A review of the risks to drinking water quality at rural public buildings in England and Wales

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Glossary

ACRE	Action with Communities in Rural England
ATSDR	Agency for Toxic Substances and Disease Registry
BBP	Butyl benzyl phthalate
DBP	Disinfection by-product
DEHP	Di-(2-ethylhexyl)phthalate
DEP	Diethyl phthalate
DNOP	Di-n-octyl phthalate
DWI	Drinking Water Inspectorate
Esri	Mapping software company
FAO	Food and Agriculture Organization
FSA	Food Standards Agency
GDWQ	Guidelines for Drinking-water Quality
HBV	Health-based value
HCGI	Highly credible gastrointestinal illness
HSE	Health and Safety Executive
IARC	International Agency for Research on Cancer
JECFA	Joint FAO/WHO Expert Committee on Food Additives
LOAEL	Lowest Observed Adverse Effect Level
MIB	2-Methylisoborneol
MRL	Minimal Risk Level
NOAEL	No Observed Adverse Effect Level
NVHF	National Village Halls Forum
ONS	Office of National Statistics
OS	Ordnance Survey
PCV	Prescribed Concentration Value
PMTDI	Provisional Maximum Tolerable Daily Intake
PRV	Pressure reducing valve
RfD	Reference Dose
RNLI	Royal National Lifeboat Institution
RUC	Rural-Urban Classification

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SPID	Supply Point ID
SQL	Structured Query Language
T&O	Taste and odour
THMs	Trihalomethanes
TPHWG	Total Petroleum Hydrocarbon Criteria Working Group
UKWIR	UK Water Industry Research
UPRN	Unique Property Reference Number
WHO	World Health Organization
WRAP	Waste and Resources Action Programme
WRAS	Water Regulations Advisory Scheme
YHA	Youth Hostel Association

Summary

i Reasons

In 2004, the Drinking Water Inspectorate (DWI) informed water companies of the actions they needed to take to ensure that England and Wales complied with the requirements of Article 6(2) of the European Drinking Water Directive (98/83/EC) with respect to establishments where water is supplied to the public. Paragraph 6(2) states *inter alia* that Member States shall be deemed to have fulfilled their obligations where it can be established that non-compliance with the parametric values is due to the domestic distribution or its maintenance, except in premises and establishments where water is supplied to the public ("public buildings"). The Directive cites schools, hospitals and restaurants as examples of "public buildings". At that time to remedy the lack of drinking water quality monitoring where water was supplied in public buildings, the DWI specified that such premises should be included in water companies' random compliance monitoring programmes from 1st January 2005.

However, it has since been recognised that due to a number of factors such as the close proximity of public buildings and ease of sampling, there may have been a bias towards sampling of urban public buildings. That being the case, the quality of water supplied to rural public buildings is less well known, in addition to any specific hazards and risks that these properties may present. To remedy this gap in knowledge, this project specifically examines rural public buildings and further limits this to those "privately owned and maintained for non-commercial purposes, by and for community use". This definition of public buildings excludes buildings such as leisure centres, restaurants, pubs and retirements homes, and buildings owned by the local authority/councils such as schools and sports grounds. It does, however, include rural community centres, village halls, properties of youth organisations such as scout huts and church halls.

ii Objectives

The project objectives include the following:

- Determine the number and proportion of rural public buildings that have been monitored by water companies in the last three years compared to urban public buildings.

- Identify specific types of hazards that rural public buildings present to consumers and determine the level of water quality risk (severity *vs*. likelihood) that these specific hazards present.

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- Establish what guidance is currently available to persons in control of water supply arrangements at rural public buildings and its quality.

- Recommend how standard guidance could be best produced and disseminated to relevant people served by and/or in control of rural public buildings.

iii Benefits

The project will confirm whether there has been a bias towards sampling of urban *vs*. rural public buildings. It will also enable an understanding of the contamination risks (chemical, aesthetic and microbiological) which are associated with drinking water quality supplied to rural public buildings, and how to assess the significance on “wholesomeness” and impact on consumers. The project will also assess whether the existing guidance for persons in control of water supply arrangements for such premises is adequate, and recommend how future standard guidance could be best produced and disseminated.

iv Conclusions

The rural public buildings analysis demonstrated that the classification of public buildings is not consistent between water companies. A standard definition of a public building and a method of audit are essential to enable meaningful analysis of potential water quality issues. The analysis also found that the spatial location of water quality sample sites is not exact enough to enable matching with a specific building in the Ordnance Survey (OS) AddressBase dataset.

There is some evidence that water companies are not sampling rural public buildings as frequently as their urban counterparts. However, it should be emphasised that the confidence in drawing this conclusion is compromised by differences in the public building classification between AddressBase and water quality sample site data. It was not possible to identify any statistically robust conclusions on the difference of water quality compliance between urban and rural public buildings due to the very low number of reported failures.

There is only very limited monitoring and literature data on chemical, aesethetic or microbiological hazards specifically associated with drinking water of rural public buildings, with the reported eight compliance failures being due to exceedance of iron, aluminium, manganese, taste and coliform bacteria parameters.

Potential chemical contaminants were identified that may be more likely to occur in drinking water of rural public buildings. Some contaminants are likely to be present as a result of the age and quality of pipework and fittings used in the buildings (e.g. copper, nickel, iron, aluminium or lead) and the intermittent use of supply (stagnation of water and increased potential of leaching). These may result in aesthetic effects (taste, odour or discolouration) which are noticeable to consumers. Another group of potential contaminants include

hydrocarbons following spills of heating oil, petrol/diesel or the use of coal-tar pitch linings in older pipework, which again can result in organoleptic effects. In addition, plasticisers from plastic pipes can potentially leach into water and the possibility of disinfection by-products or compounds of microbial origin (geosmin and 2-methylisoborneol (MIB)) leading to taste and odour problems.

One factor related to rural public buildings considered as giving increased potential for risk of microbiological contamination is their location on remote sections of a distribution system. For example, the greater the length of a distribution system the more likely it will be to experience an ingress event. In addition, water quality at remote locations may have deteriorated caused by decay of the disinfectant residual, the rate of which is dependent on several factors including type of water, temperature and residence time. This may result in an increased potential for microbial growth within the distribution system.

A search of the guidance provided by water companies, local authorities, places of worship networks and insurance companies and the questionnaire to village hall committees showed that there are only a few guidance documents available and none are specifically on water supply systems in rural public buildings.

Several gaps were identified in the review of existing guidance which included that people are unaware that current guidance exists, clarifying the responsibilities of owners/committees members to maintain “wholesome” drinking water in these types of buildings and recognising the lack of consolidated and non-technical data. Inconsistencies were identified on the available guidance from water companies and Water Regulations Advisory Scheme (WRAS) about the length of time stagnant water may cause aesthetic and/or health problems from the drinking water.

It is considered that a standalone official DWI guidance document or guidance pack is needed hosted on the DWI website and then stakeholders may choose to disseminate this directly or include the guidance in their own literature as checklists, posters and other formats to effectively communicate with their own audiences.

v Suggestions

It is recommended that the recording of the OS unique property reference number (UPRN) of the water quality sample site building becomes mandatory. The UPRN provides an unambiguous location of a sampling point and allows public (and other) building classification to be audited. All UK water companies use the OS AddressBase product so have commercial use of this dataset (Open Water uses UPRN as a unique identifier of supply point IDs (SPIDs)).

It is also recommended that the definition of public building is standardised between the DWI and all water companies in order to achieve consistent reporting. This could be achieved by

specifying a data definition from OS AddressBase for public buildings similar to that used by this project.

It is recommended that Water Companies review their monitoring processes to ensure that a fair balance is achieved between rural and urban public building sampling.

It is recommended that where monitoring data are available for chemical contaminants in rural buildings, a comparison be made with drinking water standards, health-based values and taste, odour or discolouration threshold effects in order to assign a level of risk as high, medium or low. Similarly, it is recommended that a qualitative approach be adopted for assessing the risks of non-compliance of microbiological contaminants, with the level of risk assigned as high, medium and low, depending on where the microbiological contamination appears to be located and the nature of the organism. The resulting actions to be taken following this assessment would depend on the category of risk. Essentially a high risk requires immediate investigation to determine and rectify the origin of contamination and consideration of a “boil water” or “do not drink” notice. Medium risk would need an investigation of the cause which may result in flushing the system, improved kitchen hygiene or improved water supply arrangements. Finally, low risk would require no action.

It is recommended that a non-technical leaflet to be distributed to the owners/committee members of rural public buildings, to explain their responsibilities and the necessary steps to reduce/prevent contamination of drinking water in rural public buildings and consequently provide “wholesome” drinking water to rural communities. The leaflet includes sections on highlighting to custodians in rural public buildings about their water supply history and their water supplier, steps to take following a contamination of drinking water, responsibilities to maintain “wholesome” drinking water, the types of chemicals which can cause aesthetic effects following contamination of pipework from outside a rural public building, and the main types of taste and odour effects that can potentially occur and are related to internal plumbing or water storage within the building.

It is recommended that the DWI actively facilitate the production and communication of the guidance by working collaboratively with the stakeholders. A steering group with the task of producing the guidance could be led by an umbrella organisation from the water industry with representation from the target audience. The steering group must have a strong technical and communications input to ensure the guidance is both accurate, understood and practical. A guidance pack should be developed with specific information targeted at the management committees for village halls, places of worship and sports clubs. Consideration should be made to where this guidance can be included in support of existing legislation i.e. health and safety, food hygiene and WRAS.

It is recommended that the development of guidance for specific sectors is considered to maximise the broadcasting of the information. Due to the broad audience, it is recommended that the guidance is disseminated through a variety of routes making use of the stakeholders identified in the production phase.

1. Introduction

In 2004, the Drinking Water Inspectorate (DWI) informed water companies of the actions they needed to take to ensure that England and Wales complied with the requirements of Article 6(2) of the European Drinking Water Directive (98/83/EC) with respect to establishments where water is supplied to the public (DWI, 2004). Paragraph 6(2) states *inter alia* that Member States shall be deemed to have fulfilled their obligations where it can be established that non-compliance with the parametric values is due to the domestic distribution or its maintenance, except in premises and establishments where water is supplied to the public ("public buildings"). The Directive cites schools, hospitals and restaurants as examples of "public buildings". At that time to remedy the lack of drinking water quality monitoring where water was supplied in public buildings, the DWI specified that such premises should be included in water companies' random compliance monitoring programmes from 1st January 2005.

Previous research conducted for DWI by WRc in 2004 estimated that there were about 225 000 public buildings in England and Wales (Jackson *et al.*, 2004). A total of 46 types of building were identified and divided by category (e.g. education, medical, hostelries, exhibition, sports/leisure and miscellaneous) as well as giving the number for each category. The listing was then used to identify a range of different types of public buildings to inspect and sample the water supply as part of the project. Water supplies were taken from a total of 200 buildings selected randomly upon relative occurrence and importance, ensuring at least one of each type was included. The samples were analysed for coliform bacteria, *Escherichia coli,* enterococci, colour, conductivity, copper, hydrogen ion, iron, lead, nickel, nitrite, odour (qualitative), taste (qualitative), turbidity and zinc. A sample was also taken for on-site determination of chlorine, temperature and appearance. The survey of plumbing arrangements during sampling identified a broad range of materials and fittings used. Overall, the level of compliance for the selected public buildings was high and comparable to that reported for statutory monitoring of water quality in supply zones.

As a result of the research, DWI required water companies to take 10% of their random compliance water samples from public buildings from 1st January 2005, estimating that it would take 18-20 years to sample the majority of public buildings (DWI, 2004). However, it has since been recognised that due to a number of factors such as the close proximity of public buildings and ease of sampling, there may have been a bias towards sampling of urban public buildings. That being the case, the quality of water supplied to rural public buildings is less well known, in addition to any specific hazards and risks that these properties may present.

To remedy this gap in knowledge, this project specifically examines rural public buildings and further limits this to those "privately owned and maintained for non-commercial purposes, by and for community use". This focuses the definition of public buildings considerably from the

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2004 report, excluding buildings such as leisure centres, restaurants, pubs and retirement homes, and buildings owned by the local authority/councils such as schools and sports grounds. It does, however, include rural community centres, village halls, properties of youth organisations such as scout huts and church halls.

The project objectives are:

1. Estimate the total number of rural public buildings (as defined in the project specification) in England and Wales served by public water supplies.

2. Determine the number and proportion of rural public buildings that have been monitored by water companies in the last three years (based on data held by DWI) compared to urban public buildings.

3. Identify specific types of water supply hazards that rural public buildings present to consumers (based on compliance data held by DWI and a wider review of the literature).

4. Determine the level of drinking water quality risk (severity *vs*. likelihood) that these specific hazards present.

5. Establish what guidance is currently available to persons in control of water supply arrangements at rural public buildings (and/or premises on which they are sited) and its quality (determining any inconsistencies, accuracy and robustness in terms of protecting the community).

6. Recommend how standard guidance could be best produced and disseminated to relevant people served by and/or in control of rural public buildings.

2. Rural Public Building Analysis

2.1 Aims

Objectives 1 and 2 of the project were to:

- Estimate the total number of rural public buildings in England and Wales served by public water supplies. As discussed in the introduction, the project definition of rural public building was limited to "those privately owned and maintained for non-commercial purposes, by and for community use". This definition removes buildings such as leisure centres, restaurants, pubs, retirement homes, schools and sports grounds. It does, however, include rural community centres, village halls, properties of youth organisations such as scout huts and church halls.

- Determine the numbers and proportion of rural public buildings that have been monitored by water companies in the last three years (based on data held by the DWI) compared to urban public buildings.

The following sections describe the methodology used to investigate these objectives and the results, conclusions and suggestions obtained from the analysis.

2.2 Methodology

2.2.1 Data acquisition

The first step of the analysis was to acquire appropriate data to ascertain the total number and subsequently the proportion of rural public buildings that have been monitored for water quality by water companies for the last three years. These datasets included:

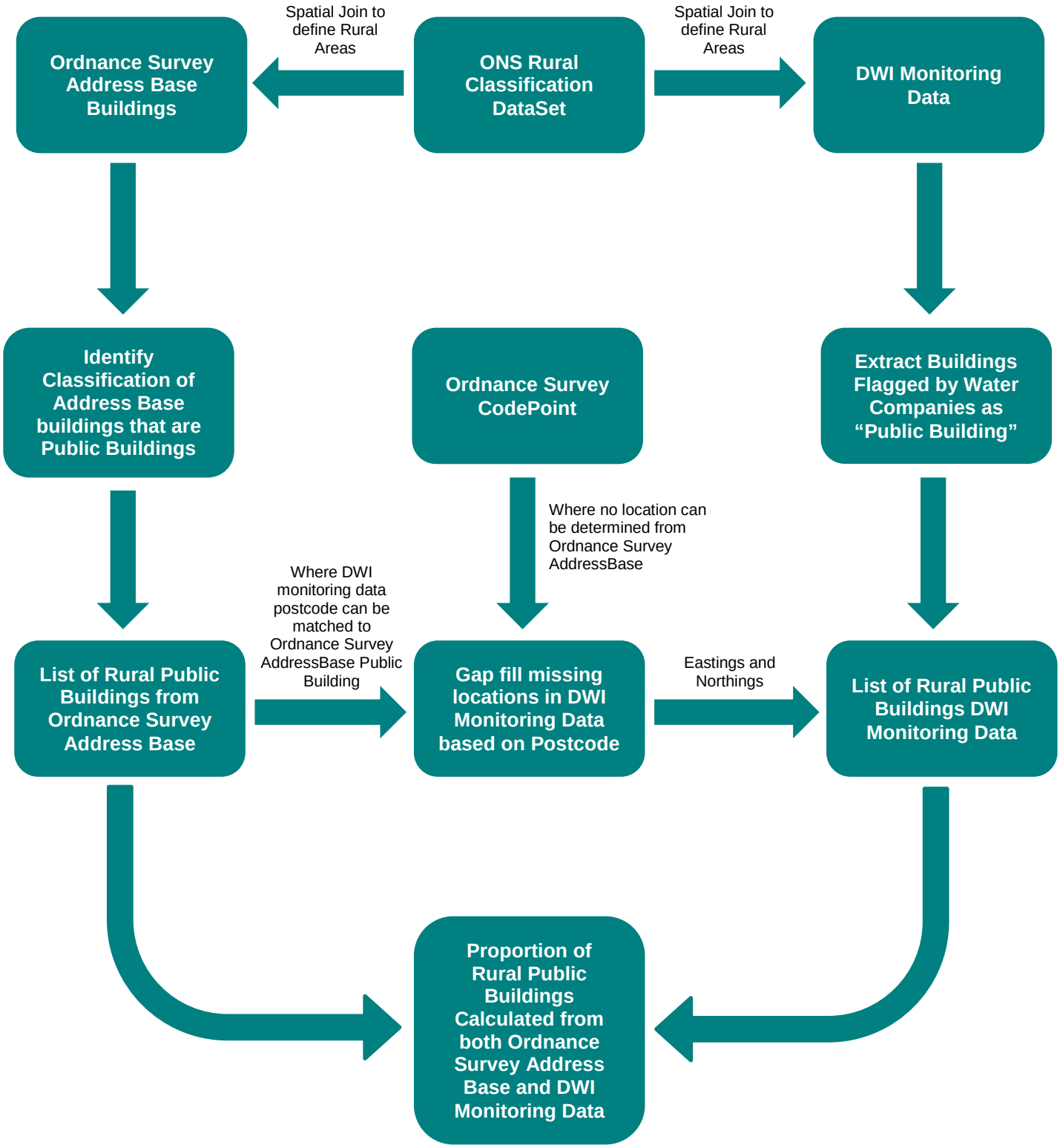
- Ordnance Survey (OS) Addressbase Premium (supplied by DWI)
- Water quality monitoring data from water companies (held by DWI)
- 2011 Census rural/urban polygon classification (downloaded from the Office of National Statistics (ONS))
- Water company polygon boundaries (dataset maintained by WRc)
- Postcode matching - OS codepoint open

All of these datasets were loaded into a Structured Query Language (SQL) server database for analysis.

