Building resilience in the UK water sector: a systems based approach to emergency management

UNIVERSITY OF EXETER

Submitted by

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to the

University of Exeter

as a thesis for the degree of

Doctor of Philosophy in Engineering

July 2019

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ABSTRACT

The ability to achieve resilience to extreme events requires a shift away from the traditional risk management approach and a progression towards understanding resilience as a dynamic process operating within a complex socio-ecological-technical emergency management system. Taking a systems based approach this research applied quantitative and qualitative methods to explore how resilience to water supply failure is achieved within the UK emergency management system. This was supported through the application of the Safe and SuRe intervention framework. Semi-structured interviews with emergency management professionals revealed that the Civil Contingencies Act, 2004 is not aligned with current operational practices to enable effective collaboration between Category 1 and Category 2 responders. This is further constrained by a lack of government funding and a lack of understanding with regard to organisational culture and how this influences the operational delivery of multi-agency emergency response. The attitudes and perceptions of individuals to water supply failure was examined through individual householder questionnaires and the analysis of Facebook comments during the 'Beast from the East'. Individuals expressed a high level of confidence in the ability of Water Service Provider's to provide a reliable, continuous and safe supply of water. While the majority of individuals do not prepare for a failure of the water supply they actively respond during an incident to achieve resilience by purchasing water from the supermarkets, staying with relatives or attending water distribution stations. However, the ability to achieve resilience requires the provision of accurate, timely and consistent information from the Water Service Providers. Resilience to emergencies can also be strengthened at the local level through the development of collaborative working partnerships. The integration of community

groups within the emergency management system enables resilience through the sharing and exchange of information to understand capabilities available for effective emergency response.

This research demonstrates how the application of a systems based approach enables a greater understanding of the complex interdependencies between different parts of the emergency management system. These were explored and developed into recommendations identifying where resilient based strategies and interventions are required at the government, inter-organisational and community level.

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LIST OF ABBREVIATIONS

AGM   Annual General Meeting

Cat 1   Category 1 Responders

Cat 2   Category 2 Responders

CCA, 2004   Civil Contingencies Act, 2004

CCG   Clinical Coordinating Group

CC Water   The Consumer Council for Water

COBR   Cabinet Office Briefing Room

CRR   Community Risk Register

DCLG RED   Department for Communities and Local Government Regional
Emergencies Division

Defra   Department for the Environment, Food and Rural Affairs

EA   Environment Agency

GCG   Gold Coordinating Group

HMIC   Her Majesty's Inspectorate of Constabulary

JESIP   Joint Emergency Services Interoperability Programme

LRF   Local Resilience Forum

MHCLG   Ministry of Housing , Communities and Local Government

NGA   National Government Association

NHS	National Health Service
NRR	National Risk Register
Ofwat	Financial Regulator for the Water Sector
RQ	Research Question
SCG	Strategic Coordinating Group
SSSI	Site of Special Scientific Interest
SPSS	Statistical Package for the Social Sciences
TCG	Tactical Coordinating Group
UK	United Kingdom
WRMP	Water Resource Management Plan
WSP	Water Service Providers

ACKNOWLEDGEMENTS

1   CHAPTER 1 - INTRODUCTION

1.1   Background

With heightened media interest in any form of disastrous situation, the world is held in suspense as every detail of the emergency is revealed in real time, minute by minute. Whether the incident is a result of a natural disaster, industrial accident or terrorism, every aspect of the emergency situation is analysed and the world is left in wonder as to why it was not prevented from happening in the first place. Emotive images of people struggling to cope in an extreme situation dominate every form of media and serve as a reminder of our vulnerability or resilience.

Extreme events are characterised as low probability, high impact events in terms of their magnitude, spatial scale and destructive potential (Alexander 2002a; Stephenson, 2008; Comfort *et al*, 2010). In a world that is constantly changing and evolving, these events present many challenges for emergency management (Gow and Paton, 2008). With a heavy reliance on critical infrastructure and the complex interdependence between society, economics, politics and the natural environment, there is a constant challenge to reduce the impact of extraneous threats in an effort to become more resilient. However, what does resilience really mean and how can it be operationalised through effective emergency management in a complex interdependent world?

The concept of resilience has been widely applied within many different disciplines including ecology (Holling, 1973; Holling 1996), psychology

(Vanderbilt-Adriance and Shaw, 2008; Luthar, 2006), engineering (McDaniels *et al*, 2008; Hollnagel *et al*, 2007; Butler *et al,* 2016) and disaster management (De Bruijne *et al,* 2010; DFID, 2011; Alexander, 2013). Each discipline defines resilience within the specific context according to what is being investigated. This has resulted in hundreds of definitions of resilience within the academic literature (Patel *et al,* 2017). While a universal definition is constantly being sought (Wright *et al,* 2012), it has also been considered that resilience should be contextualised (Carpenter *et al,* 2001), in order to understand its true meaning and how this can applied within different situations (Vanderbilt-Adriance and Shaw, 2008; Gow and Paton, 2008; DFID, 2011; Alexander, 2013). This requires an understanding of the system or process that needs to be made resilient and the threat or hazard that it needs to be resilient to (Carpenter *et al,* 2001; DFID, 2011; Butler *et al,* 2016).

A failure of foresight and the inability to determine a 'worst case' scenario is a recurring theme within 'lessons learned' reports following extreme events (Turner, 1975; Crichton *et al*, 2009; Paltrinieri *et* al, 2011; Constantinides, 2013; Turoff *et al*, 2013). Whilst the anticipation of threats and hazards and the assessment of risk is considered to be a primary stage in the emergency planning process (Ferrier and Emdad Haque, 2003; Smith, 2013), it is extremely difficult to determine with any certainty (Meyer, 2005; Boin and Hart, 2010; Paltrinieri *et al,* 2011), particularly regarding low probability, high consequence extreme events. These are typically characterised by a rapidly changing dynamic situation (Vespignani, 2010; Park *et al*, 2013; Linkov *et al*, 2014) where many of the threats and hazards are largely unknown (Park *et al*, 2013; Linkov *et al,* 2014; Butler *et al,* 2014) making the assessment of potential risk an impossible task. For those

that are known, there is the potential for them to escalate into a series of cascading events (Boin and McConnell, 2007; Crichton *et al,* 2009; Vespignani, 2010) where again the threats and hazards may be unknown.

Highly publicised events such as Hurricane Katrina and the Great East Japan Earthquake (McCallum and Heming, 2006; Hollnagel and Fujita, 2012; Constantinides, 2013) demonstrate how a reliance on a risk based approach to emergency management is not adequate for extreme events, particularly considering the complex independencies between society and critical infrastructure (Luiijf and Klaver, 2005) and the ability of events to cascade. It has been recognised that in order to prepare for low probability, high consequence events requires the application of a resilient based approach (DFID, 2011; Comfort *et al,* 2010; Boin and McConnell, 2007). With emergency planning becoming increasingly focussed on reducing risk and increasing resilience to emergencies, this research will explore what these terms actually mean in practice and how they can be applied within a framework of emergency management.

The main principles of emergency management are to reduce the magnitude of a given event through adequate preparedness and mitigation and to minimise the event duration through effective emergency response and recovery (Figure 1.1). However, events such as Hurricane Katrina and the Great East Japan Earthquake (McCallum and Heming, 2006; Hollnagel and Fujita, 2012; Constantinides, 2013) demonstrate how a lack of preparation for the failure of critical infrastructure can have disastrous consequences for society (Luiijf and

Klaver, 2005; Boin and McConnell, 2007). These events also serve as a reminder that our reliance on technology to enable the prediction and warning of natural hazards is necessary but not sufficient in terms of building a resilient approach to emergency response and recovery for extreme events (Huppert and Sparks, 2006; McCallum and Heming, 2006; Comfort *et al*, 2013).
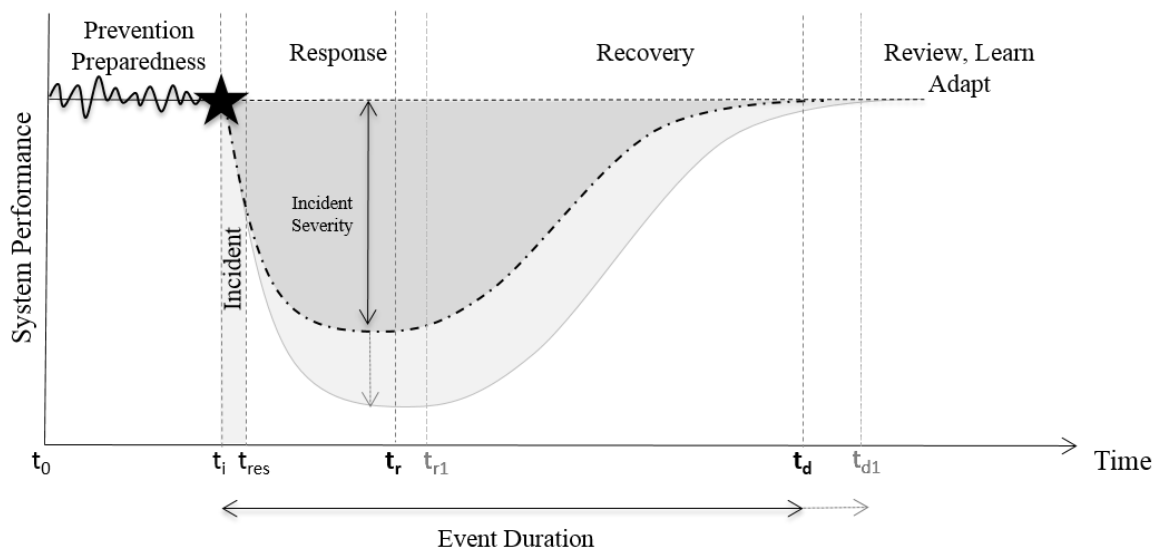
Figure 1.1: System performance relating to emergency planning. Adapted from McDaniels *et al,* 2002 and Mugame *et al*, 2015.

It could be argued that these and many other events can be predicted and should therefore be adequately prepared for (Turner, 1975; Turoff *et al*, 2013). However, it is the extreme nature of these events in terms of magnitude, spatial scale and destructive potential that result in the exceedance of available resources and capabilities for effective emergency management and the protection of critical infrastructure. The inevitability of human error in the prediction, response and recovery of an extreme event (Perrow, 2011), whether this is the result of complacency, inadequate planning, preparation, lack of inter-agency cooperation

(Pitt, 2008), or poor communication (Kapucu, 2005), can also lead to a long process of recovery. This demonstrates the importance of performing a rigorous assessment of the impact and consequences of threats and hazards (Butler *et al,* 2016; Comfort *et al,* 2013; Huppert and Sparks, 2006; McCallum and Heming, 2006), particularly with respect to the continuation of services provided by critical infrastructure following an extreme event (Butler *et al,* 2016; Butler *et al,* 2014).

Within the UK, statutory duties of civil protection are assigned to emergency responder organisations and delivered through Local Resilience Forums (LRF's). These were established following the introduction of the Civil Contingencies Act, 2004 (CCA, 2004) and aimed to encourage greater collaboration between responder organisations to ensure an effective emergency response at a local level (Cabinet Office, 2013a). Within England and Wales there are 42 LRF's located within Police operational boundaries and consisting of Category 1 and Category 2 responders.

Category 1 responders include the emergency services, Local Authorities, Health Authorities and the Environment Agency (Cabinet Office, 2012). These organisations have statutory duties under the CCA, 2004 to cooperate, share information, assess risk, maintain emergency and business continuity plans, communicate to the public and promote business continuity (Cabinet Office, 2012). Category 2 responders include Utility, Telecommunications and Transport companies and although they do not have any statutory duties defined within the Act they are expected to support the Category 1 responders in their duties (Cabinet Office, 2012). Built within a framework of integrated emergency

management, the introduction of the CCA, 2004 sought to provide the flexibility required to respond to changing dynamic emergency situations through a multi-agency collaborative approach at a local level (CCA, 2004; Cabinet Office, 2013b).

However, the 2007 summer flood event in Gloucestershire highlighted a significant problem with this approach when Mythe Water Treatment works became inundated with floodwater resulting in over 350,000 people left without a centralised water supply for 17 days (Pitt, 2008; Environment Agency, 2010; Ofwat, 2010). The Gloucestershire Resilience Forum had prepared what they considered to be an adequate assessment of the threats and hazards within their local area however, the potential failure of critical infrastructure had not been anticipated. This was further exemplified when Waltham Electricity Sub Station became at risk of inundation. This would have resulted in over 500,000 people without electricity for up to three weeks (Pitt, 2008). The scale of this event was unprecedented for the UK water sector leading to a series of unpredictable events that had to be managed within a complex, chaotic and uncertain environment.

An inadequate level of understanding regarding the potential consequences of critical infrastructure failure was largely attributed to the lack of participation of Category 2 responders in the risk assessment process. It was argued that by not placing a statutory duty on them to perform an assessment of the potential hazards it allowed them to dissociate themselves from the risk assessment process (Pitt, 2008; McMaster and Baber, 2012).

This was not just an issue within Gloucestershire. Throughout the country rising flood waters affected 5 water treatment works, over 300 sewage treatment works and seriously threatened the electricity supply in Gloucestershire, Yorkshire and Humberside (Pitt, 2008). This event provided the first real test of the effectiveness of the multi-agency approach to emergency management following the introduction of the CCA, 2004. A lack of collaboration and sharing information by Category 2 responders regarding the vulnerability of critical infrastructure assets demonstrated a weakness in this approach and the ability to achieve resilience of critical infrastructure failure to flooding (Pitt, 2008).

Following the 2007 severe flood event, the UK Government initiated a series of reviews to build resilience of critical infrastructure to natural hazards (HM Government, 2010; HM Government, 2011; Cabinet Office, 2011b; UKRN, 2015; UKRN, 2016; HM Government, 2016; National Infrastructure Commission, 2018). Many of these reviews also encouraged collaboration and the sharing of information by Category 2 responders regarding the vulnerability of critical infrastructure assets to ensure effective emergency response. However, lessons learned from recent incidents and multi-agency exercises (Watermark, 2011; Environment Agency, 2016; HM Government 2016; Ofwat 2018) demonstrate these difficulties continue to persist despite numerous recommendations for improvement. This raises the question as to whether there is a fundamental problem within the system of emergency management allowing the same failures to occur time and time again.

1.2   Research perspective

This PhD forms part of the EPSRC-funded Safe and SuRe research fellowship project (EP/K006924/1) undertaken at the Centre for Water Systems, University of Exeter. Safe and SuRe represents an integrated socio-ecological-technical approach to resilience within the Urban Water Management Sector (Butler *et al,* 2016; Butler *et al*, 2014).   It has long been realised that the threat of climate change and increasing urbanisation as a result of population growth has put a significant strain on the existing water service systems and their effective future provision. The ability to continually provide a safe (reliable) provision of service is constantly being challenged and requires the development of new and innovative strategies to achieve resilience within the water sector to extreme events. However, in order to be effective the strategies must also be sustainable in response to a dynamic and changing environment.

The Safe and SuRe approach defines resilience as the *"degree to which the system minimises level of service failure magnitude and duration over its design life when subject to exceptional conditions."*   In the context of emergency planning, the system is representative of the emergency management system. Failure magnitude is synonymous with incident severity (Figure 1.1) and can be reduced in a number of different ways. These could include the incorporation of lessons learned within operational procedures, preparedness through the development of emergency plans, training and regular exercising of standard operational procedures.   This also includes the ability to develop accurate situational awareness to respond quickly and effectively to emergency situations. The event duration, the time taken for the system to recover is also considered

as a determinant of resilience. However, social systems differ from engineered systems and do not always have the potential to *"bounce back"* to the original state or level of functioning (DFID, 2011). For instance, it may be difficult for individuals and communities to recover from an extreme event due to a poor infrastructure, a lack of governance and economic instability. These social systems can fail or even collapse following an extreme event (Lindell, 2010; Carpenter, 2008).
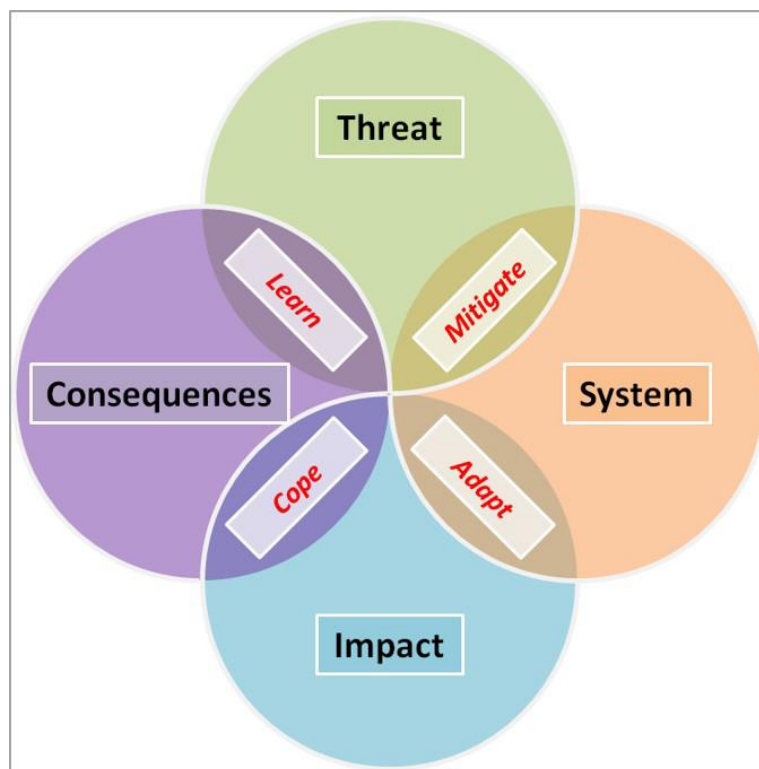
Figure 1.2: Safe and SuRe Intervention Framework, taken from

Butler *et al,* 2016.

The Safe and SuRe Intervention Framework is comprised of 4 elements, threat, system, impact and consequences (Figure 1.2). Threats are defined as *"any event with the potential to reduce the degree to which the system delivers a defined level of service".* Within the context of Safe and SuRe, there is no differentiation between threats, hazards, disturbances or crisis. Threats have the

potential to cause failure within the system and the resulting impact may have consequences for society, economic stability or damage to the environment. Within the UK emergency management system threats are defined as *'malicious attacks'* and hazards are defined as *'non malicious events'* which may contribute to an emergency (Cabinet Office, 2012). An emergency is defined as *"an event or situation which threatens serious damage to human welfare in a place in the United Kingdom, an event or situation which threatens serious damage to the environment of a place in the United Kingdom, or war, or terrorism, which threatens serious damage to the security of the United Kingdom"* (Cabinet Office, 2012). Within this research, hazards will be considered as per the Safe and SuRe methodology and referred to as threats.

At the intersection of each element are intervention measures of mitigation, adaptation, coping and learning. These provide the opportunity to build resilience and sustainability in the system. The framework can be evaluated by taking a top down, bottom up, middle based or circular approach to analysis (Figure 1.3).

The top down analysis is representative of the traditional risk management approach to emergency planning. This is based on the identification and anticipation of known threats and hazards and the implementation of mitigation and preparedness mechanisms to ensure effective emergency response and recovery. However, there are difficulties with this approach because this assumes that all threats are known and their impact and consequence can be predicted. As demonstrated within Section 1.1, the complex interdependencies that exist between infrastructure, society, the economy and the environment,

combined with the potential for an emergency situation to escalate or cascade may result in a series of unknown threats.
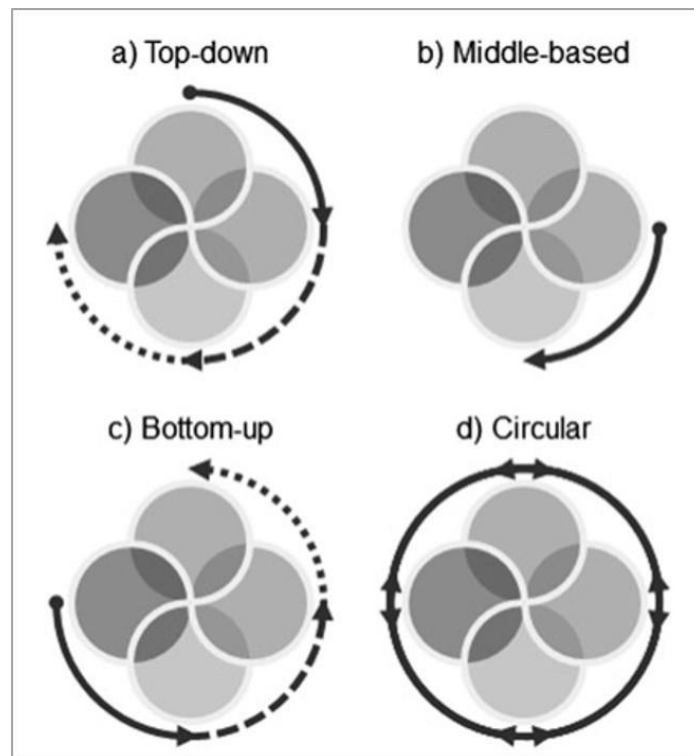
Figure 1.3: Different approaches to the evaluation of the Safe and SuRe framework, taken from Butler *et al,* 2016.

In response to the shift towards encouraging greater resilience within the emergency management system, there is also evidence of a bottom up approach concentrating on consequence based analysis. This is evident within the field of flood risk management where Local Authorities and responder organisations work together with local communities to develop flood mitigation measures and ensure the local community is able to cope during a flood.

The Safe and SuRe approach is primarily focussed on the middle-based analysis and recognises that it is impossible to identify every possible threat to the system,

the resultant impact or the socio-ecological-technical consequences. Instead this approach focuses on failure modes and how they impact the system while acknowledging different threats may result in the same failure of the system. This approach is not currently being applied within the field of emergency management and will be explored in greater detail throughout this research.

Finally, the circular approach considers all of the elements within the system and how a greater understanding of applying intervention measures contributes to a cycle of continual improvement through the process of learning. Within the field of emergency management, lessons learned are identified from the analysis of an emergency situation and are incorporated as actions within operational procedures. These are developed within training programmes and their effectiveness is assessed through exercising and responding to a future event. However, the emphasis is placed on improving individual or multi-agency response and neglects other aspects of the emergency management system where failure may have occurred or contributed to the original failure. Taking a systems based approach would allow a greater understanding of the connections and relationships between different parts of the system and allow for the identification of where potential failure modes exist. Once these have been identified, it will be possible to understand how resilience can be achieved through the application of intervention measures. The example provided within the following section (Section 1.3) demonstrates the importance of applying a systems based approach.

1.3 The requirement for a systems based approach to water supply failure

The flooding of Mythe Water Treatment works during the summer 2007 floods, seriously challenged the ability of individuals to cope and adapt to the loss of their centralised water supply (Severn Trent Water, 2007; BBC Gloucestershire, 2007; CCWater, 2007; Environment Agency, 2007). This event also presented the Water Service Provider (WSP) with the logistical challenge of supplying over 350,000 people with an alternative supply of water (Severn Trent Water, 2007; BBC Gloucestershire, 2007; CCWater, 2007). The lessons learned reports (Severn Trent Water, 2007; Ofwat, 2007; CCWater, 2007; Environment Agency, 2007) focussed on the need for adequate flood defences, resilience of assets, adequate training, collaborative working partnerships and the effect of water supply failure on the customer. However, none of these reports explored how individual (customer) perceptions, attitudes and behaviour influenced the emerging situation and how this could affect the ability to achieve resilience to this event.

While it is difficult to infer individual perceptions to water supply failure from this event, individual behaviour provided an indication of attitudes to water supply failure. When Mythe water treatment works was shut down on Sunday 22nd July, 2007 there were two service reservoirs that were still operational (Severn Trent, 2007). The Hewletts service reservoir and the Churchdown service reservoir. According to Severn Trent the reservoirs were 84% full and 64% full respectively which would provide the equivalent of *'36 hours supply of water in normal circumstances'* (Severn Trent, 2007). However, as soon as the WSP issued a

statement to the media informing customers there would be a loss of their water supply, *'water usage doubled, resulting in a more rapid depletion of water supplies'* (Severn Trent, 2007)*.*

The individual response in this situation was to immediately store water within pots, pans and the bath (BBC Radio Gloucestershire, 2007; CC Water, 2007) to ensure there would be water available throughout the emergency. However, this also resulted in depletion of the service reservoirs that potentially could have supplied water for a further 36 hours if everyone had used water wisely. There were also reports within the media of individuals 'panic buying' water at local supermarkets and shops becoming depleted of their normal supplies of bottled water (Guardian, 2007; BBC News, 2007).   While this behaviour demonstrated resilience at the individual level of the customer, the act of storing water and 'panic buying' also contributed to a loss of resilience for customers unable to source an alternative supply of water. This behaviour also contributed to a loss of resilience in the ability of the WSP to provide an alternative supply of water to all of those affected.

The Security and Emergency Measures Directive (SEMD, 2009) places a responsibility on a WSP to ensure an alternative supply of water to their customers in the event of a failure of the water supply. At the time of the 2007 incident, WSP's were expected to provide a minimum of 10 litres of drinking water per day, per person. However, this is not consistent with the average amount of water an individual will use during a 24 hour period for drinking, washing, preparing food and flushing the toilet. The average water consumption per

person, per day is considered to be approximately 135 litres (Severn Trent, 2007). There existed a discrepancy between the expectation of the WSP as to how much water should be provided and the expectation of the customer to be provided with enough water to continue as normal. This also included the expectation that normal services would resume as soon as possible.

The WSP was presented with the logistical challenge of providing an alternative supply of water to over 350,000 people. The flooding of main arterial routes prevented the delivery of water using large industrial tankers because they were unable to travel through small, narrow roads (Pitt, 2008). This resulted in a delay providing customers with water because the water had to be transferred to smaller tankers and delivered as bowsers to the affected locations. However, as soon as the bowsers were delivered they were rapidly depleted because customers were taking more water than had been anticipated by the WSP.

