). The European WFD has recently been implemented into Icelandic legislation (Act on Water Governance, 36/2011).

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[8] Although most of the public network should no longer result in lead contamination, the practice in the UK jurisdictions is to treat supply to avoid lead contamination, rather than requiring (or subsidising) householders to replace domestic pipework.

[9] Our thanks to Maria Gunnarsdottir for her contributions to this section, as well as to our workshop and the final report. Any legislation cited but not in the references list was provided by Dr Gunnarsdottir.

According to statistic for 2012 (Gunnarsdottir & Gardarsson, 2015) there are 797 regulated water supplies in Iceland serving 98% of the population whereof 9 are large (>5000 pp) serving 75% of the population, 178 are small (50-5000 pp) serving 22% of the population, and 610 are very small (<50 pp but serving food processing activity). According to recent WHO/UNECE (2010) data, 100% of both the urban and rural population in Iceland has access to improved drinking water supplies. Compliance for 2010-2012 is 99.9% for E.coli for large supplies (>5000) whereas it is 92.2% for very small supplies (<50 pp).

Since 1997 when the HACCPs were first implemented, it was clear that standard HACCP procedure was too complicated for the smaller utilities and therefore the water sector developed a simpler five step model in 2004. The five step model applies to supplies serving 500 to 5000 people. It is simpler than a standard HACCP but nevertheless includes all the critical elements such as risk assessment, procedures for maintenance, control at critical points, and deviation response. There is provision for a sanitary checklist for supplies serving 50 to 500 people as well as suppliers serving food processing companies such as milk farms (Gunnarsdottir et al 2012a). In addition to the sanitary checklist for food processing companies, a systematic preventive approach to water safety management is required by the Icelandic legislation before licensing an operation permit.

Fourteen out of the 31 water supplies use the five step model for smaller systems while seventeen have adapted the standard HACCP model or WSP (Gunnarsdottir et al 2012a). There is growing evidence that risk assessment, in the form of the standard HACCP or WSP, or the five step model, or the sanitary checklist, has indeed led to improvements in drinking water quality in Iceland (Gunnarsdottir et al 2012b). This includes for example improved maintenance policies and procedures, systematic repair of pipes, cleaning plan (e.g. regular flushing of fire hydrants) and improvements in the system (e.g. backflow prevention). Such interventions aim to reduce contamination and microbial growth in the system, and result in safer water. These are especially important in Iceland as residual disinfection (e.g. with chlorine) is not used. Groundwater, which is the main source of water supply, is not usually treated unless there is a danger of surface water intrusion and then UV treatment often together with filtration is added (Gunnarsdottir et al 2012b). Research in Iceland has revealed that WSP has improved water quality and decreased diarrheal incidence. It has been shown that non-compliance in drinking water quality is 3.7 times more likely in supplies that are without WSP and that there is 14% less risk of clinical cases of diarrhea where WSP in use (Gunnarsdottir et al 2012b).

Problems with the effectiveness of HACCPs and their equivalent procedures for smaller supplies arise mainly because of the exemptions in the regulations; land use pressures and a lack of enforcement, especially for small supplies (Gunnarsdottir 2012a). The regulator has put a legal requirement on the supplies to use a risk assessment/ management approach; however there is a need for follow up compliance and guidelines on how to systematically test the functionality of the risk assessment approach (Gunnarsdottir 2012).

The approach to safe water in Iceland in summarised in Table A2.6.

Table A2.6. Public management of small water supplies in Iceland

Country	Iceland
Statistics	Iceland is a sparsely populated country with many very small water supplies (610) serving less than 50 people with food processing activity. 97% of the population is served by water supplies serving more than 50 people.
Source	Mainly groundwater
Management -Governance	Municipal ownership, operation and regulation integrated in the policies of a number of Ministries (e.g. Industries and Innovation, Environment and Natural Resources etc.)
Treatment	As a rule no treatment of groundwater but filtration and UV disinfection is applied for surface water and if danger of surface water intrusion. Chlorination is not used.
Monitoring	Monitoring does not apply to supplies serving fewer than 50 people with no food processing.
Risk assessment	Water is regulated as food. Therefore: -A simple HACCP procedure (aka the five step model) applies to supplies serving 500 to 5000 people. -A sanitary check-list applies to supplies serving 50 to 500 people and serving food processing companies such as milk farms.
Enforcement	There is no effective enforcement in place.
Information-Reporting	The Local Authorities have the responsibility of recordkeeping and annual reporting but reports are not available to the general public
References	Gunnarsdóttir et al 2012a, b; Gunnarsdottir et al 2015.

Indonesia

An example from developing countries relates to the water management system developed in villages on the island of Lombok in Indonesia, where the villagers took the initiative to construct, maintain and monitor collective drinking water facilities (Lepot & Doosje 2013, cited in van Montfort et al 2014). A partnership was developed between the Indian NGO Plan and the Dutch company BWN to ensure the use of affordable water filters by small communities at the outskirts of New Delhi (Plan-BWN 2014). Indonesia is an example of a country with abundant water resources but where focus on the needs of the large urban conurbations, and the wide geographic, economic, social and cultural diversity in the population, has left small rural supply neglected. Recent work funded by AustraliaAID has sought to examine the regulation and governance of rural water supply (Aid Investment Plan Indonesia 2015).

Kyrgyzstan

In northern **Kyrgyzstan**, 200 villages rehabilitated their water supplies (which were run by the Kyrgyz government before the collapse of the Soviet Union) between 2002-2008 with financial and technical assistance from the Department for International Development (UK), and the World Bank (Wardle 2010). The International NGO Training and Research Centre (INTRAC) supported a local team of Community Development (CD) workers, recruited from NGOs (e.g. Women in Europe for a Common Future, Vasheva et al 2014) to build the capacity of these villages to operate and manage their water systems. The CD team used a process-based approach to capacity building over 12-18 months. The main elements of this approach were: raising awareness; mobilising communities; creating Community Drinking Water Users Unions (the Users' Unions) in each village to manage and operate the water supply; delivering practical training and support; encouraging peer learning; and involving local partners. One of our interviewees considered that the process is reminiscent of the Soviet decision making structures (representatives from each working group, or groups with particular interests). It because it may be difficult to apply this system in the West, but in the modern Kyrgyzstan, it seems effective.

In Kyrgyzstan there are 1891 settlements, of which 1805 have the official status of the village; there are 1037 centralised water supply systems (Vashneva et al 2014). The Law on Drinking Water (Art.14) (cited in Vashneva et al 2014: 10), stipulates that the operation of drinking water supply without systematic control of the production of drinking water quality is prohibited. At present, production control is exercised in urban supplies (Vasheva et al 2014). In rural areas, the operation of water supplies was under State control during the Soviet period. Tests were performed at least twice a month from about 600 staff members of the National Production Operations and Construction Department and its original offices. At the present time, the control system is destroyed and not carried out any more. As of 2014, there were 633 Users' Unions, of which 390 work and collaborate with the Department of Rural Water Supply and Sanitation (Vasheva et al 2014).

The Users' Unions were created through meetings organised by the CD team and attended by representatives from each village quarter; membership comprises all households of a village (Wardle 2010). In addition the CD Team suggested four selection criteria to be adopted when deciding which villages to include in the project. These were the level of need for clean water; the willingness of the community to be involved and take over the operation and management of the water supply; the technical feasibility; and cost of rehabilitation per villager.

According to Wardle (2010), major problems emerged with respect to:

- **Management** of Users' Unions, with the Chair or Board selected by the villagers being ineffective;
- High-turnover of trained **staff,** who after receiving training sought a job somewhere else;
- **Population base**, with Users' Unions managing supplies serving up to 5000 inhabitants;
- **Financial sustainability**, which depended on two interrelated parameters: the willingness of villagers to pay for water (i.e. without revenue from water payments, the Users' Union cannot afford to pay its staff to run and maintain the supply); and the motivation and ability of the Users' Union to provide a reliable supply of clean water to the village Z(without a regular supply of clean water, most villagers are unlikely to want to pay for water).

As Wardle (2010) concluded, the community-based experience in Kyrgyzstan shows that many rural villages can manage their drinking water systems in regions where government has neither the money nor the capacity to do this.

Switzerland

Switzerland is not a member of the EU or the EEA though it is a member of the European Free Trade Association. In **Switzerland** self-governed municipalities own water infrastructure and are responsible for the operation of water supplies and water prices (according to the principle of cost recovery) and the cantons regulate and coordinate water services with other water and regional environmental, forestry and flood management policies under the legal control of the Federal government (Vermont 2005). Connection charges are largely based on the value of the house or on the size of the plot. Water is regulated as food in Switzerland and thus all small supplies have to implement a form of HACCP procedure, but there is flexibility depending mainly on the degree of risks (Girsberger 2003). Switzerland does not plan to implement the EU WFD but takes part in cooperation on international river basins, such as the Rhine (Nilsson et al 2004).

In Switzerland there is **National Public Management**. There are many small municipalities responsible for water supplies serving fewer than 2000 people and relying on forests for natural purification of water. Indeed, nearly 47 % of the water from groundwater (mostly from forested catchments) can be distributed without treatment. Another 40 % of groundwater requires only minimal treatment, e.g. chlorine, UV or ozone (Switzerland National Report 2004). As a result, Swiss water is comparatively inexpensive. Connection charges are largely based on the value of the house or on the size of the plot.

Some small municipalities have been found to delegate operational activities to communities (water cooperatives) and more rarely to private companies (Saladin 2002). But the dominant model is still direct public management.

For example, Rehetobel is a small self-governed village of about 1700 people (Swiss Federal Statistics Office – STAT-TAB 2014). The village administration covers an area of of 6.7 km^2 at 650 m altitude. As in many villages in Switzerland, the existing municipal water network was built with the aim to support primarily fire-fighting activities and secondarily drinking water purposes, rather than complying with drinking water standards, because forest fires posed serious threats to village infrastructure and households during dry summers. Thus the piped network suffered from low pressure or shortages because the source was not adequate to provide water to the increasing population of the village in the second half of the 20th century. Here is what a small village council did to rehabilitate the small and inadequate water supply network (Saladin 2002).

The Rehetobel village administration had to adjust to the drinking water quality regulations, which were first incorporated in the

legislation in the 1980s, and implement HACCP procedures towards safe water. The **village council** installed new pipework which was financially supported partly by the **Fire Insurance Bureau**, a public organisation that usually covers 15-30% of the investment costs of new water supply infrastructure projects. In parallel, the village council set up the '**Water Supply Committee**' to develop new regulations (i.e. prioritise provision of drinking water and lay down water quality requirements); transparent pricing mechanisms (e.g. annual charges and connection fees, management of surpluses); and management and operational procedures (e.g. planning for the renewal of the network, disconnection of contaminated sources, improving state of sources). Regulations required that **house owners** are responsible for their maintenance and renewal of their connection.

The council also established collaboration with accredited local small companies specialising in maintenance and repair work. If work needs to be done on a house connection, the village administration may order the house owner to commission the work to those companies and pay for it. The council also employed municipal members to run the supply but on a part-time basis to make best use of a limited budget.

Finally, the **managers of village supply** had to delineate protection zones around water sources and negotiate with **farmers** where certain activities such as the spreading of fertiliser and slurry should be restricted or prohibited. Small villages usually struggle with this unpopular task as the different stakeholders know each other personally. The **Canton** however provides a stable and consistent law enforcement policy to support the village water supplies in enforcing such restrictions. This is a win-win situation in small supply administration and governance. As shown, all the community and government actors contributed to this success (Figure A1). Even if the Rehetobel supply has to be amalgamated with other small supplies in the region, households outside the main village are already connected and a regulatory framework has already been developed.