2.2.2 Data pre-processing

The following section describes the pre-processing that was required for the data to be used in the analysis, with Figure 2.1 summarising the methology described below.

Figure 2.1 Pre-processing methodology



OS AddressBase Premium

OS AddressBase Premium was supplied as a number of tables in Esri File Geodatabase format. WRc imported these tables into the SQL server, and generated a single “flat” table with all of the required attributes for analysis (which included location in terms of northings and eastings, address with postcode, name of organisation and classification information in terms of type of property e.g. residential, hospital, youth hostel). All properties located in Scotland were removed from the dataset using the post code area to identify them.

In order to further process the AddressBase Premium (and water company monitoring sample sites) into urban and rural areas, a further attribute was required to be spatially joined to these datasets, using the rural/urban classification (sourced from the ONS Rural-Urban Classification (RUC) for small area geographies dataset 2011). In addition, the AddressBase Premium dataset was also assigned the attribute of water company name (sourced from the WRc water company layer).

Rural/urban classification

In order for the datasets to be assigned an overall rural/urban classification, the definition of each had to be established. In the ONS RUC dataset the following categories were considered as rural for this analysis:

- Rural: Town and Fringe (D1)
- Rural: Town and Fringe in a Sparse Setting (D2)
- Rural: Village (E1)
- Rural: Village in a Sparse Setting (E2)
- Rural: Hamlets and Isolated Dwellings (F1)
- Rural: Hamlets and Isolated Dwellings in a Sparse Setting (F2)

The following categories were considered as urban for this analysis:

- Urban: Major Conurbation (A1)
- Urban: Minor Conurbation (B1)
- Urban: City and Town (C1)
- Urban: City and Town in a Sparse Setting (C2)

Classification of properties in AddressBase as public buildings

In the scope of this project, public buildings are further defined as those which are *"Privately-owned and maintained for non-commercial purposes, by and for community use".* A review was performed on classifications within the AddressBase dataset to identify classifications that matched this definition (i.e. the project definition) (see Table 2.1).

Table 2.1 Total number of public buildings (as specified in the project definition) in England and Wales

Classification	Total Number in AddressBase		
	Rural	Urban	Total
Beach office / First aid facility	3	14	17
Bowls facility	14	29	43
Chapel	92	213	305
Church	1 564	7 239	8 803
Church Hall / Religious meeting place / Hall	1 189	4 382	5 571
Coastguard Rescue / Lookout / Station	80	63	143
Community service centre / Office	345	1 981	2 326
Community services	1 396[a,b] (reduced from 1528)	5 706[a,b] (reduced from 6258)	7 102[a,b] (reduced from 7786)
Crematorium	54	90	144
Cricket facility	182	417	599
Football facility	137[a,c] (reduced from 143)	343[a,c] (reduced from 384)	480[a,c] (reduced from 527)
Gurdwara	0	13	13
Kingdom hall	33	238	271
Lifeboat services / Station	62	64	126
Lifeguard facility	3	9	12
Mosque	1	206	207
Mountain rescue station	20	5	25
Place of worship	14 001	13 111	27 112
Public / Village hall / Other community facility	11 146	15 365	26 511

Classification	Total Number in AddressBase		
	Rural	Urban	Total
Racquet sports facility	8 962	9 431	18 393
Religious community	13	67	80
Rugby facility	123	281	404
Synagogue	1	105	106
Temple	0	67	67
Youth hostel	30	19	49
Youth recreational / Social club	127	455	582
Total	**39 578**	**59 913**	**99 491**

a: Two classifications required further processing to remove properties that did not meet the definition of "public building" as in the scope of this project. These were "community centre" and "football facility".

b: For "community centre", any address or organisation name containing the following keywords were excluded from the definition of a "public building": Police, ambulance, fire, council, gym, post, constabulary, lifeboat, social services, probation, rescue, Royal National Lifeboat Institution (RNLI), coastguard, young offender, prison, borough, school, coroner, café, takeaway and funeral.

c: For "football facility" any address or organisation name matching an English football league club were removed as these were deemed to be commercial organisations.

Water quality monitoring data from water companies

The received water quality monitoring data were raw records of each water sample taken by the water companies (over the last three years) and did not contain attributes that allowed a list of unique monitoring sites to be defined. To create this list, WRc used an SQL server query that was grouped by the following attributes:

- CompanyName
- SiteRef
- PublicBuildingFlag
- Easting
- Northing
- Postcode
- CosampleRef

The output of this process defined 425 811 unique sample sites, of which 11 631 (2.7%) were flagged as public buildings and 414 180 (97.3%) as non-public buildings.

The unique sample site data also presented an issue in establishing exact locations for a number of sites where only postcode data were available (i.e. with no easting and northing attributes) as summarised in Table 2.2.

Table 2.2 Analysis of water quality sample site location

Type of Building	Total number of sample sites	With full location[a]		With postcode only	
		Number	Percentage	Number	Percentage
Public	11 631	6 253	54%	5 378	46%
Non-public	41 4180	254 296	61%	159 884	39%
Total	42 5811	260 549	61%	165 262	39%

a: Full location includes postcode with easting and northing attributes

Further analysis could be undertaken on the sample sites where an exact location was available but, where there was only postcode information, further processing was required (see below section on adding spatial location to postcode only water quality sample sites).

Adding spatial location to postcode only sample sites

Where either an easting or northing coordinate was unavailable in the water quality sample site, the following process using the postcode was used to geolocate the sample point:

1. The AddressBase easting and northing were used where there was only a single property within the same postcode in the AddressBase Public Building dataset.

2. The OS Codepoint Open central easting and northing were used where there was no or more than one property within the same postcode in the AddressBase Public Building dataset.

A number of postcodes supplied had typographical mistakes. Obvious errors were corrected but some postcodes were not able to be validated. A summary of this exercise is given in Table 2.3:

Table 2.3 Location analysis for water quality sample sites with postcodes only

Postcode only – location source	Number of sites	Percentage of sites
AddressBase easting and northing used	4 172	2.5%
OS code point open central easting and northing	159 197	96.3%
No location validation	1 893	1.2%

To verify the validity of this approach, a test was performed by using the approach applied to assigning locations for postcodes, but on the sample data with existing easting and northings therefore allowing a comparison to be assessed. In terms of rural to urban ratios, the validation showed a strong correlation between using the postcode method to derive location as opposed to using the provided easting and northings. Nationally, there were 25.5% rural and 74.5% urban from the sample site eastings and northings. From the postcode location method, the ratios were 23.4% rural and 67.4% urban, with a further 9.1% where a location could not be derived. This showed a good correlation and validated the approach to deriving postcode locations.

2.3 Results

2.3.1 Urban-rural ratios

The urban-rural ratios of public buildings were calculated for the AddressBase public buildings dataset, as well as the water quality sample sites from both easting and northings and those with only postcode information. A comparison was made between the ratios from AddressBase and those from the water company sampled sites. Overall the results show that within the water company sampled sites, fewer public buildings are sampled in rural areas, and more in urban areas than would be expected based upon the ratios calculated from the AddressBase public buildings dataset (see Table 2.4). The pattern was consistent for every water company, whether their location data were predominantly based upon exact easting and northings or postcode unit centroids.

Table 2.4 Summary of rural to urban ratio of public buildings in England and Wales

Source of Ratio	Rural		Urban	
	Number	%	Number	%
AddressBase all buildings[a]	7 034 504	21.3%	26 005 925	78.7%
AddressBase public buildings[b]	39 578	39.8%	59 913	60.2%
All public building sample sites[c]	2 654	23.1%	8 853	76.9%

a: AddressBase all buildings is the number and percentage of all buildings in the OS AddressBase dataset regardless of public building status

b: AddressBase public buildings is the number and percentage of buildings in the OS AddressBase dataset that are classified as “public” by the WRc project classification

c: All public building sample sites is the number of water quality sample sites provided by water companies that they have classified as public buildings

2.3.2 Results validation

A number of tests were undertaken to validate the results, which were performed in three stages:

1. Testing whether there was a match between the project classification of public buildings in AddressBase and the water quality sample sites, i.e. are the same buildings found in both datasets. This validates the project classification and the water company provided sample site public building classification.

2. Testing whether the public building water quality sample sites match properties in AddressBase that are not part of the project classification. This tests the project classification by checking if any classifications may have been missed that should be included as public buildings.

3. Assigning an overall confidence to the match between the public building water quality sample sites and AddressBase.

Stage 1: Public building matching between AddressBase and water quality sample sites

Analysis was undertaken to validate the WRc generated AddressBase public buildings dataset by comparing their locations with those of known water quality sample sites flagged as public buildings.

Given the AddressBase property point location is the delivery point, it was assumed that the distance from the public building sample site to its AddressBase counterpart is less than 100 metres. A spatial analysis was conducted for all water quality sample sites to find the nearest AddressBase public building and the distance to it.

Overall the results show that there is a very poor correlation between the AddressBase public building dataset and the water quality sample sites. Not a single water company had a match of over 50% of its sample sites within 100 metres of an AddressBase public buildings property. Nationally, the average for all water quality sample sites was around 30%.

This poor correlation was demonstrated in detail by randomly selecting five sites, each from a different water company with known eastings and northings. The results of this analysis are below:

1. Site 1 Reference Z308

   Easting: 391738, Northing: 376278

   Water Company: United Utilities Water Plc

   Distance to nearest AddressBase public building: 445 m

   Findings: Observed from aerial photography that the sample site is in a field, and not a building location. The coordinate would appear to be inaccurate.

2. Site 2 Reference ZMW34

   Easting: 500825, Northing: 228094

   Water Company: Anglian Water Services Ltd

   Distance to nearest AddressBase public building: 604.7 m

   Findings: According to AddressBase Premium this is an “Emergency / Rescue Service” building, which falls outside the definition of public building used for this project.

3. Site 3 Reference: Z2801503

   Easting: 518704, Northing: 466813

   Water Company: Yorkshire Water Services Ltd

   Distance to nearest AddressBase public building: 232 m

   Findings: According to AddressBase this property is “residential”. However, there is a building adjacent that is an amusement arcade. This is classified as “amusements” in AddressBase. It appears that the public building flag in the sample dataset is not consistent with AddressBase classification used in this project.

4. Site 4 Reference: ZHAV

   Easting: 465686, Northing: 104847

   Water Company: Portsmouth Water Plc

   Distance to nearest AddressBase public building: 136 m

   Findings: Location falls on a residential building, however there is a sports complex to the north that would fit the criteria. It is therefore possible that this coordinate is incorrect.

5. Site Reference: Z1010B23

   Easting: 330592, Northing: 263612

   Water Company: Dŵr Cymru (Welsh Water)

   Distance to nearest AddressBase Public Building: 1058 m

Findings: Location falls on a residential building, no other public buildings nearby. It appears that the public building flag in the sample dataset is not consistent with AddressBase classification used in this project.

Stage 2: Validity of Project Classification

An analysis was performed to test the validity of the project classification. Where water quality sample sites were tagged as public buildings but the nearest AddressBase public buildings were not located within 100 metres, the closest AddressBase (non-Public) building was found and its classification recorded.

139 different classifications were identified from this analysis with the most distinct pattern being 43% of them being residential buildings. This seems to indicate a misclassification of public buildings in the sample sites dataset, and not an issue with the project classification used.

Stage 3: Confidence in matching between AddressBase and water quality sample site buildings

An analysis was performed of water quality sample site correlation with AddressBase buildings regardless of their classification (i.e. no distinction for public buildings) (see Table 2.5). Each sample site was assigned a confidence level (A, B, C, D or U) in their correlation with AddressBase location based upon how well they matched with eastings, northings and postcode unit centroids.

Table 2.5 Confidence level on location match between water quality sample sites and AddressBase

Confidence	Number	Percentage
A: Exact match between water quality sample site and AddressBase Premium on easting and northing and postcode	34 244	13.1%
B: Exact match between water quality sample site and AddressBase Premium on easting and northing, but NOT on postcode	22 377	8.6%
C: Nearest AddressBase point to water quality sample site is <100 metres and postcode matches	122 161	46.9%
D: Nearest AddressBase point to water quality sample site is <100 metres and postcode does not match	78 813	30.2%
Public Building Flag agreement between water quality sample site and AddressBase Premium where confidence is A-D	228	3.7%
U: No confident match (unclassified)	2 954	1.1%

Overall, the correlation shows a good match between AddressBase and the water quality sample sites with the results showing a confidence (A-D) in 98.8% of sample sites. This shows that the majority of sample sites do largely correlate with building locations in AddressBase regardless of their public building status.

However, as has already been discussed in previous sections, the mapping between the project AddressBase public building and water quality sample site public building flag classifications are inconsistent. Out of the 6 111 public building sample sites which were matched with AddressBase with any confidence, only 228 (3.7%) shared a public building status with the project classification.

2.3.3 Analysis of failures of Prescribed Concentration Values (PCVs)

An analysis was performed on the number of failures of PCV standards within the water quality sample data, to test if any pattern could be observed between PCV failure and rural/urban areas.

Overall there were only 28 failures on samples marked as public buildings (defined by the water companies) of which 8 were in rural areas (out of 2 775 samples) and 20 were in urban areas (out of 10 984). Of the 8 failures in rural areas, four related to chemical contaminants (iron, aluminium and manganese), two related to taste, and the remaining two to microbiological failures (coliform bacteria) (see Sections 3.3.1 and 3.4.1 for further detail). Of the 20 failures in urban area, four related to chemical contaminants (iron and lead), three related to taste and odour, with the remaining thirteen related to microbiological failures (coliform bacteria). It is impossible to draw valid conclusions from these results due the small numbers involved.

This analysis was repeated on the project classification AddressBase properties to test whether any other result trends might be observed. The results yielded no failure results, and so this was unable to provide any further indications of trends.

2.4 Conclusions

The main conclusion of the rural buildings analysis is that the classification of public buildings is not consistent. Exactly how the public building flag in the sample dataset is populated by different water companies is unclear. The classification scheme used by OS AddressBase is not ideal for identification of public buildings for water quality sampling purposes. It has been shown that some classifications contain a mixture of public and non-public buildings in terms of the project definition e.g. community centre, football grounds. A standard definition of a public building and a method of audit are essential to enable meaningful analysis of potential water quality issues.

The analysis also demonstrates that the spatial location of water quality sample sites is not exact enough to enable matching with a specific building in the OS AddressBase dataset.

Although there are some shortcomings in the data analysis there is some evidence that water companies are not sampling rural public buildings as frequently as their urban counterparts. Based on the AddressBase classification used in this project, it is estimated the ~40% of public buildings are in rural areas. Based on water company public building flag ~20% of public building samples are taken in rural areas. However, it should be emphasised that the confidence in drawing this conclusion is compromised by differences in the public building classification between AddressBase and water quality sample site data.

Finally, it is not possible to identify any statistically robust conclusions on the differences of water quality failures between urban and rural public buildings as the number of failures at public buildings (as defined by water companies) were low (total 28, with 8 and 20 failures reported in rural and urban areas, respectively). There were no failures on public buildings as defined by this project using the OS AddressBase product.

2.5 Suggestions

It is recommended that the recording of the OS Unique Property Reference Number (UPRN) of the sample site building becomes mandatory. The UPRN provides an unambiguous location of a sampling point and allows public building classification to be audited. All UK water companies use the OS AddressBase product so have commercial use of this dataset (Open Water uses UPRN as a unique identifier of Supply Point IDs (SPIDs)).

It is also recommended that the definition of public building is standardised between the DWI and all water companies in order to achieve consistent reporting. This could be achieved by specifying a data definition from OS AddressBase for public buildings similar to that used by this project. However, the weakness of any definition that relies solely on the property type classification fields should be noted. Should this approach be adopted it is still important to include some flexibility to add additional properties based on local knowledge that may not satisfy the data definition from OS AddressBase.

It has been shown that there is some evidence of under representation of rural public buildings in the sampling. Therefore it is recommended that Water Companies review their monitoring processes to ensure that this is corrected and a fair balance achieved between rural and urban public building sampling.

3. Water Quality of Rural Public Buildings

3.1 Aims

Objectives 3 and 4 of the project were to:

- Identify specific hazards (in terms of chemical, aesthetic and microbiological quality of drinking water) that rural public buildings present to consumers based on compliance data held by DWI and a wider review of the literature.