The WSP was criticised for not providing customers with enough information regarding the location of bowsers and the amount of time it would take before the centralised water supply was reinstated. A lack of situational awareness and an increased level of uncertainty regarding the availability of future water supplies may have prompted individuals to collect more water than required to ensure they were able to cope should the situation persist. However as they increased their individual level of resilience, other customers were deprived of water reducing their ability to cope, decreasing their resilience and the WSP was not able to provide enough water to satisfy the demand, resulting in a negative reinforcing feedback loop (Figure 1.4).
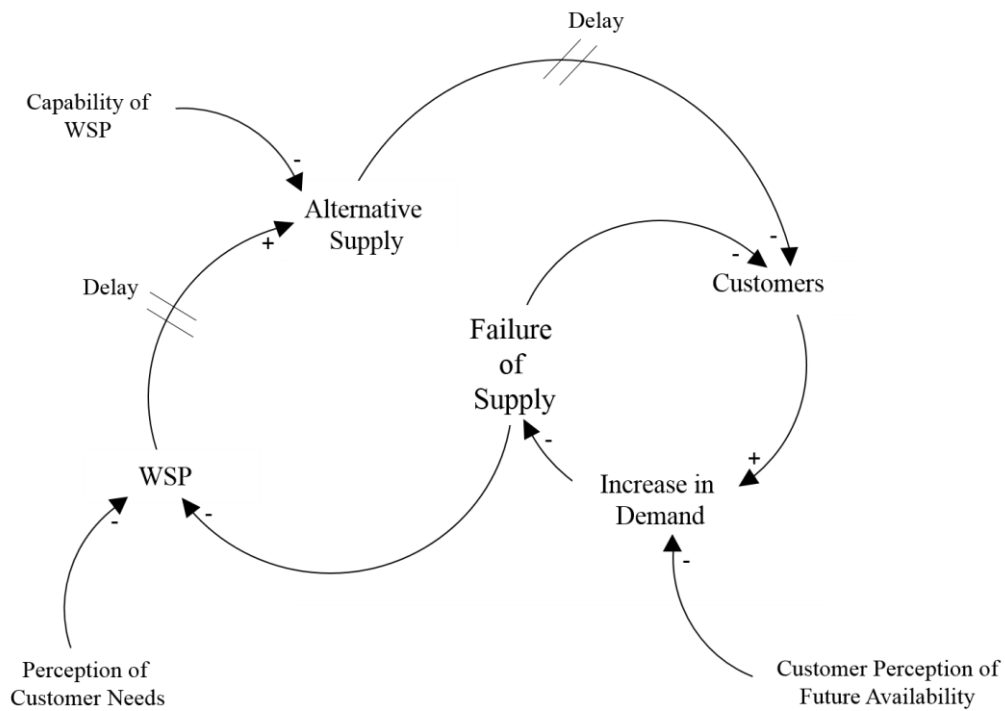
Figure 1.4: Causal loop diagram of water supply failure in Gloucestershire,

2007.

From a systems perspective, this event provided an example of a *'learning disability'* (Senge, 2006) where individual customers were not aware they were part of a wider system and the consequences of their actions could have the potential to create a failure at another point in the system. It could be argued that if this information had been provided to customers, it may have influenced customer attitudes and behaviour and reduced stress on the WSP's ability to provide an alternative supply of water. This event highlighted the importance of understanding the concept of resilience in the context of the wider system of which it is being assessed.

This event also demonstrated that resilience was not solely dependent on the operational functioning of physical assets but existed as part of a complex and integrated socio-ecological-technical system (Pitt, 2008). Category 2 responders are responsible for the provision of essential services such as water, electricity and transport networks (Cabinet Office, 2012). The consequences of critical infrastructure failure have the potential to impact quality of life, economic stability and contribute to civil unrest (Boin and McConnell, 2007). While lessons learned reports are used to identify where failures have occurred, it is also necessary to explore interdependencies within the wider socio-ecological-technical system. This will enable a more accurate assessment of whether these failures have the potential to happen again.

Systems thinking and systems dynamic modelling is increasingly being used to identify where resilience measures need to be applied within the emergency management system. These will be explored in greater detail within Chapter 2 (Section 2.3). Many of these models take a high level approach to identify interdependencies between different sectors (HM Government, 2010), determine the physical structure of the system (Franchin, 2018; Pagano *et al,* 2017), or seek to develop methods to measure resilience in terms of system performance (Bruneau *et al,* 2003; Franchin, 2018). Models have also been developed to explore how resilience can be enhanced within one particular element of the system (O'Sullivan *et al,* 2015; Kim *et al,* 2012). However, the concept of resilience is a complex and dynamic process that operates on many different levels within society from the resilience of the individual (Paton *et al,* 2006; Luthar *et al,* 2000), community resilience (Patel *et al,* 2017; Gilchrist, 2009), inter-

organisational resilience (Boin and McConnell, 2007; Smith and Dowell, 2000), and institutional resilience at the level of government (Djalante, 2012; Aoki, 2016).

These models are very useful to understand how the system is structurally connected, where interdependencies exist and identify where resilience measures need to be applied at specific points of the system. For instance, it is possible to identify where collaboration and coordination may be required between different organisations at a specific part of the system (Pagano *et al,* 2017), or identifying the need for greater community awareness and engagement (O'Sullivan *et al,* 2015; Kim *et al,* 2012). However, in the context of UK emergency management, many of these have already been identified as persistent problems within lessons learned reports and exercises (Section 11). This demonstrates a gap in the research between the application of a systems based approach to understand the structural elements of the emergency management system and social research to explore how resilience operates as a complex dynamic process within the system.

To understand the influence of social interactions and how resilience to water supply failure can be achieved across different levels of society requires taking a pragmatic and applied approach to the research design. Action research combined with social research methods can be used to explore, examine and analyse the social interactions between different organisations, individuals and communities within the emergency management system. This enables the system to be understood from the perspective of the practitioner, the individual and the community, providing a more realistic interpretation of how the system

actually operates in practice and how the ability to achieve resilience is influenced by these interactions (Pagano *et al,* 2017; O'Sullivan *et* al; Kim *et al,* 2012). This also provides an opportunity for the researcher to become immersed within the process of data collection which enhances the development of practical solutions and recommendations for improvement (Bernard, 2006; Robson, 2011). This approach will be applied as a grounding for the overall research design and is explained in greater detail with Chapter 3 (Section 3.1). However, it is also necessary to identify the main structural elements of the UK emergency management system and how these will be used to develop the research design and the sequence of study.

The UK emergency management system operates on the principle of subsidiarity. Strategic direction is provided at a national level by government and supported through the delivery of the CCA 2004, government guidance, the National Risk Register (NRR) and the National Capability Survey. These provide a framework and structure to the application of resilience within the emergency management system at an institutional level. Although the legislation is driven by government, it is focussed on the delivery of emergency management at the local level through the development of LRF's. These comprise a multi-agency approach to the anticipation and assessment of risk through the process of emergency planning, response and recovery and represent the operational element of the emergency management system. At this level resilience is applied within (organisational resilience) and between organisations (inter-organisational resilience) to ensure the daily operational delivery of each individual organisation. The final element of the system is represented by the individuals and communities affected by a particular emergency. At this level, resilience is applied at the individual

householder level but may also be supported through the development of community resilience.
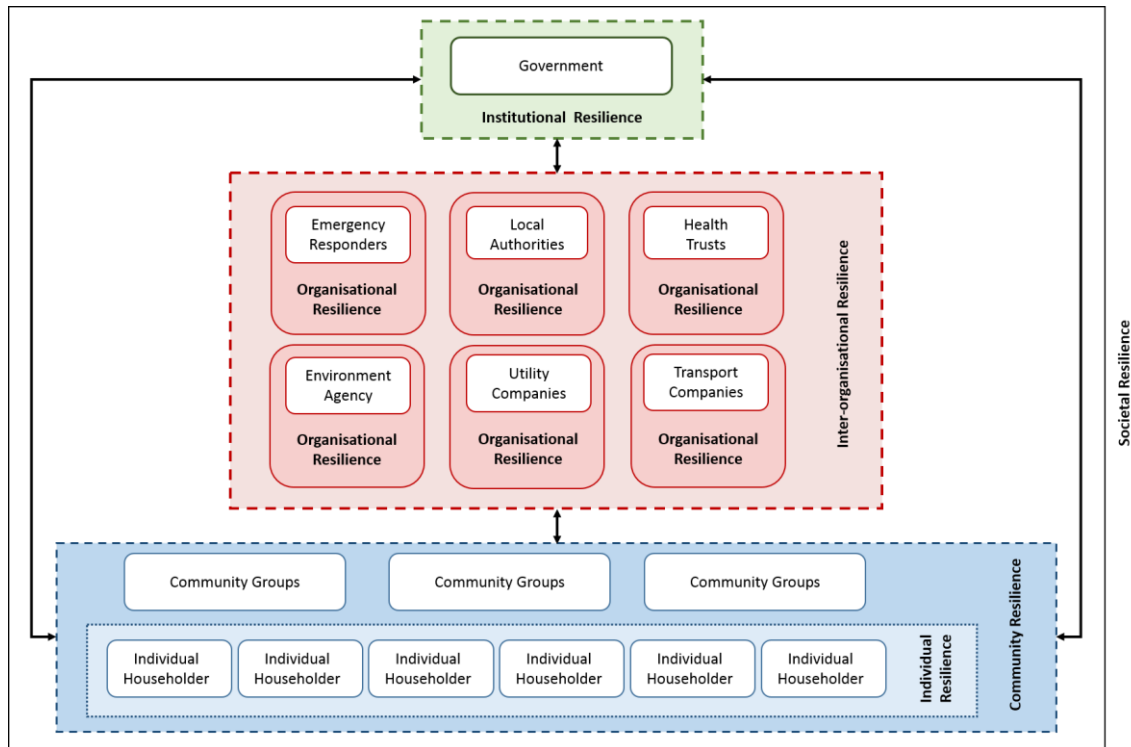
Figure 1.5: Simplified system of emergency management in the UK and the relationship to resilience. (The colour scheme will also be applied within Chapter 9, Section 9.3: Recommendations)

Although this represents a simplified approach to the UK emergency management system, it allows the identification of three main structural elements contributing to the operational delivery of the system (Figure 1.5). These comprise an institutional element identified at the national level of government, an operational multi-agency element represented by the organisations that comprise the LRF at the local level and the individuals and communities affected by an emergency (Figure 1.3). The elements are connected at three different

points in the system. The institutional element is connected to both the operational element and the individual householder and community element and a connection exists between the operational element and the individual householder and community element. Each element is defined at the level of operation within the system and characterised by a specific application of resilience. While a greater understanding of the influence of organisational resilience and institutional resilience are beyond the scope of this research, they have been included for added clarity.

This research will explore how improved resilience to water supply failure can be achieved within the context of the UK emergency management system. The simplified structure of the UK emergency management system (Figure 1.5) provides a foundation for the research design and a direction for the sequence of study. This will start with an examination of the institutional element to understand the legislative framework of emergency management in the UK and how this is achieved through the development of LRF's within the operational multi-agency element. Action research and social research methods will be used to explore and understand how resilience to water supply failure operates within and between each structural element of the system using a series of specific objectives that will be discussed within the following section.

1.4 Aim and Objectives

The aim of this research is to explore how improved resilience to water supply failure can be achieved through effective emergency management. This will be achieved through the following objectives:

Objective 1: Critically analyse the traditional risk based approach to emergency management and its application towards achieving resilience.

Within the system of UK emergency management, Objective 1 explores the 'top down' approach to explore the relationship between risk and resilience within the context of the UK emergency management system. Although risk assessment is important to help identify known threats and hazards it is not adequate in the context of extreme emergency situations where the threats and hazards may be unknown (Butler *et al,* 2016; Boin and Hart, 2010; Park *et al,* 2013). As demonstrated throughout the discussion within Section 1.1, it is impossible to anticipate every threat to a system (Vespignani, 2010; Part *et al,* 2013*;* Linkov, *et al,* 2014), resilience assessment and resilience strategies must also be applied to be able to prepare for unknown situations (Butler *et al,* 2016; Comfort *et al,* 2010). This objective explores whether this can be achieved within an emergency management framework that has always been centred on the traditional risk management approach.

Objective 2: Investigate the multi-agency approach to emergency management.

Lessons learned reports (Pitt, 2008; Watermark, 2011; Environment Agency, 2016; HM Government 2016; Ofwat 2018) academic and empirical research (Kim *et al,* 2012: Crichton *et al,* 2009; Perry and Lindall, 2004; Boin and McConnell, 2007) have identified that effective emergency response occurs where strong

partnerships have been formed during the emergency planning process. The CCA, 2004 actively promotes the multi-agency approach through the development of LRF's. However, lessons learned from recent incidents in the UK (Watermark, 2011; Environment Agency, 2016; HM Government 2016; Ofwat 2018) have also demonstrated that difficulties persist in the collaboration and sharing of information regarding the impact of critical infrastructure failure during planning, preparing and emergency response. While systems thinking and system dynamic modelling (Pagano *et al,* 2017) have been applied to specific case studies to explore the emergency management system (O'Sullivan *et* al; Kim *et al,* 2012), these models do not explore resilience as a process operating within a complex dynamic system of interconnecting elements that may include legislation and different operational practices between responder organisations.

This requires a more pragmatic approach using social research methods to explore and understand how practitioners from different organisations work together in a multi-agency approach before, during and after an emergency. This may enable the identification of the causative factors creating difficulties in the ability to achieve multi-agency collaboration and the sharing of information. This objective applies the principles of action research by seeking to explore the operational element of the system (Figure 1.5) through the process of active listening at practitioner conferences, conducting semi-structured interviews with practitioners and through analysing the multi-agency approach during an actual emergency. The following research questions aim to explore how resilience is achieved within the operational element of the UK emergency management system;

RQ1 – Does the CCA, 2004 support the multi-agency approach to emergency management? As already discussed within this Chapter, the system of emergency management in the UK is legislatively driven by the CCA, 2004. This research question aims to develop a greater understanding of the practitioner perspective of how the CCA, 2004 contributes to an effective multi-agency approach to emergency management in the UK and to identify where the legislation may contribute to difficulties regarding the collaboration and sharing of information.

RQ2 – How do the Cat 1 responders and the WSP's perceive the multi-agency approach? This research questions specifically explores how Cat 1 responders and the WSP's work together during the process of emergency planning and response. This is to explore and understand what factors practitioners perceive to be important to develop greater collaboration and encourage the sharing of information during multi-agency emergency management.

RQ3 – How do LRF's and the WSP's collaborate with local community groups in the multi-agency approach to emergency management? This research question explores the link connecting the operational element and the community element within the emergency management system (Figure 1.5) to understand what this connection means in terms of contributing to building resilience between local communities and the responder organisations.

Objective 3: Understand individual attitudes and perceptions of water supply failure.

Objective 3, focuses on the 'bottom up' approach to emergency management. Since the introduction of the CCA, 2004, there has been a paradigm shift in emergency management from a focus on emergency response to encouraging greater resilience (CCA, 2004). However, in order to develop effective resilience based strategies that engage and encourage individuals to achieve resilience, a greater understanding of individual attitudes and perceptions of water supply failure is required. It has been recognised in the approach taken to develop system dynamic models of the emergency management system that there is a lack of understanding regarding water use and how individual behaviour may influence the dynamical behaviour of the wider system (Pagano *et al,* 2017; O'Sullivan *et* al; Kim *et al,* 2012). This objective aims to explore individual attitudes and perceptions to water supply failure to understand how this may influence individual behaviour during an emergency situation to achieve resilience. This explores how resilience operates within the individual element of the emergency management system (Figure 1.5).

There are two elements to achieving this objective. Initially attitudes and perceptions to water supply failure were explored using the results of a postal questionnaire sent to individual householders (Chapter 5). However, while this research was being conducted, a severe weather event during March 2018, resulted in the failure of the centralised water supply to over 200,000 people. This added another dimension to this research and provided an opportunity to observe

individual behaviour during an emergency situation. Social media is increasingly being used to disseminate emergency information to the general public. It was considered that analysing the interaction between WSP's and their customers in real time on the social media platform Facebook may provide an insight into attitudes and perceptions to water supply failure during an emergency (Chapter 6).

The following research questions were used to explore general attitudes and perceptions to water supply failure (Chapter 5);

RQ1 – How do individuals perceive water supply failure compared to other hazards? This research question was included to understand attitudes and perceptions to water supply failure in the context of other hazards. Do individuals perceive water supply failure to be high or low risk compared with other hazards identified within the national risk register? (National Risk Register, 2015).

RQ2 – What are the general attitudes and perceptions of water supply failure? This research question specifically explores the factors that contribute to the perceived risk of water supply failure. This is conducted through a series of Likert scale questions to understand whether individuals have experience of water supply failure, do they perceive it necessary to prepare and is this influenced by attitudes and perceptions of the WSP?

RQ3 – Where do individuals obtain information regarding hazards within their local area and if there is a failure of the water supply? Emergency management at the local level is informed through the risk assessment process and the development of the NRR and the Community Risk Register (CRR) at both a national level within government and a local level through the LRF. This research question explores where individuals obtain information regarding hazards in their local area. Is there awareness of the NRR, the CRR and information regarding how to prepare for emergencies on the Government website? This question also explores the use of social media by the WSP to disseminate information during an emergency.

Individual attitudes and perceptions to water supply failure during an emergency (Chapter 6) was explored using the following research questions:

RQ1 – What are the attitudes and perceptions of individuals to water supply failure during an extreme event as observed on the social media platform Facebook? Analysis of Facebook comments was conducted to develop a greater understanding of how individuals react and respond to water supply failure. This will enable the identification of factors that enhance or inhibit the ability of individuals to achieve resilience to water supply failure.

RQ2 – How is information shared through the social media platform Facebook between WSP's and customers during an extreme event? This research question seeks to identify whether the information provided by WSP's enables customers

to achieve resilience to water supply failure and whether the information provided by customers can be used to strengthen the WSP emergency response.

RQ3 – What information is required by customers and WSP's to enable resilience during an extreme event? This research question seeks to explore whether customers take active steps to achieve resilience to water supply failure during an emergency and what information can be provided by the WSP to support this. This research question also provides the opportunity to understand the connection between the individual and community element of the emergency management system and the operational element (Figure 1.5).

Objective 4: Investigate how the bottom up approach to emergency management can help to achieve resilience to extreme events through collaborative working partnerships

The Pathfinder Project (Twigger-Ross *et al*, 2015) highlighted the importance of working with community groups to achieve a greater resilience to the threat of flooding. Working collaboratively with local community groups strengthens local emergency response and provides access to greater resources and expertise (O'Sullivan *et al,* 2015; Coles and Buckle, 2004). However, are community groups being effectively integrated within the wider emergency management system? This is explored within Chapter 7, using a case study of a community that has developed strong links with responder organisations to ensure they are actively involved in the flood risk management system. This objective analyses

how resilience can be achieved within the community element of the emergency management system and whether community led schemes could be developed to achieve resilience to other hazards such as water supply failure incidents. This was explored using the following research questions;

RQ1 – What approach was taken to develop and establish a relationship with the LA within the case study example? Using participatory action research, this question seeks to identify how resilience can be achieved within the community element of the emergency management system (Figure 1.5) through the development of an extended network.

RQ2 – How does the process of building collaborative working partnerships contribute to improving resilience for the community, LA's and the WSP's? This research question explores the difficulties encountered in the process of developing strong working partnerships between local communities and responder organisations and what this means in terms of achieving resilience.

RQ3 – What are the challenges integrating the community into the emergency management process? This research question aims to provide a greater understanding of the connection between the individual and community element of the emergency management system and the operational element (Figure 1.5). What does this connection mean in terms of achieving resilience to extreme events and how can this be strengthened?

Objective 5: Taking a systems based approach, investigate the impact of the failure state to assess where vulnerabilities exist within the socio-ecological-technical system and how resilience can be achieved through effective emergency management.

Systems thinking and systems dynamic modelling are often used to develop a greater understanding of the structural aspects of the emergency management system (Franchin, 2018; Pagano, *et al,* 2017). However, emergency management systems are strongly influenced by social interactions between responder organisations and individual and communities affected by an emergency. As discussed within Section 1.3, these models do not necessarily explore these interactions within or across the wider system and this indicates a gap in the research between the systems based approach and the application of social research to understand how resilience operates within and across the wider system of emergency management (Franchin, 2018). This research incorporates social research within a systems based model to develop a greater understanding of the processes the drive the emergency management system to achieve resilience to water supply failure.

This objective takes a systems based approach to explore and understand how resilience to water supply failure is interpreted, applied and operationalised within and across each structural element of the emergency management system (Section 1.3, Figure 1.5). Each element of the system will be explored using qualitative and quantitative research methods as defined within Chapter 3 to achieve Objectives 1,2,3 and 4 (Chapters 1, 2, 4, 5, 6 and 7). The results of each

analysis will be synthesised through the process of triangulation (Chapter 3, Section 3.8) to determine how resilience operates within the emergency management system and will be discussed within Chapter 8.

The emergency management system will be applied to the Safe and SuRe intervention framework as defined within Section 1.2 (Figure 1.2). This will enable the identification of the main threats to the system and how the impact and consequences of these threats may affect the ability to achieve resilience to water supply failure. The use of intervention measures including mitigation, adaptation, coping and learning will also be explored to understand how these can be applied within the system of emergency management to achieve system resilience to water supply failure (Chapter 8). This will be presented as a series of recommendations within Chapter 9.

1.5   Thesis plan

The thesis plan demonstrates how a strucutured and methodical approach was taken to explore the UK emergency management system using the objectives discussed in Section 1.4 and demonstrates how the thesis will proceed.

AIM
To explore how improved resilience to water supply failure can be achieved through effective emergency management.

Chapter 1

Introduction

Chapter 2

Objective 1
Critically analyse the traditional risk based approach to emergency management and its application towards achieving resilience

Method
Literature Review

Chapter 3

Research Methodologies

Chapter 4

Objective 2
Investigate the multi-agency approach to emergency management in the UK.

Method
Semi-structured Interviews

Objective 3
Understanding Attitudes and Perceptions to Water Supply Failure

Methods

Chapter 5

Individual Homeowner Questionnaire

Chapter 6

Analysis of Facebook Comments during the 'Beast from the East'

Chapter 7

Objective 4
Investigate how the 'bottom up' approach to emergency management can help to achieve resilience to extreme events through collaborative working partnerships

Method
Case Study

Chapter 8

Objective 5
Taking a systems based approach, investigate the impact of the failure state to assess where vulnerabilities exist within the socio-technical system and how resilience can be achieved through effective emergency management.

Chapter 9

Conclusion and Recommendations

Figure 1.6: Plan of how the thesis will progress.

1.6 Originality and contribution to knowledge

This research takes a pragmatic and applied approach using quantitative and qualitative social research methodologies to explore how resilience to water supply failure can be achieved within the UK emergency management system. As demonstrated within Section 1.3 (Figure 1.4), in order to achieve resilience to an extreme event, effective collaboration and cooperation is required between emergency responders, infrastructure owners and operators and the individuals and communities affected. Systems thinking and systems dynamic modelling have been used to develop a greater understanding of the structural elements of emergency management systems. However, these models are limited with regard to understanding how social interactions influence the dynamical processes operating within and across the system (Pagano *et al,* 2017; O'Sullivan *et* al; Kim *et al,* 2012). The concept of resilience is a complex and dynamic process operating within and between different levels of society. However, it is often categorised within the contextual confines of one particular element of society and the relationship between different elements is rarely explored (Kimhi, 2016).

This research will apply a systems based approach to understand the structural elements of the system with social research methods to understand how resilience operates within and across the UK emergency management system. It is also the intention to demonstrate that future research should seek to explore and understand resilience as a dynamic process operating within a complex socio-ecological-technical system.

2 CHAPTER 2 - LITERATURE REVIEW

2.1 Introduction

Chapter 1 demonstrated how applying a risk based approach to preparing for extreme events may seriously challenge the ability of governments, emergency responders and society to provide effective emergency management with regard to the failure of critical infrastructure and the loss of essential services (Boin and McConnell, 2007). These events require the re-establishment of essential services within an environment that is complex, uncertain, chaotic and unpredictable in terms of the ability to determine the resources and capabilities required for effective emergency response (McMaster and Baber, 2012). These rapidly changing emergency situations have the potential to exceed the resources and capabilities required for a single organisation to respond effectively and require a multi-agency approach built around a framework of resilience (Boin and McConnell, 2007; Kapucu, 2006; McConnell and Drennan, 2006).

This research seeks to explore how improved resilience to water supply failure can be achieved through effective emergency management. One approach that can be used to identify where resilience measures are required is through the application of the Safe and SuRe Intervention Framework. However, the effective application of this framework requires a greater understanding of how the UK emergency management system operates with regard to water supply failure incidents and how resilience can be achieved within a complex dynamic system of interconnecting elements.

Within Chapter 1, Section 1.3 (Figure 1.5), the main elements of the emergency management systems were identified and comprise an institutional element at the level of government, an operational multi-agency element and individuals and communities affected by an emergency. This review of the literature will explore how the concept of resilience is defined within these different levels of society and briefly examine the system based approach to explore resilience within emergency management systems. This is to develop a greater understanding of what is meant by resilience within the context of a socio-ecological-technical system.

This Chapter will proceed with an introduction to the concept of resilience and how systems based models are used to explore resilience within socio-ecological-technical systems. This will be followed by an examination of how individual and community resilience are defined to provide a foundation for understanding resilience within the context of this research. Finally, this Chapter will explore the historical development of the UK emergency management system to understand how resilience is currently applied within the confines of the existing legislation and through the development of the multi-agency approach.

2.2   Exploring resilience within emergency management

As discussed in Chapter 1, (Section 1.1) the concept of resilience has been defined and conceptualised within many different disciplines. This has resulted in a great deal of confusion regarding what resilience actually means and how it can be effectively operationalised (Patel *et al,* 2017).

The concept of resilience established particular notoriety within the field of ecology following the publication of *"Resilience and Stability of Ecological Systems"* by Holling, 1973 to understand how ecosystems managed to continue functioning following a significant disturbance. Initially resilience was defined as *"The measure of the persistence of systems and of the ability to absorb change and disturbance and still maintain the same relationships between state variables."* (Holling, 1973). Later through the understanding of complex adaptive systems the theory of ecological resilience was extended to include socio-ecological systems and the adaptive capacity of a system to manage a disturbance resulting from an extreme event (Holling, 2001; Walker *et al,* 2004). In this context resilience was defined as "*The capacity of a system to absorb a disturbance and reorganise while undergoing change while retaining the same function, structure, identity and feedback."* (Walker *et al,* 2004). With resilience measured according to the magnitude of disturbance that the system could absorb before it changed to a different state.