United States

In the US, all supplies serving more than 25 people are public in terms of regulatory obligations for US EPA. Citizens bear the cost of water services while some small supplies are fully 'privatised', i.e. their assets are not owned by a public authority; they are managed under the market-based model (CPWS US/WST Board/ DELS/NRC 2002). The US Environmental Protection Agency (US EPA) defines a small system as one that serves fewer than 3,300 people, characterising as very small supplies those serving 25 to 500 people (Ford et al 2005; US EPA 2015c, US EPA 2016); for the US Geological Survey (USGS) a small system can be one that serves fewer than 10,000 people (Ford et al 2005; US EPA 2015c). All supplies serving more than 25 people are regulated by US EPA. The majority of systems in the US are small systems, under either the US EPA or the USGS definition, but the majority of consumers are served by large public supplies. There are significant differences in the management of water, including the delivery of water services, across different states in the US.

In the US, there are many community-based systems, as well as public systems. Water cooperatives and small supplies managed under the public or community-based models are eligible to low-interest Federal loans, and funding from the Department of Agriculture and the Land Conservation Grant (Ford et al 2005). The US EPA in each State can also provide money for operators of community-managed systems to obtain the training necessary for certification and for continuing education (Ford et al 2005). For example, Mississippi requires that elected members of local water system boards have at least eight hours of training per term of office (US EPA 2006)[10] Also, every four years, the (Federal) EPA works with states and community water systems to estimate the Drinking Water State Revolving Fund eligible needs of systems by state. The assessment of need is for 20 years from the time of the survey. The assessment results in a report to Congress and is the basis for allotting DWSRF grant monies to states for community-managed systems (US EPA 2015a).

[10] In the US, reports from surveys of community water supply systems are published by US EPA in six year cycles. The most recent available is 2006.

FigureA1. The factors contributing to the success of Rehetobel village supply.

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Annex 3 Case Studies

Finland

Introduction and Overview

Like Scotland, Finland has a small population and a large rural hinterland. Around 90% of the population have a centralised water supply (Seppala 2012). Around 60% of supply is from groundwater or artificial groundwater, and 40% from surface water. Finland complies with the DWQ Directive and implements it through, inter alia, Government Decrees issued by the Ministry of Social Affairs and Health. As most of the Finnish legislation is not available in English, this case study depends on secondary sources and on the inputs from our interviewees (by written answers). We are grateful for their inputs, especially on monitoring, reporting and enforcement.

The Water Act (for water resources, permits etc.) was recently renewed and re-enacted (Water Act (Finland) 587/2011) as was the Environmental Protection Act (Finland) 527/2014. The Water Services Act (Finland) 119/2001 has recently been amended (Water Services Act (Finland) 681/2014, and see Hukka and Katko, 2015). There are separate Decrees issued by the Ministry of Social Affairs and Health for supplies above the Directive limit and very small supplies below that limit, including individual household wells (Decree for suppliers over 10m3/day or 50 persons (Finland) 2015:1352 2015; Decree for suppliers under 10m3/day or 50 persons (Finland) 2001:401 2001.)

Water services in Finland are mainly provided by municipal water and sewerage utilities, organised as municipal enterprises, which are semi-autonomous within the municipality. A recent trend is to organise water utilities as companies owned by municipalities. Inter- and supra-municipal cooperation is increasing, including regional water companies owned by several municipalities. Mergers of municipalities are also taking place. At the end of 2012 there were 336 municipalities, and 313 at the start of 2016. Municipal mergers affect also the organisation of water services. Since 2010 water services in utilities in the Helsinki metropolitan area (Helsinki, Espoo, Vantaa and Kauniainen) have been provided by the Helsinki Region Environmental Services Authority (HSY). This is the biggest water utility in the Nordic countries (Seppala 2012), providing water and wastewater services to about 1 million people (About HSY 2016).

EU Reporting and Compliance

(This section is taken from the latest EU synthesis report (European Commission 2014d). The evidence refers to type of source, degree of monitoring, compliance with water quality standards and remedial action.)

In Finland, small water supplies mostly used groundwater sources (more than 95%). There were 697 small water supplies supplying water to 0.62 million inhabitants (representing 11% of the total population). A relatively low percentage (59.4 %) of the small water supply zones was in full compliance with the drinking water quality requirements in the DWD Directive. Both microbiological parameters E.coli and Enterococci were non-compliant in a small percentage, 0.9 % and 1.0 % respectively, of the small water supply zones. Indicators, such as iron and manganese, coliform bacteria and colony counts, organoleptic parameters (odour, taste, colour, turbidity) were often non-compliant, indicating problems at source and insufficient treatment. Finland did not provide information on monitoring, causes of non-compliance, remedial actions and time frames for compliance. A general comment was made that mostly remedial actions were taken e.g. change of source, improvements in treatment, additional chlorination, flushing and additional monitoring.

Cooperatives and Private Wells

Finland makes extensive use of water cooperatives (Heivo and Anttiroiko 2014). There are an estimated 1400 cooperatives usually in sparsely populated areas (Takala et al 2011). The greatest challenges for the operation of a small cooperative are from diffuse pollution and the need for continuous maintenance of the infrastructure (Pietila et al 2004; Isomaki et al 2008). The smallest cooperatives may serve less than 10 people, and the largest, over 4000. A Decree for Cooperatives applies and addresses, e.g., economic accounting and business operation of cooperatives.

Government subsidies for water supply and sewerage investments are given for community water supply measures including measures for preparedness in emergency situations, incentives for regional co-operation and water supply, and in rural areas (Heivo and Anttiroiko 2014). The respective municipality and Regional Environment Centre support major infrastructure projects for water cooperatives. This is to guarantee the quality of the operations, and a smooth transition, if the municipality has to take over the water system in the future (Pietila et al 2004; Takala et al 2011). Separate water cooperatives may subsequently join and become a part of municipal water supply. Often, water co-operatives in Finland function like municipal service providers. Where cooperatives run their own treatment plant, usually they perform only alkalisation because of the good quality of groundwater. Reverse osmosis, flotation, filtration, disinfection etc. are also used. Some cooperatives can allow the abstracted water go through the piped network to the tap even without disinfection (Pietila et al 2004; Takala et al 2011), though the Decree by the Ministry of Social Affairs and Health on quality requirements and monitoring of drinking water says that water utilities have to be prepared for disinfection in six hours after the need is observed.

Finland has many sparsely populated rural areas where it is not possible to establish a piped network (Pietila et al 2004; Isomaki et al 2008; WHO 2008; Stenroos and Katko 2011; Finland's Letter OHCHR 2013). Between 250 000 to 300 000 people rely on private shallow wells or bedrock boreholes. Usually the quality and quantity of Finnish groundwater is good without treatment. Though due to Finnish soil conditions, the quality of the water in private wells does not usually meet all the standards set for the technical and aesthetic quality of drinking water (Pietila et al 2004; Isomaki et al 2008; Stenroos and Katko 2011). Some standards are less strict than in the DWQ Directive, e.g. there is no limit for Clostridium perfringens; and there are differences inter alia in relation to turbidity, colour, odour, and taste (Makinen 2008 cited in Inkinen et al 2014).[11] There have also been some occasional quantity problems with private wells.

Monitoring, Reporting and Enforcement

The Ministry of Social Affairs and Health is responsible for the quality requirements and monitoring of drinking water in Finland. The National Supervisory Authority for Welfare and Health (Valvira) is a national agency operating under the Ministry of Social Affairs and Health. Valvira guides Health Care Inspectors in municipalities, who inspect small rural water supplies according to the relevant Decree (depending on whether the supply falls above the DWQ Directive limit).

Monitoring takes place usually one – three times per year depending on the size of the utility. The water utilities perform

[11] There are 29 chemical quality parameters and 2 microbiological parameters for very small supplies, and 16 quality recommendations; for supplies above the Directive limits there are 28 chemical quality parameters, 3 parameters for radioactive quality and 18 quality recommendations – Finnish Environment Institute pers. Comm.

also constant quality and quantity monitoring by themselves. For supplies above the Directive limit, monitoring results showing exceedances will be reported to the Provincial Government. Epidemic incidents are always reported to the Provincial Governments. The National Institute for Health and Welfare give support.

The National Institute for Health and Welfare is also involved in the monitoring of DW quality. The Institute is responsible for reporting the summaries of drinking water quality and monitoring of the largest suppliers (more than 5000 people / 1000m3/day) each year. There are about 150 suppliers this size, cover most of those who are connected to public drinking water pipelines. These summaries are used for the reporting to the European Commission under the DWQ Directive every third year. The Institute also collects data for summaries from big DW suppliers (between 50 people / 10m3/day and 5000 people / 1000m^3/day).

Municipal health authorities collect data but there is no national register for supplies of less than 50 people / 10m3/day. Health Care Inspectors in Municipalities have their own registers for their own use but they are not synchronized nationally, though there has been discussion of a nation-wide database (European Commission 2014). Inspectors will intervene if there is a known problem, e.g. contamination of a private well. There is no difference in the management of an individual supply to a single household than other very small supplies. Where there is any commercial or public use, the Directive standards are applied and are again within the remit if the Health Care Inspectors. Other Health Care decrees may also be relevant.

Under the Decree, operators of systems offering drinking water above the 10m3/day or over 50 persons must have a Water Licence approved by Valvira, to ensure capacity for disinfection etc. The test for the Water Licence is also recommended for operators of smaller systems.

If a property is within the operational area of a municipality, the owner can be required to connect to the network. Exceptions can be made on financial grounds, but, the private supply must also fulfil any quantity and quality requirements. There is financial support for connections which covers part of the costs and depends on both household income and the population served. The financial support for joint networks (cooperation) is decided every year by the local Centre for Economic Development, Transport and the Environment depending on the total amount of the applications nationally (there are 15 different Centres). The support is provided for the biggest projects only (compared nationally). There is also a possibility of support for individual households, but this support is quite rare. These applications are addressed to the municipalities.

If the Health Care Inspector of the Municipality notices that the water quality of private well does not fulfil the requirements of the Decrees and the quality of the water in the area is bad, health authorities will provide support and guidance. The authorities in the municipalities can decide that the property must be connected to the public network if it is near enough and the connection is possible, or try to organize supply some other way; but this does not happen often in Finland. Again it is possible for individual households to apply to the municipality for support. There is no requirement to supply information on sale of a property, but this is recommended and can be requested from a buyer.

Support for Operators and Householders

Finland promotes a Water Safety Planning approach for risk assessment. The Ministry of Social Affairs and Health published an electronic WSP tool for Water Utilities for free in 2015 and will publish an Excel-based WSP tool for small plant / cooperatives in 2016. In addition, a Building Water Safety Plan for individual households is being prepared and will be published in the year 2016 by the Ministry. Valvira also provides guidance for Health Care Inspectors.[12]

Our interviewees suggested that owners should be encouraged to observe and analyse the water from their supply regularly; at least every three years; when the property is being sold; when a baby is born; or if the water tastes, smells or looks different.

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France

Introduction

In France, the Law on Water and Aquatic Environments (2006) stipulates that water is a common heritage and every person has the right to access to water in sufficient quantity and quality. The French Civil Code (1804) provides that navigable and floatable streams are in the public domain (Art. 538) and that owners of property have the right to use rainwater and springwater (Art. 641). Article 213-9-2 of the Environmental Code (France) provides that water agencies ascribe aid to rural communities for drinking water supply and sanitation works. The water agencies in France do not play a role either in carrying out projects or in regulating or supervising water. In France water agencies are supplementary to the existing structures and their role is to accelerate or stimulate necessary projects by offering technical and financial incentives at the river basin scale, to allow for water policy to be adjusted to local and regional circumstances (Reynaud 2007). This is one of the unique aspects of French water services and has direct implications for the management of small rural water supplies.