- Determine the level of water quality risk (severity and likelihood) that these hazards present.

3.2 Methodology

The objectives listed above were addressed by reviewing water companies' water quality monitoring data for the last three years (held by DWI).

A literature search to locate published information pertaining to actual or potential water quality problems identified in rural communities with public supplies or in the type of public building identified in this project was also undertaken. The systematic search was conducted using key words ('water supply risk', 'drinking water', 'water', 'lead pipes', 'lead', 'water quality', 'legionella', 'microorganisms', 'water discolouration', 'heavy metals', 'chemicals', crossed matched to 'rural' and different locations) and defined library search engines (Scopus, Google, PubMed).

A number of interested parties such as Water Safe and Anglian Water were also contacted for their opinions on potential hazards associated with rural public buildings. Water Safe is an umbrella organisation for approved plumbers and installers set up by the water industry offering free advice on water fittings and their regulation. Anglian Water provided information on the recurring problems they find in drinking water of rural public buildings (Pers. comm., 2015a).

Finally, community organisations such as Action with Communities in Rural England (ACRE), and the National Village Halls Forum (NVHF) were contacted, and questionnaires were sent to rural village hall controllers (as provided by ACRE) and parish councils for any information on water supply problems associated with rural community buildings. The detailed results of responses to the questionnaire are given in Section 4.3.1.

3.3 Chemical and aesthetic hazards

3.3.1 Identified or potential chemical and aesthetic hazards in the drinking water of rural public buildings

DWI data

The DWI provided WRc with a list of parameters detected in the drinking water of rural public buildings, and which failed to comply with drinking water standards (see Section 2.3.3). There were a total of eight compliance failures out of 2 775 samples reported in the drinking water of rural public buildings, compared with 20 failures out of 10 984 samples in urban public buildings. However, these differences in the number of compliance failures were not statistically significant. Of the eight failures, there were four that related to chemical contaminants and two related to effects on taste. In a rural public building in 2012, South West Water reported a failure due to iron being detected above the drinking water standard. Additionally in November 2012, South West Water reported two failures due to aluminium and manganese in drinking water in a rural public building. From review of the database provided by DWI and the DWI 2012 Annual Drinking Water Quality Report (DWI, 2013), it is assumed that both these metals were detected in the same water sample from the same rural public building; however, no additional data were located. In 2013, Essex and Suffolk Water, and Southern Water each reported a failure due to taste effects. In March 2013, South West Water also identified a failure as a result of iron being detected in drinking water in a rural public building. DWI annual drinking water quality reports were reviewed to try and find additional information on the eight failures; however, very limited data were included in these reports, which precluded the identification of the cause, location or concentrations/levels on these occasions.

Anglian Water

Discussion with Anglian Water provided WRc with information on their potential issues with regards to the drinking water quality of rural public buildings (Pers. comm., 2015a), which included:

- increased nickel from corroded taps;
- poor quality/old tap fittings;
- stagnation;
- the potential for coliform bacteria;
- the detection of hydrocarbons; and
- lack of access to rural public building for taking samples for routine monitoring.

Contaminants from questionnaire

Very limited data were provided from the responses of WRc's questionnaire to rural village halls; however, one response reported an "odd" taste to the drinking water (see Section 4.3.1). The water company of this particular incident advised the customer to "*run the water for a while*" due to potential stagnation of water in the pipes. No additional data were located on this incident. Another response from the questionnaire reported a "slight blue tinge to deposits left by dripping taps". This could potentially be due to corrosion of copper plumbing, including hot water storage containers and cylinders, as well as new pipes (DWI, 2010; WRAS, 2015a). WRAS (2015a) reports that there is a "*risk of slight staining*" due to blue-green tint of copper ions in the drinking water.

Literature search

Information that could be reliably considered as a reference source that specifically related to the chemical or aesthetic drinking water quality of rural public buildings was not identified during the literature search. However, potential contaminants that could cause chemical and/or aesthetic effects in the drinking water of rural buildings have been identified and discussed below.

WRc (2009) identified three main taste and odour complaints from all drinking water customers, these include "musty/earthy", "chlorinous" and "metallic" taste and odours. Chemicals such as geosmin (*trans*-1,10-dimethyl *trans*-9-decalol) and 2-methylisoborneol (MIB), produced by actinomycetes and cyanobacteria, have potent taste and odour effects. The likely sources of these chemicals include dead microorganisms from treatment works, which release taste and odour effects of geosmin and MIB (WRc, 2009). These two chemicals are also reported to be released in long-run pipes and often "stagnant" is used as a descriptor for geosmin and MIB. Geosmin and MIB are also described as having "earthy" and "musty" taste and odours, respectively. Odour thresholds of 1.3 and 6.3 ng/l, and taste thresholds of 10-20 and 30-40 ng/l have been reported for geosmin and MIB, respectively (WRc, 2009). "Chlorinous" taste and odour effects are anticipated to be a result of disinfection by-products (DBPs) in drinking water, for example taste effects have been reported at 130 µg/l for dichloramine and odour effects reported at 20 µg/l for trichloramine (WRc, 2009). "Metallic" taste effects are reported following the installation of new copper pipes or when other metal pipes are in contact with copper pipes, which can cause the release of metal ions (WRc, 2009).

Community organisation

Additionally, ACRE (2011a) reported in their national survey that 56% of rural public buildings are over 60 years old. Therefore, assuming that the majority of rural public buildings have older pipes and pipe fittings, discussions with water quality experts have identified lead and hydrocarbons from coal tar linings as potential contaminants. It is of note that the presence of hydrocarbons in drinking water can also originate from heating oils (from leaking heating-system tanks) or spills of petrol/diesel in car parks. In addition, plasticisers from plastic pipes

have also been identified as contaminants which can potentially leach into drinking water (WHO, 2011a). Aging pipes and intermittent water use may lead to discolouration of the water supply being a potential problem in these older rural public buildings.

Potential chemical contaminants of concern

Using all the above information the following list of potential chemicals contaminants and groups of contaminants, which may be of particular concern to the quality of drinking water in rural public buildings were identified:

- iron;
- manganese;
- aluminium;
- nickel;
- copper;
- lead;
- hydrocarbons;
    - heating oils;
    - coal tar linings;
    - petrol/diesel;
- compounds of microbial origin such as geosmin and MIB leading to taste and odour problems;
- DBPs; and
- plasticisers.

"Safe" levels

Lifetime health-based and aesthetic guidelines for these chemical contaminants are reported in Table 3.1 as a guide to their potential toxicity. Despite the anticipated intermittent use of drinking water in rural public buildings, the frequency of exposure to these chemicals in drinking water is not clear. Therefore, the precautionary principle has been applied and in the absence of a regulatory standard for a particular chemical, lifetime values (either as a World Health Organization (WHO) Guidelines for Drinking-water Quality (GDWQ) or a derived value) have been identified.

A three-stage approach has been developed in assessing the significance of any detected concentrations of these chemical contaminants:

1. Firstly, comparison with the England and Wales drinking water standards (Defra, 2010).

2. Secondly, comparison with the WHO GDWQ (WHO, 2011b).

3. If neither of these authoritative evaluations were available then a lifetime value was derived using the methodology employed by WHO in deriving GDWQ for threshold chemicals (WHO, 2009). The standard assumptions that were used to derive lifetime guideline values are as follows:

- 60 kg adult;
- drinking 2 litres of water per day; and
- 20% allocation to drinking water.

It is important to note that lifetime exposure to drinking water in rural public buildings is highly unlikely. However, an extra margin of safety is applied using this methodology, especially for potential vulnerable groups, such as pregnant women and children who may be common users of such facilities.

Table 3.1 Health-based and aesthetic values for chemicals potentially detected in rural public buildings

Identified contaminants	CAS number	England and Wales Drinking Water Standard (µg/l)	WHO GDWQ / Lifetime health-based value (µg/l) [a]	Taste thresholds (µg/l) [b]	Odour thresholds (µg/l) [b]	References
Metals						
Iron	7439-89-6	200 [c]	[d]	40	-	WHO, 2003
Manganese	7439-96-5	50	400 [e]	150 [f]	- [f]	Prager, 1980
Aluminium	7429-90-5	200	900 [g]	- [h]	- [h]	-
Nickel	7440-02-0	20	70	-	-	-
Copper	7440-50-8	2000	2000 [i]	800-1000	-	Beguin-Bruhin *et al.*, 1983
Lead	7439-92-1	10	10 [j]	-	-	-
DBPs						
Trihalomethanes (THMs)	Various	100 [k]	300 (chloroform); 100 (bromoform); 100 (dibromochloromethane); 60 (bromodichloromethane [l]) [m]	784 (minimum); 2800 (median) [n]	20 (minimum); 800 (median) [n]	Pers. comm., 2015b
Bromate	15541-45-4	10	10, l,o	-	-	-
Hydrocarbons						
Benzo[b]fluoranthene, benzo[k]fluoranthene, benzo[g,h,i]perylene, indeno[1,2,3-cd]pyrene	Various	0.1 (maximum) [p]	-	-	10 [q]	Pers. comm., 2015b

Identified contaminants	CAS number	England and Wales Drinking Water Standard (µg/l)	WHO GDWQ / Lifetime health-based value (µg/l) [a]	Taste thresholds (µg/l) [b]	Odour thresholds (µg/l) [b]	References
Benzo[a]pyrene	50-32-8	0.01 (maximum) [w]	0.7 [l]	-	10 [q]	Pers. comm., 2015b
Naphthalene	91-20-3	-	240 [r]	25 (minimum); 50 (median)	2.5 (minimum); 5.5 (median)	WRc, 1996
Fluoranthene	206-44-0	-	4 [s]	-	10 [q]	Pers. comm., 2015b
Pyrene	129-00-0	-	460 [t]	-	10 [q]	Pers. comm., 2015b
Benzene	71-43-2	1 (maximum) [w]	10 [l]	400	10 (60°C)	Verschueren, 1996; Alexander *et al.*, 1982
Toluene	108-88-3	-	700	120 (40°C)	24 (60°C)	Alexander *et al.*, 1982
Ethylbenzene	100-41-4	-	300	29	1.6 (60°C)	US EPA, 1988; Alexander *et al.*, 1982
Xylene	Various	-	500 (xylenes)	300 [x]	20	Mallevialle and Suffet, 1987; WHO, 2011b; Sax, 1984
Aromatic >EC7-EC8	Various	-	1200 [u]	-	10 [q]	Pers. comm., 2015b
Aromatic >EC8-EC16	Various	-	90 [v]	-	10 [q]	Pers. comm., 2015b
Aromatic >EC16-EC35	Various	-	90 [v]	-	10 [q]	Pers. comm., 2015b

Identified contaminants	CAS number	England and Wales Drinking Water Standard (µg/l)	WHO GDWQ / Lifetime health-based value (µg/l) [a]	Taste thresholds (µg/l) [b]	Odour thresholds (µg/l) [b]	References
Plasticisers						
Di-(2-ethylhexyl)phthalate (DEHP)	117-81-7	-	8	-	-	-
Butyl Benzyl Phthalate (BBP)	85-68-7	-	3000 [y]	-	-	-
Dibutylphthalate	84-74-2	-	400 [z]	-	-	-
Diethyl phthalate (DEP)	84-66-2	-	900 [aa]	-	-	-
Di-n-octyl phthalate (DNOP)	117-84-0	-	2400 [bb]	-	-	-
Other Chemicals						
Geosmin	23333-91-7; 19700-21-1	-	[cc]	0.0075 (minimum); 0.016 (median) [dd]	0.00125 (minimum); 0.00375 (median) [dd]	WRc, 1996
MIB	2371-42-8	-	[cc]	0.0025 (minimum); 0.018 (median)	0.004	Sano, 1988; WRc, 1996

a: Reported from either WHO GDWQ or derived using toxicological data and the methodology for deriving lifetime exposure values reported in WHO (2009).

b: Lowest reported value for that individual chemical or group of chemicals.

c: Aesthetic-based.

d: WHO did not derive a GDWQ, but did state that if the Joint Food and Agriculture Organization (FAO)/WHO Expert Committee on Food Additives (JECFA) Provisional Maximum Tolerable Daily Intake (PMTDI) for iron of 0.8 mg/kg bw/day was used, and assuming a 10% allocation of the PMTDI to drinking water, a guideline value of 2 mg/l (2000 µg/l; rounded)

would be derived. WHO concluded that iron intake at this level did not present a hazard to health, but laundry and sanitary ware will stain at iron concentrations above 0.3 mg/l (WHO, 2003).

e: Health-based value for manganese. In 2011, WHO withdrew their GDWQ (of the same value), concluding that it was unnecessary to derive a formal guideline.

f: At concentrations as low as 0.02 mg/l, manganese can form coatings on water pipes that may later slough off as a black precipitate. Discolouration and dirty water problems are likely to occur above a concentration of 0.05 mg/l (WHO, 2011c).

g: Health-based value that could be derived for aluminium. WHO noted that there remain uncertainties as to the extent of aluminium absorption, and that absorption is dependent on a number of parameters including the aluminium salt administered, the pH (for aluminium speciation and solubility), bioavailability and dietary factors. WHO also derived practicable levels based on optimisation of the coagulation process in drinking water treatment plants using aluminium-based coagulants. These levels are 0.1 mg/l or less in large water treatment facilities, and 0.2 mg/l or less in small facilities (WHO, 2010).

h: No taste or odour threshold concentrations were located for aluminium. However, WHO report that the presence of aluminium at concentrations greater than 0.1-0.2 mg/l often leads to consumer complaints as a result of deposition of aluminium hydroxide floc and the exacerbation of discoloration of water by iron (WHO, 2011b).

i: Staining of laundry and sanitary ware may occur below GDWQ.

j: Considered to be a provisional guideline, on the basis of treatment performance and analytical achievability (WHO, 2011b).

k: Sum of the specified compounds, which are chloroform, bromoform, dibromochloromethane and bromodichloromethane. The parametric value applies to the sum of the concentrations of the individual compounds detected and quantified in the monitoring process.

l: For substances that are considered to be carcinogenic, the guideline value is the concentration in drinking water associated with an upper-bound excess lifetime cancer risk of $x10^{-5}$ (one additional cancer per 100,000 of the population ingesting drinking water containing the substance at the guideline value for 70 years).

m: The sum of the ratio of the concentration of each to its respective guideline value should not exceed 1.

n: Lowest thresholds reported for dibromochloromethane.

o: Provisional guideline value for bromate because the calculated guideline value is below the level that can be achieved through practical treatment methods, source protection, or is below the achievable quantification level.

p: Sum of benzo[b]fluoranthene, benzo[k]fluoranthene, benzo[g,h,i]perylene and indeno[1,2,3-cd]pyrene.

q: In the event of a water contamination incident involving, for example, petrol, diesel or kerosene, low molecular weight polycyclic aromatic hydrocarbons (PAHs) and monoaromatic hydrocarbons (e.g. toluene and ethylbenzene) are the components that are most likely to give rise to taste and odour in water. At total alkylaromatic concentrations of 100 µg/l, an odour is certain to be perceived; at 10 µg/l, a perceptible odour is still possible while at 1 µg/l, the odour should have disappeared. However, it is possible that some particularly sensitive individuals may be able to detect taste and odour below this level.

r: Health-based value for naphthalene derived using a maternal No Observed Adverse Effect Level (NOAEL) of 40 mg/kg bw/day identified in a rabbit developmental study (EU, 2003), with an uncertainty factor of 1000.

s: Health-based value for fluoranthene derived by WHO; no GDWQ was derived on the basis that fluoranthene 'occurs in drinking-water at concentrations well below those at which toxic effects may occur'.

t: Health-based value for pyrene derived using a NOAEL of 75 mg/kg bw/day identified in a 13-week mouse study (IPCS, 1998), with an uncertainty factor of 1000.

u: Derived using the oral Reference Dose (RfD) of 0.2 mg/kg bw/day proposed by the Total Petroleum Hydrocarbon Criteria Working Group (TPHWG) for this aromatic hydrocarbon fraction (Total Petroleum Hydrocarbon Criteria Working Group Series, 1997). WHO did not derive a health-based value for this fraction on the basis that Drinking Water Standards are available for both benzene and toluene, the two compounds in this range (WHO, 2008).

v: WHO health-based values derived using the oral RfDs proposed by the TPHWG (WHO, 2008).

w: Classified as an International Agency for Research on Cancer (IARC) Group 1 carcinogen (i.e. it is carcinogenic to humans) and so its concentration in water should be as low as reasonably practicable.

x: Lowest threshold reported for *o*-xylene.

y: Health-based value for butyl benzyl phthalate derived using a NOAEL of 50 mg/kg bw/day identified in a two-generation rat study (EU, 2007), with an uncertainty factor of 100.

z: Health-based value for dibutyl phthalate derived using a Lowest Observed Adverse Effect Level (LOAEL) of 1000 mg/kg diet (reported to be 66 mg/kg bw/day) identified in a continuous breeding rat study (IPCS, 1997), with an uncertainty factor of 1000.

aa: Health-based value for diethyl phthalate derived using a NOAEL of 0.2% (reported to be 150 mg/kg bw/day) identified in a 16-week rat study (SCCNFP, 2002) and an uncertainty factor of 1000.

bb: Health-based value for di-n-octyl phthalate derived using the intermediate (14-365 days) Minimal Risk Level (MRL) 0.4 mg/kg bw/day derived by the US Agency for Toxic Substances and Disease Registry (ATSDR) for di-n-octylphthalate (ATSDR, 1997).

cc: Limited toxicity data available; not considered to pose a hazard to health at the extremely low concentrations at which it causes organoleptic problems.

dd: WRc data, and probably most other literature threshold data, were obtained using commercial geosmin, which is a mixture of the 4*S*- and 4*R*-enantiomers, rather than the naturally occurring 4*S*-enantiomer. Therefore, the minimum concentrations detected and threshold values may not be strictly applicable for natural geosmin.