Within the context of the UK emergency management system, the Cabinet Office, 2013c), defines resilience as:

> *"The ability of the community, services, area or infrastructure to detect, prevent and if necessary to withstand, handle and recover from disruptive challenges."*

However, the ability to *"detect, prevent, withstand, handle and recover"* may have a different meaning for a *"community, service, area or infrastructure"* organisation. This definition also suggests that resilience operates independently within each particular element of the system, rather than a dynamic process operating within a complex socio-ecological-technical system. A greater understanding of the complex inter-dependencies that exist within and across a system may provide a greater opportunity to identify, understand and determine where failures may occur and where resilience intervention measures are required (Weick and Sutcliffe, 2001; Crichton *et al*, 2009; Boin and McConnell, 2007).

Systems thinking and systems dynamic modelling have been applied to emergency management systems to explore and understand these complex interdependencies and where resilience intervention measures may be required. These will be discussed in the following section.

2.3   A systems based approach to understanding resilience

Systems thinking and systems based models provide an opportunity to understand how the physical and social system is connected and this approach is increasingly being used to understand the resilience of the emergency management system (Bruneau *et al*, 2003; Pagano *et al*, 2017; Franchin, 2018). Within many of these models resilience is considered a property of the system and is measured in terms of system performance (Chapter 1, Section 1.2, and Figure 1.1). This traditional approach within the field of engineering, defines resilience in terms of maintaining the stability of system performance when

subject to a disturbance (Holling, 1996; Gunderson, 2000; Hollnagel *et al*, 2007). Resilience is measured according to the ability of the system to anticipate and resist a disturbance and the time taken for the system to return to the stable state (Holling 1996, Hollnagel *et al*, 2007; De Bruijne *et al,* 2010; Matyas and Pelling, 2012). This assumes a predictable, linear, single stable state where system performance does not stray far from optimum operating conditions and the disturbance to the system is known. However, as discussed within Chapter 1, Section 1.1, extreme events are characterised by a rapidly changing and uncertain environment where many of the threats and hazards are unknown (Boin and McConnell, 2007; Crichton *et al,* 2009; Vespignani, 2010). Not only that, social systems are highly complex and may not necessarily 'bounce back' to the original state or level of functioning (Carpenter, 2008; Lindell, 2010; DFID, 2011).

There are many examples of system based methodologies to assess resilience of the emergency management system. These include probabilistic assessments to develop performance measures and targets, network modelling and system based analysis (Bruneau, *et al,* 2003; Franchin, 2018).

Bruneau *et al,* 2003, applied a systems based approach to measure community resilience to the threat of seismic risk. It was recognised that community resilience was influenced by four interdependent elements within the system. These included, the technical element which comprise the physical systems upon which the community depend such as water and electricity, the ability of these organisations to continue functioning during an emergency, the economic loss incurred from seismic damage and the societal element. This includes the

actions and measures taken to reduce the impact on communities and local government (TOSE framework).   It was recognised that attributing performance measures to each of these individual elements would provide a more effective measure of resilience than using the same measure of performance for the whole system.   However, while this approach provides a framework and foundation to understand how the physical system is connected for the purpose of performance measurement (Franchin, 2018) it does not explore how the system operates with respect to the social interactions between different organisations, individuals and communities affected by an emergency.   As discussed within Chapter 1, Section 1.3, attitudinal, perceptual and behavioural influences from the social environment can exert a strong influence on the ability to achieve resilience of technical and physical systems during an emergency.

Building on this approach, Pagano *et al,* 2017, applied systems dynamic modelling to understand resilience in the context of the L'Aquila earthquake case study.   A probabilistic approach was taken to assess the physical vulnerability of the drinking water distribution system to understand levels of service currently provided within the network.   This information was included within a series of systems dynamic models incorporating the four elements identified with the TOSE framework (Bruneau *et al,* 2003).   The models were developed together with emergency management professionals to understand how the system was connected and where resilience measures were required.   While this was an effective method to understand the resilience of physical infrastructure, again it does not explore how the behaviour of individuals or the local community may influence the system.   Another limitation of this approach is that while systems dynamic modelling may identify "community awareness" or "cooperation with

other institutions" as a potential constraint to achieving resilience, these models do not explore why this may be the case and whether this is a persistent problem within the system. As discussed within Chapter 1, Section 1.1, persistent problems identified within successive lessons learned reports may contribute to the continued failure to provide adequate emergency response and an inability to achieve resilience. However, identifying the cause of these persistent problems requires a greater understanding of how organisations, individuals and communities work together and the influence of these interactions on the resilience of the system.

Many of the system based models reflect a 'top down' approach to analysing or measuring the resilience of physical systems. The application of social research methods may provide the opportunity to explore and understand resilience from the 'bottom up'. This approach may provide a greater understanding of the underlying causative mechanisms inhibiting the ability to achieve resilience or enable the identification of methods to improve resilience.

O'Sullivan *et al,* 2015, applied the structured interview matrix approach (SIM) to explore and understand how to achieve a sustainable approach to build community resilience. This methodology relies on a participatory approach to encourage community engagement through the process of building collaborative working partnerships by combining a systems based approach with action research. The SIM approach was used to encourage participants from within the community to engage, collaborate and share information. This was conducted through a three stage process consisting of individual interviews, small group

discussions and a full group discussion. It was found that improved resilience to emergencies can be achieved by actively engaging communities in the decision making process. This contributed to a shared understanding of risk and a greater awareness of the resources and capabilities available within and outside the community for effective emergency response. Developing collaborative working partnerships between local community groups and responder organisations also strengthens emergency management through sharing local knowledge, information and expertise through the creation of social networks and building social capital (Norris *et al,* 2008; Gilchrist, 2009). This will be discussed in greater detail in Section 2.5. While the SIM approach is a useful approach to encourage greater engagement between community groups and responder organisations, it does not include the influence of the technical system and how a reliance on physical infrastructure influences the ability to achieve resilience.

Kim *et al,* 2012 applied a social technical approach to explore the complex interdependence between emergency responders and the technical systems required for effective emergency management. Emergency responders were asked to complete a structured survey to assess their confidence in delivering emergency response. This included questions relating to emotional support, training, information sharing, logistics and leadership. The results demonstrated how effective emergency management was dependent on the provision of adequate training, emotional support and the effective use of technology to share information. However, this approach did not explore the wider context and how working together with individuals and community groups may also influence the ability to achieve resilience in the emergency management system.

Examination of the empirical literature demonstrates how a system based approach to understanding resilience within emergency management systems provides a foundation to understand how the system is structurally connected and the identification of the complex interdependencies between different elements of the physical system. However, the limitation of these models is that they do not fully explore how resilience operates as a complex dynamic process within and across the emergency management system. This is because many of these models concentrate on understanding the physical characteristics of the system or the influence of social interactions within one part of the system. These models do not explore the complex interactions between organisations, individuals and communities within and across the wider emergency management system and how this may influence the ability to achieve resilience.

In the context of emergency management, resilience is also often applied within the confines of a risk management approach (Cabinet Office, 2013a) where the likelihood and impact of known threats and hazards is used to determine resources and capabilities for effective emergency response. While this approach is extremely effective for routine emergencies, it was demonstrated within Chapter 1, Section 1.1 and Section 1.3, this approach is not effective with regard to building resilience to extreme events (Huppert and Sparks, 2006; McCallum and Hemming. 2006; Pitt, 2008; Comfort *et al*, 2013).

As discussed within Chapter 1, Section 1.2, the Safe and SuRe methodology encompasses a socio-ecological-technical approach and defines resilience according to the *"degree to which the system minimises level of service failure*

magnitude and duration over its design life when subject to exception conditions".

It is not the intention of this research to develop or support specific definitions of resilience. There are hundreds of definitions within the academic and practitioner literature (Patel *et al.* 2017). While the use of definitions may provide a framework to understand the concept of resilience they can also be restrictive in terms of exploring how resilience operates as a dynamic process within and across a system. This is because there is tendency for definitions to constrain the understanding of resilience to specific threats or hazards or within one part of the system (Kimhi, 2016). It was identified by Franchin, 2018 that understanding the flow of resilience through a system would enhance the development of system dynamic models. This requires a greater understanding of the structural elements of the emergency management system and what resilience means in terms of the contributing and inhibiting social factors that influence the ability to achieve resilience.

The Safe and SuRe intervention framework is one approach that can be used to understand where resilience intervention measures need to be applied within a system. This approach has traditionally been applied to understand resilience of physical systems (Mugame *et al*, 2015; Butler *et al,* 2016). This research is developing the Safe and SuRe approach by applying the intervention framework to a social system, the UK emergency management system. However, to develop this approach requires a greater understanding of the UK emergency management system in terms of how resilience operates within and between the different structural elements of the system. As discussed within Chapter 1, (Section 1.3) these include the institutional element, the operational element and the individuals and communities affected by an emergency.

The following sections (Section 2.4 and 2.5) will examine the academic literature to develop a theoretical understanding regarding the concepts of individual and community resilience. The historical development of the UK emergency management system will be examined within Section 2.7 to understand how the institutional and operational element of the system was developed to incorporate the principles of resilience within a legislative framework. This information will provide a foundation to develop knowledge generated within this research, regarding how resilience operates within and between the different structural elements of the UK emergency management system. This will also provide a greater insight regarding the influence of institutional, individual and community resilience when applying the Safe and SuRe intervention framework to the UK emergency management system.

2.4   Understanding Individual resilience

According to the International Federation of the Red Cross *"A resilient individual is healthy; has knowledge, skills, competencies and mind-set to adapt to new situations and improve his/her life, and those of her/his family, friends and community. A resilient person is empowered"* (International Federation of the Red Cross, 2014). Understanding key concepts and exploring what is meant by individual resilience will help to inform a greater understanding of how attitudes and perceptions to water supply failure as defined within Objective 3, (Chapter 1, Section 1.4) contribute to the ability to achieve resilience to water supply failure.

The study of resilience at an individual level has its foundations within the field of psychology where resilience is defined as *"A dynamic process encompassing*

positive adaptation within the context of significant adversity" (Luther *et al*, 2000)*.* Individual resilience is dynamic, complex and relies upon internal strategies dependant on the individual's personality traits, mental health and personal wellbeing and the ability to use and possess resources within the external environment to overcome an adverse situation (Luthar, 2006). While individual personality traits will not be explored within the context of this research, this research will explore how the provision of information by WSP's during an emergency may increase the ability to achieve access to resources within the external environment (Chapter 1, Section 1.4, Objective 3 and Chapter 6).

Within the field of disaster risk reduction, understanding of psychological resilience has many practical applications and provided the foundation for understanding and developing effective coping mechanisms and strategies that may result in *'positive adaptation'* to the complex, dynamic and unpredictable nature of extreme events (Luther *et al,* 2000; Masten, 2001; Shalev, 2004; Mitchell, 2013; Hofler, 2014). In order to understand *'positive adaptation'* and the ability to achieve individual resilience to extreme events, it is also necessary to understand the components that contribute to this (Bonanno, 2004; Hofler, 2014) within the context of the wider society in which an individual resides (Becker *et al,* 2013; Eiser *et al,* 2012; Paton *et al,* 2006). Understanding the cognitive processes that shape and influence how an individual will perceive threats and hazards within their surrounding environment has important applications in disaster risk reduction because it may influence whether an individual perceives it necessary to take action to prepare.

According to the SEMD, 2009 (Chapter 1, Section 1.3) WSP's have a responsibility to ensure individuals affected by water supply failure are provided with an alternative supply of water. This increases an individual's ability to achieve resilience through the provision of resources by the WSP. A reliance on the WSP to provide an alternative supply of water may influence whether an individual perceives it to be necessary to take action to prepare. However, this will also depend on how they perceive the threat of water supply failure within their local environment compared to other hazards (Chapter 1, Section 1.4, Objective 3).

An individual's perception of their surrounding environment may be influenced by societal interactions and societal hazards (Dobbie *et al*, 2016; Donahue *et al*, 2014; Paton*,* 2013; Becker *et al,* 2013; Eiser *et al,* 2012; Paton *et al,* 2006; Dow and Cutter *et al*, 2000; Mileti, 1999). Societal hazards are hazards encountered on a daily basis and may include heavy traffic experienced during the rush hour, failure of public services preventing the ability to attend meetings, appointments or work, political instability or the threat of unemployment due to economic uncertainty. A daily exposure to these 'societal hazards' reinforced through the media and through societal interactions will naturally compete with the level of perceived risk attributed to an event that has a low probability of occurrence and may result in low preparedness for other hazards (Paton, 2003).

These complexities create many challenges for government institutions to raise awareness and encourage individual and societal preparedness to hazards within the natural environment. According to Donahue *et al,* 2014:

"Governments typically view individual-level preparedness responsibilities as involving activities like being informed about relevant hazards, developing an emergency communications plan, and maintaining a disaster supplies kit."

This 'top down' approach assumes that providing individuals with information regarding hazards will translate into action in the form of preparedness (Brodie *et al,* 2006). However, if an individual does not perceive a hazard to have an immediate effect or influence in their daily life it may not be considered relevant and will not be perceived as important to prepare (Bryan *et al,* 2019).

Within the TOSE framework the societal element relies on the 'top down' provision of emergency assistance in the form of alternative housing and the continuation of essential services (Bruneau *et al,* 2003; Pagano *et al,* 2017),. However, it may not be possible to provide emergency assistance during an extreme emergency event due to a lack of capability or resources (Pitt, 2008). To build resilience within the emergency management system and ensure the provision of adequate information to enable people to achieve resilience during an extreme emergency situation, requires understanding individual perceptions and attitudes to hazards within their local area (Chapter 1, Section 1.4, Objective 3).

The 'top down' approach also relies on the assumption that 'experts' and individuals share the same perception of risk. However, 'experts' whether they

are scientists, emergency management professionals or practitioners may have a different interpretation and perception of risk based on 'technical knowledge' and differences in how risk is defined (Donahue *et al,* 2014; Eiser *et al,* 2012; Slovic and Webber, 2002; Slovic, 1987). The 'expert' may define risk objectively based on numbers of individuals 'at risk' or the number of potential fatalities should a particular event occur. Whereas, an individual may define risk subjectively based on emotion, beliefs, sense of control, trust and values (Dobbie *et al*, 2016; Slovic and Webber, 2002; Ajzens, 1991). This may also be influenced by the collective knowledge of society, social identity, culture, the influence of the media (Dobbie *et al*, 2016; Rundblad *et al*, 2010) and whether an individual has direct experience of a hazard. In order to develop effective campaigns to encourage individuals to prepare for hazards and become more resilient to extreme events, it is necessary to explore individual perceptions of specific hazards and whether these exert an influence stimulating an individual to prepare. This will enable the effective targeting of campaigns and strategies to encourage individual resilience to specific hazards or extreme events in general. The inclusion of this information within systems based modelling (Bruneau *et al,* 2003; Pagano *et al,* 2017) may enhance the ability to understand how resilience operates within the wider system of emergency management. This may also enable the identification of persistent problems where a low awareness of hazards reduces the ability of individuals to achieve resilience and where effective targeting of information is required during an emergency situation (Chapter 1, Section 1.4, Objective 5).

The increasing use of social media and the ability to send and receive information very quickly may also have an influence on how risk is perceived particularly

during an emergency situation. WSP's are increasingly using social media platforms such as Twitter and Facebook to provide their customers with both general information and information regarding water supply issues. An absence of technical and specific information can lead to the spread of misinformation and the social amplification of risk (Slovic and Webber, 2002) especially if that information is disseminated quickly through social media (Bunney *et al,* 2018). For instance, the media and response of individuals on social media may present an image of a hazard that exceeds an individual's perception of their ability to cope or respond. This could allow an individual to assume they have no control over the situation leading to complacency (Dobbie *et al*, 2016; Paton, 2003) and a potential loss of resilience.

Individual perceptions of attributed responsibility and societal expectations of governments, responder organisations and utility companies may also influence whether an individual actively prepares for an extreme event (Levac *et al,* 2012). This may influence how the risk of a specific hazard such as water supply failure is perceived and whether it is perceived necessary to prepare (Levac *et al,* 2012; Paton, 2003). If an individual has a high level of confidence in the WSP's ability to provide a reliable, continuous and safe supply of water they may not take steps to actively prepare during an emergency (Shrubsole, 2000). Developing a greater understanding of individual perceptions and attitudes regarding the ability of WSP's to provide water in all circumstances may provide an insight into whether an individual will take action to prepare during a water supply failure incident. It may also provide further information regarding why individuals hold specific attitudes and perceptions and whether this will influence the type of action

individuals are willing to take to increase their resilience during an emergency (Chapter 1, Section 1.4, Objective 3).

Understanding individual interpretation and perception of risk is a complex process because it is influenced by many different factors. Slovic *et al*, 2004, explored the *'affect heuristic'*, how an individual's perception of risk may be influenced by experience or through association, the ability to imagine a particular event occurring (Slovic *et al*, 2004; Slovic and Webber, 2002). This stimulates *'affective reactions'* in the form of emotions and feelings of *'fear, dread, anxiety'* (Slovic *et al*, 2004). These emotions, whether positive or negative may stimulate hazard anxiety and affect how risk is interpreted and perceived but this does not necessarily translate into action (Paton, 2003).

The relationship between risk perception and whether an individual prepares for an emergency or disaster situation is also complex (Donahue *et al*, 2014; Carlino *et al*, 2008; Paton and Johnston. 2001). Governments, organisations and agencies rely on educational awareness programmes and communication strategies to warn and inform individuals of threats and hazards to encourage preparedness, response and improve recovery (Paton, 2013; Levac, *et al*, 2012; Paton, 2003). However, there is evidence to suggest these rarely encourage individuals to prepare (Donahue *et al*, 2014; Rundblad *et al*, 2010; Paton *et al*, 2008; Paton, 2006). Even in locations where hazards frequently occur, research suggests that individuals are not as prepared as would be expected and in some instances consider themselves to have a high level of preparedness when in fact their preparedness is low (Donahue *et al*, 2014; Levac *et al*, 2012; Eiser *et al*,

2012; Johnson *et al,* 2014; Lane *et al,* 2003; King, 2000; Ballantyne*,* 2000). This does not mean attempts to communicate the risk of hazards should be abandoned but that a greater understanding of the relationship between risk perception and preparedness is required. For instance, this may help to inform the communication of information by WSP's during a water supply failure incident to ensure individuals are informed regarding the actions taken by the WSP and the actions individuals make take to achieve greater resilience. It was discussed within Chapter 1, (Section 1.3) that following the flooding of Mythe water treatment works, the service reservoirs may have contained '*36 hours supply of water in normal circumstances'* (Severn Trent, 2007). However, this information was not communicated to the public and as result the service reservoirs were rapidly depleted. Understanding how the communication of information may influence individual's attitudes, perceptions and an intention to prepare may reduce the impact of these incidents and their contribution to a negative reinforcing feedback loop (Chapter 1, Section 1.3, and Figure 1.4).

The inter-relationship between risk perception, knowledge, trust and preparedness provides some interesting insights for the communication of hazards before, during and after an emergency and the process of building individual resilience to extreme events. It is considered the provision of information regarding the risk of hazards will provide individuals with the information they require to prepare and this will naturally translate into action. However, this is also dependent on how that information is interpreted and this can depend on many factors. These include personal beliefs, values, attitudes and trust particularly regarding how the sender of the information is perceived (Dobbie *et al*, 2016). If the information is provided from a trusted source this may

exert an influence on preparedness but is also dependent on whether an individual perceives preparedness as their responsibility, that of another organisation or the trusted source (Paton, 2003; Paton and Johnston, 2001). A greater understanding of these complex inter-relationships and the influence on preparedness, may provide further insight regarding how individuals can achieve resilience to water supply failure.
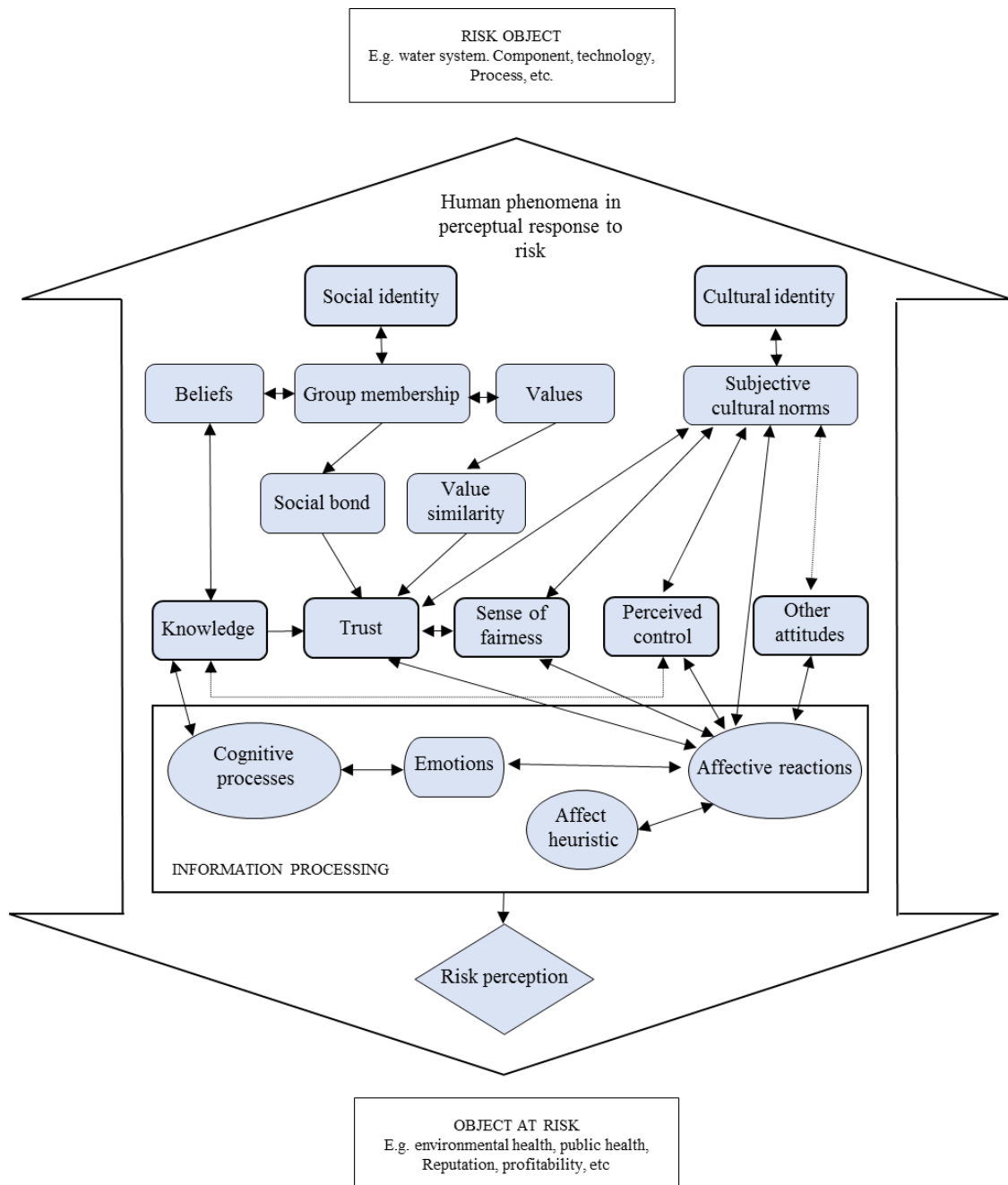
Figure 2.1: Framework showing influences of risk and perception adapted from Dobbie *et al*, 2016.

Building on the research conducted by Slovic *et al,* 1980 (Slovic *et al,* 1982; Slovic, 1987; Slovic, 2001), Dobbie *et al*, (2016) conducted a review of the literature and incorporated these processes within a framework of risk perception. This was developed to increase understanding among water practitioners of the factors that influence risk perception. Within the framework, Dobbie *et al*, (2016) demonstrate how knowledge, trust, sense of fairness, perceived control and other attitudes, influence affective reactions and cognitive processes and how these in turn influence risk perception (Figure 2.3). However, this model did not explore whether risk perception influences an individual to actively prepare. Paton, 2003, proposed a social cognitive model to understand the relationship between risk perception, the intention to prepare and actual preparedness. The model was developed to understand the motivations encouraging individuals to take action (Figure 2.4).
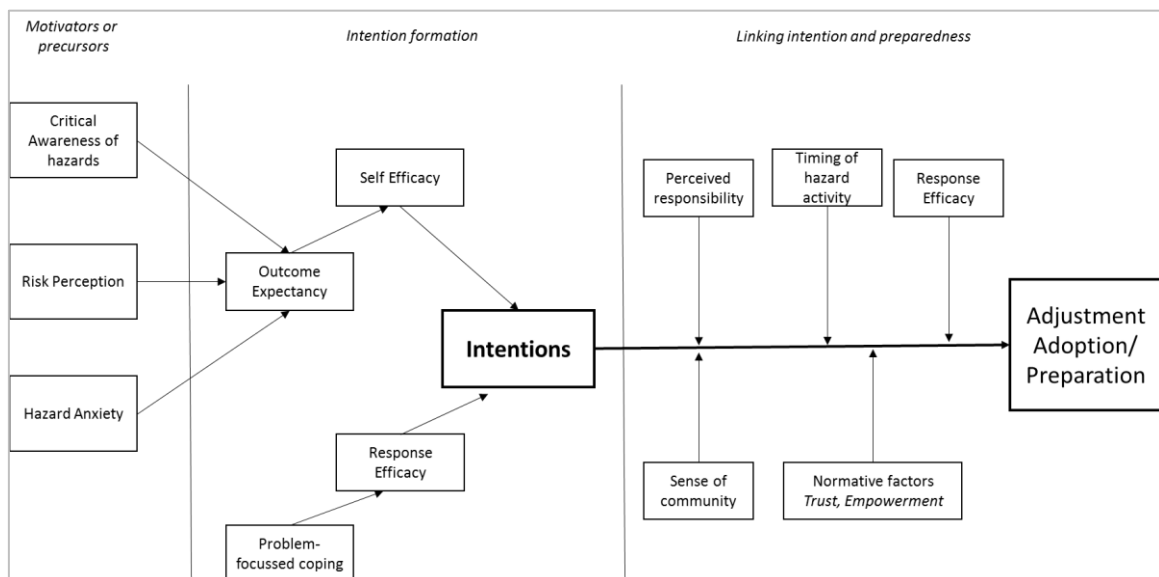
Figure 2.2: Social cognitive preparation model adapted from Paton, 2003

It was considered that risk perception is not the only influencing factor that may encourage an individual to take effective action to prepare. The model proposes that a combination of hazard anxiety, risk perception and an awareness of the consequences of a specific hazard all contribute to a determination of whether an individual perceives they possess the capability to take action to prepare. This is also determined by an individual's perception regarding the availability of resources enabling them to respond. These may include personal circumstances, availability of finances, social support and community cohesion. These are also influenced by social and cultural identity, knowledge, trust and perceived control in the determination of perceived responsibility to prepare for extreme events. All of which influence the cognitive processes contributing to risk perception. This demonstrates there are many similarities between the two models in that a critical awareness of hazards requires knowledge and trust which also influences an individual's perceived control, the affect heuristic and contribute to an increase or decrease in hazard anxiety.