France supported the adoption by the United Nations General Assembly in July 2010 of Resolution (A/RES/64/292) (French Ministry of Foreign Affairs and International Development 2016). A high level evaluation of water policy was recently compiled in two reports by Levraut et al (2013a, b) on the long-term work from the general inspectorates of the Ministries of Environment, Agriculture and Finance and the General Inspectorate of Administration. The report highlighted a consensus among the various legislative and regulatory bodies in: (i) considering water as a common heritage for the Nation; (ii) recognising and guaranteeing the right of everyone to use water and to have access to a quality drinking water at an affordable cost; and (iii) implementing the 'polluter pays' principle ('water pays for water') [13].

EU Reporting and Compliance

(This section is taken from the latest EU synthesis report (European Commission 2014d). The evidence refers to type of source, degree of monitoring, compliance with water quality standards and remedial action.)

In France, small water supplies mostly use groundwater sources (more than 80 %). There were 18,363 small water supplies (10,069 of them supply less than 500 inhabitants) supplying water to 16.4 million inhabitants (representing 25 % of the total population). In France, nearly 100 % of population is served by public network and, in accordance with DWD, all French water supply zones are controlled by mayors (or operators) and local health agencies, and results are saved in a national database. A relatively low percentage (50.4 %) of the small water supply zones was in full compliance with the drinking water quality requirements in the DWD Directive. Overall, 49.6 % of the total number of water supply zones was not in compliance with the drinking water standards for various parameters, while 1.1 % of the total number of water supply zones was failing to meet the monitoring requirements These non-compliances are, on the one hand, most often occasional (sometimes only one non-compliant result was recorded in 2010) and, on the other hand, frequently located in areas subjected to weather conditions (mountains, karst), mainly caused by agricultural pollution and insufficient treatment of the water. Overall, 1.1 % small water supply zones were not monitored in accordance with the DWD Directive (Article 7) corresponding to 62,206 people or 0.1 % of the population. France did not provide information on causes of non-compliance, remedial actions and time frames for compliance.

Administrative Structures

The country has more than 36,000 communes (municipalities)[14], 95 counties (départements), and 22 regions, as well as numerous structures designed to facilitate co-operation between its various administrative entities (Bauby 2009). This diversity has important consequences on the regulation of the water services, which is generally considered as politically and administratively complex (Bauby 2009; Levraut et al 2013a, b). Water supplied through public networks (regardless of size and whether these be under direct or delegated public management, see section4.4) is one of the most stringently controlled products for consumption. Monitoring under the DWQ Directive of all public supplies is performed by the Regional Health Services (ARS). Small supplies serving fewer than 3000 people are under public (municipal) management (Levraut et al 2013a). Additional analyses, about half the number of the total number performed by ARS, are also performed by the operators-companies in larger supplies (Demoulier et al 2012). The organizational outline of the water sector in France is given in Fig. A2.

[13] The price of drinking water is within the European average (Levraut et al 2013a).

[14] France's many communes vary considerably in size. Over 30,000 communes have less than 2,000 inhabitants (accounting for 25.3% of the country's total population). At the other end of the scale, 102 communes have between 50,000 and 200,000 inhabitants (14.4% of France's population) and 10 have over 200,000 (8.9%) (Bauby 2009).

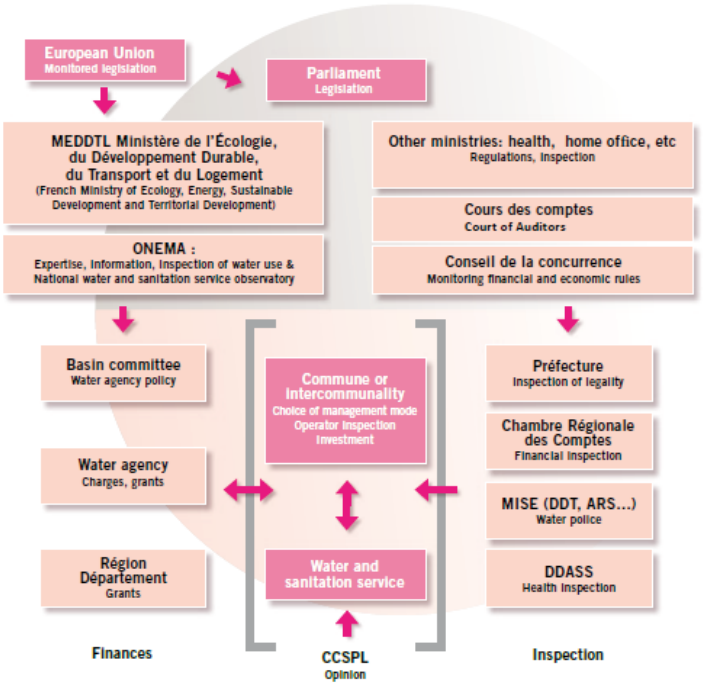

Figure A2. Main players in the governance and regulation large and small water services in France. Source: Demouliere et al 2012.

For water supply, the vast majority (three-quarters) of municipalities opt to group together; there are about 14,000 inter-municipalities (Bauby 2009). The management of water supply and of waste-water treatment are independent. According to the National Office for Water and Aquatic Environments (ONEMA), in 2009 France had approximately 31,500 public collective water or sanitation services: 14,200 drinking water services and 17,300 for collective sanitation (cited in Water Policy in France 2012). As reported by the High Council of Public Health (Haut Coseil del a Sante Publique, HCSP), in 2015 production and distribution of tap water was based on the exploitation of almost 33,500 catchments, 16,300 stations of drinking water production and 25 300 distribution networks, **nearly 60 % of which serve municipalities/communities with less than 500 inhabitants and representing only 3% of the population** (HCSP 2015). Water supplies serving fewer than 50 people are exempt from monitoring (European Union 2011); but this may apply only to supplies outwith the public network. It must be noted that this refers to a less than 1% of the population relying on supplies serving a single or very few households in remote areas / villages, where there is no public water network yet (Smets 2007). Recent legislation is clearly encouraging municipalities to group each other for the management of drinking water and waste waters; Loi 2014-58 de modernisation de l'action publique territorial et d'affirmation des metropoles; and Loi 2015-991portant nouvelle organisation territorial de la Republique.

Monitoring and Reporting

Nearly 100 % of population is served by the public network and French water supply zones are controlled by mayors (or operators) and local health agencies. Results are saved in a national database.

The Mayor or the president of inter-municipalities (syndicates) and the Departments (Prefects) have the responsibility of ensuring compliance with drinking water standards, monitoring and reporting requirements. Departures from water quality standards are more frequent in rural and mountainous supply zones. In 2012, although nationally only 3.3 % of the population were supplied with water not complying continuously with quality criteria for microbiological parameters, this percentage reached 17.4% of inhabitants served by distribution networks serving less than 500 people) (HCSP 2015; HCSP considers this to be 'small'). After consultation with the Directorate of Health, HCSP is authorised to make proposals managing situations of non - compliance, as these situations can lead to a feeling of inequality in relation to the potential risk to consumers, and disturb the consumers' confidence in the quality of the water (HCSP 2015). Levraut et al (2013a) mention administrative sanctions (suspension, logging, automatic execution of legislation, deletion, and fines and penalties) for those who fail to comply with formal authority on water policy. In case of exceedances, the Prefects advise whether the supply should be cut-off or appropriate remedial action be taken. Prefects also ensure that municipalities are informed about water quality data.

Management Models

Municipalities are obliged to choose between two public management approaches: either direct public management, or delegated public management (Elnaboulsi 2001 cited in Bauby 2009). Direct management is carried out through a public operator, or régie (board); it covers the water supply needs of approximately 40% of the population in metropolitan France and provides 70% of public drinking-water services (ONEMA n.d.). Smaller drinking-water services, those serving fewer than 3 000 inhabitants, are generally managed directly by the local government whereas large services may delegate to a private company (ONEMA n.d.; Levraut et al 2013a). In the context of small supplies, delegation contracts may run for between 7 to 20 years, and are awarded on the basis of tender procedures open to competition. In general, approximately 75% of the water services market is controlled by 3 major companies: SUEZ, Veolia and SAUR (Hall and Lobina 2012). Although some larger municipal authorities (such as Paris) are moving back to direct public management, private operators are still very active in (larger) rural supply as they provide technical capacity which may be lacking in smaller municipalities.

Having said this, and according to the latest figures, over 30,000 municipalities have fewer than 2,000 inhabitants (accounting for 25.3% of the country's total population) and 10,000 of them have fewer than 200 inhabitants (Bauby 2009). Levreut et al (2013b: page 57) report that there are 29,100 small public supplies for water and sanitation (Systems public pour l'eau et assainissment, SPEA) serving municipalities with fewer

than 3,500 inhabitants. Drinking water regulations (standards, monitoring, reporting) in these small supplies are aligned with the requirements of the DWQ Directive.

According to recent estimates by the Ministry of Health there are nearly 34,000 water intake facilities. 96% are groundwater intakes that supply two thirds of the volume of water used to produce drinking water in the public network (Demouliere et al 2012). The remaining 4% are surface water intakes that supply one third of the national drinking water production. Five facilities abstract sea water to produce drinking water with a capacity of more than 25,000 m3/day). The greatest threat for drinking water quality is diffuse pollution from agricultural land use (Levraut 2013).

A regulatory water safety system, chiefly concerned with protecting drinking water intakes from temporary and accidental pollution, is in place and goes further than requirements under article 7 of the WFD (Demoullier et al 2012). This system defines the intake protection perimeters (Article L. 1321-2 and R.1321-13 from the Public Health Code (France)) as per the prefectoral order (Declaration of Public Interest: Declaration d'utilite publique) with the aim to secure the safety of water, minimise any unnecessary chlorination and, in the event of accidental pollution, to ensure there is enough time available to prevent the population from being exposed to various pollutants. Protection of an intake is composed of three main perimeters, determined in accordance with the pollution risks and vulnerability of the intake, as follows:

- An immediate protection perimeter surrounding the intake locations: the area and fencing are to be secured by the owner of the site in which no activities are permitted;
- A perimeter of closer protection, inside which all activities or installations that may or may not affect the water quality may be prohibited or regulated;
- If required by a specific situation, a remote protection perimeter, inside which activities and installations may be regulated.

A help tool (a.k.a. Ogeris) has also been developed by the Scientific and Technical Association for the Water and the Environment (ASTEE) to assist managers of small water supplies serving fewer than 5000 people in the assessment of risks to their water systems (ASTEE n.d.). The Ogeris tool aims at helping users implement key health safety measures, most notably: (i) conduct a site description; (ii) conduct a hazard analysis and control measures; and (iii) establish adequate monitoring at key stages of production and distribution of drinking water. The tool is indicative of risks and measures that need be in place and is accompanied by online software (Excel 2003) that allows for consistent recording the results.

Section 5.3 of the main report discusses cooperative agreements with farmers, where many of the examples at small scale are from France.

Connections Policy

Until the mid-twentieth century connection rates in France were highly dependent on the size of local communities; but this was seen as incompatible with the notion of public service (Reynaud 2007). A national fund (FNDAE) established in 1954 provided grants for proposals submitted by rural municipalities or inter-municipalities with the aim to cover the additional cost of water investment (e.g. establish a public/municipal network); this fund largely contributed to the near-universal connection to the public network in France (Reynaud 2007; Smets 2007; and see Box A below). Until 2005 the FNDAE was financed by an urban-to-rural solidarity tax on piped water.

Box A. Facts about the high connection rate of the population to the public network in France:

- The process of connecting households took one to two generations.
- Achieving a full connection of the French population has required high level of investment (urban to rural solidarity subsidies).
- The process of connecting households has benefited from long periods of economic growth
- The public network has not reached areas where building a water network is either not possible (e.g. absence of appropriate source) or too costly to undertake (e.g. because of very small population).

Source: Reynaud 2007.