3.3.2 Specific factors associated with rural public buildings that can increase the risk of chemical contamination and aesthetic effects

It is important to assess any additional risk in rural public buildings which may lead to an increased risk of the presence of chemicals, particularly those identified in Section 3.3.1. These risks, which are associated with pipework, taps and fittings and the intermittent frequency of use of the water supply have been identified by Anglian Water as well as the authors of this report. The following risks have been identified which may potentially increase the detection of chemicals in drinking water of rural public buildings, and could form the basis of a simple assessment that can be conducted by non-experts such as those who commonly form the members of a committee running rural public buildings, such as village halls.

Water supply quality from service pipe/mains into the building

The entry of the water supply from the mains into the building may be a potential source of contamination. For example, if this pipe lies underneath a well-used car park, there may be the potential for the leakage of hydrocarbon fuels through plastic supply pipes into the water supply (WRAS, 2015a). As well as fuels leaching into drinking water, there is also potential for heating oils from heating tanks and plasticisers from plastic piping to leach into the drinking water (WRAS, 2015a).

Another source of hydrocarbon chemical contamination in drinking water could be a result of aging pipes within the water distribution system. Hydrocarbons from coal tar linings, which are typically found in older pipework, could potentially leach into the drinking water.

Additionally other taste and odour effects could be a result of drinking water treatment processes, such as DBPs, and geosmin and MIB, which give rise to “chlorinous” and “musty/earthy” taste and odours, respectively.

Age and quality of pipework within building

ACRE (2011a) have identified that 56% of rural public buildings are over 60 years old and 33% are over 90 years old. Therefore, there is an assumption that the plumbing of the rural public buildings is likely to have been fitted using older quality controls and standards and may also be based on lead piping. As a result it is anticipated that there is a greater potential for lead to leach into drinking water compared to urban public supplies. The pipework may also have deteriorated over time if not maintained and other older systems in the building such as heating may also lead to problems such as leakage of heating oil.

It is important to note that there is an increased risk of exposure to many of these identified contaminants through inappropriate/problems with internal plumbing, particularly in older pipework, such as blind ends and elbows in the pipes.

Age and quality of taps and fittings

The quality of taps and fittings as well as their age may also prove to be a risk factor for the presence of discolouration and the presence of metals such as copper or nickel in the water supply. It is noted that in their guidance on water supplies, ACRE indicate that taps and fittings should be Water Regulations Advisory Scheme (WRAS) approved and gives a link to the WRAS website.

Frequency of use of supply

Due to the anticipated intermittent use in rural public buildings, there is a greater potential for stagnation of water. As a result of stagnated water there is an increase in corrosion of pipework and fittings, releasing metals such as copper and nickel, and which can lead to aesthetic effects of the drinking water (WHO, 2011a). In addition, intermittent usage of end-of-plumbing fixtures also increases leaching of heavy metals into drinking water, such as copper from piping and lead from brass fixtures (WHO, 2011a).

In older buildings, water is often stored in tanks and therefore, the length of time of water storage, together with the quality and material of the tank should also be assessed, as this could have a corrosive/leaching effect.

Stagnant drinking water can often lead to taste and odour issues, which are anticipated to be a result of the presence of the chemicals geosmin and MIB.

3.4 Microbiological hazards

3.4.1 Identified and potential microbiological hazards in the drinking water of rural public buildings

As reported in Section 2.3.3, the analysis conducted from the DWI database identified that of eight compliance failures in rural areas, two related to microbiological failures in terms of non-compliance for coliforms. Of the 20 failures in urban area, thirteen related to microbiological failures (coliform bacteria). However, the number of observations was too small to attach any statistical significance to the findings, thereby making it is impossible to draw valid conclusions.

Information that could be reliably considered as a reference source that specifically related to the microbiological drinking water quality of rural public buildings, was not identified during the literature search. Instead, an assessment was undertaken of the impact of specific factors known to influence water quality in distribution and how these might relate to the water supply of rural public buildings.

3.4.2 Specific factors associated with rural public buildings that can increase the risk of microbiological contamination

Rural buildings may be located on sections of a distribution system that are furthest from the supply water treatment works. For example, the greater the length of a distribution system the more likely it will be to experience an ingress event. In addition, water quality at remote locations may have deteriorated caused by decay of the disinfectant residual, the rate of which is dependent on several factors including type of water, temperature and residence time. This may result in an increased potential for microbial growth within the distribution system.

Potential for ingress within the distribution system

In the absence of outbreak situations, a number of epidemiological studies have concluded that consumption of drinking water is responsible for an increase in the burden of gastrointestinal illness (Ercumen *et al*., 2014). Failure to adequately treat the water is partly responsible as a relationship could be established with increased turbidity in the source water and hospital visits for gastrointestinal illness (Tinker *et al*., 2010). Other studies, however, have pointed to ingress into the distribution system as being a significant risk factor.

A prospective epidemiological study by Payment *et al*. (1997) reported an excess in the numbers of cases of highly credible gastrointestinal illness (HCGI) attributable directly to the distribution system and treatment breakthrough. In their study, no association was found between residence time of the water in supply and number of reported cases of HCGI. A more recent study by Tinker *et al*. (2009) did observe a significant correlation between greater distance from a water works and increased number of emergency visits to hospitals. It was suggested that supplies to more remote locations provided more opportunity for ingress of contamination between the treatment works and the point of consumption.

A number of studies have implicated events giving rise to pressure loss. Hunter *et al*. (2005) observed a direct relationship between low pressure at the tap and self-reported diarrhoea. Various mechanisms have been put forward to account for the health risk associated with distribution systems. Mains breaks have been shown to be positively associated with increased cases of gastrointestinal illness (Nygård *et al*., 2007). Lambertini *et al*. (2011 and 2012) provided evidence of virus intrusion after pipe installation work but, interestingly, not from mains breaks.

More controversial is the relationship between mains pressure and gastrointestinal illness; Besner *et al*. (2010 and 2011) conceptually demonstrated the feasibility for ingress associated with pressure transients and risk it would pose to health and has been demonstrated experimentally (Fox *et al*., 2014). However, work undertaken by Creasey and Garrow (2011), reported that the probability of very low (surge) pressures as a result of a sudden demand was very low and probability of very low pressures as a result of exceptional high demands was very low. This work did not preclude ingress occurring through activities such as; isolating

mains for repair, mains draining down during valving operations, pump failure or rapid pump switching and pressure reducing valve (PRV) failure or maintenance.

The likelihood, therefore, exists that drinking water supplied to rural public buildings could pose a greater microbiological risk to public health than buildings in urban locations because of the greater length of the distribution system supplying rural premises. The epidemiological studies have not investigated the etiological agents and the majority have reported that water quality fully complied with prevailing regulations; thus indicating a low volume of ingress. The most likely pathogens, therefore, would be those that are most infectious and more tolerant of the residual disinfection in a distribution system. Obvious candidates would be certain viruses; being smaller than other waterborne pathogens, viruses have a greater ability for transport through the ground overlying water mains and so increasing the area of vulnerability for a distribution system.

Potential for microbiological growth within the distribution system

Regardless of a risk from intrusion, deterioration in water quality can occur through growth of the natural bacterial community in a distribution. Growth would be most evident in water supplies obtained from a surface water source because of their higher organic carbon content than groundwater sources and would provide adequate nutrient for microbial growth. Another consequence would be that a stable residual is difficult to maintain in surface water derived supplies. Remote locations on such supplies are more likely, therefore, to experience no or minimal concentrations of disinfectant residuals and possess sufficient nutrients for microbial growth.

The predominant organisms responding to such conditions are the heterotrophic bacterial populations. These organisms are not considered to be responsible for gastrointestinal illness, although there is some controversy over the health significance of aeromonads. These bacteria can be found in high numbers at the extremities of a network (Pitchers, 1992). They are considered capable of causing gastrointestinal illness but the evidence, however, is strongly circumstantial and there is no conclusive proof of their ability to infect by this route.

Other members of the bacterial community, such as legionellae, mycobacteria and pseudomonads, have the ability to cause respiratory or soft tissue infections. They do not occur in sufficient numbers or are in a viable condition to pose a risk to public health through occurrence in a distribution system. The risk would be manifest in a plumbing installation rather than water mains (Pitchers, 2013). It may be greater in premises because of a greater opportunity for decay of the residual in the distribution system supplying rural locations.

Another consequence of favourable conditions for microbial growth at the extremities of a distribution system is the possibility of certain species of bacteria and fungi to impart “earthy” and “musty” tastes and odours to drinking water (Wood *et al*., 2001). Often, the compounds responsible are more pronounced at such locations because of favourable conditions for microbial growth (Proulx *et al*., 2011) or they were not completely removed by water treatment

but their presence was masked until the disinfectant residual decayed to a concentration that no longer inhibited their detection (Bruchet *et al*., 2004; Oestman *et al*., 2004).

3.5 Monitoring data and likely concentrations of identified contaminants

Due to the limited monitoring and literature data for the identified chemical and microbiological contaminants of concern, it was not possible to determine their likely concentrations and whether these concentrations are typical concentrations found in drinking water of rural public buildings.

3.6 Prioritisation and risk assessment of chemical, aesthetic and microbiological hazards

3.6.1 Chemical and aesthetic hazards

Due to the lack of monitoring and occurrence data, it is not possible to determine a ratio of severity/likelihood for chemicals found in drinking water of rural public buildings. In addition, as reported in Section 2.3.3, there was no statistically significant difference between the percentage of failures of chemicals in drinking water in rural and urban public buildings. Therefore, the limited data indicate that there is no increased risk of failures in drinking water in rural public buildings, compared with urban public buildings.

If sufficient data are available, a comparison of the health-based values (Table 3.1) and likely exposure concentrations of each contaminant (Section 3.5) can be performed to rank the identified contaminants as low, medium and high risk, as seen in Figure 3.1. There are several approaches that could be applied here for example, an exposure concentration of a particular contaminant, which is below its drinking water standard, WHO GDWQ or derived lifetime values, and aesthetic effects would be classed as low risk. Medium risk contaminants would be those chemicals which have likely exposure concentrations above any aesthetic effects, but below health-based values. Chemicals which have likely concentrations above any taste and odour effects and health-based values would be classed as high risk.

3.6.2 Microbiological hazards

Regardless of building location, it is important to be able to identify the cause of a bacteriological non-compliance and take appropriate measures to protect public health and conduct remedial work to rectify the deficiency. A scheme has been developed to undertake a risk assessment that draws on the previous work undertaken by WRc for UK Water Industry Research (UKWIR) and DWI that provided guidance on investigating the cause of bacteriological non-compliance in water supplies (Hall and Pitchers, 2009). It was not considered necessary to describe the procedure for an investigation in this review.

A qualitative approach can be adopted for assessing the risk of non-compliance because of the difficulty of attaching health significance to the numbers of bacteria. Accordingly, the level of the risk has been assigned into one of three categories, comprising high, medium and low,

depending on where the contamination appears to be located and the nature of the organism (Figure 3.2). The locations included in the risk matrix are the tap itself or the plumbing installation. Detection of *Escherichia coli* has been taken to represent a potential source of faecal contamination regardless of its location, although evidence of contamination of the installation was considered a high risk, compared to a medium risk where an investigation concluded its occurrence was restricted to only the tap. The presence of coliforms, although not as definitive a faecal indicator as *Escherichia coli*, was considered to be of concern if present in the installation, rather than only at the tap. Without further investigation, it could not be excluded that their presence had occurred through ingress. Their detection may also indicate favourable conditions for bacterial growth, especially if supported by higher than normal numbers of heterotrophic bacteria. Both scenarios were considered to represent a medium risk. A low risk was given where an investigation concluded that coliforms or high numbers of heterotrophic bacteria were restricted to a tap.

The extent of the risk would determine the level of response. A high risk would require an immediate investigation to identify the source of contamination and a boil water notice may also be necessary. A medium risk was considered to provide an alert of a potential deficiency in either the integrity of the plumbing installation or that it was configured and operated in a way that was conducive to microbial growth. For this risk category, an investigation would be necessary to establish the cause and conduct appropriate remedial work. No further investigative action would be required for a low risk, although it would be prudent to advise the property owner of kitchen hygiene, where only the tap was identified as the source of either the indicator bacteria or high numbers of heterotrophic bacteria.

Figure 3.1 Diagram of the level of chemical contamination risk

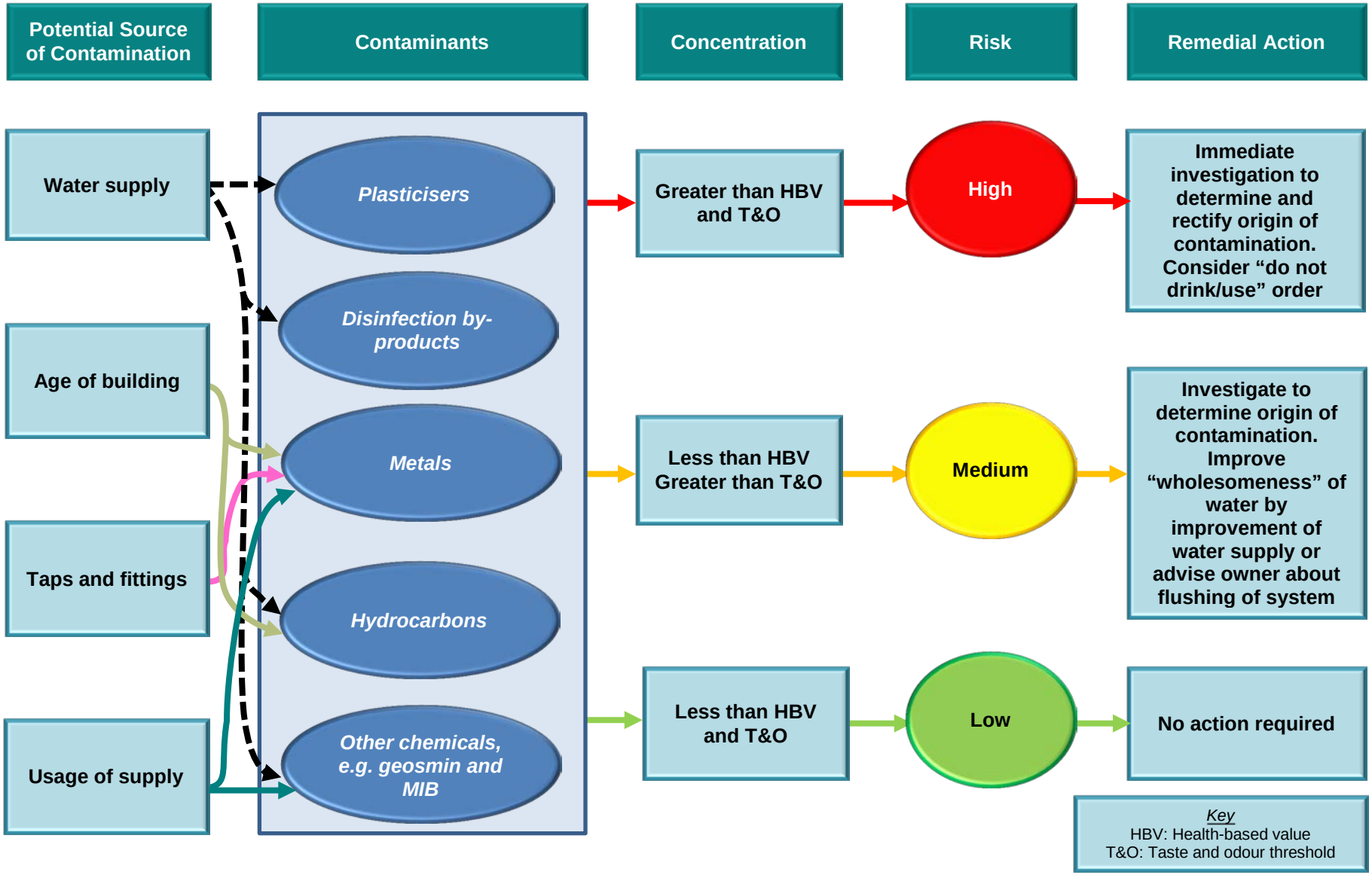
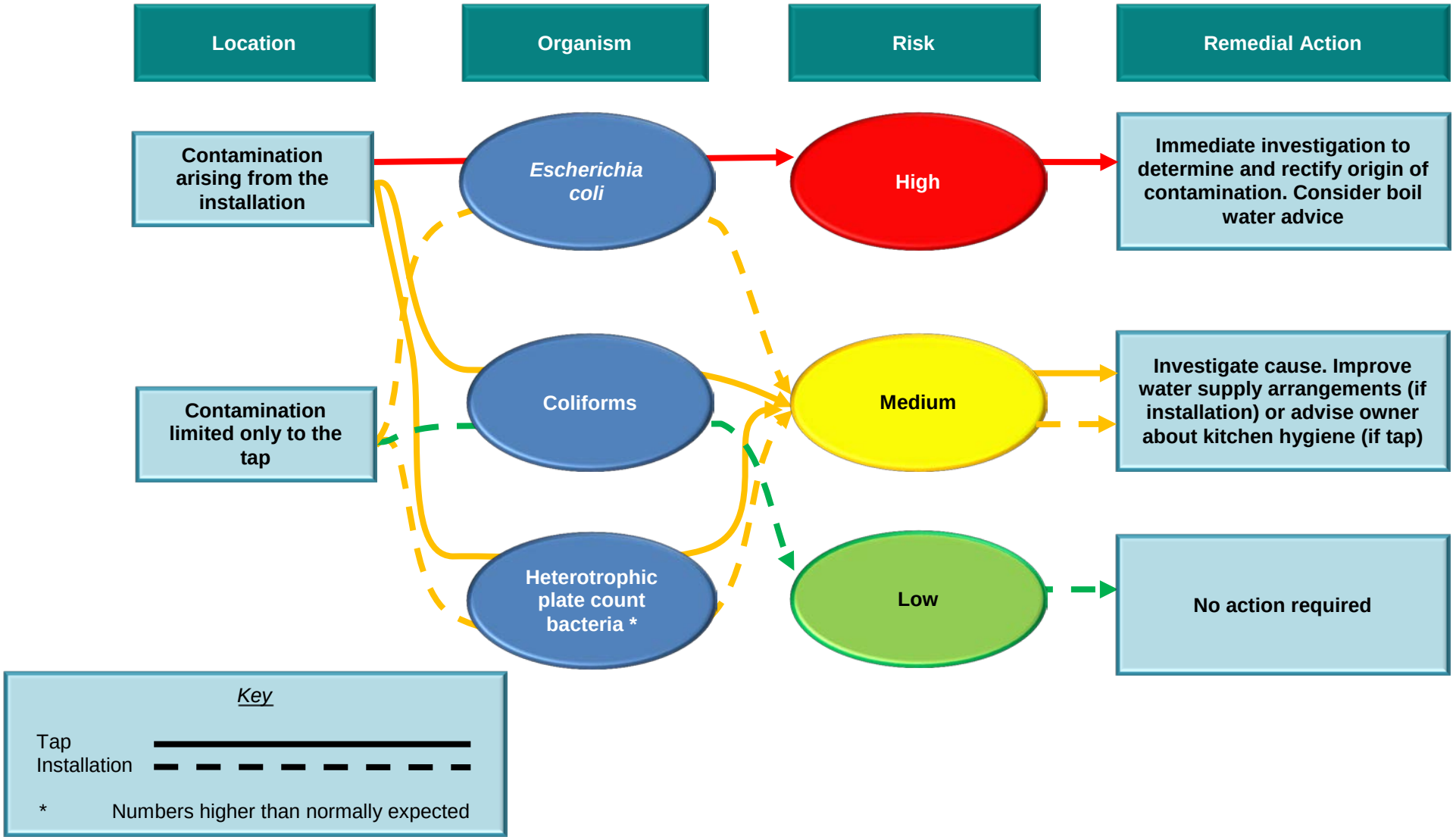