All of this information contributes to a greater understanding of individual resilience to water supply failure and provides a foundation for further exploration within this research. This review of the literature highlights the many complexities associated with understanding individual resilience. To understand how to build individual resilience to water supply failure requires a greater understanding of the relationship between an individual's perception of risk and the factors that may influence preparedness. There is a tendency for hazard information to be communicated to the individual with the assumption that the individual will understand this information and use it to prepare. However, as research has demonstrated the intended outcome is not always achieved and this is related to

how an individual will perceive the risk within the context of their ability to prepare and perceived responsibility.

Society is composed of a collection of individuals who will go about their daily lives interacting and integrating within society but also operating as an individual. It is also important to understand how societal hazards, interactions and knowledge influence individual perceptions and attitudes. This is of particular interest with regard to the increasing use of social media and how this may influence an individual's perception of risk during an emergency.

While this review of the literature and the empirical research have highlighted how a lack of individual and *'community awareness'* (Pagano *et al,* 2017), may provide a constraint to achieving resilience to water supply failure, it is also necessary to contextualise this information within the wider emergency management system. This will enable the development of recommendations regarding how resilience can be achieved and supported though appropriate resilience intervention measures. This information will contribute to the triangulation of results presented within Chapter 8 and a greater understanding of how resilience operates within the context of the UK emergency management system. This section demonstrates the empirical approach to systems based models may also be supported through knowledge and understanding of resilience from within other disciplines.

As demonstrated within the social cognitive model proposed by Paton 2003, individual resilience can also be supported through the development of social networks through a sense of community and increased community involvement (Eiser *et al,* 2012; Paton, 2008; Paton, 2006; Werner and Smith, 1992). This will be explored within the following section.

2.5   Understanding Community resilience

The concept of community resilience has been widely explored throughout the academic literature. However, a consensus regarding a definition of community resilience has been difficult to achieve (Patel *et al,* 2017; Ostadtaghizadeh *et* al, 2015; Deeming *et al*, 2014; Norris *et al,* 2008). This has created difficulties in the operationalisation of resilience by practitioners because many of the definitions of community resilience are specifically related to the community being studied (Patel *et al,* 2017). This section explores what is meant by community resilience to inform a greater understanding of how working together with community groups as defined within Objective 4, (Chapter 1, Section 1.4) may contribute to achieving resilience to water supply failure.

O Sullivan *et al,* (2015), demonstrated how a participatory approach could be used to encourage community resilience through building collaborative working partnerships that actively engage communities within the emergency management process. This approach allows for the heterogeneity that exists within and between community groups. However, this approach also requires a great deal of time and resources in order to be effective. The 'top down' approach taken by Governments to encourage community resilience does not necessarily

support the heterogeneity that exists between communities through the delivery of standard community resilience plan templates (Cabinet Office, 2016).   The approach taken with the TOSE framework (Bruneau *et al*, 2003) also assumes a homogenous approach to the societal measurement of resilience.

Within the UK emergency management system there is a focus on building community resilience to flooding (Cabinet Office, 2016).   However, as demonstrated within Chapter 1, (Section 1.1 and 1.3) and the recent *'Beast from the East'* (Ofwat, 2018; Water UK, 2018) water supply failure incident, the failure of critical infrastructure and the resultant loss of essential services, are also hazards that should be prepared for.

Communities by their very nature are heterogeneous and susceptible to different challenges in response to threats and hazards depending on their location, structure, connectivity and socio-economic status (Gilchrist, 2009; Paton, 2003; Paton and Johnston, 2001; Paton *et al,* 2000). While the application of a specific set of attributes and measurement scales may be appropriate to understand resilience within one particular community, they might not be transferable to another. This has the potential to create difficulties operationalising the concept of resilience because a 'one size fits all' approach does not allow for the differences that exist within and between community groups (Gilchrist, 2009). Attempting to constrain the concept of resilience within a prescribed set of attributes and associated measurement scales is challenging the ability to achieve a consensus regarding a definition for community resilience (Patel *et al,* 2017). In an attempt to overcome some of these difficulties Norris *et al,* (2008)

considered the concept of community resilience as *'a process linking a network of adaptive capacities'.* These include economic development, social capital, information and communication and community competence (Figure 2.5).

Economic development may influence the ability of a community to achieve resilience if there is adequate financial resources to invest in mitigation to reduce the risk of hazards and this is available within each socio-economic status of society. This ensures that vulnerable communities who under normal circumstances may have limited access to physical resources are provided with the necessary financial support and assistance required for mitigation and recovery following an event (Levac *et al,* 2012; Paton, 2003).
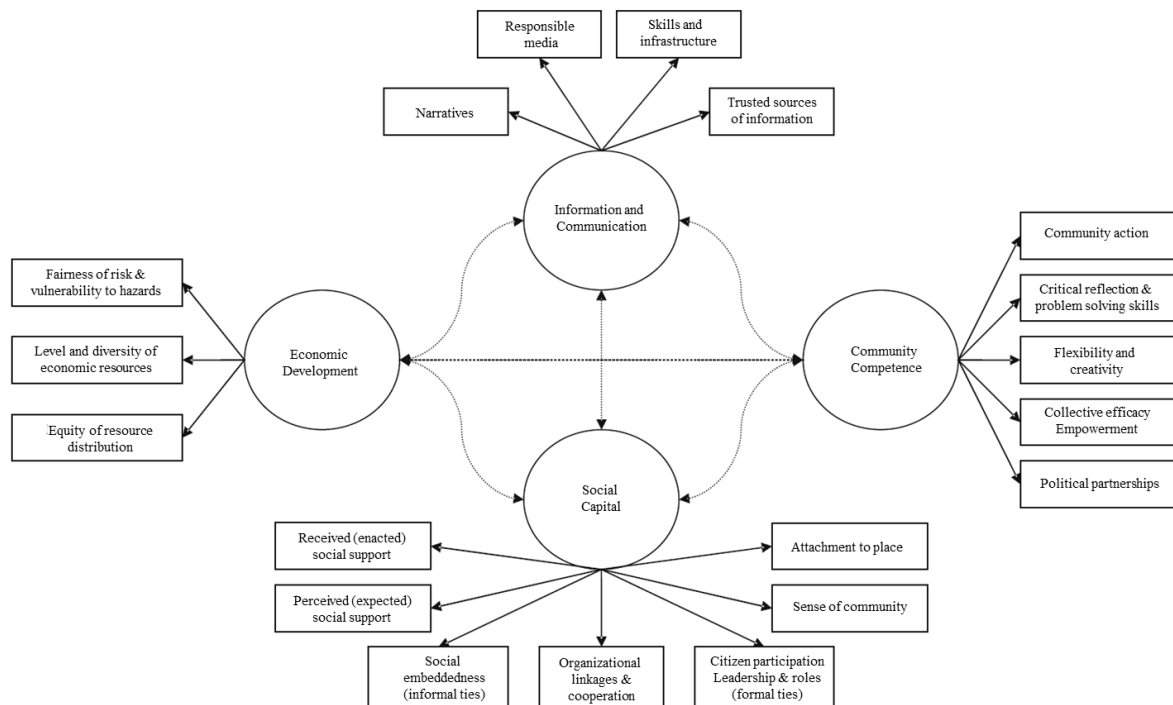
Figure 2.3: Community resilience represented as networked adaptive capacities from Norris *et al,* 2008.

Social capital is the process of establishing connections and building relationships with people, communities and organisations and understanding how these relationships may provide benefit through access to resources (Aldrich and Meyer, 2015; Murphy, 2007; Dynes, 2002; Lin *et al*, 2001; Portes, 1998). However, it is not simply the process of establishing a connection with a person or organisation but understanding how that connection develops into a sustainable relationship over time, how the strength of that connection may change and what this means in terms of access to resources (Portes, 1998; Burt 1992; Granovetter 1983). This in turn influences the process of encouraging collective action before, during and after an emergency and may provide a deeper understanding of what a community needs in order to build resilience (Aldrich and Meyer, 2015; Dynes, 2002; Portes, 1998). It may also provide a deeper understanding of how a responder organisation or utility company can work together with a community during an emergency situation.

Information and communication relates to the provision of accurate and timely information required for effective emergency response. However, as demonstrated within the previous section regarding individual resilience, access to information does not necessarily encourage individuals or communities to prepare (Donahue *et al,* 2014; Levac *et al*, 2012; Eiser *et al,* 2012; Johnson *et al*, 2014; Lane *et al,* 2003; King, 2000; Ballantyne, 2000).

Community competence is the ability of a community to actively engage in the process of preparedness through the acquisition of accurate local knowledge and information regarding the threats and hazards prevalent within their local area.

This information can be used to assess the resources and capabilities that exist within the local community in the development of a community plan and to determine the collective ability to respond (Paton and Johnston, 2001). As demonstrated by O'Sullivan *et al,* (2015), the sharing of local knowledge with responder organisations may also strengthen the emergency management process and the development of effective communication networks.

Patel *et al,* 2017, conducted a thematic analysis of the literature to explore the characteristics of community resilience. From a review of over 80 papers, they identified 9 key *'elements'* of resilience. These include local knowledge, community networks and relationships, communication, health, governance, resources, preparedness, economic investment and mental outlook. These themes share many similarities to the adaptive capacities identified by Norris *et al*, 2008, with economic development, social capital, information and communication and social competence synonymous with economic investment, community networks, communication, local knowledge, resources and preparedness.

The identification of themes allows for the heterogeneity that exists within and between different communities. This approach also allows for the development of resilience based strategies and increases the ability to effectively operationalise the concept of community resilience within the wider system of emergency management. In contrast, the application of a homogenous set of measurement scales and indicators constrain the concept of resilience within a prescribed set of attributes. This approach does not allow for heterogeneity of

community groups and assumes a homogenous set of criteria is applicable within all communities.

The identification of specific indicators as a measure of community resilience may also contribute to the perception that resilience is a static outcome rather than a continually evolving, dynamic and flexible process (Patel *et al,* 2017; Cutter *et al,* 2008; Norris *et al,* 2008). Simply possessing a particular set of attributes does not necessarily result in a resilient community particularly considering the unpredictable nature of cascading events and the consequences of unknown threats and hazards. Community resilience needs to be understood as part of a wider system of emergency management (Paton *et al*, 2000; Tobin *et al*, 2014). A system that is dynamic, driven and motivated through the development of relationships based on trust, knowledge, sharing of information and support. A sense of community and the building of relationships may contribute to a shared perception of risk and the development of appropriate mitigation strategies relevant to the community (Paton, 2003). The incorporation of this knowledge within systems based models will enhance the understanding of how resilience operates within the wider system of emergency management and this is approach taken within this research (Chapter 1, Section 1.4, Objective 4).

This review of the literature demonstrates how community resilience can be viewed as the collective ability of a community to cope, adapt and recover from an adverse situation (Faas and Jones, 2017: Cox and Hamlen, 2015; Cutter, 2008; Paton and Johnston, 2001). However, all of these actions require the support of external organisations and must be considered within the context of a

wider emergency management system. The next section will explore how the process of emergency management is defined.

2.6   The emergency management cycle

The process of emergency management is traditionally defined by the four stages of the emergency management cycle, mitigation, preparedness, response and recovery (NGA, 1979; Dynes, 1982; Quarentelli, 1986; Neal, 1997; Alexander, 2002b). These represent the main stages through which an emergency develops and define the process by which emergency management is conducted. Mitigation typically involves the development of physical changes within the built environment to reduce exposure to hazards. For instance, this may include the building of flood defences within urban areas to reduce the consequences of flooding or the building of earthquake resistant structures within seismically active regions.

Emergency preparedness encompasses the accurate identification and anticipation of known threats and hazards, the assessment of the potential risk, a defined methodology for forecasting and warning, the preparation of an emergency plan (Alexander, 2003), training personnel in the operational delivery of emergency response and exercising to ensure operational effectiveness (Alexander, 2002a: Perry and Lindell, 2004).

Emergency response is the active process of responding to an emergency and typically involves the collaboration and coordination of multiple agencies. This

requires the development of accurate situational awareness to ensure effective emergency response (Quarentelli and Dynes, 1977; Perry and Lindell, 2004), knowledge of organisational roles and responsibilities to encourage multi-agency coordination (Perry, 1991) and the flexibility to respond to rapidly changing, dynamic situations (Perry and Lindell, 2004)

Recovery is the process of rebuilding community structure, re-establishing the provision of essential services, rebuilding damaged infrastructure and conducting a review of the emergency response with an intention to learn lessons and adapt. This may be through the development of mitigation strategies, the incorporation of lessons learned into emergency procedures or the development of improved working practices (Dynes, 1982).

This cycle of emergency management represents a continual and dynamic process to reduce the magnitude of any given event through adequate mitigation and preparedness and to minimise the event duration through effective emergency response and recovery (Dynes, 1982; Alexander, 2002a; Neal, 1997; Perry and Lindell, 2004; De Bruijne *et al,* 2010).

While the emergency management cycle is typically used to define the process of emergency management, there are a number of limitations with this approach and its application to emergency planning (Neal, 1997; Crondstedt, 2002). It gives the impression that each phase represents a single entity of equal measure that follows a natural progression from one phase to the next (Crondstedt, 2002).

However, studies of natural disasters demonstrate these phases are often interrelated, integrated and include actions that may have attributes that cannot easily be applied to one specific phase (Neal, 1997). Not only that, specific actions attributed to a particular phase may be implemented prior to the commencement of that phase to ensure an effective emergency response (Neal, 1997). The cycle also assumes a linear approach to emergency planning and response when in reality this process is non-linear (Perry and Lindell, 2004). Despite these limitations, the emergency management cycle is still referred to when seeking definitions of emergency management.

This chapter will continue to explore the historical development of emergency management within the context of the UK emergency management system and the development of the multi-agency approach.

2.7   The development of the UK emergency management system

Kim *et al,* (2012) explored the complex interdependence between emergency responders and technical systems. However, understanding the historical context and legislative framework developed to enhance resilience through encouraging multi-agency collaboration will provide a greater insight into how resilience operates within the UK emergency management system. This section examines how the UK emergency management system operates within a legislative framework to achieve resilience through a multi-agency approach as defined within Objective 2 (Chapter 1, Section 1.4).

The last 60 years have seen a considerable change in how emergency management is conducted within the UK. With the introduction of the Civil Defence Act, 1948, in response to the singular threat of a nuclear attack, emergency management followed the *'command and control'* methodology typified by the zeitgeist of the period. This was conducted at a local level where *'expert knowledge'* would allow for the effective response to a war related emergency (Jackson, 1994; Neal and Phillips, 1995: Alexander, 2002b).

The public were actively encouraged to prepare for nuclear attack and by building upon the success of voluntary organisations during World War II and strengthening the resolve for preparation in the event of attack, the Civil Defence Corps was established (Jackson, 1994). By the 1960's there were over 30,000 highly trained volunteers available to provide the necessary assistance before, during and after a nuclear emergency (Jackson, 1994).

Throughout this period emergency management was very reactive in terms of emergency response (Dynes, 1982; Quarentelli, 1986; Salter, 1998) and was largely driven by a focus on single hazards with response organisations working in isolation of one another (Salter, 1998; Cronstedt, 2002). However, poor planning, the inability to consider multiple hazards and a lack of collaboration between multiple agencies in emergency response demonstrated that this approach was not adequate to deal with extreme emergency situations (Dynes, 1982; Quarentelli, 1986).

The authoritarian '*command and control'* methodology also presented challenges in dealing with extreme emergency situations (Alexander, 2002b; Davis, 2011). Whilst this approach is very effective when dealing with '*routine*' emergencies (Kapucu, 2005; Boin and Hart, 2010), it does not provide the flexibility that is required to deal with a rapidly changing dynamic situation characterised by an extreme event or disaster (Alexander, 2002b; Anderson and Adey, 2012; Boin and Bynander 2015).

A period of review followed and led to the introduction of the Civil Protection in Peacetime Act, 1986 (Jackson, 1994; O'Brien, 2008; Cabinet Office, 2012). However, the transition in emergency management from one of Civil Defence to Civil Protection was not without difficulty (Hill, 1993: Jackson 1994). The systems that had been developed to ensure effective civil protection, were subject to a reduction in government spending resulting in the loss of the 30,000 highly trained volunteers and led to an uncertain future for emergency management (Jackson, 1994; Zebrowski, 2015).

Publications such as *'Dealing with Disaster'* issued by the Home Office sought to provide guidance for emergency responders in how to effectively deal with a disaster situation (Home Office, 1993; Jackson, 1994; Bye and Horner, 1998). The guidance aimed to support greater flexibility within civil protection for dealing with extreme events through an integrated approach. The Local Authority was responsible for the co-ordination of emergency planning with the Police taking the lead role of command and control during a major incident. However, the guidance was still constrained within the legislative framework and methodology of the Civil

Defence Act, 1948. Furthermore, it was questionable as to whether there were adequate resources to deal with a disaster at a local level given the fact that government funding had been reduced and there was a significant loss of emergency response systems that had been developed and relied upon for Civil Defence purposes (Jackson, 1994).

In order to create a flexible and dynamic response to an extreme event, a radical change in the legislation would be required. Tragically, the driving force for a fundamental change in government policy typically results from a major incident and the UK is no exception, particularly in the case of flooding (Boin and Hart, 2010; Johnson *et al,* 2005). The 1998 Easter Floods represented a significant moment in terms of influencing policy within the UK with respect to the management of flooding. Over 4500 properties were flooded (Bye and Horner, 1998), with peak river flows in many of the affected locations exceeding historic flood levels. With the formation of a new agency to deal with flood related issues, it was easy to apportion blame to a lack of warning and inadequate flood defences. However, the poor response of the emergency services in terms of coordination, inadequate resources and multi-agency collaboration were also identified as contributing factors (Bye and Horner, 1998). This also highlighted a lack of resilience within emergency management to the challenges imposed by a changing climate (Johnson *et al*, 2005).

While flooding was high on the political agenda in response to the 1998 flood event, it was not the only threat to civil protection within the UK.   Throughout the

years that followed, a number of incidents occurred that seriously tested the effectiveness of the way in which emergency management was being conducted.

The extensive and widespread flooding during Autumn 2000 provided another defining moment for UK emergency management. With over 10,000 properties flooded, major disruption to transport networks, critical infrastructure and damage totalling over £1 billion (Environment Agency, 2001; Penning-Rowsell *et al,* 2002; Johnson *et al,* 2005; Penning-Rowsell and Wilson, 2006; Cabinet Office, 2004), the true cost of an extreme event was realised.   The ability to deal with an escalating situation where one event cascades into a series of events of increasing magnitude, demonstrated the need for a flexible approach to emergency management (Perry and Lindell, 2004).

This was further reinforced during 2001. While the country was recovering from the effects of Autumn 2000, a severe outbreak of the highly contagious Foot and Mouth disease exerted a further strain on the UK emergency management system (Anderson, 2002; National Audit Office, 2002). Again, challenging the system of emergency management to respond dynamically to the changing needs and pressures resulting from a cascade of multiple events that had not been anticipated.

The current system was inadequate to deal with emerging threats of this scale and magnitude (Home Office, 1991; Anderson, 2002; National Audit Office, 2002). In order to be able to effectively prepare and respond to these rapidly

changing, dynamic, extreme events required an approach that had the capacity to anticipate, adapt and change in response to the emerging situation (O'Brien, 2008; Boin and Hart, 2010; Anderson and Adey, 2012). The future of emergency management was in need of a radical change.

These events prompted the government to initiate a thorough review of the existing legislative framework and structure. The responsibility for emergency management was passed from the Home Office to a newly formed Civil Contingencies Secretariat and a consultation period ensued to change the existing legislation (O'Brien and Read, 2005).

The introduction of the CCA, 2004 led to a shift in the way emergency management was conducted in the UK with the concept of resilience incorporated within a legislative framework and operationalised through the delivery of the Resilience Capability Programme (Cabinet Office, 2012; O'Brien and Read, 2005; O'Brien, 2008). Building on the principle of integrated emergency management this involved the incorporation of 6 main themes of anticipation, assessment, prevention, preparation, response and recovery into the emergency planning process (Cabinet Office, 2012; McMaster and Barber, 2012). With resilience building initiatives to be promoted within each theme to ensure the country was adequately prepared to respond to an extreme event rapidly and effectively (Cabinet Office, 2013a). It was recognised that in order to be able to respond effectively to extreme events would require greater integration, cooperation and collaboration between all of the organisations involved in emergency management in the UK. This multi-agency approach was promoted

through the development of LRF's and supported with the publication of guidance documents including Emergency Preparedness (Cabinet Office, 2011), Emergency Response and Recovery (Cabinet Office, 2013a) and the Concept of Operations (Cabinet Office, 2013b).

As discussed within Chapter 1 (Section 1.3), LRF's are composed of Category 1 and Category 2 responders (Figure 2.6). Category 1 responders include the emergency services, Local Authorities, Health Authorities and the Environment Agency (Cabinet Office, 2012). These organisations have statutory duties under the CCA, 2004 to cooperate, share information, assess risk, maintain emergency and business continuity plans, communicate to the public and promote business continuity (Cabinet Office, 2012).
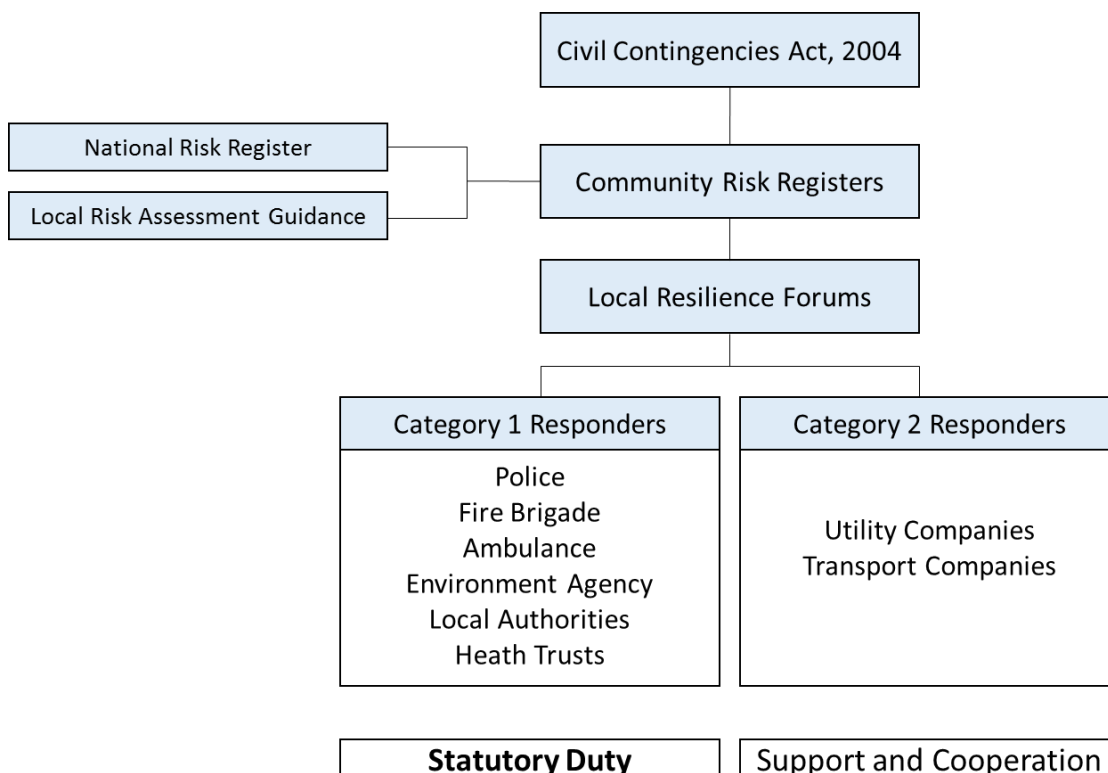
Figure 2.4: The UK multi-agency approach to emergency management

Category 2 responders include Utility, Telecommunications and Transport companies and although they do not have any statutory duties defined within the Act they are expected to assist Category 1 responders in their duties:

'*Category 1 responders should be supported in their assessment by Category 2 responders, local bodies, DCLG RED and national organisations sharing information and cooperating as appropriate.'* (Section 4.34, Cabinet Office, 2012).

LRF's operate locally within the confines of Police operational boundaries. However, some of the Category 1 responders such as the Environment Agency, Health Trusts and the Ambulance Service operate regionally and cover a much larger geographical area. Within a region, these organisations may encompass 1 or more LRF's. Many of the Category 2 responders such as the WSP's, electricity and telecommunication providers operate over a much wider geographical area that may encompass one or more regions and therefore multiple LRF's (Figure 2.7).