Since 2005, each water agency (under the supervision of the Departmental Prefects, which managed the FNDAE budget) organized solidarity between urban and rural users by redistributing water abstraction and pollution charges, on the basis of the 'water pays for water' principle (i.e. that subsidies should not be seen as a major source of financing), to assist maintenance and treatment in small rural supplies and generally achieve economies of scale. As several authors describe, such as Reynaud 2007; Smets 2007; Barraque and Le Bris 2007, urban and rural users are also called upon to finance actions of common interest taken at national level. This kind of financial support is essential for the sustainability of the public network in rural areas, as the network in some areas is more than 30 or even 60 years old (Reynaud 2007). However FNDAE has now been discontinued.[16]

Constitutional / Human Right to Water [17]

The Charter of the Environment was added to the Constitution in 2004. This does not mention water, but gives a right to a clean and healthy environment and establishes duties around preserving and protecting the environment, preventing and remedying damage done to the environment.

The right to water and sanitation is also implied in recognized constitutional rights such as the right to housing, right to dignity, regulations of public health or tenants' protection.

The Human Right to water is also recognized by law and the Environmental Code since 2006: L.210-1: 'Dans le cadre des lois et règlements ainsi que des droits antérieurement établis, l'usage de l'eau appartient à tous et chaque personne physique, pour son alimentation et son hygiène, a le droit d'accéder à l'eau potable dans des conditions économiquement acceptables par tous.'[18]

A bill was circulated in 2015 on the effective implementation to the human right to drinking water and sanitation in France: which contains an official right to water and sanitation in French law, the provision of free water for the poorest, and communal showers, toilets and taps for travelling people or the homeless, via a preventive fund of help for water for those who can't pay (defined as those spending more than 3% of their household budget on water). The fund is a choice for municipalities.

France has ratified both the Helsinki Convention and the Protocol on Water and Health (main report, Section 5.4), and was a pilot country for the Equitable Access Score –card. France therefore undertook a self-assessment procedure to enable (hopefully) the French Authorities to evaluate reliably (i.e. according to UN and international criteria, in line with MDGs and SDGs) their water and sanitation policies, and identify implementation gaps and actions to improve outcomes.

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[15] The data reported by Levraut et al (2013b) come from the most recent report on SPEA statistics.

[16] Pers.comm., Dr Francois Touchais, Office de l'Eau. We would like to thank Dr Touchais for his comments on this case study.

[17] With thanks to Laure-Elise Mayard, LLM Candidate, University of Dundee.

[18] 'The use of water belongs to everyone and each physical person, for its alimentation and hygiene, has the right to access drinkable water in conditions affordable for all'.

Ireland

Water services in Ireland have been subject to significant and well-publicised restructuring recently and this has been well-documented. However it has not significantly changed the system for small-scale rural supply. Ireland also uses the terminology of public and private supplies and the system has many similarities to that in Scotland and indeed England.

Since 1 January 2014 Irish Water has statutory responsibility for all aspects of water services planning, delivery and operation at national, regional and local levels for public water schemes.

Apart from private individual wells (supplying a single rural dwelling) which are exempt under the national drinking water regulations (see below), the balance of drinking water is provided through Group Water Schemes (GWS) or Small Private Supplies (SPS). The latter are almost all for commercial, rather than domestic, use.

GWS are community-run schemes that supply drinking water to their members (see 'Group Water Schemes' below). SPS cover a range of supplies such as industrial water supplies (eg brewing industry), commercial premises (e.g. pubs, hotels etc.) and public buildings (e.g. schools, nursing homes).

Irish Water monitors and reports to the supervisory authority on 973 public supplies, serving 81.9% of the population (compare to Scottish Water with under 300 for a similar population to Ireland). The rest of the population is supplied by GWS (6.1%). Of these GWS, about 70% get their water from their own privately-sourced water supply. The remainder get their water from an Irish Water connection. The balance of supplies are SPS (0.9%) and private wells (11.1%) (Irish EPA n.d.).

The supervisory authority is the Environmental Protection Agency (EPA) in the case of public supplies and Local Authorities in the case of GWS (see 'Enforcement and Supervision', below).

Legislation

In Ireland responsibility for policy and legislation in relation to water quality issues rests with the Minister for Housing, Planning, Community and Local Government,[19] taking account of any advice of the Minister for Health on matters pertaining to public health.

The principal legislation remains the Water Services Act (Ireland) 2007 (in this section, the 2007 Act). A series of amending Acts, established Irish Water (Water Services Act (Ireland) 2013), transferred functions from water services authorities (local authorities) (Water Services Act 2013 No.2) and made further provision for metering (Water Services Act (Ireland) 2014). The Water Services Act (Ireland) 2014 also provided for Water Conservation Grants by Irish Water - see 'Water Conservation Grants' below.

The 2013 Act No.2 transferred functions from water services authorities (s.7), but not 'excluded functions'. These include powers of appointed persons (s.22 of the 2007 Act) and also Part 4A and Part 6 except ss.91-92 (of the 2007 Act). Part 4A relates to domestic wastewater and includes a registration requirement for septic tanks (Water Services (Amendment) Act 2012). Part 6 covers rural supply and maintains local authorities' supervisory and enforcement functions with regard to private supply (ss.91-92 provide for taking over of waterworks, and these functions do transfer).

EU Reporting and Compliance

(This section is taken from the latest EU synthesis report (European Commission 2014d). The evidence refers to type of source, degree of monitoring, compliance with water quality standards and remedial action.)

In Ireland, small water supplies use a mix of surface water and groundwater sources. In Ireland, there were 1920 small water supplies supplying water to 0.7 million inhabitants (representing 15 % of the total population). A relatively high percentage (77.6 %) of the small water supply zones was in full compliance with the drinking water quality requirements in the DWD Directive. Both microbiological parameters E.coli and Enterococci were non-compliant in 4.4 % and 1.2% of the small water supply zones. Four percent of small supply zones were not-compliant with trihalomethanes because of disinfection of the water that was probably high in organic material and caused the formation of disinfection by-products. Poor treatment of the water was also indicated by the 4.8 % non-compliance in small water supply zones for Cl. perfringens. Also the aluminium parameter was in non-compliance, which was probably caused by poor treatment. The causes for non-compliance were not reported by Ireland. Overall, 14.2 % of small water supply zones were not monitored in accordance with the DWD Directive. Ireland did not report on causes of non-compliance, remedial actions to achieve compliance or timeframes for remedial action. Since it is not a requirement under the Directive for a Member State to report on this matter, the information was not reported by local authorities, who are responsible for addressing remedial actions in the water supplies in Ireland. This does not necessarily mean that remedial measures were not taken.

Enforcement and Supervision

New regulations were made in 2014 (European Union (Drinking Water) (Ireland) Regulations 2014 SI No.122, in this section, the 2014 Regulations) to reflect the arrival of Irish Water. The 2014 regulations continue to implement the DWQ Directives, and define public supply, as 'a water supply which is in the charge or ownership of Irish Water or any person acting jointly with it or on its behalf under a service level agreement or contract' (Reg.3). The 2014 Regulations place duties on all suppliers of water to ensure that the water is 'wholesome and clean' and 'meets the requirements of [the] Regulations' (Reg.4) which in turn include the quality standards in the Schedule.

The 2014 Regulations exempt certain supplies. These are defined as a supply which '(a) constitutes an individual supply of less than 10 cubic metres a day, on average or serves fewer than 50 persons, and is not supplied as part of a commercial or public activity, or (b) is used exclusively for purposes in respect of which the relevant supervisory authority is satisfied that the quality of the water has no influence, either directly or indirectly, on the health of the consumers concerned'. In other words, supplies below the Directive limits are exempt; but para.(b) would indicate that where these is a potential health effect, the authority may intervene.

Irish Water must monitor public supplies. For private supplies which are not exempted, the local authority has the responsibility for compliance monitoring (Regulation 7 (2)). The Local Authority may charge the water supplier for this monitoring (Regulation 20). The local authority may insist that additional monitoring, over and above the over and above the compliance monitoring requirements, if there is reason to believe that there may be a danger to public health (Regulation 7 (10).

[19] The Department has recently been renamed from the Department of Environment, Communities and Local Government DECLG). The text of this case study will use the new name, but, any documentation etc. referred to will retain the name of the Department at that time.

Where there is public supply, the EPA (the Agency) has supervisory authority (Reg.3), verifies compliance by Irish Water and is responsible for enforcement (Reg.7). For private supplies (above the exempted threshold) local authorities have supervisory authority and exercise the same powers as the Agency. These include powers to issue Directions as well as providing assistance and support (Reg.12); it is an offence not to comply with a Direction. Supervisory authorities should undertake audits (Reg.17) and the Agency may issue guidelines which also bind other supervisory authorities.

Some powers are granted to Irish Water and also replicated for local authorities for private supply. There is a specific obligation on owners of premises where water is supplied for a commercial or public activity to maintain the domestic distribution system to avoid a risk of non-compliance risking public health (Reg.6). Irish Water or the local authority have powers to prevent or restrict supply, and restore the distribution system to the necessary standard, having regard to the risk to health in restricting supply. Where water is supplied for consumption but not for public or commercial use, Irish Water or the local authority should still ensure that measures are taken to reduce or eliminate risk of non-compliance, including advice as to remedial actions or treatment options for owners and consumers.

Under Reg.10, where the values in Part 1 of the schedule are breached, this must be investigated. Suppliers have a duty to notify supervisory authorities, who must in turn ensure remedial action. To do so, the authority may issue a Direction including a requirement to prepare and submit an action programme for approval (and see further below).

Where there is an exempt supply, local authorities have a specific duty, in accordance with any guidelines from the Agency, to notify the populations served that the Regulations do not apply, and of actions that can be taken to protect human health; and give advice promptly if any potential danger to health arises (Reg.14). Again the Agency can issue binding guidance, and has issued such binding guidance on local authorities relevant to exempt supplies and Reg.14. (EPA 2011). This requires local authorities to use advertisements in the local press, advice leaflets and liaison with community groups to ensure their notification duties are met.

Reporting, Advice and Guidance

The EPA produces an annual Drinking Water Report based on the monitoring results (from Irish Water and from the local authorities). The most recent covers 2014 (Irish EPA 2015) but additionally the EPA publishes lists of remedial actions quarterly (Irish EPA n.d.) for public supplies. The Report notes that there were 2,691 private supplies operating in 2014 that were reported to the EPA by local authorities – '512 Public Group Water Schemes serving 86,058 people (1.9 % of population); 421 Private Group Water Schemes serving 192,312 people (4.2% of population), and 1,758 Small Private Supplies serving 39,994 people (0.9% of population)' (Irish EPA 2015 section 3). Private supplies are operated, managed and are the responsibility of private individuals or organisations.

The Report also indicates that there are problems with exempt supplies: 'Private water supplies providing water to individual private dwellings are exempt from regulation. It is estimated that 30% of private wells in Ireland are contaminated by E. coli arising from animal or human waste. The HSE has reported a growing number of cases of VTEC – a pathogenic form of E.coli. Analysis of cases shows that patients are up to four times more likely to have consumed untreated water from private wells.' (Irish EPA 2015, section 3.3).

The EPA provides advice and guidance, which may be (variously) relevant to Irish water, to suppliers of regulated private schemes, or to exempt supplies such as private wells (Irish EPA 2011). These sources include guidance for local authorities on Water Safety Planning; for farming communities on protecting water and habitats from impacts from livestock access; the guidance noted above on exempt supplies; as well as an infographic for private wells (see further below); and technical handbooks, including one for private supplies (Irish EPA 2010). This handbook in turn includes information on Drinking Water Safety Plans as well as guidance on monitoring, sampling, analysis and compliance procedures.