Figure 3.2 Diagram of the level of microbiological contamination risk



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3.7 Conclusions

There is only very limited monitoring and literature data on chemical, aesthetic or microbiological hazards specifically associated with drinking water of rural public buildings, with the reported eight compliance failures being due to iron, aluminium, manganese, taste and coliform bacteria.

Potential chemical contaminants were identified that may be more likely to occur in drinking water of rural public buildings. Some contaminants are likely to be present as a result of the age and quality of pipework and fittings used in the buildings (e.g. copper, nickel, iron, aluminium or lead) and the intermittent use of supply (stagnation of water and increased potential of leaching). These may result in aesthetic effects (taste, odour or discolouration) which are noticeable to consumers. Another group of potential contaminants include hydrocarbons following spills of heating oil, petrol/diesel or the use of coal-tar pitch linings in older pipework, which again can result in organoleptic effects. In addition, plasticisers from plastic pipes can potentially leach into water and the possibility of disinfection by-products or compounds of microbial origin (geosmin and MIB) leading to taste and odour problems.

One factor related to rural public buildings considered as giving increased potential for risk of microbiological contamination is their location on remote sections of a distribution system. For example, the greater the length of a distribution system the more likely it will be to experience an ingress event. In addition, water quality at remote locations may have deteriorated caused by decay of the disinfectant residual, the rate of which is dependent on several factors including type of water, temperature and residence time. This may result in an increased potential for microbial growth within the distribution system.

3.8 Suggestions

It is recommended that where monitoring data are available for chemical contaminants in rural buildings, a comparison be made with drinking water standards, health-based values and taste, odour or discolouration threshold effects in order to assign a level of risk as high, medium or low. Similarly, it is recommended that a qualitative approach be adopted for assessing the risks of non-compliance of microbiological contaminants, with the level of risk assigned as high, medium and low, depending on where the microbiological contamination appears to be located and the nature of the organism.

The resulting actions to be taken following this assessment would depend on the category of risk. Essentially a high risk require immediate investigation to determine and rectify the origin of contamination and consideration of a “boil water” or “do not drink” notice. Medium risk would need an investigation of the cause which may result in flushing the system, improved kitchen hygiene or improved water supply arrangements. Finally, low risk would require no action.

4. Review of Existing Guidance and Proposed Framework

4.1 Aims

Objective 5 of the project was to:

- Establish what guidance is currently available to persons in control of the water supply arrangement at rural public buildings, and/or premises on which they are sited;
- Determine any inconsistencies with any available guidance currently made available; and
- Determine its accuracy and robustness in terms of protecting the community.

The following section describes the existing guidance, a proposed framework for guidance and the inconsistencies and gaps in the existing guidance.

4.2 Methodology

A range of people who manage rural public buildings were asked what guidance documents they refer to and this is detailed below with the findings from the village hall management committees, as well as the guidance that is available from water companies, local authorities, places of worship networks and insurance companies. Guidance documents were subsequently reviewed for any inconsistencies and judgement made on accuracy and robustness.

4.3 Existing guidance

4.3.1 Questionnaire to village hall management committees

ACRE is an umbrella organisation for the 38 rural community councils. They have a remit to support the 80 000 volunteers who manage and run village halls and issue guidance documents to their network. The documents (ACRE, 2010; 2011b; 2011c) on managing village halls provide awareness of the duty of care to supply water fit to drink, the requirement to comply with WRAS and/or use an approved plumber and detailed advice on managing the risks of Legionnaire's Disease in sports facilities with showers.

ACRE agreed to support this project by sending out a questionnaire by email to the network of 10 911 village halls that they represent. The aims of the questionnaire were to identify hazards, guidance used, any barriers to the guidance and seek views on the format of any future guidance. There were 93 responses (0.85%) which is a low response rate. This could

be due to a low motivation to respond or the lack of an incentive. In addition the questionnaire format using a return email may not be user friendly for the target audience – for example some questionnaires were returned as hard copy by post rather than as an email.

The questions posed and a summary of the responses are shown in Table 4.1.

Table 4.1 Responses from the questionnaire

Question	Yes	No	Total
Are you aware of any problems in water quality in the last five years? For example tastes, odours, contamination and colour problems.	7	86	93
Are you aware of any guidance documents on the use and maintenance of water supplies (pipes, taps and water storage)?	13	80	93
For those aware of guidance - are there any barriers to implementing this guidance?	3	10	13
There may be a need for new guidance to be produced for committees managing village halls and similar rural buildings. What format would you like this to take?	See communication report section		

The responses show that there were few water quality problems and low awareness of guidance documents. In answer to the question on barriers to implementing the guidance time, cost and knowledge were given as potential barriers. The water quality problems are reported in detail in Section 3.3 and the preferred format of the guidance is reported in the communication section of this report Section 5.3.2.

From the questionnaire, sources of guidance stated by 13 respondents have been grouped into categories as shown in Table 4.2.

Table 4.2 Sources of guidance stated in questionnaire responses

Category	Guidance used
Employees	Caretaker is aware of rules and regulations
	Contractors who service boilers
Water Company	Water Companies (telephone helplines, website)
Local Authority	District Council Environmental Health Officer
Legislation	HSE guidance on the risks of Legionnaires' Disease
	DWI website
ACRE	WRAS as referred to in ACRE publication "Health and safety legislation and village halls"
	ACRE publication "Health and hygiene in village halls"

4.3.2 Guidance from water company websites

A search of 25 of the England and Wales water company websites was carried out from the point of view of a village hall committee who may be searching for advice. The terms public building, village hall, sports club, rural and community building were entered to identify specific guidance. The search found little specific guidance for these types of buildings. Most of the websites had drinking water quality information about tastes and odour under information for households or business menus but there was no mention of public buildings. The exception was the United Utilities website that had a section on "advice for businesses and community buildings" and a link to a simple risk assessment for locating lead pipes (United Utilities, 2015) that referred to the duty of care to provide drinking water in public buildings (Figure 4.1).

Figure 4.1 Guidance from United Utilities website and lead pipe risk assessment

Lead pipes

Advice for businesses and community buildings

If you own or manage a building in which members of the public or work colleagues have access to drinking water, it's important to find out if you have lead pipes.

Ensuring the water is safe to drink is part of your duty of care to all users of the building.

Consumers	Do young children and or pregnant mothers consume water or prepare food? Is the property a public building?	The unborn child, and young children are most significantly impacted by lead In a public building there is a greater duty of care required by the owner. Legal enforcements notices can be imposed if there is likelihood of a lead infringement

Water companies also direct customers to use a plumber from the approved plumbers WaterSafe scheme.

4.3.3 Guidance from local authorities - Environmental Health Officer

Local Authorities regulate private water supplies as set out by DWI. They also register premises used for preparing food as under the direction of the Food Standards Agency (FSA). There is general guidance available from each local authority through Environmental Health Officers and on the FSA website.

4.3.4 Guidance from places of worship networks

Many of the places of worship in rural areas are managed locally with support and guidance available nationally from umbrella organisations. An example of the way that a network of buildings are managed is the Methodist Property Manager who makes use of the Health and Safety Executive (HSE) website, the Health and Safety At Work Act through The HSE's Approved Code of Practice (Workplace (Health, Safety and Welfare) Regulations 1992), *Legionella* and the building regulations (Part G) in managing their buildings.

In addition the Baptists and Church of England websites provide detailed health and safety guidance, buildings maintenance guidance and inspection checklists for building managers. The online versions of these were examined in October 2015 and found to include general health and safety advice on provision of drinking water but there was no detailed specific guidance on maintenance of drinking water systems.

4.3.5 Guidance from insurance companies

Insurance companies provide bespoke insurance for public buildings and guidance on building maintenance are often provided. For example, the Ecclesiastical Insurance Group (who insure over 95% of Anglican church buildings and 40 000 charities and community organisations) provide guidance on prevention of water leaks but no detailed information on the maintenance of drinking water systems.

4.3.6 Summary

The existing guidance documents with details of water supply systems that have been reported to be used are listed in Table 4.3. This does not include the websites that are referred to above or the advice provided (e.g. specific advice from water companies or Environmental Health Officers).

Table 4.3 Existing guidance documents used to manage drinking water systems

Guidance documents	Source	Information
Maintaining Your Hall, 2010	only available to ACRE members	These documents provide awareness of the duty of care to supply water fit to drink, the requirement to comply with WRAS and/or use an approved plumber and detailed advice on managing the risks of Legionnaire's Disease in sports facilities with showers.
Village Hall Information Sheet 15 - Health and safety legislation and village halls (Revised December 2011; ACRE, 2011b)		
Village Hall Information Sheet 20 - Health and Hygiene in Village Halls (Revised December 2011; ACRE, 2011c)		

Guidance documents	Source	Information
Workplace health, safety and welfare Workplace (Health, Safety and Welfare) Regulations 1992. Approved Code of Practice and guidance L24 (second edition) Published 2013	free to download from HSE website	Storage, testing and treatment of water; location of taps to avoid contamination; provision of cups.
The Building Regulations 2010 Sanitation, hot water safety and water efficiency (Part G) (downloaded 26/10/2015)	free to download from HSE website	Water supplied for drinking water or food preparation areas must be wholesome.

4.4 Proposed framework for guidance

After assessing the available guidance for persons managing rural public buildings, the following additional guidance is also recommended to ensure "wholesome" drinking water is provided in these types of buildings. The work covered in Section 3 identified specific contaminants which may potentially be released into drinking water in rural public buildings. In this section consideration is given also to the importance of additional risks, which may arise from these hazards.

Identifying the hazards and assessing risks could form the basis of a simple procedure that can be conducted by those who commonly form the members of a committee running rural public buildings, such as village halls. It is not expected that members of a rural public building would have technical expertise, but they would be required to manage the risks.

Guidance on such an assessment could be distributed through organisations such as ACRE. WRc suggests that the type of guidance highlighting/informing people, who are non-experts about any potential issues with drinking water in rural public buildings, could potentially be presented with a short leaflet, with various questions about typical taste and odour problems, information about water companies and their responsibilities, the best practice to minimise poor water quality and actions to take if aesthetic effects of drinking water are identified. Below is the type of information that could be presented in a leaflet (see Section 5).

It is important to note in any guidance, that consumers who experience problems with their water with regards to its appearance and/or taste and odour, that it may or may not indicate a health risk and therefore as a precaution should not drink until the issue is resolved.

4.4.1 Knowing the water supplier for your public building:

It is important to know how to contact your water supplier, if there are issues with the quality, or anything unusual with the drinking water.

1. Do you know who your water supplier is and their contact details?

Awareness: Contamination of your water supply is possible and therefore it is important to know your water supplier and who to contact if there is a problem. A private water supplier is governed by your local authority, while there are several public water suppliers, depending on the location of your public building. The link will lead you to a list of water companies and their contact details http://www.ofwat.gov.uk/households/your-water-company/map/

2. Do you have any previous information about the quality of your drinking water?

Awareness: Previous information about your water quality could provide details for any potential future problems with your drinking water quality.

3. Has your drinking water been monitored/sampled by your water company before?

Awareness: Has there been any advanced warning of work or an incident on the water supply?

4.4.2 What do you do if you suspect contamination of your drinking water?

Awareness: As a precaution it is advised if there is a suspected contamination incident then consumers should not drink the water until the cause is known and the incident is resolved.

Awareness: Before contacting your water company, if you have an issue with your water quality, have you thought about flushing your plumbing system (both hot and cold water)? Running the water system can flush out stagnant water, which may in turn remove any taste, odour and discolouration problems in the drinking water.

Awareness: It is advisable to check with neighbouring properties whether they are also experiencing similar problems with either water quality. Finding out if other neighbouring properties are affected can help water companies to identify the potential source of contamination, i.e. is it an internal plumbing issue or is it a problem in the water distribution.

4.4.3 Knowing about your water supply into your public building

The water supply to your public building may have risk of local contamination from various different sources. Unless stated otherwise, contact your water company to investigate the contamination if you suspect not to do with your building.

4. Do you know if your water pipes lie under a car park?

5. Are there are heating oil tanks on site?

Awareness: Chemicals from oil tanks and cars, such as hydrocarbons, can leach into drinking water giving a "petrol", "diesel" and "solvent" taste and odour.

6. Does your drinking water have a brown/orange discolouration?

Awareness: Brown/orange discolouration of drinking water is indicative of iron deposits in the mains pipes and is often seen in older galvanised pipework. You should run the water for 30 minutes or until the water is clear. Contact your water company if your water is still discoloured following flushing of the system.

7. Does your drinking water have a "chlorinous", "TCP" or "medicinal" taste and/or odour?

Awareness: Some chemicals used in drinking water treatment works can form compounds that have a chlorinous-type taste and/or odour. These chemicals also can react with the rubber/plastic seals found in kettles, therefore you should try rinsing your kettle out before use or boiling your water in a saucepan. Running the water supply for a few minutes may remove the taste and odour effects.

8. Does your drinking water have a "musty/earthy" taste and/or odour?

Awareness: Potential microbial activity from the water distribution system. Flush the water system by running the cold water for a few minutes.

4.4.4 Knowing about the internal plumbing of your public building

9. Do you know the materials of the pipework in your public building?

Awareness: Knowing the age of your public building can potentially give an indication of the materials used for the internal plumbing of your building.

10. Was your public building built before 1970s?

Awareness: If your public building was built before 1970s, there is a possibility that your internal plumbing is made from lead. Lead can also be released into drinking water from brass water fittings and lead-based soldering. To reduce lead in your water over the short-term you should run the water in your taps to remove any standing water (which has been left standing overnight). However, over the long-term, replacement of the lead piping is best advised. You can request your water company to test potential lead levels in your water. It is the property owner's responsibility to replace internal lead pipes; however, you should contact your water company to co-ordinate any pipe replacement outside of the building's boundaries. As well as your

water company you can get additional advice from your Local Authority Environmental Health Officer and a WaterSafe qualified plumber.