In order to ensure good practice and a consistent approach the Cabinet Office provided guidance for responders on how the risk assessment process should be conducted. This is contained within Chapter 4 of the Emergency Preparedness Guidance (Cabinet Office, 2012) and enables LRF's to assess risk through the development of a Community Risk Register (CRR).
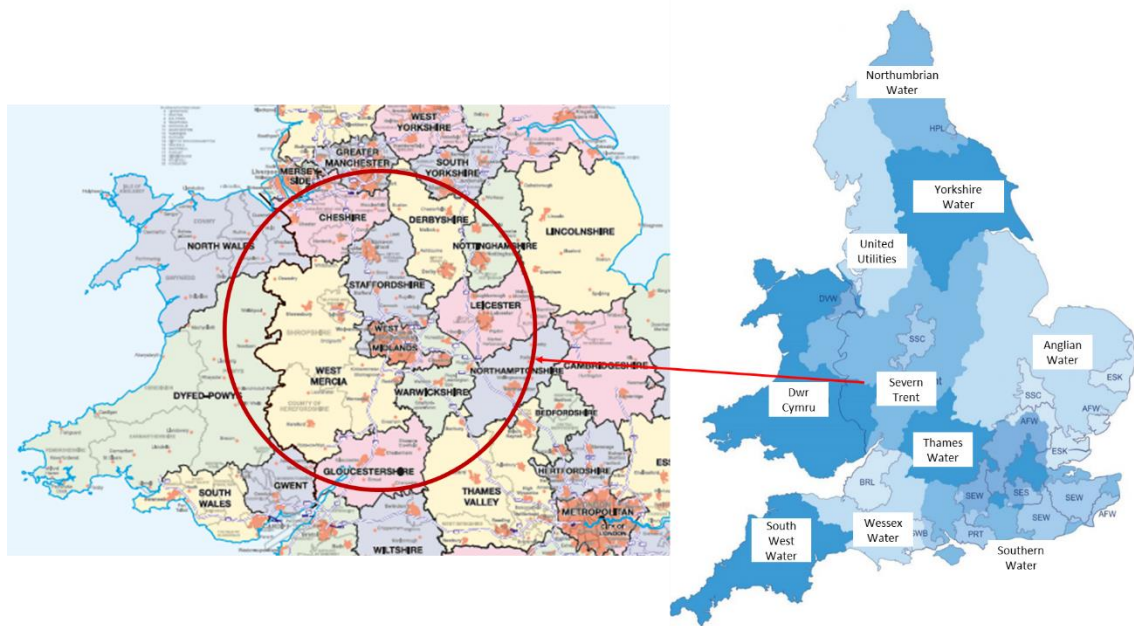
Figure 2.5: The area covered by Severn Trent encompasses many Police operational boundaries and LRF's.

(Police operational boundaries map adapted from HMSO, 2019.

WSP boundary map adapted from Ofwat, 2019)

Further information regarding hazard and threat categories is provided on an annual basis by central government within the Local Risk Assessment Guidance and the National Risk Register (NRR). It is the intention that through the accurate identification and understanding of local risks, Category 1 responders are able to use this information to inform future planning and assess current and future contingency arrangements (Cabinet Office, 2012). It was considered that within a framework of integrated emergency management the introduction of the CCA, 2004, would provide the flexibility required to respond to changing dynamic emergency situations through a multi-agency collaborative approach at a local level.
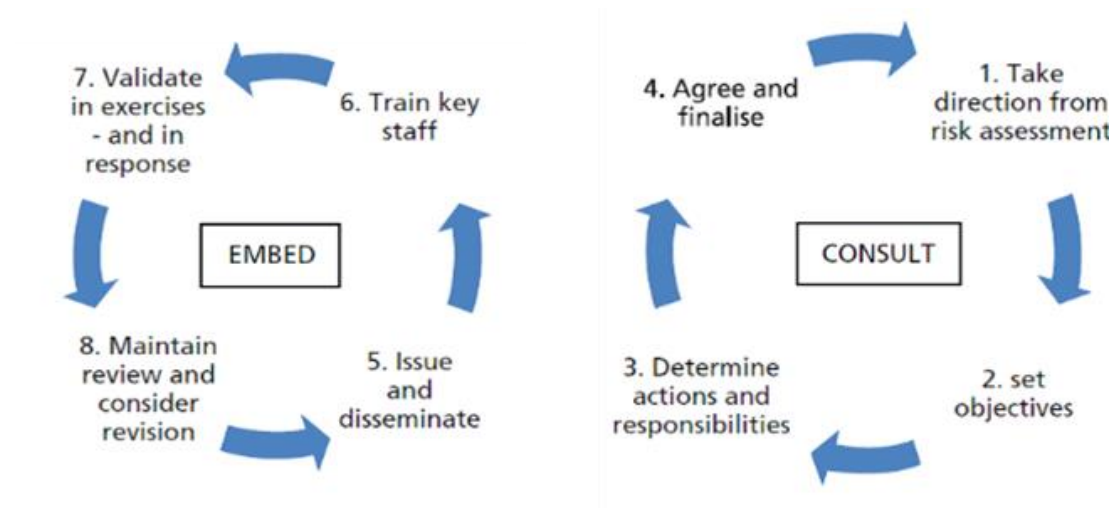
Figure 2.6: Cycle of emergency planning as determined by the UK Cabinet

Office, (2011)

The UK cabinet office categorises the process of emergency management into two phases of development (Figure 2.8). The consult phase involves the assessment of risk, defining objectives, the determination of roles and responsibilities and finalisation through agreement. The embed phase is where the information determined within the consult phase is incorporated within training and exercising for effective emergency response. These stages are to be conducted within the framework of the LRF.

Emergency planning is a continuous process involving the interaction of many different organisations in the identification and anticipation of multiple threats and hazards, the assessment of risk, mitigation, preparedness and the delivery of an effective emergency response (Dynes, 1982; Alexander, 2002a; Perry and Lindell, 2004). The introduction of the CCA, 2004 sought to apply this approach to achieve a greater resilience to extreme events. However, the flooding of Mythe

water treatment works in 2007 highlighted difficulties with the multi-agency response and the sharing and exchange of information required for effective emergency response between the Category 1 and the Category 2 responders (Pitt, 2008). As discussed within Chapter 1, (Section 1.3) this led to a loss of resilience contributing to a cascade of failures, increasing the failure magnitude and the time taken for recovery (Chapter 1, Figure 1.1).

The Pitt report (Pitt, 2008) proposed 2 recommendation regarding multi-agency collaboration:

> *"**Recommendation 55:** The Government should strengthen and enforce the duty on Category 2 responders to share information on the risks to their infrastructure assets, enabling more effective emergency planning within Local Resilience Forums"*

> *"**Recommendation 56:** The Government should issue clear guidance on expected levels of Category 2 responders' engagement in planning, exercising and response and consider the case for strengthening arrangements."*

These recommendations assume that the process of multi-agency emergency management operates effectively within the framework of the CCA, 2004 and enforcing a duty on the Category 2 responders to share information regarding risk will prevent this problem from reoccurring in the future. However, there may be underlying causative mechanisms within the wider system of emergency management preventing Category 2 responders from actively participating in the emergency management process and these have not been explored.

The multi-agency approach is also based on the assumption that organisations that operate very differently on a daily basis will be able to work together effectively within a pressurised, rapidly changing, dynamic emergency situation (Smith and Dowell, 2000). On a daily basis, many of these organisations operate within a very different organisational culture and this may have an influence on the management style and structure. For instance, an emergency response organisation typically operates within a top-down, hierarchical, command and control environment because this is how they respond to emergency situations every day. Whereas a utility company may adopt a different management style where decision making is shared across the organisation. Operating within a different organisational culture may influence an organisations ability to respond effectively to an extreme event and this was identified as a problem during the flooding of Mythe water treatment works (Pitt, 2008). The WSP was not familiar with the command and control approach adopted by the Category 1 responders in the development of accurate situational awareness and the Category 1 responders were also not aware of the restrictions placed on WSP's regarding the security of information (Pitt, 2008). This lack of understanding regarding roles and responsibilities of each operating organisation created difficulties in the sharing of information.

Following the terrorist attack on the World Trade Centre during 2001, a great deal of attention was focussed on the protection of critical infrastructure from the threat of terrorism (Perry and Lindell, 2004; O'Brien and Read, 2005). However, as the 2007 flood event demonstrated, resilience to other hazards and preparedness for extreme emergency situations needed to be assessed. The lessons learned report following this event (Pitt, 2008) was instrumental in changing government

policy with regard to achieving a greater resilience of critical infrastructure to flooding.

The 'Adapting to Climate Change' programme led by Defra and the 2009 programme 'Adapting Infrastructure to Climate Change' sought to investigate how the resilience of critical infrastructure could be achieved. This included a critical infrastructure mapping project that identified 63 WSP sites at risk of a 1:200 year flood event (Cabinet Office, 2010) and recommended all critical national infrastructure should be protected to a 1:200 year standard. In 2010, Ofwat published 'Asset Resilience to Flood Hazards: Development of an analytical framework', this was developed to provide good practice guidance to achieving flood resilience (Ofwat, 2010). The Cabinet Office Infrastructure Resilience Programme also published 'Keeping the Country Running: Natural Hazards and Infrastructure' as guidance for achieving resilience of critical infrastructure and a national programme was developed to introduce sector resilience plans (Cabinet Office, 2011b). These were developed to identify the current level of resilience within the utility sector, assess and anticipate the risks associated with the failure of critical infrastructure to enable the development of future plans to achieve resilience.

In 2014 the Water Act provided the water sector financial regulator, Ofwat with a duty to ensure the long term resilience of both water and wastewater services and during May 2015 the UK Regulators Network embarked upon a cross-sector resilience project to identify current levels of resilience and how inter-dependence can be improved across sectors. While there was a great deal of focus on the

physical resilience of critical infrastructure within these reports, relatively little attention was applied to the resilience of the emergency management system with regard to the effectiveness of the CCA, 2004, encouraging Category 1 and Category 2 responders to cooperate and collaborate within the multi-agency approach defined by the LRF's.

In response to severe flood events experienced in 2013 and 2015, the UK government initiated the National Flood Resilience Review, 2018 to assess how the country can improve resilience to future flood events (HM Government, 2016). Within the review it was stated:

> "   *In particular, we are proactively working with the utilities to establish a national infrastructure resilience council or forum to:*
>
> •   *sponsor inter-industry cooperation and information sharing;*
>
> •   *develop suitable proposals on resilience;*
>
> •   *carefully examine and document interdependencies between different sectors; and*
>
> •   *In an emergency make the link between different industry sectors and the relevant local LRFs and the Government COBR machinery"*

This suggests that despite all of the lessons learned reports following severe flood events and reports and guidance documents for achieving resilience of critical infrastructure to extreme events, the same difficulties are being experienced with regard to the sharing and exchange of information and multi-agency collaboration. A lack of understanding regarding the roles and responsibilities of each operating responder organisation were also included within lessons learned reports and flood management reviews following widespread flood events within the UK (Bye and Horner, 1998; Environment Agency, 2001; Pitt, 2008;

Environment Agency 2009a; Environment Agency, 2014a; Defra, 2014; HM Government, 2016)

To improve the level of cooperation, coordination and the sharing of information between the Category 1 responders, the government initiated the Joint Emergency Services Inter-Operability Programme (JESIP, 2016). This was developed to provide a standardised framework encouraging a consistent approach to emergency response. This included the development of principles for joint working, a shared understanding of risk and situational awareness, a clearly defined operational command profile, a joint decision making model and joint organisational learning tools. These were developed to incorporate lesson learned from emergency events through training and exercising to improve the operational delivery of multi-agency emergency response.

However, the framework was focussed on encouraging greater operability between the Category 1 responders and did not include understanding inter-operability with regard to the Category 2 responders. While they are able to follow the framework and apply the principles of joint operational working, a lack of understanding of the roles and responsibilities of Category 2 responders and how they deliver emergency response within the context of their organisational culture may continue to perpetuate difficulties in the sharing of information. This may also affect the ability to achieve resilience to extreme events through the delivery of multi-agency emergency response. As demonstrated during the flooding of Mythe water treatment works, Category 2 responders experience different challenges with regard to the organisational structure, security regarding sharing

information, the technical aspects of delivering effective emergency response, the physical protection of assets and ensuring the continual delivery of essential services to the public.

During 2007, Ofwat published 'Resilience in the Round' to provide guidance and good practice for WSP's to encourage the development of innovative strategies to increase the resilience of service delivery for their customers (Ofwat, 2017a). This encouraged WSP's to develop a greater understanding of corporate, financial and operational resilience within their organisation and to apply the principles of systems thinking to understand inter-dependencies between different sectors that may influence the ability to provide a service.

The guidance does not provide specific instructions regarding how to achieve this but allows WSP's to develop their own resilience based strategies according to how their organisation operates. This is very similar to the approach taken by the UK government during the introduction of the CCA, 2004 and the development of LRF's. This allows for heterogeneity and for organisations to develop an approach that is relevant to their organisational needs. The guidance also encourages customer engagement and builds on the findings of the 'Tapped In' report, 2017 where customers are considered as active participants in the future delivery of water services (Ofwat, 2017b).

However, there is no mention within the guidance regarding the building of resilience through the development of emergency preparedness and response to

water system failure. While it is important to take a systems based approach to understand the inter-relationships between different sectors, it is also necessary to recognise the existence of systems within systems as demonstrated within Chapter 1 (Section 1.3). There is also a requirement to understand the system of emergency management and how customer behaviour may influence the ability to achieve resilience or contribute to an increase in the potential for system failure. This was demonstrated within the negative reinforcing feedback loop (Chapter 1, Figure 1.4) where a lack of information and increased timescales contributed to customer anxiety regarding a failure of the water supply. When the WSP finally delivered an alternative supply of water, customers responded by taking more than they required. This increased the pressure on the WSP to deliver more water and contributed to a lack of resilience for other customers.

In order to build resilience to extreme events, it is necessary to incorporate the principles of effective emergency management within resilience based strategies. The lessons learned from the flooding of Mythe water treatment works were not included or incorporated as part of the Ofwat guidance, 'Resilience in the Round' and there was no mention of effective emergency management with regard to developing emergency preparedness and response to extreme events.

This was reinforced following the 'Beast from the East', freeze thaw event that occurred within the UK during late February, early March 2018. This event will be discussed in greater detail within Chapter 3 (Section 3.5.2) and Chapter 6. During this event a number of UK WSP's experienced a series of pipe bursts

resulting in the loss of a centralised water supply to over 200,000 customers (Ofwat, 2018).

Section 2, of the Water Industry Act, 1991, requires Ofwat to *'secure the long-term resilience of undertakers' water supply and wastewater systems, and to secure they take steps to enable them, in the long term, to meet the need for water supplies and wastewater services'* (Defra, 2016). The subsequent loss of water supply prompted the UK water regulator, Ofwat to conduct a review of the WSP response to the *'The Beast from the East'* (Ofwat, 2018).

This involved engaging with LRFs, government departments, politicians, a local school, utility and environment regulators and consumer representative groups to understand how WSP's performed during the event. The review concentrated on the key aspects of emergency planning such as the initial assessment of the emergency situation, planning and preparation, incident response, communication with customers and key stakeholders and recovery.

The review demonstrated there was a lack of consistency in all aspects of emergency planning across the country. There were examples of WSP's taking a proactive approach, anticipating the requirement for alternative water supplies and working together with suppliers and LRFs to ensure customers would be provided with an alternative supply of water if necessary. However, there were also examples of WSP's acting reactively, not being able to source alternative supplies within sufficient time or having adequate plans and procedures in place

to ensure an alternative supply of water for all affected. This was exacerbated where WSP's failed to communicate effectively with members of the LRF.

In order to understand individual customer's experience of the event, the Consumer Council for Water (CC Water) was commissioned to conduct qualitative and quantitative research (CC Water, 2018). This was to explore customer perceptions of four main themes comprising Information and Communication, Alternative Supplies of Water, Overall Experience and Compensation. The results revealed the customer experience of this event as being negative.

It could be argued that each review was reactive placing responsibility on the WSP's for a failure to develop effective emergency plans and response procedures and yet these were not included as part of the resilience based strategies within 'Resilience in the Round'. The reviews did not consider customers to be active participants in the emergency management process but rather considered customers as passive recipients of a failed service. While the consequences of this event demonstrate the importance of incorporating emergency preparedness and response within resilience based strategies, it also highlights the importance of considering customer's as active participants in the emergency management process.

The results of each review also demonstrated a lack of incorporating lessons learned from the flooding of Mythe water treatment works during the 2007 flood

event. This is because the same difficulties were experienced during each event. These included an inability to effectively prepare, plan and respond to an extreme event involving water supply failure. A lack of multi-agency coordination regarding the delivery of alternative supplies of water and a lack of information sharing between the WSP and the LRF. There was also a lack of communication and information regarding the provision of alternative supplies of water and when the water supply would be restored.

A large part of the emergency management system comprise individuals and communities affected by potential threats and hazards. It has been demonstrated within the literature review that the active participation of individuals and communities during emergency preparedness will strengthen the emergency response. However, this depends on the provision of information, the development of trust and the resources available to be able to respond effectively. The 'Resilience in the Round' guidance does not reference the active participation of customers with regard to emergency preparedness or emergency response and yet it was demonstrated within Chapter 1, (Section 1.3) that customer behaviour may exert a strong influence on the ability of the WSP and the customer to achieve resilience to water supply failure.

Within the wider context of emergency management the UK government initiated a public awareness campaign in 2004 to encourage individuals to prepare for emergencies. The government distributed a booklet *'Preparing for Emergencies'* (HM Government, 2004) to each individual householder. The booklet contained advice regarding what actions individuals should take during an emergency.

While there was a heavy focus on responding to a terrorist threat, there was also general advice regarding emergency preparedness. However, the booklet did not contain information regarding a failure of essential services. Since 2004, the government has established a dedicated website providing information to the public regarding how they can prepare for an emergency. The website contains a wider range of information regarding potential threats and hazards and links to the NRR and the LRF's so the public are able to access the CRR to promote a greater understanding of risk and how threats and hazards may influence the provision of essential services to the public. The website also contains information regarding individual preparedness, business preparedness and community preparedness with links to emergency plan toolkits, templates and guidance documents (Cabinet Office, 2018). However, all of this information relies on the individual and community having knowledge regarding the availability of this information and gaining access to the website.

2.8   Summary

This Chapter sought to explore Objective 1, to critically analyse the traditional risk based approach to emergency management and its application towards achieving resilience. This review of the literature and the discussion within Chapter 1 (Section 1.1) demonstrates how a risk management approach to the anticipation and assessment of known threats and hazards has many limitations with respect to achieving resilience to extreme events. It was also demonstrated how the traditional application of the emergency management cycle reinforces the risk management approach and simplifies the process of emergency management into 4 or more separate stages. This approach doesn't allow for a

greater understanding of the complex inter-dependencies within the wider socio-ecological-technical system. As highlighted within Chapter 1 (Section 1.3), a lack of understanding may result in a cascade of failures.

The UK emergency management system operates within the framework of the CCA, 2004. Although this was introduced to build resilience, it still operates within the confines of a risk management approach through the development of the NRR and the local CRR's. To achieve resilience within emergency management requires a greater understanding of how the system is connected, the influence of these connections and how resilience operates within the wider system.

The lessons learned report from the flooding of Mythe water treatment works demonstrated there were difficulties regarding the sharing and exchange of information between WSP's and the LRF's during the risk assessment process and emergency response. The WSP's were not active participants in the risk assessment process and did not provide the LRF with information regarding the consequences of water supply failure. Despite the introduction of the CCA in 2004 and the development of LRF's to encourage resilience through a multi-agency approach to emergency management, these are still identified as persistent problems within lessons learned reports and emergency exercises (Watermark, 2011; Environment Agency, 2016; HM Government 2016; Ofwat 2018). However, while recommendations are made to improve multi-agency communication and cooperation these do not include further exploration of the wider system of emergency management to establish whether the failures are related to the application and operation of the CCA, 2004.

It was also identified within the literature review that successful multi-agency coordination and collaboration is enhanced through active participation throughout the emergency management process. However, WSP's and many of the Category 2 responders are expected to engage with multiple LRF's in order to be able to achieve this. It was demonstrated during the 'Beast from the East' that difficulties persist with regard to the sharing and exchange of information between WSP's and the LRF's. There requires a deeper exploration of the processes defined within the CCA, 2004 to understand if there are causative mechanisms preventing the sharing and exchange of information between WSP's and LRF's and the ability to achieve multi-agency resilience to extreme events. This will be explored in greater detail within Objective 2.

This review of the literature demonstrated there are many complexities associated with applying the concept of resilience. At an individual level resilience may be influenced by a number of different factors. These may include, an individual's personality traits, how hazards are perceived within the local environment, knowledge and experience of hazards, perceived control, trust and perceived responsibility of governments, responder organisations and the providers of essential services. It was also demonstrated that these did not necessarily contribute to an intention to prepare or the process of actively preparing for an extreme event. The application of a risk management approach by governments, responder organisations and providers of essential services, to encourage raising awareness of known hazards may encourage greater preparedness. However, evidence from the literature also indicates that even in locations where hazards frequently occur, many individuals do not perceive it necessary to prepare.

The review of individual resilience combined with the lessons learned from individual behaviour during the flooding of Mythe water treatment works (Chapter 1, Section 1.3) demonstrated how a greater understanding was required regarding individual perception of water supply failure and the factors that may influence individual preparedness. This provided the foundation for Objective 3 (Chapter 1, Section 1.4).

At the community level, resilience was interpreted with regard to themes. These included, economic development, local knowledge, social capital, sharing and exchange of information, availability of resources and community capability to utilise resources for effective emergency response. Understanding resilience as themes allowed for the heterogeneity that exists between different communities with regard to location, structure, connectivity and socio-economic status.

Community resilience may be regarded as the collective ability of a community to cope, adapt and recover from an extreme event or emergency. However, the ability to achieve resilience requires the support of responder organisations. The review of the literature suggests the development of strong relational ties between the community and responder organisations may strengthen the emergency response through the sharing of local knowledge and a greater understanding of the roles, responsibilities and capabilities of both the responder organisations and the local community. While there is a great deal of research regarding the attributes of community resilience, there is relatively little research regarding the evolutionary development of relationships between responder organisations and community groups during the formation of collaborative working partnerships and

how the development of these relationships may contribute to resilience within the system of emergency management. This formed the basis of Objective 4 (Chapter 1, Section 1.4).

It was identified within Chapter 1, Section 1.3 that in order to be able to achieve resilience to extreme events, it is necessary to develop a deeper understanding of the system of emergency management. This involves the identification of the main structural elements that comprise the system, how the system is connected and the influence of these connections with regard to the ability to achieve resilience. This Chapter examined different applications of the concept of resilience by exploring the empirical literature and how a system based approach is used to understand resilience within the emergency management system and discipline specific literature to understand the meaning of resilience. While the systems based approach provides a foundation to understand how the physical system is connected it does not explore the influence of social interactions between different parts of the system or how attitudes, perception and behaviour influence the ability to achieve resilience within the physical system. The importance of understanding how these elements are connected within the system of emergency management and their influence on achieving resilience is rarely recognised within resilience based strategies or guidance documents (Kimhi, 2016).

This research seeks to apply a systems based approach to understand the structural elements that comprise the UK emergency management system and apply social research methods to explore the meaning of resilience within and

across each structural element of the system (Chapter 1, Section 1.4). The emergency management system will be applied to the Safe and SuRe intervention framework (Chapter 1, Section 1.2, Figure 1.5) to identify the main threats to the system and the impact and consequence of these threats on the ability to achieve resilience to water supply failure . This information will be applied within the Safe and SuRe intervention framework to identify the main threats to the emergency management system, the impact and consequence of these threats to the system and how the application of intervention measures may increase the ability to achieve overall resilience of the system. This is defined within Objective 5 (Chapter 1, Section 1.4) and will be achieved through the triangulation of results obtained through the analysis of Objectives 1, 2, 3 and 4. This will be presented within Chapter 8.

The following chapter will present the methodological design chosen to explore the characteristics of resilience within each objective and the implementation of specific research methodologies to understand the application of resilience within the UK emergency management system.

3   CHAPTER 3 - RESEARCH METHODOLOGIES

3.1   Introduction

The literature review (Chapter 2) explored the traditional risk based approach to emergency management and the different applications of resilience within the wider context of the emergency management system and society. It was recognised that in order to be able to achieve resilience to extreme events, it is necessary to develop a deeper understanding of how resilience operates within the wider system of emergency management. This was demonstrated within Chapter 1, (Section 1.3). A lack of understanding of how the emergency management system is connected may perpetuate failure within the system leading to a negative reinforcing feedback loop (Chapter 1, Figure 1.4). This has the potential to reduce the resilience of a system during an incident and may result in an increase in the failure magnitude, prolong the event duration and lead to a greater period of recovery (Chapter 1, Figure 1.1).

To develop knowledge and understanding of how resilience to water supply failure can be achieved within and across the UK emergency management system, it is necessary to examine and explore how the system actually works in practice. Chapter 2, Section 2.7 explored how the UK emergency management system has evolved to incorporate resilience within a legislative framework of the CCA, (2004). However, examination of lessons learned reports and multi-agency exercises would suggest there are difficulties with this approach (Chapter 1, Section 1.1). To explore how the system operates in practice, a pragmatic and applied approach was used to develop the research design. This involved the

incorporation of action research and social research methods to examine and explore how the legislation supports or constrains the ability of different organisations to work together. This also included participant observation to understand attitudes, perceptions and behaviour of individuals during an actual emergency and participatory action research to understand how a community functions and operates in order to achieve resilience to emergency situations. Taking a pragmatic and applied approach to the research design using action research provides an opportunity for the researcher to participate and become immersed within the process of data collection (Bernard, 2006; Robson, 2011). This approach provided a grounding for the overall research design because it enabled a realistic and contextualised understanding of attitudes, perceptions and behaviours towards water supply failure within the context of how the emergency management system operates in practice. This also allowed the researcher to explore whether the system operates in accordance with the legislation and to identify causative mechanisms that may promote or inhibit the ability to achieve resilience throughout the system.