Group Water Schemes

The Group Water Schemes (GWS) are an important part of the Irish system and may offer a number of useful lessons for Scotland. These may be Public Group Schemes or Private Group Schemes but both are 'private' in that they are not part of the public supply as defined, and their owners and managers will remain responsible for their operation and maintenance. Although both types own their own networks, the Public Group Schemes take the water supply from Irish Water's mains network. Public Group Water Schemes comprise around 30% of the total. Group Schemes may serve as few as 2 properties or more than 1500 (Brady and Grey 2010).

Both Public and Private Group Schemes may be members of the National Federation of Group Water Schemes (NFGWS; see NFGWS n.d.). There are 600+ schemes in total and the NFGWS represents them all, whether or not they have actually joined the Federation. They charge 5 Euro per household per annum for membership. The NFGWS provides a key role in improving group water schemes and in the provision of guidance and training to the operators of these schemes. Recently the NFGWS have published a guide to the implementation of Quality Assurance (HACCP) System for the group water sector. This practical guidance provides essential advice to operators on managing and monitoring their supplies. The guide follows the principles of the Water Safety Plan approach (Irish EPA 2016; see also NFGWS n.d.).

Group Water Schemes may use different corporate forms. When they began in the 1950s they were often constituted as trusts, but that has been problematic, for example when trustees die or move away; and are not always democratic. Some are registered companies with a board of management, but since its establishment the NFGWS has strongly supported the use of cooperatives, giving every member an equal share. The NFGWS will provide advice to anyone seeking it, including individual households; and would direct queries to appropriate places, for example hydrogeology. They provide a model Charter of Rights and Responsibilities with model clauses and consider that some local authorities could put more emphasis on these, for example requiring improvements to organisational structures as a condition of funding (as should be the case; see below and Department of the Environment, Community and Local Government, DECLG 2015). They will assist Schemes in drawing up remedial Action Programmes required under Reg.10 and assist with monitoring requirements; and work with them to identify capital needs and a capital upgrade plan so the Scheme can apply to the local authority for funding.

Annual subsidies for members of Group Schemes are paid by the local authorities, but come from the Rural Water Programme ('Rural Water Programme' 2016, Department of the Environment, Community and Local Government (DECLG) 2015, 2016 and see further below). Subsidies cover the operational cost of providing safe water (DECLG 2015). The subsidy is intended to ensure that a GWS can withstand with the cost of reducing Unaccounted for Water (UFW) and of proactive implementation of Water Conservation Measures (WCM), e.g. identifying and reducing leakages. Therefore, reducing UFW and implementing WCM

are general conditions for eligibility. Other eligibility conditions include: agreement to implement a risk assessment/quality assurance system, such as the HACCP developed by the National Rural Services Committee, or a system approved by National Standards Authority of Ireland (NSAI), or equivalent; and a specific legal form for the GWS, i.e. that it is constituted as a co-operative or limited company.
There is an annual subsidy per house of up to 40 euro for each house supplied from a public source, up to 95 euro for each house supplied from a private source (well, lake, borehole etc.) (Part A subsidy) and up to 220 euro for each house where water disinfection and/or treatment is provided under a Design, Build, Operate (DBO) contract (Part B subsidy). Where a supply provides both domestic and non-domestic users, then (in the absence of full metering) there is an assumption that 60% of the supply is for domestic purposes.

Design, Build, Operate Contracts

From 2003, a number of Design, Build, Operate (DBO) water treatment contracts were established, long-term contracts (20 years) at a fixed price. A number of Group Water Schemes were 'bundled' together for the purpose of procurement. These were awarded under public procurement rules; some to European service providers such as Veolia, but increasingly now with Irish partners as well. There was state funding of 100% for treatment and 85% for other works, the same as provided for all activities funded under the Rural Water Programme (below). Contracts stipulate full compliance with the regulations, which is for the operator to achieve. The additional part B subsidy was introduced in order to encourage Group Water Schemes purpose of the additional part B subsidy is to encourage households to sign up to a long-term DBO contract.

Private Wells

Approximately 11% of Irish households are served by private wells, and householders are responsible for monitoring, treating and testing well water. The EPA provides support and guidance for such households, including a simple infographic with information on contamination and testing ('Drinking Water Guidance' undated). The Department of Housing, Planning, Community and Local Government (DHPCLG) provides grants under the Rural Water Programme (see below) for the provision of, or improvements to, an individual water supply in a house. A grant of up to 75% of the cost (maximum 2,031.58 euro) is available, subject to certain conditions (DHPCLG 2016a):

- There cannot be an alternative group or public supply available.
- The house must be more than seven years old and not connected to either a public supply or group scheme.
- Only one grant per house will be allowed in any seven year period.
- The proposed work must cost more than 635 euro.

There are also other private supplies which are not necessarily Group Schemes, and these may be above the Directive limit and regulated by local authorities, or exempt (for small communities, of 50 persons or less, with no commercial or public use).

The Rural Water Programme

The Rural Water Programme (from 2016 onwards known as the Multi-Annual Rural Water Programme) is administered by local authorities and on behalf of the Department of Housing, Planning, Community and Local Government (DELCG 2016). It provides financial assistance for all private supplies including private wells, but its focus (and the general policy focus) is on domestic need and ensuring that larger supplies are compliant and indeed safe.

County Councils should have a Strategic Rural Water Plan. Where owners or managers of private supplies have to prepare a remedial action programme, they should do so working with the local authority (and consistent with the Strategic Rural Water Plan). Action programmes should include a description of the quality issues; details of the changes required; whether a capital grant is needed; a timeframe; and details of the management or operational changes made to achieve compliance. Under regulation 10 (4) & (12) it is an offence not produce an action plan within 60 days if so directed by the local authority (Citizens' Information 2016).

Additional funding towards DBO Capital Replacement works was administered provided by the (then) Department of the Environment, Community and Local Government separately from the overall allocation from the RWP and on an 'as required' basis. As of 2013, there were 17 DBO 'bundled' groups across Ireland consisting of 151 GWSs (Brady 2013).

From 2016 onwards, a new multi-annual funding programme has been introduced to cover the needs of the schemes from 2016 to 2018. Local authorities have been requested (Rural Water Multi-Annual Programme, Circular L1/16) by the Department to bid for funding GWS under the following measures:

- Environmental and public health compliance;
- Enhancement of existing schemes;
- Rural development;
- Take-over of schemes by Irish Water;
- Innovation and Research.

In part this new programme reflects the move to Irish Water but also some TTHM exceedances (currently the subject of a EU Pilot by the EU Commission for a small number of GWS; Circular L1/16 covering letter).The new multi-annual programme should help with start-stop funding issues in the past; the priority of the programme continues to be quality deficient Group Schemes.. The Circular notes that Irish Water's 25 year strategic plan addresses investment (and innovation) in rural areas (section 1) and the difficulties of ensuring, for private supply, that the 25 authorities act consistently. A remedial action list will be developed by the Department of Housing, Planning, Community and Local Government for private GWS which will be modelled on the the EPA's existing process

Although there is no funding for an individual household to join an existing Group Scheme (but see reference to grants under 'Private Wells' above), there is support for new Group Schemes (two or more houses): there are grants of 85% up to 7650 euro (i.e. maximum cost per household for grant purposes of 9000 euro); and potential supplementary grants, with a maximum combined grant per household of 90% with a minimum household contribution of per household of 1350 euro. Households may form a group scheme and then use the funding for pipework to link to an existing safe supply elsewhere.

Grants are significantly higher than here, though local authorities must bid for this funding by identifying priorities. There is funding for 100% of the capital cost of treatment works (irrespective of procurement type, see below), and 85% of other works up to 7650 euro (i.e. a maximum cost per household for grant purposes of 9000 euro). However if extensive pipelines need laid in difficult terrain, the 15% may still be significant. Source protection plans are funded up to 2250 euro and capital replacement costs in relation to DBO treatment plants are funded at 85%. Subsidies are payable in two parts.

Also as part of this new approach, funding of 100% is provided for upgrading that is required prior to the takeover of a Group Water Scheme by Irish Water. As evidenced by the Circular,

attention is currently focused on rural supply. As well as identifying 'orphan' schemes (schemes with no management structures or organisers), the NFGWS is working with the authorities to encourage the formation of larger cooperatives, improve take-up of funding and improve management support, for example, by putting in a scheme manager (who may not be full-time) with the technical expertise to run the system. The concepts of rationalisation and amalgamation of schemes and the introduction of professional management structures, rather than relying totally on voluntary input, were introduced as part the DBO process with great success. The Government has just announced levels of funding for group schemes for 2016 at 14.9m. euro, a 30% increase on last year (DEHPLG 2016b).

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New Zealand

Legislation and Definitions

In New Zealand, the principal Act is the Health (Drinking Water Amendment) Act 2007, amending the Health Act 1956 (in this section, the 2007 Act). The regime is described as risk based and outcome focused (Drinking Water Legislation 2016).

New Zealand recognises both public and private supplies (publicly or privately owned, 2007 Act s.69G). Most water is supplied by local government or by other public or community bodies. The Local Government Act (New Zealand) 2002 Part 7 provides for municipal water supply. The Act also allows for the provision of a Bulk supplier arrangement where water can be provided to another networked supplier. This recognises the potential for source and treatment operation to be managed by one entity and the networked delivery to customers by another.

It is not permitted to divest assets except to the community and only then if <200 persons, and supported by the Medical Officer of Health and a referendum (s.131). Provision can be transferred (under similar rules) to another local government entity. Parts of the service can be contracted out; but the municipality retains responsibility and control, including of prices. Joint arrangements can be made and this occurs throughout New Zealand, e.g. Auckland has a council organisation (Watercare Services Ltd) (NZ Government Environmental Science Group 2015).

The 2007 Act defines drinking water supplies of different sizes, where supply is for at least 60 days / year. Large supplies serve >10,000 people. Medium supplies serve 5001–10,000 people, minor supplies 501-5000 people, and small supplies 101–500. Neighbourhood supplies serve between 25-100 people; but also any number of persons (up to 100) for at least 60 days / year, if the total number of persons multiplied by the total number of days is 6000 or more (s.69G). Temporary suppliers supply water on a temporary basis to more than 25 people, or to any number of people but on less than 60 days / year. Supplies to less than 25 persons have no obligations under the Act; the Act allows registration of networked supplies below 25 people but this is not

routinely done. The Act places duties on suppliers, and suppliers carry out routine monitoring. The Ministry of Health, along with District Health Boards, are responsible for regulation and surveillance / audit monitoring.

The 2007 Act also defines rural agricultural drinking water supply (s.69G). This may be a supply of any scale (from large to neighbourhood) but where 75% or more of the water supplied is used for commercial agriculture and does not enter a dwelling or other building where water is drunk and food prepared; and, does not supply, via a single connection, a town or a village with a permanent population of 50 or more people.

The 2007 Act defines different drinking water suppliers, including bulk suppliers; networked suppliers, who supply drinking water from the place where the supply is to one or more other properties; and others (such as water carriers, operators of airports, or those designated by regulation); but excluding temporary drinking water suppliers or self-suppliers (s.69G). The point of supply and its pipework is separately defined from the network.

Self-suppliers are defined as those who own a drinking water supply exclusively used to supply water to one property owned by that person, or one or more buildings also owned by that person (s.69G). Hence it is quite specific as to ownership of assets. Self-supply is not restricted to individual households but may include schools, community centres and tourist locations such as campsites; as long as the properties are all owned by the owner of the distribution system on a single title (NZ Ministry of Health 2016a, para.19.2.6). Self-supply may also be found in premises supplying food and drink (though food producers would be regulated through other agencies, especially, the Ministry for Primary Industries (Food Safety (New Zealand) 2016). The 2007 Act also defines 'specified self-suppliers'. These supply water to community-purpose buildings owned by them (s.69J).