11. Does your drinking water have a blue/green discolouration?

Awareness: Often blue/green discolouration is associated with corrosion of copper piping, especially if the water has been left stagnant in the pipes.

12. Does your drinking water have a “plastic” taste and/or odour?

Awareness: Typically newer properties have internal plastic pipes, which come into contact with water and can potentially release a “plastic” taste and odour.

13. Does your drinking water have a “bitter” and/or “metallic” taste and/or odour?

Awareness: Bitter or metallic taste and odours in drinking water typically come from metals such as copper, iron, zinc and nickel. These metals are commonly from new plumbing, faulty-fitted, corroded pipes and coatings from taps and fittings. Try running your water to clear the system of the metallic taste and odour.

14. Have you experienced a microbiological infringement with your water supply?

Awareness: The quality of drinking water supplied to consumers is tested by sampling from their kitchen tap. When a water sample is collected, effort is taken to avoid contamination by bacteria living on tap surfaces. By keeping your sink area and taps clean, you will minimise the chance of producing a false result.

15. Do you have a storage tank?

Awareness: Traditionally water storage tanks are made from iron, which can rust over time giving a brown/orange discolouration to the drinking water. More modern tanks are made from plastic (polyethylene), which are unlikely to cause problems, provided the tank has a close fitting lid. It is advisable to use a WRAS Approved water tank product to ensure the tank is in agreement with Regulations. For further information about water storage tanks please see http://dwi.defra.gov.uk/consumers/advice-leaflets/tanks.pdf

16. How often do you use the water in your rural public building – daily, weekly or more than weekly?

Awareness: Taste and odour effects are typically observed following periods of non-use of the water supply. It is advisable to flush the water system (hot and cold water) for a few minutes to remove the stagnant water, especially if the building has

remained vacant for 2 weeks or more. If you have internal lead pipes, you should run the water system to remove any standing water, which has been left for several hour or overnight.

17. Does your drinking water have a “musty/earthy” taste and/or odour?

Awareness: Water left to stand for long periods of time in the internal plumbing may encourage the growth of bacteria. The vast majority of these bacteria are harmless. Flush the water system by running the hot and cold water for a few minutes.

Awareness: The hot water supply may, however, permit the growth of *Legionella* in pipework where water is not used frequently. It is a legal requirement that you undertake a *Legionella* risk assessment and have in place a control plan that is acted on.

References for Section 4.4 include:

- Anglian Water, 2015;
- South East Water, 2010;
- Thames Water, 2008; and
- WRAS, 2015a.

4.5 Inconsistencies and gaps in the existing guidance

One of the main gaps highlighted from the questionnaire was that 80 of the 93 (86%) respondents were not aware of any available guidance for maintenance of the water supply. There is a variety of different guidance documents for maintaining the “wholesomeness” of water either in the rural public buildings or households. The quality of the drinking water in households and rural public buildings should be of equal standard; however, the managers/committee members of public buildings also have an additional duty of care to other users of these types of buildings.

It is also unclear whether managers/committee members of rural public buildings are aware that it is their responsibility to ensure the “wholesomeness” of the water supply and maintain the internal plumbing and the service pipe into the building from the boundary of the rural public building (WRAS, 2015a). The Water Supply (Water Fittings) Regulations 1999, apply to plumbing installations that are supplied by licensed water undertakers who have a duty to enforce the Regulations. Local Authorities also enforce fittings failures for private water supplies using WRAS standards.

Under the Water Supply (Water Fittings) Regulations, if there are proposed plumbing installations in a rural public building, it necessary to employ an approved plumber or if owners/committee members carry out the work themselves, it is their responsibility to contact to the water undertaker to obtain consent and give advanced notice of the proposed work. If after ten working days consent has neither been granted or refused from the water undertaker, the proposed installation is considered granted (WRAS, 2015b). Regardless of who carries out the proposed installations advanced notice applies to the following types of installations (WRAS, 2015c):

- construction of any new building/structure;
- extension/alteration of the water system in any building (except a domestic dwelling)[1];
- change in the use of the building;
- installation of:
    - bath larger than 230 litres;
    - bidet with an ascending spray or flexible hose[1];
    - shower unit of a type specified by the Regulator (none are currently specified);
    - pump or booster using more than 12 litres/minute;
    - reverse osmosis unit;
    - water treatment unit producing wastewater discharge or requiring water for regeneration;
    - reduced pressure zone valve or other mechanisms to prevent against backflow in fluid category 4 or 5;
    - garden watering system, unless hand operated;
    - water pipes at either less than 750 mm or more than 1350 mm below ground level outside a building; and
- construction of over a 10,000 litre pond or swimming pool, which is replenished by a public water supply.

As well as the above installations, Northern Ireland and Scotland have additional requirements that must be complied with and prior consent requested from the water companies.

[1] Prior consent is not required; however, on completion, compliance certificate copies must be sent to the water undertaker.

From the questionnaire it was also clear that owners of rural public buildings were not aware that older, more traditional water storage tanks were a source of potential contamination to drinking water, which could result in aesthetic or potential public health issues.

Data searching identified a discrepancy between WRAS and water companies on their interpretation of the length of time stagnant water may cause taste and odour problems to drinking water. WRAS (2015a) states that water quality may deteriorate if the water supply is not used for **two weeks**. Thames Water report that if a property is vacant for **four weeks** or more, taste and dour issues in drinking water are anticipated (Thames Water, 2008). Thames Water also state that water which is left standing in lead pipes **overnight** or for **several hours** should not be consumed (Thames Water, 2008). South East Water and Bristol Water identify that taste and odour issues may arise following a "**period of non-use**" and "**long periods**", respectively. Neither water company specify the length of time standing water could cause taste and odour effects (Bristol Water, 2015; South East Water, 2010). Water customers could potentially find this information confusing and therefore may be unclear about whether to flush their water systems and/or contact their water companies if they have taste and odour problems with their drinking water.

The main data gap identified was the lack of consolidated, non-expert information about the responsibilities, maintenance and steps to reduce/prevent contamination of drinking water in rural public buildings and provide "wholesome" drinking water to rural communities. It is anticipated that due to the nature of rural public buildings, it is more likely that they will have an increased risk to aesthetic or potential public health effects; therefore, consolidated information which could be provided to owners/committee members of rural public buildings could potentially be of great use. It is also important to note that the consolidated information should be written for non-experts, for example, the WHO (2011a) guidance document on "Water safety in buildings" is written in more general terms and not necessarily for technical experts. The document is directed primarily to those who design, construct, manage, operate, maintain and regulate building water systems and is intended to be a useful resource for the development of training and information material. Some guidance that is available, for example WRAS and relevant British Standards, require more technical expertise, which members of a rural public building may not necessarily have.

4.6 Conclusions

A search of the guidance provided by water companies, local authorities, places of worship networks and insurance companies and the questionnaire to village hall committees showed that there are only a few guidance documents available and none are specifically on water supply systems in rural public buildings.

Several gaps were identified in the review of existing guidance which included that people are unaware that current guidance exists, clarifying the responsibilities of owners/committees members to maintain "wholesome" drinking water in these types of buildings and recognising the lack of consolidated and non-technical data. Inconsistencies were identified on the

available guidance from water companies and WRAS about the length of time stagnant water may cause aesthetic and/or health problems from the drinking water.

4.7 Suggestions

It is recommended that a non-technical leaflet to be distributed to the owners/committee members of rural public buildings, to explain their responsibilities and the necessary steps to reduce/prevent contamination of drinking water in rural public buildings and consequently provide “wholesome” drinking water to rural communities. The leaflet includes sections on highlighting to water customers in rural public buildings about their water supply history and their water supplier, steps to take following a contamination of drinking water, responsibilities to maintain “wholesome” drinking water, the types of chemicals which can cause aesthetic effects following contamination of pipework from outside a rural public building, and the main types of taste and odour effects that can potentially occur and are related to internal plumbing or water storage within the building.

5. Guidance Production and Dissemination

5.1 Aims

Objective 6 of the project was to:

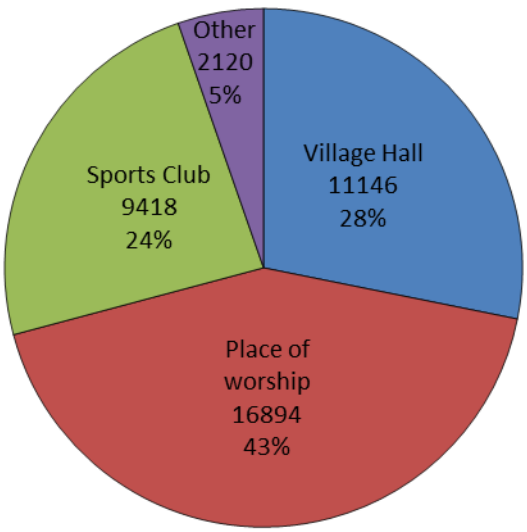
- Suggest how standard guidance to relevant people served by and/or in control of rural public buildings could best be produced and disseminated. This should be through collaboration between water suppliers and the regulators of private water supplies (local authorities).

It is critical to understand the target audience for the guidance to produce and disseminate it effectively so this will be considered first.

5.2 The target audience

In producing and disseminating guidance it is useful to define who it is for. The target audience for this guidance are the committees and individuals who have the responsibility of maintaining the water supply fittings to provide clean drinking water in those rural public buildings that are "privately-owned and maintained for non-commercial purposes, by and for community use". The majority of these buildings are owned by charities and managed by volunteer committees (overseen by trustees) who run the building to provide a venue for local activities that benefit the community. There will also be some managed by an individual such as a caretaker. For the purposes of defining target audiences the number of rural public buildings in the categories set out in Table 2.1 were grouped broadly as 'Village Hall', 'Place of Worship', 'Sports Club' and 'Other'. The proportion of each is given in Figure 5.1.

Figure 5.1 Proportion of rural public buildings in England and Wales in target audience categories



5.2.1 Place of worship management committee

Places of worship represent 43% of rural public buildings. There are many types of places of worship including Chapels, Churches, Church Hall, Religious Meeting Place in the AddressBase categories. Most of these will be managed by a local committee with the same roles as a village hall management committee while some will be managed nationally (Methodists and Baptist Union) and others will be managed by one individual (caretaker).

5.2.2 Village hall management committee

Village halls represent 28% of rural public buildings. Village halls typically are run by a management committee composed of representatives of users. The committee roles are varied and include: opening up the hall for groups to use the hall (key holder), fundraising, carrying out repairs, finances, administration, negotiating with hires/users, assessments (e.g. testing fire equipment), redecorating and supervising staff (e.g. cleaners, contractors to service boilers). This volunteer time (on average 18.5 hours per week per hall) provided throughout the year is a significant benefit to local communities (ACRE, 2011a).

5.2.3 Sports club committees

Sports clubs represent 24% of rural public buildings. These type of sports club buildings (Bowls, Cricket, Football, Racquet Sports and Rugby Facilities in AddressBase) are mainly managed locally by committees to provide changing rooms and refreshments facilities. In some clubs maintenance roles are informal and carried out by volunteer Facilities Co-ordinator from the committee while in others a Groundsperson or Greenkeeper will be employed. There are national, regional and county level organisations that most sports clubs are affiliated to and these provide advice on developing and managing the facilities. The quality of indoor facilities like changing rooms are acknowledged as important in terms of recruiting and retaining club members.

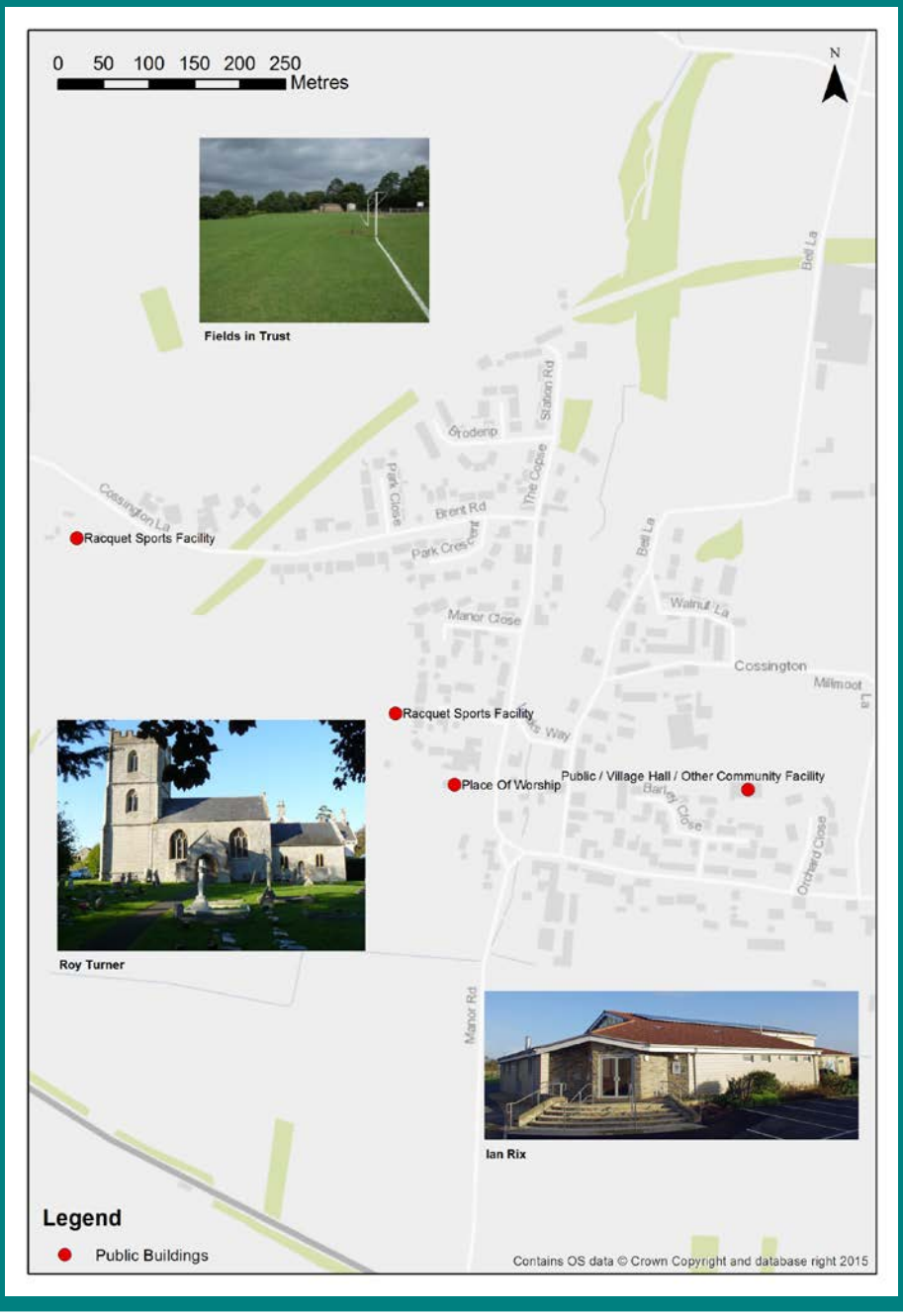
The other 5% of rural public buildings are also likely to be run by local committees or individuals and face similar management issues as those described above.

An example of the three main target audiences in a village are given in Case Study One.

Case Study One: Cossington, Somerset

Cossington (population 564 in the 2011 Census) is a village and civil parish close to Woolavington, 5 miles north of Bridgwater in Somerset, England. The location of public buildings found using AddressBase are shown in Figure 5.2, where four were identified. The village hall management committee confirmed that the 'Village Hall' and the 'Place of Worship' are public buildings with a drinking water supply. The two 'Racquet Sports Facility' locations are privately owned tennis courts. There is also a football club changing room at the Playing Fields that has a water supply used for showers and toilets.

Figure 5.2 Map of public buildings identified in Cossington village



Case Study One: Cossington, Somerset continued…

Village Hall Management Committee **The Cossington Village Hall Management Committee is a group of volunteers who meet monthly to organise the maintenance of the hall. The Committee, like many in rural areas, was established after the First World War to build and administer a memorial hall for the inhabitants of Cossington and the neighbourhood. The current committee hold the Hallmark Quality Standards Award (Hallmark Three) which indicates that the charity is well managed, they meet health, safety and security requirements, have a website to advertise events, are accessible and carry out forward planning.**

The current Cossington Village Hall is a modern building (rebuilt in 2011) with a catering standard kitchen, bar, main hall with stage and a meeting room. The hall is used by 14 regular groups and these provide for all ages: pre-school, children's and adults dance/exercise activities, club meetings, concerts and social events. Generally the hall is in daily use although there are occasional days with no bookings during August when some regular groups do not meet.