It was proposed in Chapter 1 (Section 1.3), that in order to understand how the Safe and SuRe intervention framework could be applied, it was necessary to explore the meaning of resilience at each stage of the emergency management system. This requires identification of the main elements and connections that comprise the system, analysis of the relationships and characteristics of resilience within and amongst the connections and how these contribute to the overall purpose of the system.
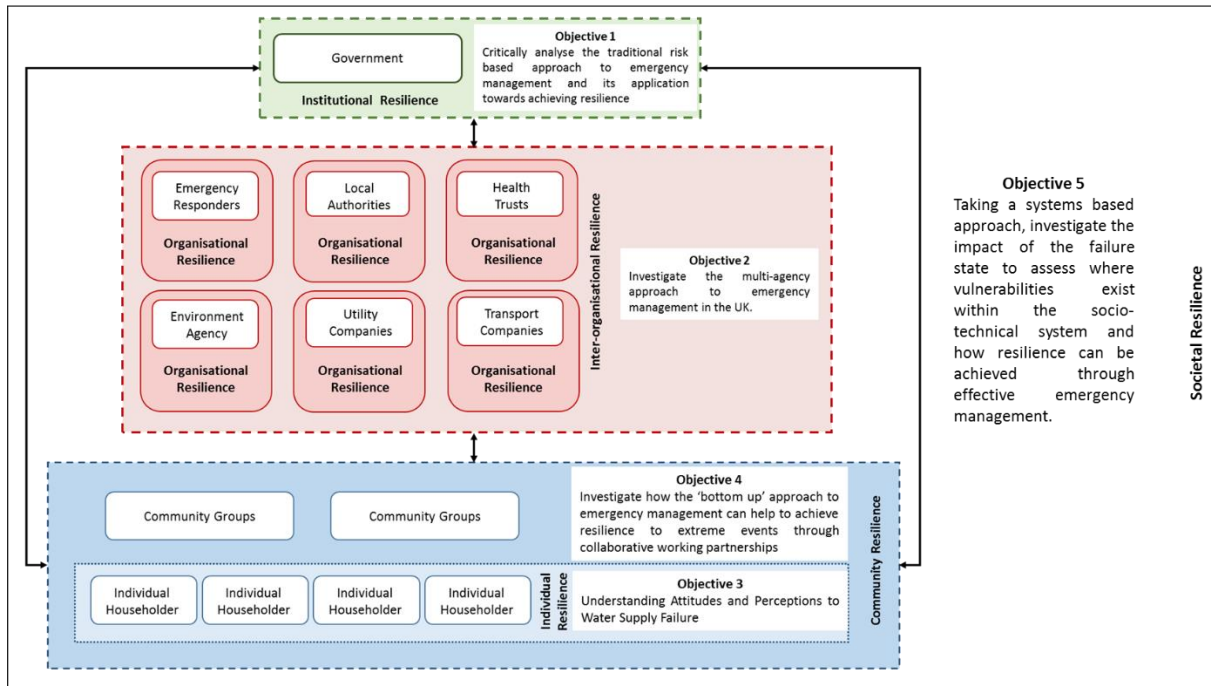
Figure 3.1: Simplified system of emergency management in the UK and the

Objectives used to examine each element of the system.

It was identified in Chapter 1, (Section 1.3) that the UK emergency management system comprises three main structural elements (Figure 3.1). The institutional element at the level of Government, the operational element represented by the organisations that comprise the LRF and the individuals and communities affected by an emergency. Each element of the system is also connected. A separate connection exists between the institutional element and both the operational element and the individuals and communities affected by an emergency. A connection also exists between the operational element and the individuals and communities affected by an emergency.

Each element of the emergency management system and its associated connection is explored through a specific objective to guide the progression of the research towards a greater understanding of how resilience can be achieved to water supply failure. The sequence of the research design is defined within the thesis plan (Chapter 1, Section 1.5) and partly follows the 'top down' structure of the emergency management system. This is because it is necessary to understand the legislative framework and how the system operates in practice in order to understand where resilience is currently being applied within the system and where difficulties may exist.

The research commences with an exploration of the institutional element as defined within Objective 1. In the context of this research the institutional element is representative of the legislation, policies and guidance documents to support the operational development of resilience to water supply failure within the emergency management system. This includes examination of the traditional risk management approach to emergency management (Chapter 1, Section 1.1) and how the system currently operates within the legislative framework defined by the CCA, 2004 (Chapter 2, Section 2.7). However, further investigation is required to understand the effectiveness of this approach to achieve resilience to water supply failure and to understand what the connections mean in terms of resilience between the institutional element, the operational element and the individuals and communities affected by an emergency.

The operational element of the system is understood within the context of Objective 2 (Figure 3.1). It was considered that exploring how resilience is

operationalised in practice through the application of applied social research methods would contribute knowledge regarding the effectiveness of the legislation in achieving residence through the multi-agency approach. It was also considered that this may provide an insight into the persistent difficulties highlighted within lessons learned reports regarding multi-agency collaboration and the sharing of information required for effective emergency response. To explore and examine the effectiveness of the multi-agency approach requires the active participation of emergency responders from both the WSP's and from within the LRF, to contribute information within semi-structured interviews. This also enables a greater understanding of the flow of information throughout the system and whether resilience to water supply failure relies on the 'top down' delivery of information in the form of legislation or if there is a flow of information back through the system.

Objectives 3 and 4 (Chapter 1, Section 1.4) explore the individuals and communities affected by an emergency through an element situated at the first level of the emergency management system. Individuals and communities represent the first element to be affected by an emergency and while information regarding the potential impact and consequence of an emergency may be passed from the operational element to individuals and communities via early warning systems, there is also a transfer of information back through the system to the operational element. As demonstrated within Chapter 1, (Section 1.1), individual resilience may be affected by attitudes, perceptions and behaviour of individuals regarding water supply failure. This was also reinforced through analysis of the academic literature within Chapter 2, Section 2.4. It was considered that developing a greater understanding of individual attitudes, perceptions and

behaviour relating to water supply failure may provide an indication of the current levels of resilience and how this can be increased through connections within the system.

This was achieved as part of Objective 3, through the application of an individual homeowner questionnaire and the analysis of comments on the social media platform Facebook during an actual emergency situation. The individual homeowner questionnaire was designed to ask individual homeowners specific questions to explore general attitudes and perceptions to water supply failure (Chapter 5). However, this approach may be limited because as demonstrated within Chapter 2, (Section 2.4) individual attitudes and perceptions do not always influence behaviour in terms of taking action. Taking a pragmatic approach through action research and participant observation of how individuals behave during an actual emergency provided a greater insight into attitudes and perceptions and how these influence behaviour with regard to achieving resilience to water supply failure. This was examined through analysis of Facebook comments during the *'The Beast from the East'* water supply failure incident (Chapter 6). Consequently, Objective 3 applied two different approaches to explore the resilience of an individual to water supply failure. The methodology is presented within Section 3.5.

Individuals form part of communities and community groups and resilience within the community was explored in Objective 4, (Chapter 1, Section 1.4). As demonstrated within Chapter 2, Section 2.5, community resilience is enhanced through building relationships, the sharing and exchange of local knowledge and

understanding the availability of resources and capability for effective emergency response. There is a great deal of focus on developing community resilience within the UK to flooding (Twigger Ross *et al*, 2015; Cabinet Office, 2016) and the connection to the operational element is usually through the local community rather than the individual (Cabinet Office, 2018). However, there is little understanding regarding the effectiveness of integrating community groups within the emergency management system. It was perceived that working together with a local community through participatory action research to explore and understand how the community built and developed relationships with local authorities and responder organisations would provide a greater understanding of both community resilience and the connections between the community and the other elements of the system (Chapter 7). The methodological approach taken to explore Objective 4, is presented in Section 3.7.

All of this information is required to develop a greater practical understanding of how resilience operates within the emergency management system and this is explored as part of Objective 5. It is necessary to understand how the system operates in practice to enable the application of the Safe and SuRe intervention framework. This will allow the identification of where resilience intervention measures are required to improve resilience to water supply failure within the emergency management system (Chapter 8). The methodological approach taken to explore Objective 5 is presented in Section 3.8. The results will be presented as series of recommendations identifying where resilience to water supply failure is required for effective emergency management (Chapter 9).

This Chapter presents a methodological design to explore the characteristics of resilience as detailed within each Objective and discusses the implementation of research strategies and methods. The Chapter starts with an exploration of the mixed methods approach.

3.2 Exploring the system of emergency management using a mixed methods approach.

A mixed methods approach involves the combination or integration of different research strategies within the same methodological design (Bryman, 2006; Leech and Onwuegbuzie, 2009). These may comprise different quantitative research methods, different qualitative research methods or represent a combination of quantitative and qualitative research methods. This approach is traditionally applied where different perspectives are sought to develop a more complete understanding of the wider context of the research (Greene *et al,* 1989; Robson, 2011). It has been considered that this contributes to a more pragmatic approach where mixed methods occupies a paradigm of research located between the traditional purist approach of quantitative and qualitative research strategies (Bryman, 2006; Johnson *et al,* 2007; Teddlie and Tashakkori, 2009).

Historically, contention existed as to whether quantitative and qualitative research strategies should be combined within a single research project because of differences in the epistemological and ontological foundations within each strategy (Johnson and Onwuegbuzie 2004; Bryman, 2008; Chipangura *et al,* 2016). These influence the implementation of specific research methods and the analysis and interpretation of research findings (Figure 3.2).
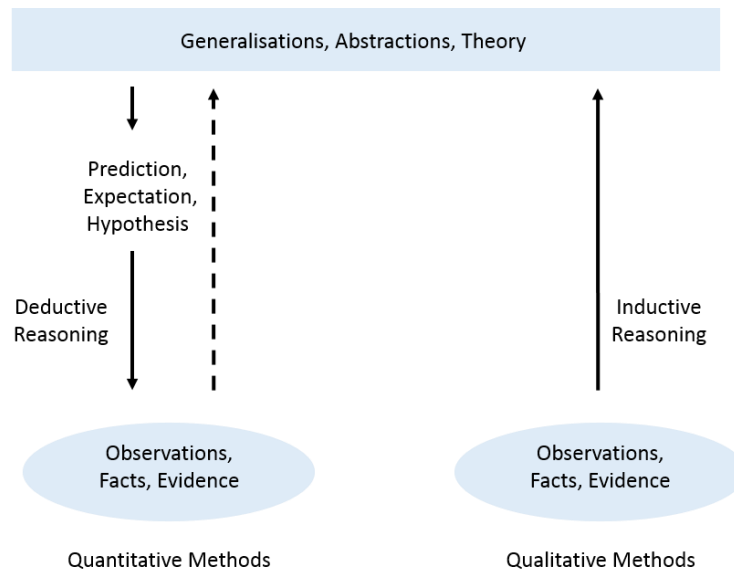
Figure 3.2: The application of quantitative and qualitative research methods.
(Adapted from Teddlie and Tashakkori, 2009).

Quantitative research takes a deductive approach where theory is derived by the researcher and hypothesis are tested under experimental conditions and supported through the mathematical analysis of data (Johnson and Onwuegbuzie 2004; Bryman, 2008; Teddlie and Tashakkori, 2009; Robson, 2011; Chipangura *et al,* 2016). These strategies take a similar approach to the physical sciences where a fixed approach is adopted in the research design to ensure reproducibility with a focus on the accurate, reliable measurement of data ensuring validity of results. From the perspective of social research, this approach supports the ontological position of objectivism and assumes reality exists independent of human thought or understanding. This is an objective approach based on fact that does not consider the subjective influence of the external environment on social behaviour.

This is in contrast to qualitative research where an inductive approach is taken and theory is developed from the research findings or observations (Johnson and Onwuegbuzie 2004; Bryman, 2008; Robson, 2011). This approach supports a more flexible research design that is focussed on understanding meaning and the influence of context. It is generally accepted that the research design will evolve to enable the development of a deeper understanding through explorative research or themes. From a sociological perspective, this approach supports the ontological position of constructionism and assumes reality is a social construct influenced by human interactions and experience of the wider environment. This approach is also subjective and open with regard to the influence of the surrounding environment on social behaviour.

While each research strategy is developed from a different philosophy, it has been demonstrated that it is possible to combine and integrate these strategies effectively by applying a mixed methods approach (Johnson and Onwuegbuzie 2004; Bryman, 2006; Johnson *et al*, 2007; Teddlie and Tashakkori, 2009). It has been proposed that the application of different research strategies can be used to enhance the development of the research process. For instance, the results of quantitative methods such as questionnaires and social network analysis can be used in the initial stages of the research process to inform a qualitative investigation through interviews (Kelman *et al,* 2016). The exploration of different perspectives can also be used to guide the research process. For instance, the discovery of conflicting results, themes or observations may indicate further exploration is required or the process of triangulation may provide validity and confirmation of a particular hypothesis.

For the purposes of this research, it was considered that the use of both qualitative and quantitative research methods would allow for a deeper exploration and understanding of the characteristics of resilience at different parts of the emergency management system. A pragmatic approach was also required to understand resilience from the perspective of the individual, community and practitioner and how this influenced the overall function and purpose of the system. The research methodology used will be discussed within Section 3.3 and detailed descriptions of each method are provided in Section 3.4.

A large proportion of this research applies a qualitative participation observation approach with regard to data collection with the intention to compliment, support or contest the information obtained from academic literature, government guidance and reports. This includes participant observation methods, such as the analysis of comments on Facebook during an emergency situation to understand individual attitudes and perceptions to water supply failure and participatory action research to work collaboratively with a local community representative to understand the development of a community flood action group.

The participant observation approach has been widely applied by anthropologists (Bernard, 2006; Musante and DeWalt 2010; Jorgenson, 2015) and social scientists (Bryman, 2008; Robson, 2011) to explore and understand human behaviour within a natural environment. It was considered that observing participants in a real world setting encourages the observation of 'normal behaviour' as opposed to behavioural studies conducted in an artificial environment under experimental conditions (Bernard, 2006; Musante and DeWalt

2010). The latter approach may stimulate a behavioural response that is not reflective of how that individual would behave in a normal environment (Bernard, 2006).

Standard methods and techniques using participant observation involve the researcher being considered a participant in the observed group (Robson, 2011). According to Musante and DeWalt (2010), *"Participant observation is a method in which a researcher takes part in the daily activities, rituals, interactions and events of a group of people as one of the means of learning the explicit and tacit aspects of their life routines and their culture."* This approach may be applied through different levels of involvement by the researcher. According to Robson (2011), these include:

- The researcher becoming a *'complete participant'* where the researcher does not inform the participants of their intention as a researcher.

- An *'observer'* where the participants are aware of the researcher who takes an active role in the group,

- A '*marginal participant'* where the researcher is known to the group but has limited involvement.

- The *'observer as participant'*. This is where the researcher is known to the participants but does not have any involvement in the research under investigation.

The active participation of the researcher within the group under observation may provide an opportunity to develop a deeper understanding of participant attitudes, perceptions and behaviour (Bernard, 2006; Robson, 2011). Increased familiarity between the researcher and the participants through the sharing of information and knowledge may encourage participants to develop trust in the researcher (Robson, 2011). This may increase the level of acceptance of the researcher providing a greater opportunity to explore and understand the context within which the research is being conducted and enhance the quality of the research (Bernard, 2006; Robson, 2011). A greater understanding of the contextual setting may also help to inform the development of suitable questions to explore the meaning of the research by providing a more intuitive insight regarding the interpretation of the data (Musante and DeWalt, 2010).

Questionnaires are also used to understand attitudes, perceptions and behaviours. However, as demonstrated within Chapter 2 (Section 2.4), this approach is limited because individual attitudes and perceptions do not always lead to a behaviour intention to prepare or act (Dobbie *et al*, 2016; Donahue *et al,* 2014; Paton, 2013). The participant observation method is considered to provide a greater understanding of the real world by observing people within their natural environment (Robson, 2011).

The analysis of comments on Facebook was used to observe how individuals responded to water supply failure during an actual emergency. The intention was to develop a greater understanding of whether attitudes and perceptions to water supply failure influence behaviour and the ability to achieve resilience during an

emergency (Chapter 1, Section 1.4, Objective 3). The methodology used to examine and explore individual resilience (Objective 3, Chapter 1, Section 1.4) is presented within Section 3.5 and Section 3.6.

As previously discussed, Robson (2011) defines participant observation methods in terms of the '*complete participant*', an '*observer*', a '*marginal participant*' or the *observer as participant*'. Standard methods and techniques as defined by Robson (2011) consider the researcher *as 'a participant in the observed group'*. However, this was not the case with the analysis of comments on Facebook and while participant observation was used, the researcher was not known to the participants throughout the process and acted as an anonymous observer.

Participant observation was also used to compliment participatory action research to explore and understand how a local community group worked collaboratively with local authorities and responder organisations to achieve community resilience. Within this part of the research, the researcher acted as a '*marginal participant*' (Robson, 2011) where the researcher was known to the community representative but had limited involvement. The researcher was not actively involved in the process of developing the social networks as they had already been developed by the local community representative. However, the researcher was involved in the development of social network graphs to document the evolutionary development of the community flood group and the community flood board. These graphs were used by the community representative at the Environment Agency Flood and Coast Conference, 2018 and at local workshops to highlight the importance of collaborative working

practices and to contribute to knowledge regarding the improvement of current operational working practices. The methodology used to explore community resilience is presented in Section 3.7.

The research ethics application process was undertaken to ensure the research complied with the University of Exeter's commitment to the ethical principles of *'Autonomy, Beneficence, Non-maleficence, Confidentiality and Integrity'* (University of Exeter Ethics Policy, 2014). This ensures that each participant is made thoroughly aware of the purpose of the research, are free to participate if they require and understand they may leave the process at any point in the research. The principles also ensure researcher integrity with regard to the confidentiality of personal data and to make certain participant's details are stored securely.

An application to the Ethics Committee had to made and accepted before any of the questionnaires could be sent to members of the public (Appendix 1). The application process involved a description of the research methodology, details of the potential ethical implications and a risk assessment. Accompanying documents included a final version of the questionnaire (Appendix 2), a covering letter for the individual questionnaire and an information and consent form for the semi-structured interviews to be conducted as part of Objective 2 (Appendix 3). These were submitted to the College of Engineering, Mathematics and Physical Sciences and the research did not commence until approval was obtained.

3.3 Methodological design

The research methodology consists of 5 stages each defined by a specific Objective (Figure 3.3). The first stage comprised a literature review and attendance at conferences to develop a theoretical framework. The literature review explored the different applications of resilience within the emergency management system and wider society. However, in order to gain a greater understanding of resilience within the emergency management system, it was also necessary to determine how the concept was being applied in practice. This was explored through attendance at conferences (Table 3.1, Appendix 4).
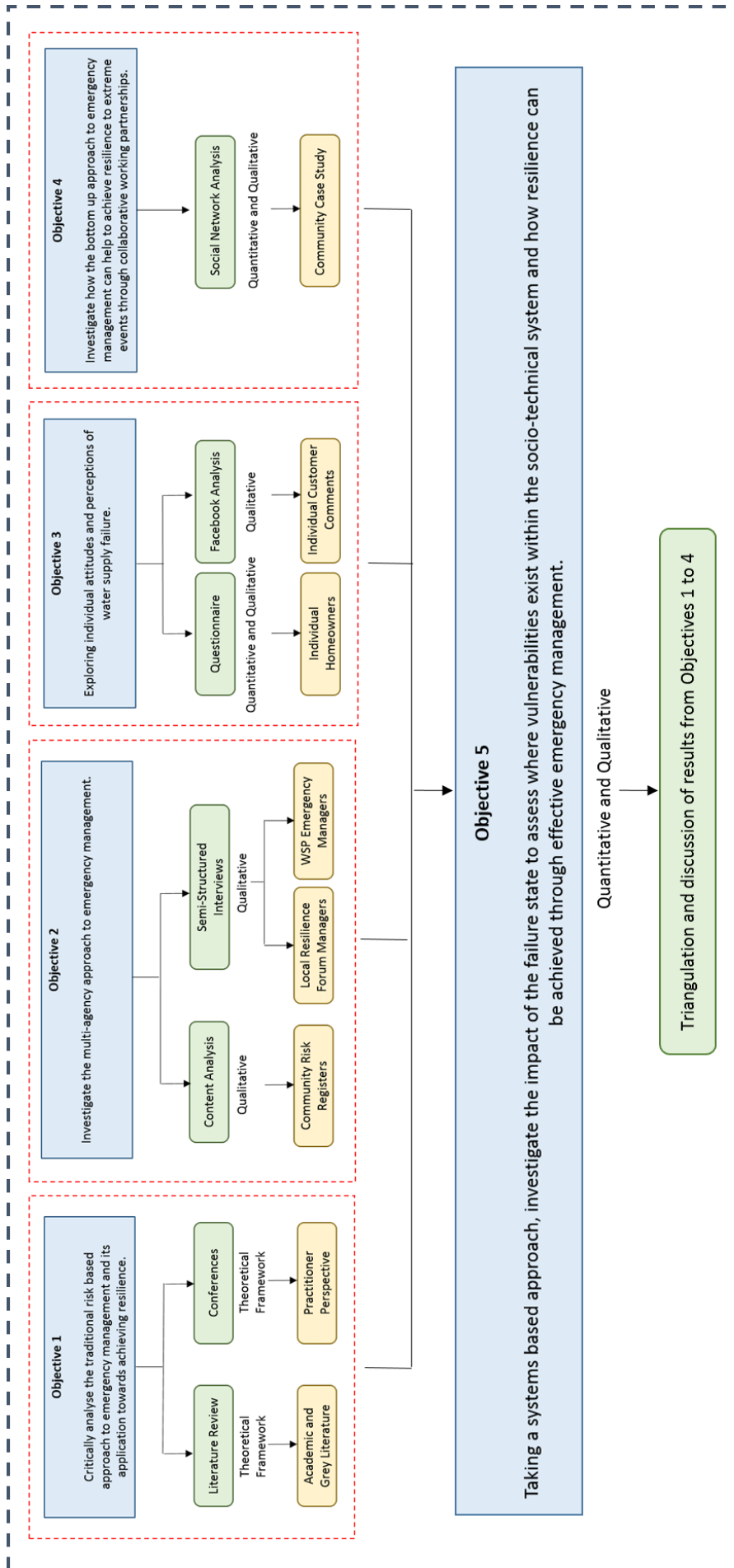
Figure 3.3: Research Methodology

Conference Title	Organiser
Water, Water Everywhere	Bristol City Council
Flood Resilient Communities: Evaluating the Defra Flood Resilience Community Pathfinder Project	CIWEM and the National Flood Forum
Making our Nation More Resilient to Flooding: Designing Effective Strategies and Delivering Key Solutions to our Communities	Public Policy Exchange
Major Incident and Emergency Planning, Preparation, Risk and Response	GovKnow
Beyond the National Flood Resilience Review: Building Resilient Infrastructure and Communities	CIWEM
Cabinet Office Emergency Ambition Conference	Cabinet Office
Flood and Coast: Resilience	Environment Agency
Delivering Resilience in PR19 and Beyond	Water Industry Forum

Table 3.1: Conferences attended to understand the practitioner approach to resilience.

The second stage involved exploring the multi-agency approach to emergency management as defined within Objective 2. A comparative content analysis was conducted on the CRR's, Chapter 4 of the Local Responder Risk Assessment Duty of the Emergency Planning Guidance (Cabinet Office 2012), WSP Water

Resource Management Plans, WSP Drought Plans and Sector Resilience Plans. This was to gain a greater understanding of the multi-agency assessment of risk and whether WSP's could manage risk and resilience as part of a multi-agency approach. It was recognised that a qualitative methodological approach would be required in the form of semi-structured interviews to explore the inconsistencies identified within the content analysis and provide a greater understanding of the multi-agency approach to emergency management.

Objective 3 represented the third stage of the research methodology and consisted of both quantitative and qualitative research methods. A quantitative approach in the form of an individual homeowner questionnaire was designed to understand general attitudes, perceptions and behaviour to water supply failure. This provided a structured approach with clearly defined research questions regarding how individuals perceive risk within their local area, water supply failure and whether they prepare for emergency situations. The qualitative approach was applied following an actual failure of the water supply. This occurred during March 2018 as a result of a freeze thaw event following the 'Beast from the East' (Ofwat, 2018; Water UK, 2018) and is discussed in greater detail within Chapter 6. A qualitative approach was taken to analyse individual customer comments on WSP Facebook pages to explore and understand perceptions and attitudes to water supply failure during an emergency.

Stage 4 was conducted with the active participation of a community representative to explore how resilience can be achieved through collaborative working partnerships. This involved a quantitative approach with social network

analysis combined with a qualitative approach exploring the development of a social network through a series of semi-structured interviews and participatory action research to understand the connections and relationships between responder organisations and the local community.

Each of the four stages represents an exploration of the characteristics of resilience at different stages within the emergency management system. The legislative approach applied at the level of Government is represented within stage 1, the operational multi-agency approach is analysed within stage 2 with individual and community resilience explored within stages 3 and 4 respectively. An investigation of the impact of the failure state is provided within the final, 5th stage through the triangulation of results from stage 1 to 4. Using a systems based approach the integration of quantitative and qualitative research methods, detailed in Section 3.8, are used to evaluate how resilience can be achieved through effective emergency management.

3.4   Research methods used to explore the multi-agency approach to emergency management (Objective 2)

3.4.1 The preliminary analysis of the Community Risk Registers

The aim of the comparative content analysis was to establish the level of engagement of WSP's in the multi-agency assessment of risk and resilience and whether this has changed since the recommendations of the Pitt Review, (2008)

Region	LRF
North West	Cheshire
	Cumbria
	Greater Manchester
	Lancashire
	Merseyside
North East	Cleveland
	Durham and Darlington
	Northumbria
Yorkshire and Humber	Humber
	North Yorkshire
	South Yorkshire
	West Yorkshire
West Midlands	Staffordshire
	Warwickshire
	West Mercia
	West Midlands
East Midlands	Derby and Derbyshire
	Leicestershire
	Lincolnshire
	Northamptonshire
	Nottingham and Nottinghamshire
East of England	Bedfordshire and Luton
	Cambridgeshire and Peterborough
	Essex
	Hertfordshire
	Norfolk
	Suffolk
South West	Avon and Somerset
	Dorset
	Devon, Cornwall and the Isle of Scilly
	Gloucestershire
	Wiltshire and Swindon
South East	Hampshire and the Isle of Wight
	Kent
	Surrey
	Sussex
	Thames Valley
London	London

Table 3.2: LRF's in England that were included in the CRR analysis.

The first step was to identify the statutory duties and recommendations of best practice within Chapter 4, Local Responder Risk Assessment Duty of the Emergency Planning Guidance (Cabinet Office, 2012). This information was used to determine how each LRF fulfilled these duties from an analysis of the CRR's

The comparative content analysis was then performed on 38 CRR's for England (Table 3.2). The risk categories relevant to the water sector were identified. These included the failure of water infrastructure to accidental contamination or a major accident, drought and the failure or collapse of a major reservoir dam. Where possible the lead assessor, likelihood and impact scores, risk rating and the current controls in place for effective emergency management were analysed. This was to provide evidence of the level of engagement of WSPs and understand how resilience is incorporated within the risk management process.