All networked suppliers, including specified self-suppliers, and tankered water carriers, must be registered (s.69J). There are currently some 950 registered suppliers, and more than two thirds of these are specified small suppliers e.g. schools or community centres (NZ Government Environmental Science Group 2015, the Register). Some of these may also provide neighbourhood supplies. Self-supply within a property boundary does not need to be on the Register. Most supplies listed are public, but some are private, such as small tourist facilities.

If more than 500 people are served, the Register may also record the public health grading of the supply. Grading began in the 1960s (NZ Ministry of Health 2016a chapter 1) and the system was updated most recently in 2003, and is currently under review. Suppliers choose to participate, or otherwise the Register specifies ungraded. The grading system is considered to have been a driver for change (Drinking Water Quality (New Zealand) n.d.). There is an excellent on-line map-based system for checking compliance and ratings for drinking water quality (Drinking Water Quality (New Zealand) n.d).

Between 2005 and 2015 there was a Drinking Water Assistance Programme focused on supplies of less than 5000 people (NZ Ministry of Health 2016a section 1.5, and see Drinking-water Assistance Programme (New Zealand) 2016). This provided subsidies of 85% of costs of improving supply, targeted on the most deprived areas with assistance provided through Facilitators within District Health Boards.

Suppliers have general obligations under the Act, including taking reasonable steps to protect sources of raw water (s.69U), taking all practicable steps to comply with drinking water standards (s.69V) and taking reasonable steps to ensure that water is wholesome (s.69W). These specifically do not apply to supplies smaller than neighbourhood supplies (s.69C(8)). However many more detailed requirements apply only to bulk or networked suppliers.

The implementation of the obligations under the Act has been phased, beginning with the largest suppliers (NZ Ministry of Health 2016b p.3). Suppliers must monitor drinking water quality, and prepare and implement a Water Safety Plan (s.69Z). (In the 2007 Act the term Public Health Risk Management Plan was used, but in 2013 this was amended to replace it with Water Safety Plan, Health Amendment Act (New Zealand) 2013). There is a general offence for actions likely to contaminate raw water or pollute drinking water (s.69ZZO). Although this requirement does not apply to small and neighbourhood supplies, a Medical Officer of Health may require a WSP for such supplies or for a temporary supply (s.69ZA); but Medical Officers of Health may not require WSPs for supplies used by less than 25 people (s.69ZA(6)).

Standards and Guidance

The Minister has powers to issue drinking water standards (s.69O), including maximum amounts and values for substances, contaminants, microbiological characteristics etc., monitoring requirements, performance standards, and criteria and procedures for demonstrating compliance. Supply performance is conducted by Drinking Water Assessors whilst enforcement is carried out by designated officers (Health Protection Officers and Medical Officers of Health). Drinking Water Assessors are appointed by the Director General and assess the performance of suppliers, and the competence of technical staff (s.69ZL). They are located in Public Health Units, which are operational units within District Health Boards (NZ Ministry of Health 2016a para.1.6.6). They notify designated officers and suppliers of any non-compliance. Designated officers have general enforcement powers and duties including ensuring compliance with requirements or directions by assessors and any compliance order issued by a Medical Officers of Health (under s.69ZZH) They have a specific power to issue boil notices (s.69ZO). The Minister may declare a drinking water emergency. If the Medical Officers of Health believes that a source of drinking water is contaminated and this might affect a self-supplied building, they may issue a notice to the local authority, which must make an assessment, and if necessary, warn users not to use the supply for drinking or food preparation, or issue a boil notice (s.96ZZP).

The Drinking-water Standards were last revised in 2008 (NZ Ministry of Health 2008; in this section, the Standards). The maximum values reflect the guideline values in the WHO guidance (WHO 2011). In 2013 Water Safety Plans replaced the prior terminology but no other changes were made. The Standards also apply to both public and private supply. The Standards focus on provision of wholesome and potable water, as defined in the Act (s.69G). Potable water is defined as water that does not exceed the maximum acceptable values specified in the Standards, but not including aesthetic values. Wholesome is defined as being potable, and not exceeding aesthetic values. The Standards provide guideline values for aesthetic determinands, but these are not part of the (binding) Standards as such. Although laboratories must be recognised (2007 Act s.69ZY), special provision can be authorised for small or remote supplies (NZ Ministry of Health 2008, 3.1.1.). There is special provision for secure bore water (NZ Ministry of Health 2008, 4.5); that is, water from confined aquifers, and from deeper unconfined aquifers, and with other requirements to ensure contamination is unlikely). There are separate regulations around permits for abstraction for drinking-water supply (Resource Management Act 1991 and Resource Management (National Environmental Standards for Sources of Human Drinking Water) Regulations 2007 SR 2007/396).

In New Zealand the same water quality standards apply to all drinking water supplies. However, sampling requirements may vary depending on the size of the supply and the treatment employed (NZ Ministry of Health 2008 sections 3 -10). Generally larger suppliers will capture and report data more frequently, to the District Health Boards.

There are alternative compliance criteria for small (including neighbourhood, and some elements of rural agricultural) supplies (NZ Ministry of Health 2008 section 10). Instead of complying with sections 4, 5, 7, 8 and 9, they may instead follow a water safety plan compliance criteria approach – in which case they will be participating supplies. It is recognised that different compliance criteria provide different levels of certainty that the standards are met, balancing the risks to public health and costs (NZ Ministry of Health 2008 10.1). The WSP must be approved by a Drinking Water Assessor and be implemented. Appropriate bacterial and chemical treatment as identified in the WSP catchment assessment, must be used, with appropriate protozoal treatment. Monitoring requirements are specified (NZ Ministry of Health 2008 10.4) and the WSP should specify remedial actions for exceedance, or where process controls are not met. The supply will then be deemed compliant with section 10 of the standards. Otherwise, compliance will revert to the full Standards procedures. When monitoring indicates a problem but the steps in the WSP are being taken, then reversion may be delayed. There is a specific requirement for the WSP to address issues around distance from laboratories / certified technical staff. Table 10.1 gives minimum treatment requirements for different catchment types (for example, presence of human wastes, livestock, depth of borehole). Bacterial monitoring should be at least 3 monthly. The Standards also give some information as to the responses required; remedial actions should be agreed with the Drinking Water Assessor or the Medical Officer of Health.

Appendix 3 of the Standards has a survey sheet for identifying hazards in a catchment.

The Standards provide for a separate section for rural agricultural supplies (section 12), but this has not been inserted. However there is specific technical guideline for these supplies (NZ Ministry of Health 2015). Following the guideline (which also applies WSPs) is another route to compliance. Only that portion of the supply being used for domestic purposes must meet the criteria. The supplier should ensure (via the WSP) that the water delivered to the network can be adequately treated by a point-of-use or point-of-entry filter, or other treatment system (which should conform to national standards); provide information and advice, and a plan for maintenance, of the treatment system; and establish the monitoring regime and remedial actions. Home owners must ensure there is no backflow. No type of treatment system is prescribed, but the Ministry of Health recommends point-of-entry which will treat all water in the building. Default responsibility lies with the supplier, though communities may decide a different arrangement. The guidelines for these supplies are more similar to those of self-supply (under the Building Act (New Zealand) 2004), although rural agricultural supplies may be of any size. The same is true for specified small suppliers.

Technical Guidelines

The general technical guidelines for suppliers were last updated in 2016 (Ministry of Health 2016). Although intended for suppliers, some parts are also of potential use to users of the services. Chapter 1 provides a useful overview of the legislative and policy developments of the last 25 years.

Chapter 2 applies to community supplies, which are defined as reticulated supplies (publicly or privately owned) serving at least two buildings on separate titles and serving at least 1500 person days (25 persons for 60 days). These should have an integrated management system to meet the requirements of the Standards. Chapter 2 outlines, and refers to, the model guidance on WSPs prepared by the Ministry of Health. Chapter 3 discusses specific sources and relevant legislation; and mitigation measures.

Chapter 19 applies to small supplies, and to individual household supplies (including rainwater harvesting). It specifically references useful resources (see especially Small Drinking-water Supplies (New Zealand) 2015). The guidelines recommend that the advice for small community supplies should also be used for self-supply, which is again subject to the Building Act 2004. Chapter 19 does also provide information for individual household supplies, which are standalone systems. These may access a variety of sources including rainwater and groundwater. Only water used for consumption must be potable under the Building Acts but non-potable taps must be clearly labelled. There are specific sections on treatment methods (point of entry and point of use) as well as plumbing requirements and on rainwater harvesting from roofs. Under the Health Act (New Zealand) 1956, it is illegal to let or sell a house unless there is a supply of potable water (s.39).

Reporting, Assistance and Connections Policy

The Ministry of Health reports annually on drinking water quality and the most recent report is for 2014/15 (NZ Ministry of Health 2016b). Although 6.87% of supplies (of more than 100 people) met bacteriological standards, and 98.7% met chemical standards, compliance with protozoal standards were much lower (80%). WSPs covered 95% of supplies, but in total, just 79.4% of supplies were fully compliant. Unsurprisingly perhaps, compliance was better in larger supplies. Similarly, monitoring requirements were met in 97.7% of supplies overall, but ranging from 99.6% for large supplies to 82.7% for small supplies. Almost all supplies met requirements for source protection and records, and investigation of complaints. When neighbourhood supplies come fully within the requirements of the 2007 Act they too will be reported on; their phased introduction begins from July 2016.

The Drinking-water Assistance Programme (New Zealand) (2016) provided capital assistance for connections, up to the property boundary, from 2005-2015. It continues to provide technical assistance and support for networked supplies, channelling funds through the Public Health Units, but does not assist with self-supply as such. Smaller communities are more likely to have private supply and to be in need of guidance and support to meet the Standards. There is no prescribed legal form for private supplies, but there must be either an individual owner or a legal entity that can meet supplier obligations under the Act. Where there is self-supply for tourist accommodation, campsites etc., local authorities will have other regulatory powers as well as the Building Act requirements for potable water. There are no specific requirements for operators of private systems or for self-suppliers, for example qualifications or training, but extensive guidance is available.

There is no mechanism to force connections to a public system, but there is a process for divesting small supplies from the municipality to the community as noted above (Local Government Act (New Zealand) 2002 s.131). In some very small communities where the population has dropped to a level where the infrastructure cannot be maintained, communities have taken a decision to abandon the networks and move to rainwater tanks. In such cases there has been a Health Impact Assessment including a Cost Benefit Assessment; it is recognised that this shifts the costs of provision to the householder (see, e.g., Future of the Ohura Water Supply 2016).

Finally, it is worth noting that there are specific regulations under the Resource Management Act (New Zealand)1991 controlling activities that may take place upstream of drinking water sources (Resource Management (National Environmental Standards for

Sources of Human Drinking Water) Regulations (new Zealand) 2007 SR 2007/396). These require councils to restrict land uses that may negatively affect supplies of more than 500 people.

Recommendations / Lessons for Scotland

New Zealand is very focused on the use of Water Safety Plans, and on using these to provide support and assistance to communities to achieve safe drinking water. This is considered to be a much more productive and proactive approach than seeking to regulate for compliance for very small systems.

There is extensive guidance and advice both for very small supplies (neighbourhood supplies, and supplies below the 25pp limit) and for self-supply.

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Sweden

Introduction

The principal water legislation in Sweden was the Water Act (Sweden) 1983, covering water resource management as well as some aspects of service provision. This was replaced in 1998 by the Environment Code, and for water services, in 2006 by the Public Water Services Act. [20]

In Sweden, municipalities are responsible for the provision of water services. The principal regulator is the National Food Agency and a number of other ministries, as well as municipal authorities for environment and health (see also Lind et al 2012). Drinking water is regulated as a foodstuff and therefore HACCPs must be developed and implemented for each water supply regardless of system size (Swedish legislation SLVFS 2001:30, cited in Niedbalski and Cos 2015).