Place of worship management committee **The Church Wardens are responsible for maintaining St Mary's Church in Cossington village and they report to the Parochial Church Council who manage three neighbouring village church buildings. They are an independent charity with access to regional and national support on health and safety, buildings maintenance and insurance requirements. The Cossington church building has a recently installed kitchen area for serving refreshments and typically it is used twice a week for social events and worship services.**

Sports club committee **The Red Tile Football Club in Cossington Village is the local pub's football club who are affiliated to the football association and manage a changing room building on the village Playing Fields with toilets and showers. The building (a converted storage container) is owned by the Parish Council who confirmed that there is not a kitchen area or drinking water tap.**

5.2.4 Summary

The target audience is varied but is typically a volunteer management committee and the individual tasked with the role of church warden, caretaker or groundsperson – the key points are:

- The audience are not experts in managing drinking water supplies.
- Drinking water systems may be one of many priorities.

- A committee involves a decision making process that can be slow (limited to monthly or quarterly meetings).

- When communicating with this audience electronic communication (emails and information on websites) are not ideal for all. For example, although some halls have online booking and email options available, others are managed by one person who holds the paper diary with bookings made over the telephone.

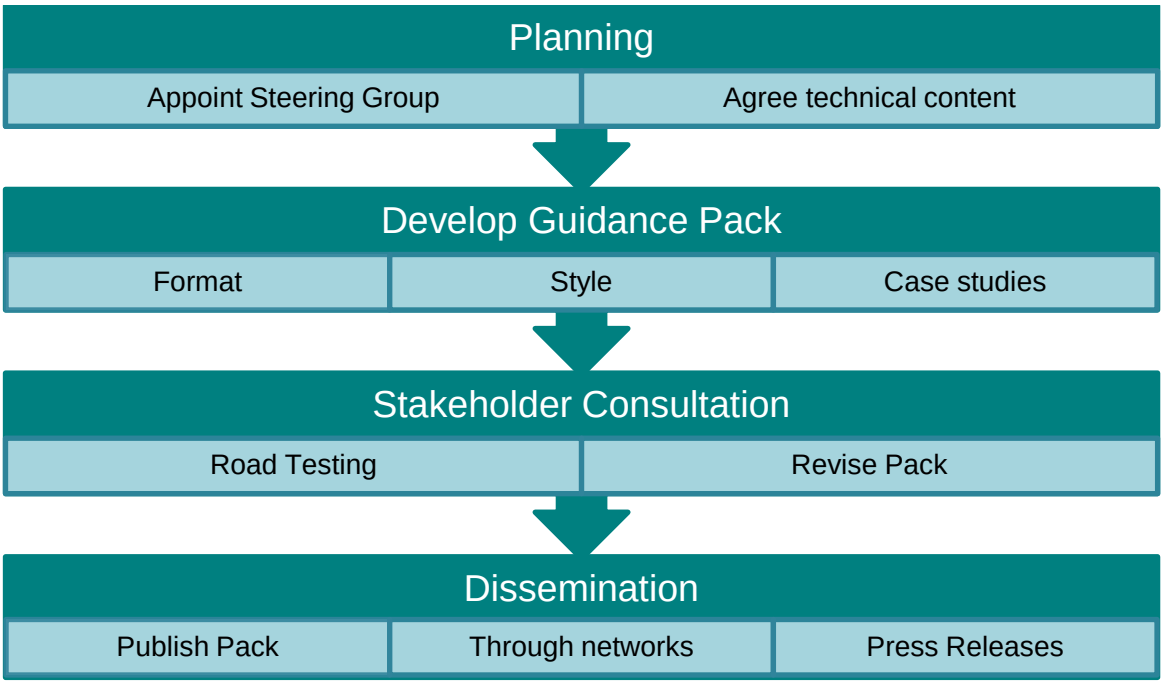
- For water companies identifying rural public buildings to take samples from local knowledge is needed to confirm the 'public use' of the building. In addition, an appointment to meet a keyholder may be needed to gain access to the drinking water tap.

5.3 Production strategy

A framework for what the guidance should include has been set out in Section 4.4 of this report, and this section covers how it could be produced and the format that it could take.

The suggested strategy for producing the guidance (Figure 5.3) is to set up a Steering Group to drive the process and agree the technical content of the guidance. Then the guidance can be developed and the contents and format can be consulted on. Finally the guidance can be disseminated.

Figure 5.3 Suggested guidance production process



5.3.1 Planning

The production of the guidance can be planned by defining the scope and remit of a steering group that includes stakeholders and technical experts. An example of this is given in Case Study Two.

Case Study Two: Producing easy to read technical guidance

A guidance leaflet on The Disposal of Fats, Oils and Food Waste targeted at Catering Outlets was produced by a steering group led by the umbrella organisation for the Water Industry, Water UK. The steering group comprised the Environment Agency, the Chartered Institute of Environmental Health, the Consumer Council for Water and Defra. A technical group of experts from the water industry (including WRc) wrote a draft guidance leaflet, then all water companies were given the opportunity to comment on the guidance from a communications viewpoint. The leaflet that was produced included a section on the legal requirements and a checklist of Do's and Don'ts. It was road tested in commercial kitchens and the technical group worked with the communications teams to ensure the messages given were accurate. It was published on Water UK's website and all the water company websites and used by water companies to give information to commercial kitchens where there were fat blockages in the sewer network.

Appoint steering group

A steering group with the goal of producing the guidance for maintenance of water supply systems in rural public buildings would to be appointed. The group should have representatives from the water industry (with expert input on drinking water quality and communications) and would benefit from including a small set of representatives from the target audience, or their umbrella bodies.

Agree technical content

The technical content of the guidance needs to be agreed by the steering group with support from experts. The legal requirements for managing water supplies should be included in the guidance as this will give clear reasons for implementing the guidance. There needs to be time allowed for communications experts to comment on the wording, images and messages given and for the technical experts to review the revised documents to ensure the facts are accurately presented.

5.3.2 Develop guidance pack

With the diverse target audience developing a Guidance Pack of checklists, posters and background information may be a useful approach. Waste and Resources Action Programme (WRAP) used this approach to promote the 2013 launch of the water efficiency label to a

range of target audiences. This allowed a range of formats and types of literature (leaflets, posters, presentations and fliers) to be developed with some focussed at consumers, some at manufacturers and some at retailers. These were all available on WRAP's website with signposts to the relevant literature for the different audiences.

Another example of a guidance pack is ACRE's Health and Hygiene information sheet for village halls which includes a sample poster on the colour coding of chopping boards and cleaning checklists that can be printed out and displayed in kitchens.

This will be especially useful as there are different management approaches and water supply systems so the 'one size fits all' approach will provide too much information for some. The pack makes it easy for the relevant information to be selected.

Format

Figure 5.4 shows a diagram of the answers to the question: *There may be a need for new guidance to be produced for committees managing village halls and similar rural buildings. What format would you like this to take?* This indicates that the majority who stated a preference would prefer a PDF emailed to them.

Figure 5.4 What format would you like the guidance to take?

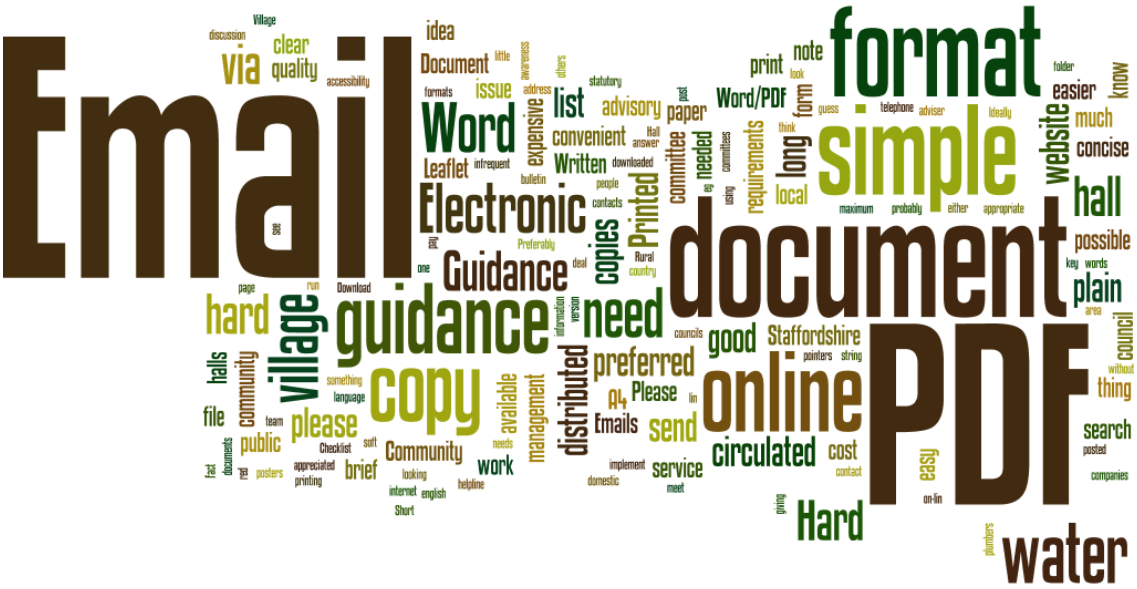
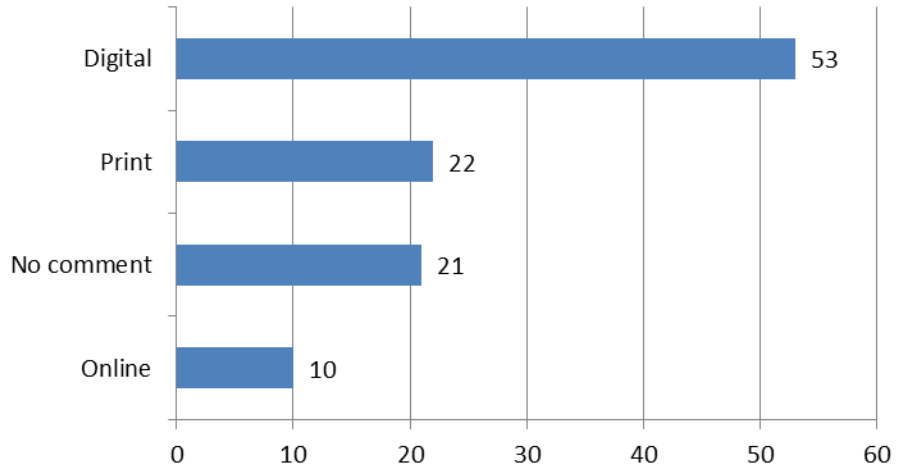


Figure 5.5 shows the requested formats for the guidance. The highest proportion asked for a digital document to be emailed to them or made available for download. There could be bias in the proportion preferring electronic formats because the questionnaire was sent out using email.

The formats requested were:

- Booklet
- Tick list
- Form
- Guide
- Check list
- Brief bullet points
- Electronic if for committees i.e. email notification. Hard copies for posters if public awareness is needed.

Figure 5.5 Preferred format of guidance



Sum is greater than total number of returned questionnaires as more than one preference given

Style

There were a number of requests for simple guidance and the following quotes are typical of the responses:

- *"Step by step do's and don'ts - Advice - i.e.: who is responsible for which pipe/where. Who to contact with concerns about quality etc."*

- *"Brief, concise document as PDF. No more than 4 sides A4, using illustrations to replace words where possible."*

- *"Simple. What to look for. What to do. How to do it."*

Case studies

Giving examples of drinking water systems relevant to the target audiences and the risk assessments process will be helpful in communicating the messages. For example the document targeted at village halls could show with pictures and diagrams how the guidance has been applied at a real hall.

5.3.3 Stakeholder consultation

The stakeholders that can be invited to be involved could be those who already make contact with the committees who manage rural public buildings as shown in Table 5.1. In working with these main stakeholders the wording of the guidance can be reviewed and tested to ensure it is useable for the target audience. Working collaboratively should allow all parties to understand the need for the technical content of the guidance, influence the format and plan how they can best communicate it to their own organisation and contacts.

Table 5.1 Stakeholders in guidance document production

Stakeholder	Contact point with rural public buildings	Reason for stakeholder to be involved
Water companies (customer billing, water quality)	Provide water, send Water Bill	Providing information and service to customers. Competitive market for England from April 2017 for business and public buildings. Links to WRAS.
ACRE	Provide advice on village hall and community building maintenance	Network of 10 000 village halls and church halls. Publish guidance. Advisory role. Verification role (HallMark Scheme)
Local Authorities Local Government Association National Association of Local Councils (England) One Voice Wales	Local Authorities regulate private water supplies and register premises used for preparing food.	Statutory duty. Local knowledge of location of public buildings.

Stakeholder	Contact point with rural public buildings	Reason for stakeholder to be involved
Places of worship networks	Advise on property matters for area/nationally	Duty of care. Established routes for circulation of information.
Insurance providers	Premium/quote for Customers, Claims	Managing risk e.g. Preventing burst pipes with a 'get ready for winter' campaign. Bespoke policies and risk assessments for places of worship, youth groups, sports facilities and village halls.
Youth Hostel Association (YHA)	Manage network of hostels across England and Wales	Experience in managing private water supplies. Centrally managed and proactively manage risk.
Sports associations	Provide advice to clubs	Develop facilities to support clubs and improve participation in sport.
Fields In Trust	Provide advice to managers of playing fields and open spaces	Improve facilities.
Contractors / Plumbers associations	Maintenance of water supplies	Improve service for customers.
Government	-	Consider if the guidance should be included or signposted from other legislation. Consider links to management of urban public buildings and other premises. E.g. register of premises where food is prepared is overseen by Food Standards Agency and managed by Local Authorities.

At the consultation stage input from technical reviewers is needed to ensure the meaning of the guidance is not lost as it is edited. The involvement of water company communications teams who are used to writing technical guidance for a non-technical audience should result in guidance with an informative and helpful tone.

Consultation should ensure the technical writing is understandable with appropriate explanation of why this guidance needs to be acted on and the possible actions and options available if any risks are identified.

Consultation can be carried out passively (asking for a written response to a formal document) or actively (nominate a host to run workshops for gathering views and meetings for a smaller group (up to 12 people) to comment on the guidance). The former may be judged to be sufficient but active consultation with a series of face to face meetings is likely to produce better guidance.

Road testing

Once the guidance reaches a final stage of development it could be 'road tested' by a number of committees managing different types of public buildings across England and Wales to determine if it is useable, practical and relevant. The participants in the road test could then be surveyed with open ended questions to ensure the meaning of the technical details set out by the authors were understood when applied to the water supply systems in village halls and community buildings.

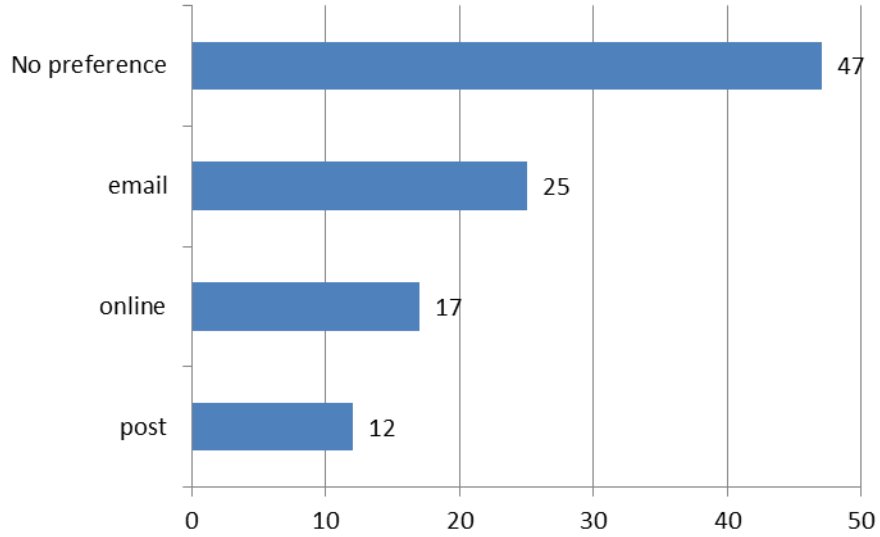
Revise pack

With input from the road testing and further feedback from communications staff working with technical experts the guidance pack can be revised ready for publishing.

5.3.4 Dissemination

In the response to the questionnaire question 'what format should the guidance take?' respondents stated some communication routes as shown in Figure 5.6. This shows most did not have a preference; followed by email, online and post. There could be bias in the proportion preferring electronic communication routes because the questionnaire was sent out using email.

Figure 5.6 Respondents preferred communication routes for guidance to be disseminated



The total is greater than total number of returned questionnaires as more than one preference given

Publish guidance pack

The guidance could be published as a free download from the DWI website and its relevance communicated through networks to reach those managing rural public buildings. An umbrella organisation like Water UK could make this available for all water companies to include on their websites and make use of in their own communications with customers.

Through networks

To communicate with the target audience it can be passed though networks for the village halls, places of worship and sports clubs (see list of contacts in Appendix A) and the stakeholders involved in the publication process. Using trusted networks as the main communication route will disseminate the information efficiently to the right people and enable them to implement it. Follow up through this network should be planned at appropriate intervals to encourage implementation. The ideal situation would be to have the guidance embedded into existing procedures which are given a high priority for example within existing health and safety assessments. This approach will mean the guidance is noted by the right people, acted on, requested by insurance companies, quality assurance schemes and (if appropriate) included in the relevant legislation. The water companies can facilitate this approach by having their own communication process specifically for public buildings to clarify the responsibilities of the water company and public building managers. Together this approach will mean that having a plan for maintaining drinking water systems and carrying out the required maintenance is as ubiquitous as a fire risk assessment.