The results of the analysis were compared to the information provided within the WSP Water Resource Management Plans, Drought plans and the nationally produced Sector Resilience Plans. This was to understand whether the results of the risk assessment correlated with information provided within WSP reports and whether the information was used to inform future planning priorities. Exploratory interviews were also conducted with Emergency Managers to test the findings of the analysis.

3.4.2 A visual representation of the multi-agency network

As discussed within Chapter 1, Section 1.1, LRF's are composed of Category 1 and Category 2 responders however, the connections between each organisation are highly complex. It was considered that representing this as a social network diagram would highlight the complexity of the multi-agency approach to emergency management.

The North West region of the UK was selected to map the connections between the Category 1 and Category 2 responders because the WSP within this region operates over a wide geographical area encompassing 5 LRF's. It was considered that this would provide a good representation of the complexity regarding the connections that exist between the responder organisations and the LRF. The Category 1 and Category 2 responders that comprise each LRF was obtained from the CRR's and the Webpages for each LRF. However, this approach was not consistent because not every LRF included the same level of detail. To ensure consistency in approach, this information was compared to the list of Category 1 and Category 2 responders identified within the CCA, 2004 (CCA, 2004).

An adjacency matrix was developed of directed relationships between each organisation within each LRF in the North West region of the UK. This information was imported into R studio for analysis using the social network package, igraph.

A simplified version of the social network diagram was also developed to provide a visual representation of the connections between 9 of the largest water and sewerage providers in England and the LRF's. An adjacency matrix of directed relationships between the WSP's and the LRF's was developed and imported within R studio for analysis using the social network package, igraph.

3.4.3 Semi-structured interviews

Semi-structured interviews are used within qualitative research to explore and understand themes identified within the research proposal. An interview guide is developed to drive the interview process however, a flexible approach is taken with regard to the response provided. This approach allows the participant to talk freely and provides the researcher with the opportunity to explore themes in greater depths (Robson, 2011; Bryman, 2008).

Within this research, semi-structured interviews provide a framework to guide and explore inconsistencies revealed within the content analysis. It was also evident throughout the development of the literature review that the multi-agency approach to emergency management was complex and there was uncertainty as to whether this influenced the application of resilience. To investigate this in greater depth required a flexible approach providing participants with the opportunity to discuss their practical experience of the multi-agency approach to emergency management.

3.4.4 Preparing the interview guide

The intention was to explore and understand the characteristics of resilience and assess the impact of failure from a multi-agency perspective. The semi-structured interview schedule comprised 5 sections that each sought to explore a different aspect of the multi-agency approach to emergency management (Appendix 5).

These comprised:

- Section 1: About You

- Section 2: Organisational Systems

- Section 3: Planning for Emergencies

- Section 4: The Role of your Organisation in the LRF

- Section 5: Community Involvement

Section 1, contained details of the participant including name, organisation, role and length of time within the organisation. The participant was also asked if the interview could be recorded and assured that the process was entirely confidential and anonymous. Prior to the interview each participant was provided with a form reinforcing confidentiality and anonymity in accordance with the Data Protection Act and ethical guidelines of the University of Exeter (Appendix 3). The participants were asked to sign the form indicating they were aware the information they provided would only be used for the purposes of this research project and all the information they provided would be anonymised.

As identified within the literature, the LRF is composed of multiple organisations that operate very differently on a daily basis. Each organisation also has a

different organisational structure. It was uncertain as to whether this would influence how resilience is perceived within an organisation and this was explored within Section 2 of the interview schedule (Appendix 5). This comprised a series of questions asking participants to describe the structure of their organisation, what they perceive to be the main threats and hazards, how they would define resilience and what it means for their organisation. Questions were also determined to understand the legislative context and whether this supports the ability to build and achieve resilience to emergencies within each organisation. This included questions relating to how an organisation determines resilience to extreme events, how they measure organisational resilience and whether they monitor the response to small events to assess the likelihood of a greater failure from occurring.

The content analysis also revealed a number of inconsistencies that required further exploration. It was difficult to assess the level of engagement of WSP's in the multi-agency assessment of risk and whether there was adequate sharing of information to enable the accurate assessment of capabilities and resources required for effective emergency planning and response. This was explored in greater detail within Section 3 of the interview schedule where a series of questions were designed to understand how organisations assess risk and prepare for emergencies both as individual organisations and within a multi-agency context (Appendix 5). This also included questions to explore what participants consider to be the purpose of an emergency plan and whether plans were developed and shared with other organisations that may be affected or involved in emergency response for a particular hazard.

WSP's occupy a wide geographical area that may encompass more than one LRF. It was difficult to understand whether this created difficulties for the WSP's to establish collaborative working relationships if they were expected to engage with multiple LRF's. Section 4 of the interview schedule explored this in greater detail comprising questions that specifically related to the multi-agency approach as defined within the statutory duties and recommendations of best practice within Chapter 4, Local Responder Risk Assessment Duty of the Emergency Planning Guidance (Cabinet Office, 2012). Questions were included to understand the perceived role of each organisation within LRF and the perceived level of collaboration and sharing of information between organisations.

The final section of the interview schedule explored whether the organisation worked together with local communities in the development of emergency plans, how this may strengthen or weaken the emergency response and how communities could be integrated within the LRF.

3.4.5 Conducting the semi-structured interviews

Semi-structured interviews were conducted with 16 emergency managers from organisations including WSP's, LRF's, Local Authorities and the Fire Rescue Service. Each emergency manager was a member of one or multiple LRF's and had experience of working with different organisations during emergency planning, response and recovery. This allowed the exploration of attitudes and perceptions of the multi-agency approach to emergency management in the UK, from a range of different perspectives.

The initial approach was to contact the LRF managers via the contact information provided on the UK Government website. However, this proved to be quite difficult as feedback from the initial set of emails revealed that the information provided on the government website was out of date. Many of the persons contacted no longer worked within the LRF's and many of the emails were forwarded within organisations before the most appropriate person responded. This demonstrated an inconsistency within the information produced by the government and the actual situation within the LRF's.

The interviews were conducted between May 2017 and September 2017 via telephone. At the start of the interview process each participant was asked for permission to record the interview and were ensured that all the information provided would be strictly confidential and anonymised. They were also offered the opportunity to be supplied with a copy of their interview transcript to provide the opportunity for further comment. In some instances the participant was eager to initiate the interview and would start with a brief discussion of their role and others required a prompt in the form of the first question. The interviews ranged in length from 42 minutes to 2 hours 6 minutes and this was dependent on the amount of time the participant had available for the interview process. The researcher would use the response provided by the participant to guide the interview process to determine which questions to include within the timescale available.

3.4.6 Thematic analysis of the interview response

The interview recordings were transcribed by a University of Exeter approved transcriber. The files were sent as .mp3 files using a secure hightail link to ensure security of data transfer. The interview transcripts were imported into the NVivo (v.12) software package for analysis and to ensure confidentiality, the response provided by each participant was anonymised. Each interview transcript was read through repeatedly to allow familiarity with the information provided and the question responses were coded using an inductive approach. The coding process was conducted independently for each interview transcript. This provided an element of validity because the majority of responses contained information that was relevant to the same codes. There were many examples where a participant would provide a detailed and full explanation that included information relating to another question within the interview. As a result of these complexities, an inductive approach was taken for the first level of analysis where the information within each transcript was categorised into codes. There were instances where some of the codes were relevant to more than one theme and resulted in themes containing information that was interconnected. In order to overcome these difficulties each code was analysed for both meaning and context, with consideration of the structure of the interview questions, the emergency management system and the process of how emergency management is conducted. These were used to identify themes that were common across all of the interviews (Table 3.3). This was very much an iterative and complex process.

A thematic analysis was considered appropriate for a number of reasons. Even though the research was guided by the interview questions, there were many instances where the participant did not specifically answer the question but provided information that was both interesting and of value to the research. Many of the participants provided examples and answered the questions based on the context of their organisation and their personal experience of the emergency management process and system. A thematic analysis provided an opportunity to identify patterns of common themes discussed within each interview transcript.

The responses to the interview questions were also potentially influenced by *'responder bias'*, where the participant had a particular issue or focus that they either consciously included within each response or it was provided at a subconscious level. This was because it was affecting or influencing the work they were conducting at that specific moment in time and this resulted in some interviews having a theme. For instance, just before the interview process, many of the participants were involved in the National Capabilities Survey (Cabinet Office, 2003). This is produced every couple of years for the government to assess the capabilities available for effective emergency management in the UK. The value of completing the survey and the information it provides to the government was discussed throughout a couple of the interviews.

	THEMES AND RELATED CODES
1	**LEGISLATION AND GOVERNANCE**
	Applying the Principles of the Civil Contingencies Act, 2004
	Government Support and Guidance
2	**COLLABORATIVE WORKING PARTNERSHIPS**
	Effective Collaboration – Proximity and Empathy
	Building Relationships
	Regional Collaboration
3	**SHARING INFORMATION – SENSITIVITIES AND TIMING**
	Resilience Direct
	Good Practice and Lessons Learned using Resilience Direct
4	**PLANNING AND PREPARING FOR EXTREME EVENTS**
	The Purpose of the Emergency Plan
	The Multi-agency Assessment of Risk
	Collaborative Development of the Multi-agency Emergency Plan
5	**BUILDING RESILIENCE**
	Perception of Resilience
	Multi-agency Exercising and Training
6	**ACHIEVING EFFECTIVE EMERGENCY RESPONSE**
	Resources AND Availability of Personnel
7	**WORKING WITH COMMUNITIES**
	Social Media
	Reliance on Water Service Providers

Table 3.3: Interview codebook including themes (highlighted in blue) identified

from related codes.

3.5 Research methods used to explore general attitudes and perceptions to water supply failure (Objective 3)

3.5.1 The individual homeowner questionnaire

The purpose of the individual questionnaire was to explore general attitudes and perceptions to water supply failure. Do individuals perceive a failure of the water supply as a potential risk or is there a reliance on the WSP to provide a continuous supply of water under all circumstances? As discussed within Chapter 2, (Section 2.4), individual resilience is complex and relies upon internal strategies dependant on the individual's personality traits, mental health and personal wellbeing and the ability to use/have resources that an individual can use to overcome an adverse situation (Luthar, 2006). Many of the definitions of psychological resilience are based on achieving or returning to a healthy mental state (Bonanno, 2004; Luthar, 2006). However, there are also extrinsic factors that must be considered. For instance, the ability of the individual to access knowledge and information regarding the potential threats and hazards and the ability to access external resources that can be used to prepare for a potential emergency situation. These required exploration and this was achieved through the development of the questionnaire.

3.5.2 Pilot study

There are many considerations when developing a questionnaire to ensure the questions are not bias, are easy to understand and will provide results related to the original research objectives (Oppenheim, 2000). It is a very detailed and meticulous process involving numerous iterations to develop the most effective questions relating to the research. A pilot study was conducted to test the

effectiveness and efficacy of the draft questionnaire on a small group of 28 respondent's representative of the 'general public' (Appendix 6). Questionnaires were administered in person and as each question was presented to the respondent, the response was assessed using the following criteria:

- Was the question clear and did it make sense to the respondent?

- Was the question of adequate length?

- Did the response provide the information required to satisfy the objective of the research?

- Did the wording of the question introduce any bias?

- Did the question response lead to interesting results that should be explored further?

Although the draft questionnaire provided an indication of the attitudes and perceptions of individuals to a failure of the water supply, it was evident from the pilot study that further work was required to develop the questionnaire further. The majority of questions were focussed on a failure of the water supply and did not explore the wider context regarding attitudes and perceptions of other hazards. This would provide an indication of how water supply failure was perceived in comparison to other hazards and whether individuals considered it necessary to prepare. The draft questionnaire also failed to explore the potential cause of water supply failure such as drought, pipe burst, water contamination or flooding and perceptions of the WSP. This information could be used to determine whether individuals had knowledge of the causative mechanisms of water supply failure and whether their perception of the WSP influenced attitudes and behaviour to water supply failure.

While the majority of questions were clear, of adequate length and understood by the respondent it was evident that a more structured approach was necessary to provide the information to satisfy the requirements of Objective 3. It was determined that this could be achieved through the development of the following research questions:

- **RQ1** How do individuals perceive water supply failure compared to other hazards?

- **RQ2** What are the general attitudes and perceptions of water supply failure?

- **RQ3** Where do individuals obtain information regarding hazards within their local area and if there is a serious failure of the water supply?

The development of research questions enabled the structure and framework of the questionnaire to be more clearly defined within the context of the research objective. The findings of the pilot study on the draft questionnaire were incorporated within the final questionnaire design to comprise three main sections, thinking about your local area, thinking about your local water supply and preparing for an emergency.

3.5.3 The development of the final questionnaire

In order to understand attitudes and behaviour to water supply failure, it was necessary to explore individual perceptions within the context of other hazards that may be experienced within the local area. This was explored within Section

1, thinking about your local area. The hazards were selected from analysis of the NRR (National Risk Register, 2015), prior analysis of the CRR's (Section 3.4.1) and represented hazards most likely to affect individuals within the UK. Questions were also designed to explore whether individuals perceived it to be important to prepare, if they actively prepared and whether this was influenced by direct experience (Appendix 2).

Section 2 of the questionnaire, thinking about your local water supply, explored individual awareness of the threats and hazards that may lead to a failure of the water supply. The questions within this section also sought to understand individual perceptions and attitudes to a failure of the water supply. This included an exploration of the reliance on the WSP to provide a safe, reliable and continuous supply of water and how long individuals perceive they are able to cope without a supply of water direct from the tap. As discussed within Chapter 2, (Section 2.6) the UK Government published the booklet 'Preparing for Emergencies' which was delivered to every household in the UK during 2004. This provided practical information regarding how individual homeowners could prepare for an emergency. Section 3 of the questionnaire explored what steps individuals take to prepare for an emergency and who they perceive as responsible for preparing for an emergency.

The questionnaire was designed to include a mixture of Likert scale questions, questions requiring a direct *'yes, no. don't know'* response and some open questions to explore why a respondent had made a particular choice. It was determined that using a combination of different styles would make the

questionnaire more interesting for the respondent to complete and ensure the respondent was engaged when providing a response (Figure 3.4).

Q4	Do you think it is important for you to prepare for the following hazards? *Please circle* **ONE** *number on each line*				
	Extremely Important	Very Important	Moderately Important	Slightly Important	Not at all Important
River flooding	1	2	3	4	5
Coastal flooding	1	2	3	4	5
Surface water flooding	1	2	3	4	5
Sewer flooding	1	2	3	4	5
Drought	1	2	3	4	5
Heatwaves	1	2	3	4	5
Low temperatures	1	2	3	4	5
Heavy snow	1	2	3	4	5

Q5	When thinking about your local area, do you actively prepare for any of the following? *Please tick* **ONE** *box on each line.*		
	Yes	No	Don't think about it
River flooding			
Coastal flooding			
Surface water flooding			
Sewer Flooding			
Drought			
Heatwaves			
Low temperatures			
Heavy snow			
Storms and gales			
Pandemic influenza			
Failure of the gas supply			

Figure 3.4: Examples of the different question styles used within the individual householder questionnaire

The questionnaire was also designed to take the respondent on a journey through the questionnaire where the content of each question was related to the content of following question. This was also designed to allow triangulation of the response during data analysis and provide a more complete understanding of perceptions, and attitudes to water supply failure and whether they influence behaviour through emergency preparedness. To complement this approach and ensure a reduction of responder bias, the questionnaire also included questions asked in a slightly different manner within a different section of the questionnaire to allow the response to be compared and contrasted (Figure 3.5).

Taken from Section 3

Q3	Please indicate whether you agree or disagree with the following statements? Please tick **ONE** box on each line					
		Strongly Agree	Agree	Don't know	Disagree	Strongly Disagree
I have a responsibility to prepare for an emergency						
I have been provided with information about how I can prepare for an emergency						
I think about how to prepare for the risks in my local area						
I know where to obtain information about how I can prepare for an emergency						
I take actions to prepare for an emergency						
The local authority has a responsibility to prepare for an emergency						
I am aware of my local authority emergency plans						
The local authority provides information about how to prepare for an emergency						
I rely on the local authority to provide me with information during an emergency						
I rely on the emergency services to provide me with assistance during an emergency						
The emergency services will arrive quickly during an emergency						
The water company will provide water if there is a failure of the water supply						
I rely on the local water company to provide water in all circumstances						
The water company will provide me with information if there is a failure of the water supply						
I trust the information provided by the water company during an emergency						
The Government provides information about how to prepare for an emergency						
I trust the information provided by the Government during an emergency						
I trust the information provided by the media during an emergency						
I trust the information provided by the local authority during an emergency						

Taken from Section 2

Q11	In the event of a serious failure of the water supply. How confident are you that the water company will provide you with a supply of water from an alternative source?				
		Extremely Confident	Very Confident	Moderately Confident	Slightly Confident	Not at all confident
Please circle **ONE** number	1	2	3	4	5

Figure 3.5: Example of a similar question included within a different section of the questionnaire to reduce responder bias.

3.5.4 Presentation of the questionnaire

An important consideration in the design of any questionnaire is appearance, format, structure and style. Particularly if the questionnaire is going to be sent to the general public and they will be expected to complete it alone without any prompts from the researcher. It needs to look professional so that the respondent will take the general theme and aspect of the questionnaire seriously. It also needs to be easy to read, understand and answer (Figure 3.5, Figure 3.7).

Following a complete review and improvement to the original draft questionnaire, the final version was presented to a group of individuals to ensure the questionnaire was easy to understand and complete. This consisted of 7 people who were not involved in the initial pilot study. They were asked to complete the questionnaire and the following items were discussed with the researcher:

- Is the introduction clear and easy to understand?
- Are the questionnaire instructions clear and easy to understand?
- Were the answer categories easy to understand?
- Comments regarding the appearance of the final questionnaire
- The size of the questionnaire. A5 booklet v A4 sheets

Preparing for an Emergency

Thank you for taking the time to complete this questionnaire. The information that you provide will be used as part of a research project by the University of Exeter to understand attitudes and opinions to preparing for an emergency. This is defined as *'an event or situation which threatens serious damage to human welfare, the environment or the security of the United Kingdom.'* This may also include an event or situation where there is widespread and severe disruption to essential services such as transport, water, electricity and gas.

Data Protection Notice

The information that you provide will be used for the purpose of this research study and any personal data you provide will be processed in the strictest confidence in accordance with the Data Protection Act. It will not be disclosed to any third parties. Personal data and the original questionnaires will be stored securely in a locked cabinet at all times and data used for analysis will be saved securely on a password protected and encrypted computer. All of the data used for analysis and the results of the research will be published in anonymised form.

Instructions

Please answer all the questions and return the questionnaire in the pre-paid envelope provided. For each question, please place a tick in the box that matches your answer. For example, if your answer is yes:

Yes ✓

No ☐

Please don't worry if you make a mistake. Just cross it out and tick the box that matches your answer.

Completing the survey online

You are more than welcome to complete the questionnaire online at:

http://www.smartsurvey.co.uk/s/bishops/

To do this, you will need to enter the Password: **water01**

Figure 3.6: Front cover of the final questionnaire including instructions for completion.

Section 1: Thinking about your local area.

The next few questions are about the local village, town or city where this questionnaire was delivered.

Q1	When thinking about your local area, do you think any of the following hazards are a risk to you? Please tick **ONE** box on each line				
	High Risk	Medium Risk	Don't know	Low Risk	No Risk
River flooding					
Coastal flooding					
Surface water flooding					
Sewer flooding					
Drought					
Heatwaves					
Low temperatures					
Heavy snow					
Storms and gales					
Pandemic influenza					
Widespread electricity failure					
Failure of the water supply					
Failure of the gas supply					
Other (please specify):					

Q2	What do you understand by a 1 in a 100 year event? Please tick **ONE** option	
An event that statistically can only happen once in every 100 years		
An event that statistically has a 1% chance of occurring in any given year		
An event that statistically has a 1% chance of occurring once in every 100 years		
An event that statistically happens every 100 years		

Figure 3.7: Example of the question layout of the final questionnaire.

The majority of respondents agreed the introduction and instructions were easy to understand and the application of different colours made it easier for respondents to select the appropriate response. It was considered that the response categories were easy to understand and this was reinforced through the use of prompts at the start of each question. The appearance of the questionnaire was evaluated as professional with the addition of the University of Exeter logo on the front of the questionnaire and the use of colour throughout the questionnaire was considered to provide an aesthetic quality that encouraged respondents to complete the questionnaire. Finally, respondents indicated a preference in the questionnaire being produced in the A4 size because it would be difficult to read as an A5-sized booklet. Amendments to the questionnaire were applied and a copy of the finalised questionnaire is presented in Appendix 2.

3.5.5 Distribution of questionnaires

Distribution of the questionnaire was conducted by post and hand delivery where possible. These were considered as the preferred methods of distribution in an attempt to achieve a representative sample of individual attitudes and perceptions to water supply failure. Traditionally, the response rate for postal surveys is relatively low (Oppenheim, 2000; Robson, 2011) and there are a number of methods that can be used in an attempt to increase the response rate of postal surveys. For example, the inclusion of a clearly defined covering letter to engage the respondent by explaining the purpose of the research, represents one method that could be applied (Appendix 3). If it is demonstrated that the research is applicable in *'real world'* situations this may influence whether a respondent decides to respond. Ensuring the questionnaire is presentable with

easy to follow instructions, the inclusion of a pre-paid envelope and the inclusion of relatable questions that are easy to understand may also contribute to an increased response. It has also been proposed that prompting respondents with follow up letter (Appendix 7) and providing an alternative method to complete the questionnaire such as online may contribute to an increased response (Oppenheim, 2000). All of these methods were used to try and increase the response rate.

However, it cannot be assumed that these methods will provide an adequate response rate for the application of statistical analysis. To ensure an adequate response rate, the postal distribution of questionnaires was supported with the delivery of questionnaires by hand. While postal questionnaires allow the rapid distribution of questionnaires to a wide geographical area, there is also an element of detachment between the researcher and the potential respondent which may result in a lack of response (Oppenheim, 2000). The delivery of a questionnaire by hand, if the respondent is at home, may provide a more personal element as the respondent has been provided with the opportunity to meet the researcher. However, there is also the potential that this may increase social desirability bias, especially if the questionnaire is administered face-to-face, where the respondent provides answers they perceive will be helpful for the researcher rather than a reflection of their true perceptions or attitudes (Bryman, 2006; Robson, 2011). In an attempt to reduce this, the researcher was not present when the questionnaire was completed.

Another potential difficulty was timing of the postal questionnaire. The questionnaires were distributed prior to an announcement by the UK Prime Minister of a General Election to determine who would take the country through the BREXIT process. It is possible that this may have influenced the response rate. There are also other considerations to be made when distributing questionnaires by post. It is not possible to ascertain if the questionnaires have been delivered to properties that are currently occupied and therefore a cooperation rate rather than a response rate is usually preferable in these cases.

600 questionnaires were distributed equally between 6 WSP areas and included, South West Water, Wessex Water, Severn Trent, Anglian Water, Yorkshire Water and United Utilities (Figure 3.8). It was considered that this would provide a broad perspective regarding the different challenges that each WSP may experience in terms of water availability, flooding of critical infrastructure, influx of tourists and the susceptibility of different regions to drought. It was not the intention to compare and contrast results of the questionnaire between WSP areas but it was necessary to select specific locations to allow for the distribution of follow up letters. However, because the response was anonymous, it was not possible to determine which respondent had provided a response. So, follow up letters were also distributed to locations that had already replied. Research was conducted to explore locations within each region that may provide a representative sample relating to the challenges identified by the WSP within the Water Resource Management Plans, the Pitt Report, Drought Reports and locations that had experience of water supply failure. It was also recognised that a low cooperation rate within a particular location would make it difficult to compare and contrast the response between different locations.
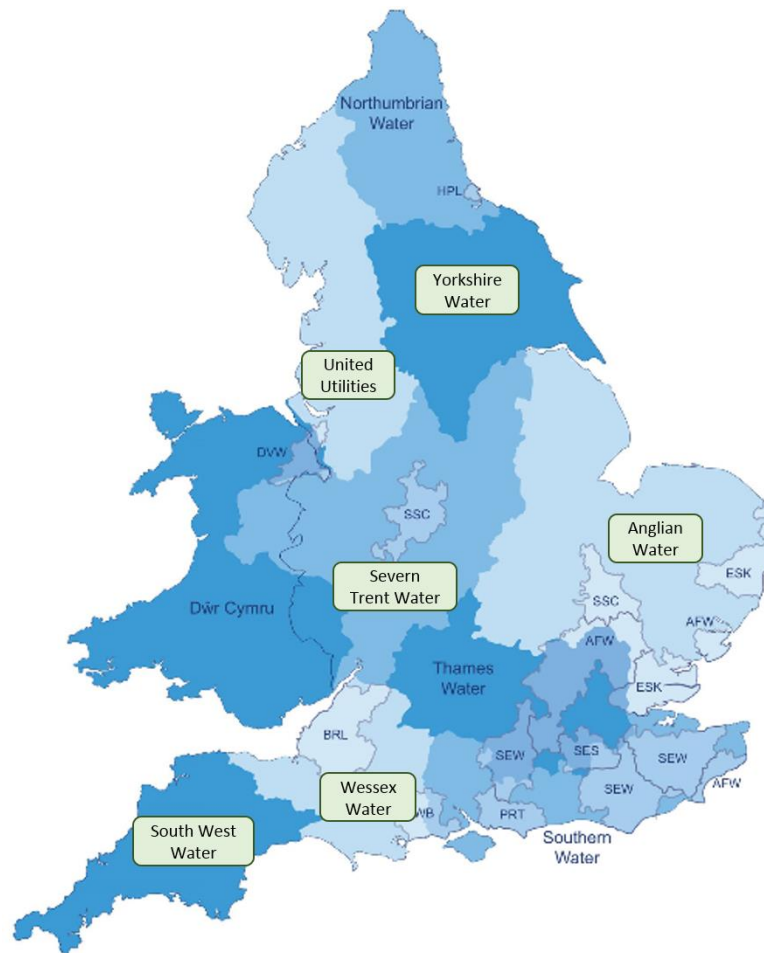
Figure 3.8: WSP locations chosen for the distribution of questionnaires

(Adapted from Ofwat, 2019)

South West Water

The region covered by South West Water experiences a water surplus (South West Water, 2015) and is able to effectively manage water supplies during the summer months despite an influx of tourists. Although the WSP covers a wide geographical area they engage with one dominant LRF within the region and 2 LRF's located on the periphery. This is relatively low compared to the other WSP regions.