In the recent past, there were 2300 municipalities in Sweden, but in the last fifty years this was reduced to 290 (Swedish Water & Wastewater Association, SWWA, n.d.). Municipalities determine the fees for services, and smaller municipalities may subsidise costs by a local tax. Some two thirds of municipalities have fully funded services (i.e. from the tariffs) but overall more than 90% of the services are fully funded, reflecting the very small size of some municipalities. Municipalities own the infrastructure and have the duty of providing the services under central State coordination with other policies. In the recent past there was some evidence that some small municipalities contracted out operations to private companies, (SWSWA n.d.). In addition municipalities may join together to provide services.

Sweden has some 1900 publicly owned water works; 10 % of which (mainly larger, and serving some 50% of the population) use surface water, and 90% ground water. A small number of large plant use artificial groundwater, serving 23 % of consumers. A large number of small groundwater plant serve 26% of the population. All in all, some 90% of the population is served by municipal supply (around 1750 plant are municipally owned) producing drinking water for 8.5 million people.

[20] An unofficial translation of this Act is available. Generally though Swedish legislation is not available in English and the analysis in this case study reflects that. We are grateful to our interviewees for much of the information in this case study.

Some 1450 supplies are 'small' (under 5000 pp). [21] The main quality problems are diffuse pollution from agriculture and flooding.

EU Reporting and Compliance

(This section is taken from the latest EU synthesis report (European Commission 2014d). The evidence refers to type of source, degree of monitoring, compliance with water quality standards and remedial action.)

In Sweden, no information was available on the type of water sources used by small water supplies. There were 1486 small water supplies supplying water to 0.9 million inhabitants (representing 10% of the total population). A high percentage 85.2% (1266) of the small water supply zones was in full compliance with the drinking water quality requirements in the DWQ Directive. Sweden did not supply information on non-compliance with the monitoring requirements in the DWQ Directive. It is possible that all small water supply zones might not have been properly monitored. The natural geo-hydrological condition of the underground combined with inadequate treatment caused too high fluoride levels in drinking water. These cases of non-compliance were reported to be addressed by improved treatment in the short term. Problems with iron can both be caused by the nature of the underground and poor conditions in the distribution systems. No immediate remedial actions were reported. Contamination of sources and inadequate treatment resulted in non-compliance for the microbiological quality of the water. Remedial action in the sense of improved treatment was reported as a short term action in Sweden.

The HACCP Approach

It has recently been estimated that 15 % of the population depend permanently on small-scale municipal water supplies serving fewer than 1000 individuals (Lind et al 2012). These supplies cover their operational costs through fees and local taxes but are facing resource limitations (e.g. budget, staff) in keeping with the regulations, including the HACCP approach to risk assessment and management (Niedbalski and Cos 2015). In addition to HACCPs, pilot studies on the feasibility of other risk assessment approaches in large versus small supplies, indicated specific challenges for smaller systems in implementing the WSP approach (Niedbalski and Cos 2015). The general opinion is that the implementation of the WSP approach is expensive and will require additional resources (e.g. financial, expertise, staff), which not all the smaller municipalities are able to afford. A possible solution is to employ a consultant company for the risk assessment; but this also translates into extra cost. Nevertheless, given the coordination of water resource management in Sweden and the ongoing integration of water services provision with WFD requirements, the interface between HACCP and the WSP approach is already well developed in some small municipalities (Niedbalski and Cos 2015).

The HACCP approach to risk assessment allows for targeting treatment where raw water is not safe. Usually the sources selected under the HACCP plans provide water needing minimal treatment. There is also flexibility to address specific risks at the source (e.g. change the source if it gets contaminated, or add more barriers in the treatment process). But in case of contamination of the source (e.g. following flooding or rain), small supplies, being resource limited, have fewer options (e.g. if either change of source and chlorination are needed, then investment may be targeted towards carbon filters to correct taste after chlorination instead of establishing a new source). HACCPs must be implemented in all supplies by expert staff, are enforceable and require record-keeping. There is evidence that not all stages of the HACCP procedure are developed because of lack of trained staff in small supplies.

Management of Small and Very Small Supplies

(The information in this section is taken from the results of our interviews (completed as a written questionnaire), for which we thank the participants.)

Very small supplies (below the Directive limit) in Sweden are not monitored. Owners of very small supplies can voluntarily send in their results for analysis, and these results are maintained in a register but it is far from complete. The Geological Survey of Sweden is responsible for this register. An estimated 1.2m people are permanently dependent on very small supplies.

The DWQ Directive requirements are not applied to very small supplies. Advice is provided, and some parameters are the same, but there are fewer parameters (see Råd om enskild dricksvattenförsörjning 2015) [22] . Although all commercial and public suppliers should come within the Directive, small tourist accommodation (up to eight beds) are not monitored. No distinction is made for supplies to single dwellings, they are encouraged to follow the same advice as for very small supplies.

In rural areas, supplies can be owned by private companies, or private associations of another type, by cooperatives or by individuals. There is no requirement for any particular legal form. If the supply is above the Directive limit then the staff and / or the owner must have the required education to be able to run the supply. The Swedish Water and Waste Water Association provides annual training.

Only supplies above the Directive limit are subject to monitoring and reporting requirements, and only these supplies have any enforcement. The enforcement mechanisms for all supplies above the Directive limits are the same. Monitoring more frequently than required in DWQ provisions is usually not performed in small supplies, although, given the relatively high rainfall regime in Sweden, it may be necessary and is indeed performed in larger supplies.

There is no power to require a connection to a public or municipal supply if one is available, but, there may be some financial support for connection costs (depending on the population served or the number of properties to be connected). If the supply is covered by the DWQ Directive, then a local authority can close the supply and prohibit its use. There is no requirement for a seller of property to provide information to a buyer, however, this could happen voluntarily. The interviewees recommended this as a positive reform.

The interviewees considered that as well as HACCP, the use of WSPs, a multiple barrier approach or even a QMRA approach could be used in Sweden; the important thing was to demonstrate some systematic risk assessment (for supplies above the Directive limit). HACCP is the most widely known and understood.

Although there is no online user guidance or tools for very small supply, municipalities can help with safety planning and risk assessment. Most advice and assistance is targeted at supplies above the Directive limits and for these there are educational programmes from local, regional and central authorities and the SWWA. For supplies below the limits, consultants can provide services.

[21] The information in this paragraph was provided by our interviewees. We note some inconsistency with the data reported to the Commission for the 2014 Synthesis report.

[22] In Swedish – reference provided by our interviewees.

Joint Facilities and Community Associations [23]

In more densely populated rural areas, joint facilities are facilitated in Sweden by the Lantmateriet (The National Land Surveyor) and are a mechanism for ensuring proper management of the system. These can be initiated by the property owners, or by the municipal authority. Meetings are arranged to explain the standards that would apply and ensure the informed consent of all parties, and to ensure the facility will operate with minimum intrusion and inconvenience for neighbouring properties and at the lowest reasonable cost. The Lantmateriet's role is purely to facilitate – they are not involved in the design, construction, management or operation. They ensure that the legal process for establishing the facility is carried out fairly for all parties.

The legal structure can be in one of two forms – a community association where all the owners manage the facility directly, not through a management board; or a joint property association, which is a legal person and owns the facility (or holds the lease on the property), of all the property owners are members but run by a board. Articles of association would then determine, e.g., voting rights and decision-making by the board and at annual general meetings – in other words, a corporate entity. The second form is preferred as it gives greater clarity and administrative simplicity. Legislation specifies the content of the Articles. The Lantmateriet registers these associations. Tariffs are levied proportionate to the share each member has in the association, which may be based on property values rather than an equal share. Membership of a joint property association depends on ownership of the associated properties, so will always transfer on sale.

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Annex 4 Interview Schedules

EU Countries

CREW 2015/5 Semi-structured Interview Questions

Introduction and Participant information.

These questions relate to the management, governance and regulation of small-scale rural drinking-water supply, in the context of the European Union's Drinking Water Quality (DWQ) Directives (1980/778/EEC; 1998/83/EC; 2015/1787/EU). It is being conducted by the University of Dundee and the Scottish Centre for Research Expertise in Water, as part of a research project for the Scottish Government.

The DWQ Directives impose general obligations on states – to ensure that water is wholesome and clean, by testing it against the parameters in the Annexes, transposed into their domestic law. If there is a 'small supply' (serving less than 5000 people / 1000m3/day), reduced reporting requirements apply.

If the supply serves less than 50 persons or 10m3/day, and does not involve any public or commercial use, (a 'very small supply'), then the supply may be exempted from the DWQ Directive requirements, but, states must inform the relevant population as to any action to protect health; and if any potential danger emerges, give appropriate advice. Protective actions might relate to e.g. water safety planning or risk assessment; advice might relate to emergency responses or alternative sources or treatments.

This project is concerned specifically with small and very small rural supply, where the quality of water delivered tends (across Europe and beyond) to be much poorer than in large public or municipal systems.

We much appreciate your willingness to participate in this work. Your responses will be anonymised in our report. All data will be held securely in accordance with the University of Dundee's ethical approval policy. If you agree to an interview, and agree to the interview being recorded, we will obtain your consent and send you a draft of the transcripts. You will be provided with a draft copy of our report for comment. If you choose to provide written answers, then you will be provided with a draft copy of our report for comment. In either case you may withdraw from the project at any time before the final report. We may hold a workshop to discuss the findings in early summer, in which case you will be asked to participate in that workshop.

1. **In your country, who has responsibility for providing public / municipal drinking water services (e.g. municipality, central government department, public corporation, private company?).**

(There may be multiple answers, for example there may be delegated management of a public system to a private entity, different municipalities may join together to secure economies of scale, different provision in rural and urban areas, etc.)

2. **In your country, who is responsible for monitoring drinking water quality?**

[23] Our thanks for this section to Stephen Dunlop, Water Industry Commission for Scotland.

3. **Does the same organisation or level of government (e.g. municipal government) monitor all drinking water supply, including very small supply?**

If YES, does that authority maintain a register of all DW supplies regardless of size?

4. **Do you apply the DWQ requirements (especially, the technical parameters) to very small supplies?**

If YES, is this monitored and information collated / reported? Where is data stored and how is it used?
If NO, do you have a different set of parameters applicable to very small supplies?

5. **How do you manage (monitor, enforce) supplies which are below the DWQ Directive limits for volume / people served, but which have some commercial or public use (e.g. small tourist accommodations?)**

6. **Do you make any different provision for individual supply i.e. supply serving a single dwelling only? (E.g., in monitoring or reporting, or the parameters applied?)**

7. **Do (small) communities in rural areas have different ownership or management structures for drinking water? (I.e., are there supplies which are owned / managed by communities rather than the municipality / public service provider?)**

If YES: do these have any particular legal form, e.g. cooperatives or similar? Is such required by law?

8. **Are DWQ standards enforced differently against:**

a) Supplies provided outwith the public / municipal system?
b) Very small supplies?
c) Supplies to single dwellings only?

(E.g., – different standards apply (and see qu.4 above); enforcement powers are the same or different; different agency is responsible; advice and assistance rather than monitoring and enforcement?)

9. **If there is public / municipal supply available to which connections can be made, can this be required of householders?**

If YES, is there any financial support for this?

10. **Are there any other factors that lead to differential treatment for very small supplies or supplies to single dwellings (e.g. geography, water source, land use?) (e.g., if groundwater source, or forest cover with no agricultural use?)**

11. **Are there any powers enabling authorities to declare that a supply is unsafe and therefore that a dwelling cannot be inhabited?**

If YES, is any compensation payable?

12. **Is there any requirement to provide information about the DW supply when a property changes hands (e.g. to certify the supply is safe, or has been recently tested)?**

If NO, does this happen voluntarily, e.g. because a buyer requests it?