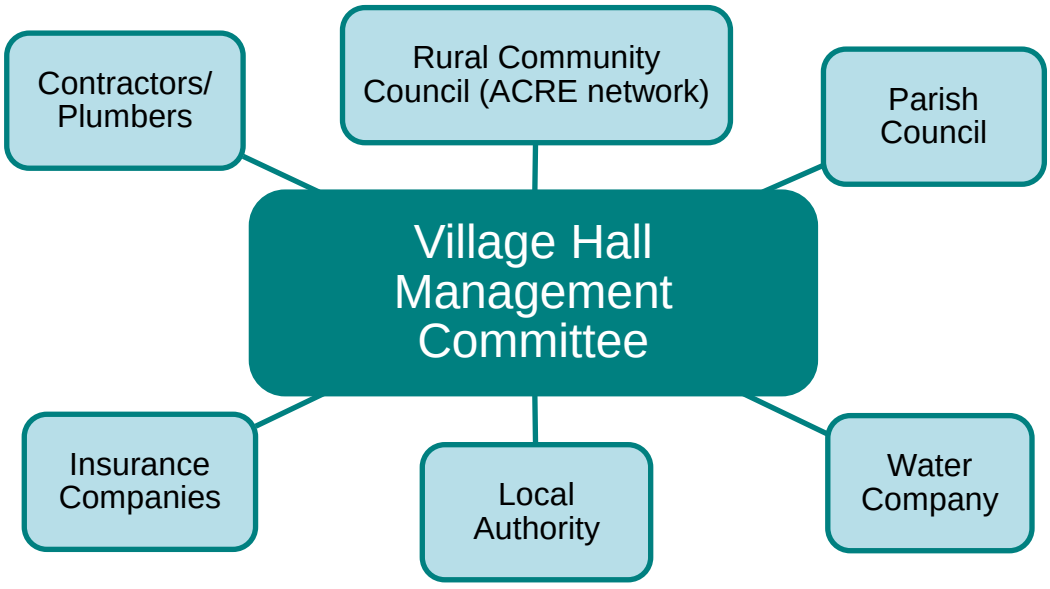
Although the response rate to the questionnaire to village hall committees was low some asked that the guidance was distributed via the ACRE network of rural community councils.

Local authorities will be well placed to disseminate guidance through those on the food preparation register. From a very local viewpoint there will be smaller buildings are not required to register and these buildings would be known about by Parish/Town Councils in England and Community/Town Councils in Wales. The networks for these local organisations (listed in the Appendix) can be used to disseminate the guidance with the request for councils to pass on the guidance to rural public buildings that have a drinking water tap in their parish/town.

Fields in Trust are an organisation that have lists of all protected public open space and they record facilities such as football changing rooms, so this is another type of network with access to rural public buildings run by sports clubs.

The guidance should be communicated by many parties to maximise the channels for prompts to act as Figure 5.7 shows for a village hall committee.

Figure 5.7 Coordinating communication to a village hall management committee



Press Releases

When the guidance is published press releases from the stakeholders will help prompt awareness and implementation of the guidance. In addition to the formal networks and contact points, there are local informal networks that the guidance will be passed through and

stories in the media can prompt action. This is from a trustee of a village hall and shows how local news about accidents and water management can affect village hall committees.

"Some months ago there was a case of a nursing home/children's centre having some issue with scalding hot water, and around the same time (although unrelated) there were a few cases of legionnaires disease reported in the news, which caused some minor concerns for trustees. We therefore undertook to ensure that we were compliant with various regulations".
ACRE Questionnaire response, November 2015.

5.4 Post production

In the post production stages to maintain the knowledge of those responsible for the water supplies in rural public buildings an on-going approach to communication on this issue is needed. Over time there may be a need to review the effectiveness of the implementation of the guidance and to update the guidance itself. An example of the commitment by a network to continuous improvement in communicating water system management is shown in Case Study Three.

Case Study Three: Continuous improvement in communicating water systems maintenance guidance using a network approach

The YHA are responsible for maintaining some private drinking water supplies (boreholes, lakes) which they have had some drinking water quality issues compared to no issues with their hostels with public water supplies (on the mains). For example at a hostel with a water treatment unit:

There was a power failure on a pump that raised water from the lake before treatment, the pump was switched back on but the treatment unit (Chlorine dioxide) had also lost power and needed attention before using the drinking water supply. The member of staff concerned was new to the site and did not recognise the significance of the power failure to the operation of the treatment unit. As a result water quality was affected and two children became ill, concerns were then raised, guests were given bottled water to use, the hostel was closed and guests were relocated at nearby hostels. This incident was followed up by a thorough review and findings were communicated to all staff in the hostel network to ensure this failure in managing the drinking water system is minimised.

Learning from the causes of this water quality incident was very important to the YHA and they have been improving the way they manage risk by continually looking to learn from issues, be proactive and more robust and apply the learning to the network of hostels. For example all tanks have recently been replaced with plastic materials and are lidded and they (along with showerheads) are routinely inspected by contractors to test for Legionnaires' Disease. They work with the Local Authority who carry out routine tests on the private supplies. The relevant staff are trained to manage the bespoke water treatment, supply and storage systems and stocks of bottled water are available if the chlorine levels are not right. The YHA are setting up a Water Safety Management Group to share information on issues and provide a route for staff to access expert advice and manage issues more effectively. For example promoting advice supplied by the Royal Society for Public Health.

This shows that technical guidance can be communicated through a network, using training and support to develop awareness of the issues of managing drinking water quality systems.

5.4.1 Verification of implementation of the guidance

To ensure that the guidance continues to be implemented over time it could be included in quality and accreditation schemes that committees have to periodically renew. This voluntary approach to promoting quality management has been seen to work in the HallMark scheme where a village hall committee is assessed and given a nationally recognised award. The scheme gives the committee confidence in their management, provides a benchmark, is

acknowledged by the Charity Commission and recognised by insurance companies. In addition, the ACRE Hallmark assessors would be well placed to carry out a review of the implementation of the guidance as they inspect village halls and could include the guidance in the Hallmark checklists.

5.4.2 Planned review of the guidance

It is suggested that a review is planned for the earlier of five years after publication or when legislation or relevant advice changes to ensure the guidance is up to date and relevant.

5.5 Conclusions

It is likely that a standalone official DWI guidance document or guidance pack is needed hosted on the DWI website and then stakeholders may choose to disseminate this directly or include the guidance in their own literature as checklists, posters and other formats to effectively communicate with their own audiences.

5.6 Suggestions

There are some suggestions for the most effective production and communication of guidance and these are set out below:

- It is recommended that the DWI *actively facilitate* the production and communication of the guidance by working collaboratively with the stakeholders. A steering group with the task of producing the guidance could be led by an umbrella organisation from the water industry with representation from the target audience.

- A guidance pack should be developed with specific information targeted at the management committees for village halls, places of worship and sports clubs.

- The steering group must have a strong technical and communications input to ensure the guidance is both accurate, understood and practical.

- Consideration should be made to where this guidance can be included in support of existing legislation i.e. health and safety, food hygiene, WRAS.

- It is recommended that the development of guidance for specific sectors is considered to maximise the broadcasting of the information.

- Due to the broad audience, it is recommended that the guidance is disseminated through a variety of routes making use of the stakeholders identified in the production phase.

The implementation of these suggestions should result in robust, usable guidance in specific formats for the different audiences who manage rural public buildings.

6. Conclusions

The rural public buildings analysis demonstrated that the classification of public buildings is not consistent between water companies. A standard definition of a public building and a method of audit are essential to enable meaningful analysis of potential water quality issues. The analysis also found that the spatial location of water quality sample sites is not exact enough to enable matching with a specific building in the OS AddressBase dataset.

There is some evidence that water companies are not sampling rural public buildings as frequently as their urban counterparts. However, it should be emphasised that the confidence in drawing this conclusion is compromised by differences in the public building classification between AddressBase and water quality sample site data. It was not possible to identify any statistically robust conclusions on the difference of water quality compliance between urban and rural public buildings due to the very low number of reported failures.

There is only very limited monitoring and literature data on chemical, aesethetic or microbiological hazards specifically associated with drinking water of rural public buildings, with the reported eight compliance failures being due to exceedance of iron, aluminium, manganese, taste and coliform bacteria parameters.

Potential chemical contaminants were identified that may be more likely to occur in drinking water of rural public buildings. Some contaminants are likely to be present as a result of the age and quality of pipework and fittings used in the buildings (e.g. copper, nickel, iron, aluminium or lead) and the intermittent use of supply (stagnation of water and increased potential of leaching). These may result in aesthetic effects (taste, odour or discolouration) which are noticeable to consumers. Another group of potential contaminants include hydrocarbons following spills of heating oil, petrol/diesel or the use of coal-tar pitch linings in older pipework, which again can result in organoleptic effects. In addition, plasticisers from plastic pipes can potentially leach into water and the possibility of disinfection by-products or compounds of microbial origin (geosmin and MIB) leading to taste and odour problems.

One factor related to rural public buildings considered as giving increased potential for risk of microbiological contamination is their location on remote sections of a distribution system. For example, the greater the length of a distribution system the more likely it will be to experience an ingress event. In addition, water quality at remote locations may have deteriorated caused by decay of the disinfectant residual, the rate of which is dependent on several factors including type of water, temperature and residence time. This may result in an increased potential for microbial growth within the distribution system.

A search of the guidance provided by water companies, local authorities, places of worship networks and insurance companies and the questionnaire to village hall committees showed

that there are only a few guidance documents available and none are specifically on water supply systems in rural public buildings.

Several gaps were identified in the review of existing guidance which included that people are unaware that current guidance exists, clarifying the responsibilities of owners/committees members to maintain “wholesome” drinking water in these types of buildings and recognising the lack of consolidated and non-technical data. Inconsistencies were identified on the available guidance from water companies and WRAS about the length of time stagnant water may cause aesthetic and/or health problems from the drinking water.

It is considered that a standalone official DWI guidance document or guidance pack is needed hosted on the DWI website and then stakeholders may choose to disseminate this directly or include the guidance in their own literature as checklists, posters and other formats to effectively communicate with their own audiences.

7. Suggestions

It is recommended that the recording of the OS UPRN of the water quality sample site building becomes mandatory. The UPRN provides an unambiguous location of a sampling point and allows public building classification to be audited. All UK water companies use the OS AddressBase product so have commercial use of this dataset (Open Water uses UPRN as a unique identifier of SPIDs).

It is also recommended that the definition of public building is standardised between the DWI and all water companies in order to achieve consistent reporting. This could be achieved by specifying a data definition from OS AddressBase for public buildings similar to that used by this project.

It is recommended that Water Companies review their monitoring processes to ensure that a fair balance is achieved between rural and urban public building sampling.

It is recommended that where monitoring data are available for chemical contaminants in rural buildings, a comparison be made with drinking water standards, health-based values and taste, odour or discolouration threshold effects in order to assign a level of risk as high, medium or low. Similarly, it is recommended that a qualitative approach be adopted for assessing the risks of non-compliance of microbiological contaminants, with the level of risk assigned as high, medium and low, depending on where the microbiological contamination appears to be located and the nature of the organism. The resulting actions to be taken following this assessment would depend on the category of risk. Essentially a high risk requires immediate investigation to determine and rectify the origin of contamination and consideration of a “boil water” or “do not drink” notice. Medium risk would need an investigation of the cause which may result in flushing the system, improved kitchen hygiene or improved water supply arrangements. Finally, low risk would require no action.

It is recommended that a non-technical leaflet to be distributed to the owners/committee members of rural public buildings, to explain their responsibilities and the necessary steps to reduce/prevent contamination of drinking water in rural public buildings and consequently provide “wholesome” drinking water to rural communities. The leaflet includes sections on highlighting to water customers in rural public buildings about their water supply history and their water supplier, steps to take following a contamination of drinking water, responsibilities to maintain “wholesome” drinking water, the types of chemicals which can cause aesthetic effects following contamination of pipework from outside a rural public building, and the main types of taste and odour effects that can potentially occur and are related to internal plumbing or water storage within the building.

It is recommended that the DWI actively facilitate the production and communication of the guidance by working collaboratively with the stakeholders. A steering group with the task of

producing the guidance could be led by an umbrella organisation from the water industry with representation from the target audience. The steering group must have a strong technical and communications input to ensure the guidance is both accurate, understood and practical. A guidance pack should be developed with specific information targeted at the management committees for village halls, places of worship and sports clubs. Consideration should be made to where this guidance can be included in support of existing legislation i.e. health and safety, food hygiene, WRAS.

It is recommended that the development of guidance for specific sectors is considered to maximise the broadcasting of the information. Due to the broad audience, it is recommended that the guidance is disseminated through a variety of routes making use of the stakeholders identified in the production phase.

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Appendix A Contacts List

The following table (Table A.1) is a list of the points of contact and umbrella organisations found during the project.

Table A.1 List of relevant contacts and organisations

Organisation	Contact name	Details	Note
ACRE	Deborah Clarke	d.clarke@acre.org.uk Suite 109, Unit 9, Cirencester Office Park, Tetbury Road, Cirencester, Gloucestershire, GL7 6JJ 01285 653477 web: www.acre.org.uk	ACRE and its network of 38 rural community councils together deliver a local advisory service tailored to the needs of approximately 10 000 rural community buildings throughout England. Hallmark Quality Scheme. Contacts with insurance companies who insure village halls.
Arthur Rank Centre	-	www.arthurrankcentre.org.uk	Provide support to rural communities.
Churches' Legislation Advisory Service	-	www.churcheslegislation.org.uk	Any religious body which is centred in the UK may apply for membership.
Cossington Parish Council	George Terry	www.cossingtonparishcouncil.org.uk	Chairman. See Case Study One.
Cossington Village Church	Roy Turner	www.wcbchurches.org.uk	Church warden of St. Mary's and on Parochial Church Council. See Case Study One.
Cossington Village Hall	Ian Rix	www.cossingtonvillagehall.org.uk	Village hall management committee. See Case Study One.
Ecclesiastical Insurance Group	-	www.ecclesiastical.com	Insure places of worship and produce guidance on security, building maintenance and health and safety.

Organisation	Contact name	Details	Note
Fields In Trust (formerly National Playing Fields Association)	-	Wales contact: FIT Cymru Manager: Rhodri Edwards Sport Wales National Centre Sophia Gardens Cardiff CF11 9SW 02920 334 935 England contact: Unit 2D, Woodstock Studios 36 Woodstock Grove London W12 8LE 020 7427 2110 /www.fieldsintrust.org	Map and lists of sports grounds and open spaces for England, Wales and Scotland – many have facilities where drinking water could be accessed (changing rooms, sports club houses, water fountains).
Local Government Association	-	Local Government House Smith Square London SW1P 3HZ 020 7664 3000 http://www.local.gov.uk/	Members include 350 English councils, the 22 Welsh councils via the Welsh LGA, 31 fire authorities, 10 national parks and one town council.
National Association of Local Councils	-	109 Great Russell Street London WC1B 3LD 020 7637 1865 www.nalc.gov.uk	Represent the interest of 9 000 local councils and 80 000 local councillors in partnership with County Associations
One Voice Wales	-	24c College Street AMMANFORD SA18 3AF 01269 595400 www.onevoicewales.org.uk	Represents community and town councils in Wales with 16 area committees. Provides advice and training.
Royal Society for Public Health	-	John Snow House, 59 Mansell Street, London E1 8AN 020 7265 7300	RSPH is an independent, multi-disciplinary charity dedicated to the improvement of the public's health and wellbeing. In 2014 ran a webinar series on water hygiene in buildings.

Organisation	Contact name	Details	Note
WRAS	-	Unit 13 Willow Road Pen y Fan Industrial Estate Crumlin Gwent NP11 4EG 0333 207 9030 www.wras.co.uk	Contributes to the protection of public health by preventing contamination of public water supplies and encouraging the efficient use of water by promoting and facilitating compliance with the Water Supply (Water Fittings) Regulations and Scottish Water Byelaws. WRAS is funded by the water industry. Online list of approved plumbers.
Water UK	-	3rd Floor, 36 Broadway Westminster London SW1H 0BH 020 7344 1844 www.water.org.uk	Represent all major statutory water and wastewater service supply organisations in England, Wales, Scotland and Northern Ireland. See Case Study Two.
WaterSafe	-	Unit 13 Willow Road Pen y Fan Industrial Estate Crumlin Gwent NP11 4EG 0333 207 9030 www.wras.co.uk www.watersafe.org.uk	WaterSafe is an online search facility bringing together thousands of qualified contractors employed by plumbing businesses from the seven existing approved contractors' schemes across the UK. The scheme is funded by the water industry and administered by WRAS.
YHA	Andy Rimmer	YHA England & Wales Trevelyan House, Dimple Road, Matlock, Derbyshire, DE4 3YH 01629 592 700 www.yha.org.uk	Safety, Health, Environment and Quality Officer for Northern Region. Provides a network of hostels (mainly in rural locations) for young people of limited means. In 2014 there were 387 180 young people who stayed overnight. See Case Study Three.