13. **Does your country assist rural communities with water safety planning / taking a multiple barrier approach?**

If YES, how is that done? (Which authorities are involved? Is there user-friendly guidance or tools e.g. online tools, apps? Is there engagement with farmers over protecting small supplies (as distinct from schemes to protect large municipal supplies)? Is there financial support available?)

ENDS.

Many thanks for your time! We will keep you informed about the work in this project.

Non-EU Countries / Non-country specific

CREW 2015/5 Semi-structured Interview Questions

Introduction and Participant information

These questions relate to the management, governance and regulation of small-scale rural drinking-water supply, for a research project being conducted by the University of Dundee and the Scottish Centre for Research Expertise in Water, as part of a research project for the Scottish Government.

This project is concerned specifically with 'small' and 'very small' rural supply, where the quality of water delivered tends (across Europe and beyond) to be much poorer than in large public or municipal systems. We are trying to identify examples of good practice that could be useful to Scotland.

Drinking water services in Scotland are managed in the context of the European Union's Drinking Water Quality (DWQ) Directives[24] These Directives impose general obligations on states – to ensure that water is wholesome and clean, by testing it against the parameters in the Annexes, transposed into their domestic law. If there is a 'small supply' (serving less than 5000 people / 1000m3/day), reduced reporting requirements apply.

If the supply serves less than 50 persons or 10m^3/day, and does not involve any public or commercial use, (a 'very small supply'), then the supply may be exempted from the DWQ Directive requirements, but, states must inform the relevant population as to any action to protect health; and if any potential danger emerges, give appropriate advice. Protective actions might relate to e.g. water safety planning or risk assessment; advice might relate to emergency responses or alternative sources or treatments.

We much appreciate your willingness to participate in this work. Your responses will be anonymised in our report. All data will be held securely in accordance with the University of Dundee's ethical approval policy. If you agree to an interview, and agree to the interview being recorded, we will obtain your consent and send you a draft of the transcripts. You will be provided with a draft copy of our report for comment. If you choose to provide written answers, then you will be provided with a draft copy of our report for comment. In either case you may withdraw from the project at any time before the final report. We may hold a workshop to discuss the findings in early summer, in which case you will be asked to participate in that workshop.

1. **Do you have a view on who should be responsible for monitoring drinking water quality? (Municipality, Government department, Health authority?)**

2. **Should there be a register of all supplies of drinking water, including very small supply and individual wells to individual households?**

[24] 1980/778/EEC; 1998/83/EC; 2015/1787/EU.

3. **Should the quality of all drinking water supply be monitored, including very small supply and individual wells to individual households?**

4. **Should the same technical parameters for DWQ apply to very small supplies as to larger municipal / urban supplies?**

5. **Should there be any different provision for individual supply i.e. supply serving a single dwelling only? (E.g., in monitoring or reporting, or the parameters applied?)**

6. **Where there are supplies which are owned / managed by communities rather than the municipality / public service provider, is it helpful if these have a specific legal form, e.g. cooperatives or similar? Should such be required by law?**

7. **Are DWQ standards enforced differently against:**

a) Supplies provided out with the public / municipal system?
b) Very small supplies?
c) Supplies to single dwellings only?

(E.g., different standards apply (and see qu.4 above); enforcement powers are the same or different; different agency is responsible; advice and assistance rather than monitoring and enforcement?)

8. **If there is public / municipal supply available to which connections can be made, should this be required of householders?**

If YES, should there be financial support for connection costs? Should that be the full cost, or a part-subsidy? Should it be dependent on household income?

9. **Are there any other factors that can justify differential treatment for very small supplies or supplies to single dwellings (e.g. geography, water source, landuse?) (e.g. if groundwater source, or forest cover with no agricultural use?)**

10. **Should there be powers enabling authorities to declare that a supply is unsafe and therefore that a dwelling cannot be inhabited?**

If YES, should compensation be payable?

11. **Should there be any requirement to provide information about the DW supply when a property changes hands (e.g. to certify the supply is safe, or has been recently tested)?**

12. **How can authorities and civil society groups assist rural communities to ensure their drinking water is safe and fit to drink?**

For example, user-friendly guidance or tools, to help with water safety planning, risk assessment, taking a multiple barrier approach and / or using Point of Entry / Point of Use technologies at household level?

ENDS. **Many thanks for your time! We will keep you informed about the work in this project.**

Annex 5 Workshop Report

Review of EU Small Rural Supply – Workshop Report

The workshop was one of the outputs of the project, to bring participants from the case studies and to share the findings in the draft report with the Scottish stakeholders. In turn, the workshop discussion enabled revision of the final report. The workshop was held in the University of Dundee in the Carnegie Building on Monday 11 July. This report follows the agenda, and includes the discussion. Key findings are reflected in Section 6 of the main document.

Introduction and welcomes: all the participants introduced themselves, and were then asked to spend a few minutes identifying their 'single biggest problem' and their 'single best solution', without a cost constraint on the solution. The results of that exercise are given below.

Introduction to the project: Richard Allan (JHI / CREW) spoke on CREW and the general work going on in Scotland re private supply and more broadly, sustainable rural communities and rural provision.

In discussion: Noted that the DWQR is working with ScotGovt to revise the DWQ Regulations re monitoring of Type B supplies, and that the current project and others (especially the epidemiology study) might be relevant. Generally, this project could help inform the choices made. The variety of views held by different users of private supplies was also noted, and the need to work with people.

Overview of the legislative and policy contexts and the regulation and governance of small supply in Scotland: Sarah Hendry presented briefly on that, to provide context; and on methods and terminology.

Overview of findings on governance and management models: Ioanna Akoumianaki presented on this and engendered much debate, especially the various models for small supply and the 'crisis of governance'.

In discussion: noted that there should always be a framework for improvement, regardless of size (WSPs might provide this); but always needed engagement / buy-in. How could people be helped? Eg testing; but also, questions of what people thought they understood eg colour / taste versus 'invisible' contamination. The household centred model likely to be important in Scotland – what is the supply; how is supply defined? Maybe common source but individual choices for household treatment. [From the case studies - New Zealand have more regulation for 'networked supply' across properties than 'self-supply' within property boundaries.]

Practitioner and NGO perspectives: presentations from Bettina Rickert of the German Federal Environment Agency, and Margriet Samwel of Women in Europe for a Common Future (WECF). Both have been involved in the UNECE Convention and the UNECE / WHO Protocol on Water and Health, and in the WHO / UNECE work on small supply in the pan-European area. Bettina was also able to comment on some of our findings on Germany.

Some general problems they both identified included lack of data, lack of regulation, no independent surveillance, lack of training; as well as economies of scale, geographical spread and how to best provide information to users. Margriet especially discussed projects involving schools, issues around hierarchy / authority, and difficulties with replication after projects end; as well as portable lab / testing kits.

In discussion: agreed the UNECE / WHO Protocol could usefully

be mentioned in section 5.5. Concern about managing 'exit strategies' when projects end. What happens to the results of citizen science initiatives – who gets the data and for what?

Noted that donors are increasingly asking for WSPs as a funding requirement and more generally, evidence of commitment / engagement for investors. Basic checklists are a starting point; appropriate tools. Agreed that building permits relevant everywhere and multi-agency approach needed.

[As Sue Petch, DWQR, had to leave, we invited her to make any comments at that point. Whilst mandatory measures might be draconian, there is a possibility of some more mandatory provisions in the Scottish regulations – building on procedures in 2006 rules – at least for new supplies. Some form of risk assessment / management plan; clearer duties, better register. The ICF project didn't find too many gaps; DWQR advises LA's, but it is not clear who had the duty (not power) to give advice and support to communities / individuals. It would be useful if there was a defined responsibility for that.]

Comparative Review: Ioanna presented the overall findings from the comparative review; including definitions and constitutional provisions; connections policies and funding; decision-making; enforcement.

Discussion centred on connections policies – much variety – and enforcement mechanisms, including how to measure effectiveness (outwith the scope of this project!) and reporting / data weaknesses. Agreement that improvements to governance in the broadest sense would always help - to empower and engage.

Case Studies: As we had representatives from Ireland, and also from Iceland (though not a case study as such) Sarah gave a brief overview of the criteria for selecting the case studies from the comparative review and then invited the external participants to share their experience.

Colm Brady gave an overview of the Irish Group Water Schemes and the role of the National Federation. Luke Varley gave a presentation more generally on private supplies in Ireland including the role of the Department of Environment, Communities and Local Government and the Environment Protection Agency. Maria Gunnarsdottir gave a presentation on Iceland, although Iceland is not a case study as such. Sarah then presented briefly on the remaining case studies (France, Finland, Iceland and New Zealand) and some overall findings from the case study work.

General discussion: participants were then invited to make any general comments or inputs to the discussion. Comments included:

- The need to provide for succession planning at the end of projects (but also to ensure ongoing help and support);
- The importance / relevance of community pride in 'our water';
- Reluctance to recognise problems that were not 'visible' (colour / odour / taste);
- The usefulness of this project to other current work;
- The need for treatment especially of surface water;
- The need for good long term data on water quality to support treatment options;
- Poor construction and maintenance of facilities;
- The need for staged process of engagement to get buy-in for solutions;
- The usefulness of health-based data;
- The need for training on operation and maintenance of different sized systems and at householder level;
- Simple and appropriate guidance and support;
- How testing can be made available, and in turn support engagement.

Certain 'golden themes' emerging **included levels of funding; engagement and support; and WSP / risk assessment.**

The workshop ended by giving participants another opportunity to add 'solutions' to the exercise from the morning:

Problems identified:

- Poor construction -> contamination
- Consistency of application of regulations; lack of common understanding of individual responsibilities
- Lack of data
- Owners / users [lack of] understanding of risks and reluctance to make improvements
- Adequate funding to ensure sustainable solutions [lack of]
- Lack of community capacity – funding, information, understanding / awareness
- Qualifications / awareness of operators
- Knowledge of water quality [lack of]
- Lack of water [quality] protection
- Awareness of risk, land use, pollution, compression of water table
- Lack of data
- Communities don't know where to get guidance
- Proportionality impacting on policy decisions / political intent
- Professional management of small schemes [lack of]
- Lack of knowledge of risk / safety
- Inadequate treatment for small supplies.

Solutions proposed:

- Connect all to public network (if money no object!)
- Enable larger suppliers to support operators of small systems
- Connect everyone to the public supply
- A centralised body / agency which can coordinate knowledge / expertise and advise communities on options
- Establish a water centre with experts to support communities
- 'one-stop'shop' for owners / users advice and guidance
- Full compliance with Regulations and Directive
- Strategy for improvement; programme of community engagement and capacity-building; clear, developed solution models
- System for adequate training for communities to ensure successful sustainable facility
- Government support – economic and education
- Improve construction; eg properly constructed boreholes / appropriate treatment.

Additional solutions after the workshop:

- Educate and involve school children
- CREW research – extend community pilot; trained facilitators to implement WSPs
- Testing end-to-end community solutions – different issues, different communities; clear understanding of actions / outcomes
- Clear process for testing Type B's – get beyond taste, colour being used to determine quality
- Clear structure for community schemes – robust register as starting point
- HACCP / WSP models – tangible and engaging tools / guide for getting communities involved; clear planning and outcomes
- Empowering communities – knowledge; recognising a governance crisis and responding appropriately
- Water is part of intrinsic culture; water is life; incentives to protect water
- Better process for supporting and testing type A supplies to improve water quality, educate and empower the community.

Follow up and next steps:

Slides from the workshop were circulated to all participants. Participants were encouraged to send any comments on the report to the team, for inclusion in the final report (end August); and to share with the team opportunities for dissemination. As ever we are grateful for all the feedback we received and hope the final report is useful.

crew

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