Exeter was chosen as one of the locations for the postal survey because the main water treatment works was particularly susceptible to flooding prior to the installation of flood defences in 2011. Exeter City Centre also suffered a short loss of supply during October 2016 as a result of a severe fire within the city centre.

Torquay was selected because during the summer months the population almost doubles due to the influx of tourists. To cope with the increased demand South West Water have upgraded the Littlehempston Water Treatment Works and installed a new service reservoir.

Wessex Water

Wessex Water is also a region experiencing a water surplus (Wessex Water, 2015). However, they are actively working toward reducing consumption through the 'Water Save' initiative involving active engagement with communities and local schools.

Bridgwater was chosen as a location for the distribution of questionnaires because it is currently experiencing growth in response to the building of Hinkley Point C. This has resulted in an increase in property development within the area and the investment of £39 million to improve sewerage infrastructure within the area (Wessex Water, 2019). The villages of Goathurst and Bawdrip were also chosen as these represent small rural communities located on opposing sides of

the town of Bridgwater. The village of Goathurst is located at the foot of the Quantock Hills and the village of Bawdrip is located at the foot of the Polden Hills.

Severn Trent

The Severn Trent region was selected because Mythe Water Treatment Works is located within this region. Mythe Water Treatment Works was severely flooded during the 2007 flood event and resulted in over 350,000 people left without a centralised water supply for over 17 days (Pitt, 2008). This was a significant event highlighting the vulnerability of the UK's critical infrastructure to flooding.

This water company also encompasses a significant number of LRF's. Within the region Severn Trent are expected to engage with 15 LRF's and a further 9 located on the periphery of the area. This presents challenges in terms of coordinating a multi-agency approach to an incident that covers a wide geographical area. Analysis of the CRR's within this region also identified differences in the level of risk assigned to the same hazards and in some locations the lead assessor was not a representative from the water company. This will be explored further within the semi-structured interviews in Chapter 4.

Bishops Cleeve was the first location to be selected within this region because it directly experienced a loss of water supply during 2007 as a result of the flooding of Mythe Water Treatment Works. Content analysis of the internet responses on the principal information provider website (BBC Radio Gloucester, 2007) revealed that the provision of information supplied by Severn Trent throughout

the emergency was not considered by the public to be adequate with a high level of complaints directed toward Severn Trent and a high response from customers requesting information, advice compensation and help (Appendix 8). A question relating to the provision of information was included as part of the individual questionnaire.

Chilwell was the second location to be targeted within the Severn Trent region. This location was not affected by a loss of water supply during 2007. However, it is supplied by Church Wilne Water Treatment Works which supplies over 600,000 customers in the Nottingham Water Resource Zone. This area also obtains water from another water resource zone to be able to meet the demands of supply.

Yorkshire Water

Yorkshire Water was selected because it has proactively adopted a resilient approach to water supply within the region through the construction of a single interconnected grid. This was in response to the 1995 drought when water had to be transported to Halifax by a continuous stream of tankers to provide a water supply to the region. To prevent a recurrence of this situation, Yorkshire Water developed a single interconnected grid where water can be transported from an area where there is a plentiful supply to an area experiencing water scarcity, providing there is an adequate supply of water within the system.

Halifax was selected as the target location for the postal questionnaires because this City had direct experience of the 1995 drought. The second location selected was the Shiregreen area of Sheffield. This area is supplied with water from two Water Treatment Works (Ewden and Langsett Reservoir) and by importing water from Severn Trent. During 2007 Ewden Water Treatment Works had to be shut down as a result of damage to the main outlet on the River Don as a result of bank erosion induced by flooding. Also during 2007, there was a major power outage which forced Yorkshire Water to switch to the on-site back-up generator resulting in a significant drop in capacity. This area of Sheffield experienced a near drought during 2012 and subsequent widespread flooding shortly after.

Anglian Water

Anglian Water was selected because this water company experiences major challenges as a result of water scarcity within the region. With a high population density and low rainfall, Anglian Water has developed a large publicity campaign called 'Every Drop Counts' to encourage customers to think about how they use water more efficiently. This water company covers a wide area encompassing and engaging with a number of LRFs in the preparation of an emergency. This region also experienced widespread coastal flooding in 1953 as a result of a tidal storm surge with over 160,000 acres of land submerged by seawater (Lumbroso and Vinet, 2011). Poringland was selected as a location for the postal questionnaire in this region because this town experienced a burst pipe during the Christmas of 2014 which resulted in the loss of a centralised water supply for over 3 days. Huntingdon was chosen as the second location because this is an area considered to be at high risk of a severe drought (Anglian Water, 2015).

United Utilities

This region experienced severe flooding during the winter of 2015/16 and resulted in the failure of the water supply within some locations and the flooding of over 85 waste water treatment works (United Utilities 2016). Following this event, United Utilities work in partnership with Local Authorities, the Environment Agency and local Community Groups as part of the Cumbria Strategic Floods Partnership. This is to encourage a catchment wide approach to the management of flood risk through a multi-agency collaborative working partnership (Environment Agency, 2016). Cockermouth and Lancaster were selected as locations for the distribution of the questionnaire because they represent locations that have presented the WSP with different challenges.

Cockermouth is located within the West Cumbria Water Resource Zone and is supplied with water from Ennerdale Water and Crummock Water (United Utilities, 2015a). These are designated Sites of Special Scientific Interest (SSSI) and it is no longer possible to continue abstracting water from these locations. United Utilities proposed the development of a pipeline between West Cumbria and Thirlmere Reservoir to provide customers with a sustainable supply of water. During the 2015/16 flood event the city of Lancaster was flooded, over 61,000 homes were without power and over 200 homes experienced water supply failure over a period of four days as a result of the flooding of water treatment works (Lancashire County Council, 2016; United Utilities, 2015b).

YORKSHIRE WATER

Halifax : Faced water shortage during 1945 drought

Hull
Sheffield
Doncaster
Driffield
} areas surrounding affected by 2012 drought
River Don   River Hull
River Rother   River Derwent

Pocklington : Yorkshire Water worst burst main in 15 yrs. 4000 customers.

Thirsk : Burst Water main affecting water supply to 3000 properties.
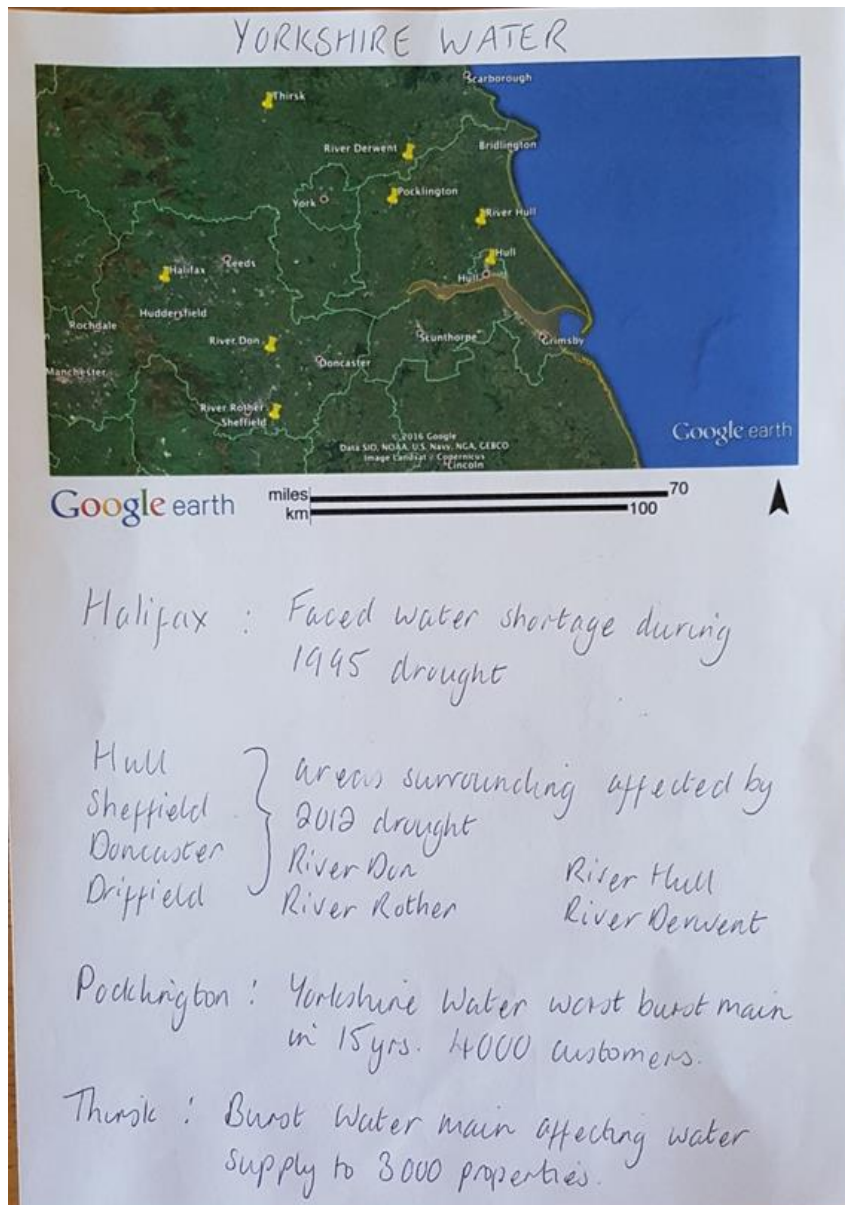
Researching
possible locations

Figure 3.9: Example of the process of targeting locations for questionnaire distribution.

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Once a location was identified, 5 streets were selected at random from an aerial map of the location using Google Earth. The individual property addresses were obtained using council tax band information available on the internet and a proportional sample of properties were selected at random for each location using google random number generator (Figure 3.9).

3.5.6 Analysis of the questionnaire response

131 respondents participated in the individual householder questionnaire, this represented a 22% cooperation rate. The response for each questionnaire was imported into the statistical software package IBM SPSS 25 for data analysis. The questionnaire data was analysed in its original form with a focus on descriptive measures of frequency rather than regression analysis. This is because it was not possible to use the same Likert scale for each individual question without losing the original meaning of the question. As discussed within Section 3.5.2, the questionnaire was designed to allow triangulation of the response during data analysis and provide a more complete understanding of perceptions, and attitudes to water supply failure. As each question was specifically designed to explore attitudes and perceptions to water supply failure, it was considered more appropriate to preserve the original meaning of the question rather than change the question to suit a standard Likert scale solely for the application of statistical analysis.

Likert data represents ordinal, discrete data with a limited range which creates difficulties with the application of suitable statistical tests (De Winter *et al, 2010*). The response to postal questionnaires may also present difficulties in obtaining

a sufficient cooperation rate for the use of statistical tests (Oppenheim, 2000). In order to overcome these difficulties and obtain specific information regarding attitudes and perceptions to water supply failure, the questionnaire was carefully constructed to ensure each question was related to and could be supported by the response provided by other questions within the questionnaire (Section 3.5.2). It was considered more appropriate to present the data accurately in its original form as a true representation of individual attitudes and perceptions to water supply failure.

The results of two respondents were removed from the analysis. Respondent STBC005 was removed from the dataset because they did not answer 71% of the questions and respondent WWBD005 was removed because they did not answer 50% of the questions.

There were also instances where respondents did not answer every question or did not answer a section within a Likert-scale response. This is recorded as *'missing data'* or an *'item of non-response'* (Schlomer *et al*, 2010) and led to a variation in the number of responses for each individual question.

There were instances within the Likert-scale question response, where a respondent did not provide information for a particular hazard even though they had provided a response above and below the item of non-response (Figure 3.10). This may be because they are unsure what to select, preferred not to say, did not understand the hazard or inadvertently missed these questions while

selecting options or changing pages. However, because the questionnaire responses were anonymous, it is not possible to ask respondents why they provided an item non-response.

Q1 — When thinking about your local area, do you think any of the following hazards are a risk to you?
Please tick ONE box on each line

	High Risk	Medium Risk	Don't know	Low Risk	No Risk
River flooding					
Coastal flooding					
Surface water flooding				✓	
Sewer flooding					
Drought					
Heatwaves				✓	
Low temperatures				✓	
Heavy snow				✓	
Storms and gales		✓			
Pandemic influenza				✓	
Widespread electricity failure		✓			
Failure of the water supply		ı		✓	
Failure of the gas supply					
Other (please specify):					

Q1 — When thinking about your local area, do you think any of the following hazards are a risk to you?
Please tick ONE box on each line

	High Risk	Medium Risk	Don't know	Low Risk	No Risk
River flooding	✓				
Coastal flooding					✓
Surface water flooding		✓			
Sewer flooding			✓		
Drought					
Heatwaves				✓	
Low temperatures				✓	
Heavy snow				✓	
Storms and gales		✓			
Pandemic influenza			✓		
Widespread electricity failure			✓		
Failure of the water supply			✓		
Failure of the gas supply			✓		
Other (please specify):					

Figure 3.10: Example of questionnaire response

There are a number of different approaches for handling missing data and items of non-response and many of these are influenced by the amount of data that is

missing. One approach is to conduct a list wise deletion and remove all of the respondents that did not provide a response for every question or questionnaires with more than a defined percentage of missing data (Pigott, 2001). However, the removal of this information may contribute to bias results and *'a loss of statistical power'* (Schlomer *et* al, 2010) if a large number of questionnaires are removed. This approach also neglects the possibility that there may be a pattern to the missing data that requires further exploration.

Examples of good practice with regard to the handling of missing data involve the determination of whether the missing data is *'missing completely at random',* *'missing at random'* or *'not missing at random'* (Schlomer *et al,* 2010)*.* Categorising missing data is based on whether there is a relationship between the variable being examined and the missing data. *'Missing completely at random'* assumes there is no relationship and no observable pattern to missing data within the data set. *'Missing at random'* also assumes there is no relationship between missing data and the variable being examined. However, a relationship may exist between the missing data and a different variable within the data. For instance, the reason for missing data is related to the answer given within another question. Where there is an observed pattern to the data, it is considered to be *'not missing at random'.* It is very difficult to assess and categorise missing data because within an anonymous questionnaire it is not possible to ask respondents why an item of non-response was given. However, missing data should not be ignored or excluded from the analysis without investigating if there is a pattern to the data because this may highlight where a particular hazard has been misunderstood.

3.5.7 Missing data analysis

Missing data was identified and recorded within SPSS as an item of '*no response'*. A missing value analysis was conducted within SPSS using the *'analyse – missing value analysis'* function. This performs a variable analysis on the dataset to calculate the percentage of missing data and to identify the existence of a pattern. The analysis produces an overall summary of missing values, the missing values pattern and the pattern frequencies graphs. The summary of missing data is presented as a series of 3 pie charts (Figure 3.11)
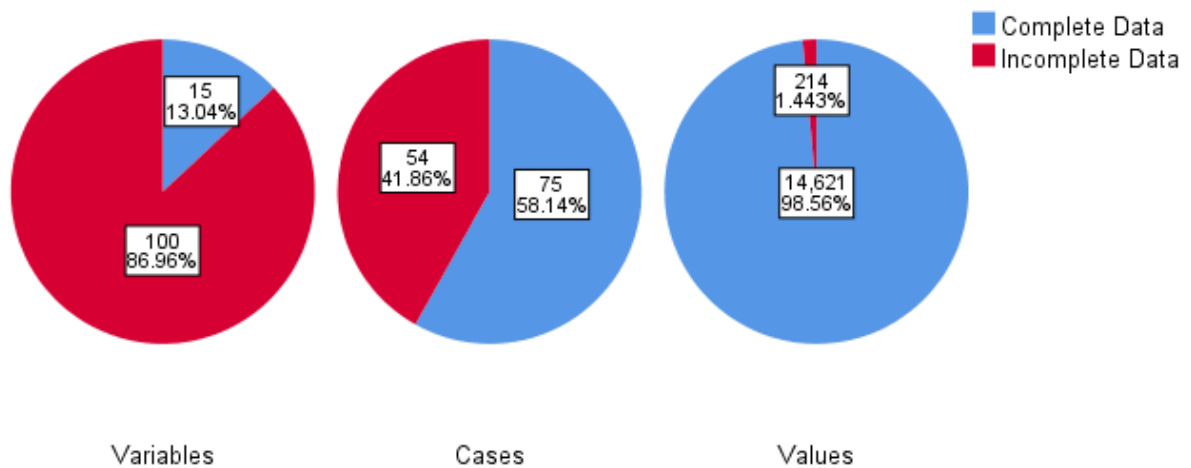
Figure 3.11**:** Overall summary of missing values

The Variables pie chart demonstrates the majority of question responses (87%) include at least one missing response. Many of the questions were designed as Likert-scale questions and as explained in Section 3.5.8, the majority of items of *'no response'* were the result of the omission of a single Likert-scale response. The Cases pie chart also reveals that 42% of respondents did not provide at least one response resulting in missing data. If a list-wise deletion was performed on

this data, this would significantly reduce the statistical power of the data set and may also contribute to bias results. The Values pie chart indicates that in total only 1.4% of the values are missing however, due to the nature and design of the questionnaire this represents missing data from a large proportion of respondents.

The graph of missing value pattern provides an indication of whether monotonicity exists within the dataset. This is to establish if there is a strong pattern or concentration of values within the data (Figure 3.12). Each row represents a group of respondent's records that have the same pattern of missing or non-missing data. The individual questions are displayed along the x-axis in increasing order of the amount of missing data each one may contain. For instance the first pattern does not contain any missing data and the final pattern consists of a greater proportion of missing data. This test is conducted to determine the appropriate method of imputation of missing data (Little and Rubin, 2019). Monotonicity is evidenced if the pattern consists of dominant blocks of adjoined missing and non-missing data. If it is demonstrated that the dataset is monotone then a monotone imputation method would be required to replace missing values.

Figure 3.12 caption content:
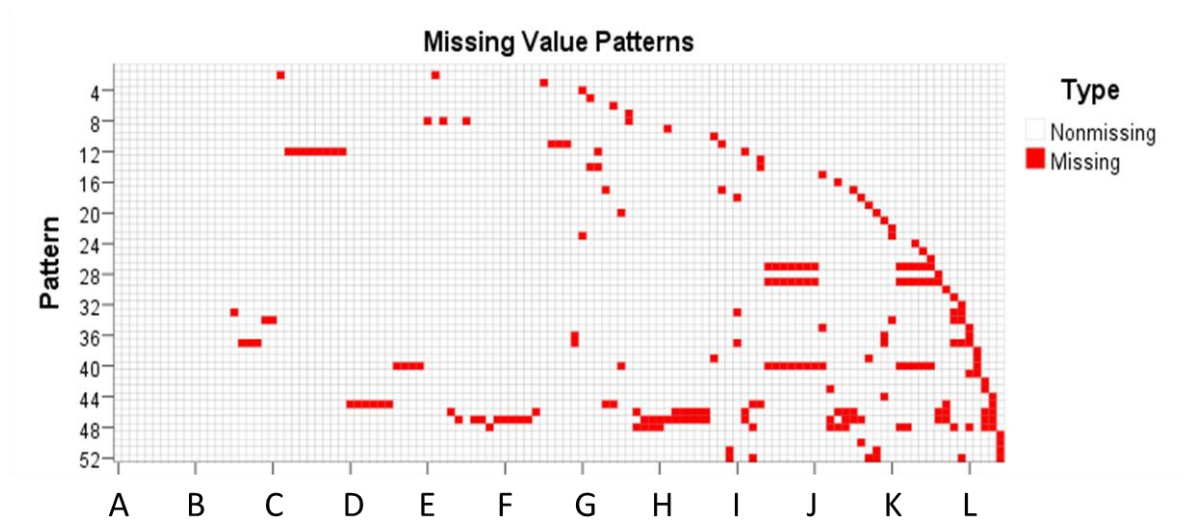
A	Do you actively prepare for Surface Water Flooding?
B	Do you obtain local area hazard information from the Met Office?
C	Do you actively prepare for heavy snow?
D	Do you have experience of sewer flooding?
E	Do you obtain information from local radio for serious water supply failure?
F	Do you obtain information about how to prepare from the Television?
G	Do you actively prepare for heatwaves?
H	Do you obtain local area hazard information from Environment Agency?
I	Do you think heatwaves are a hazard in your local area?
J	What is the likelihood malicious attack could cause water supply failure
K	Do you actively prepare for drought?
L	Do you think pandemic influenza is a hazard in your local area?

Figure 3.12: Graph of Missing Value Patterns

Within this dataset, the missing data is represented as discrete islands and small clumps and would indicate no systemic pattern to the missing values. This is supported within the pattern frequencies graph (Figure 3.13). This demonstrates that Pattern 1, representative of no missing data is the most common pattern with a percentage of over 80%.
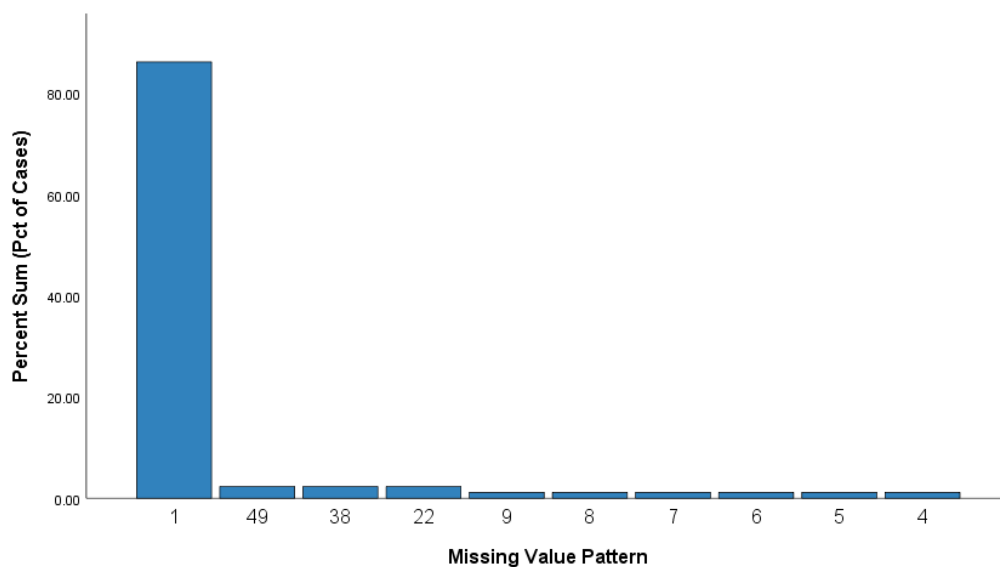
Figure 3.13: Pattern Frequencies Graph

These tests indicate there is no pattern to the missing data. A Little's MCAR Test was performed using the missing values analysis procedure in SPSS to assess if the missing data was *'missing completely at random'*. This approach calculates the difference between the estimated and observed mean within each data pattern with the null hypothesis that data are missing completely at random (Little, 1988).

Chi-Square	Degrees of Freedom	P Value
1664	1838	.998

Table 3.4: Results of the Little's MCAR Test

The results demonstrate a non-significant Little's MCAR test, χ^2 (1664), df.1838, p = .998, indicating the data are missing completely at random (Table 3.4). This was supported by a visual inspection of the dataset to assess whether the lack of response was related to an answer provided for another question. This also involved referring back to the original questionnaires to see if a respondent had provided any further information regarding their *'no response'*.

A multiple imputation was performed on the dataset to replace the missing data. This is an iterative process using a Monte Carlo Simulation and simulates possible values for the missing data. However, before this can conducted it was necessary to set the parameters required for imputation.

The *'Analyse - Multiple Imputation – Impute Missing Data Values'* function in SPSS was selected to perform the multiple imputation. The variables requiring imputation were selected within the *'variables tab'* with a maximum of 5 imputations selected for each variable. Within the methods tab, the *'Fully Conditional Specification Markov Chain Monte Carlo (MCMC)'* was selected as the appropriate method to be applied to the data because there was no evidence of monotonicity. A maximum of 100 iterations per imputation was selected to improve the likelihood of reaching convergence. The default model type of a standard linear regression was selected for scale variables. Within the

constraints tab, the minimum and maximum values were determined manually for the model variables, the imputations were selected to open as a new dataset within the output tab and the multiple imputation was performed.

This created a dataset containing the results of each of the 5 imputations for each item of missing data. The next stage was to compare the range of imputations with the original dataset and determine the most appropriate value for each item of missing data. To ensure validity of this process, a sample of question responses from the original dataset were compared with the new dataset containing imputed missing values to establish if there was a significant difference between the two datasets. This was performed using an independent samples T Test. The results indicated there was no significant difference between the original data and the data containing imputed values for each question sampled t = (0.08, 0.23, 0.13, 0.08), df = 8 , $p > 0.05$, (Appendix 9**)**. The final dataset was analysed and the results are presented in Chapter 5.

3.6 Research methods used to explore attitudes and perceptions to water supply failure during an emergency (Objective 3)

During late February and early March 2018 the UK experienced a prolonged period of sub-zero temperatures affecting many parts of the country. Termed the *'Beast from the East'* by the UK media, the freezing conditions coincided with strong north easterly winds bringing heavy snow into many parts of the country. This prompted the Met Office to issue a red warning of snow, indicating *'Widespread damage, travel and power disruption and risk to life is likely'.* Thousands of schools were closed, road and rail travel was severely affected with

motorists trapped in their cars overnight in freezing conditions, a major incident was declared in one region and tragically 10 people lost their lives. The heavy snow, freezing conditions and the resultant thaw presented a new set of challenges particularly for the UK water sector.

Throughout the event, UK WSP's were actively providing customers with advice regarding the potential consequences of frozen pipes within their homes. However, as the temperatures increased, it was the WSP's that were confronted with a series of pipe bursts resulting in the loss of the centralised water supply to over 200,000 customers (Ofwat, 2018). 36,000 people were left without a centralised water supply for over 24hrs and in some instances this extended over 5 days (CCWater, 2018).

As demonstrated in Chapter 1, (Section 1.3) individual behaviour to water supply failure can significantly influence the ability of both individuals and WSP's to achieve resilience during an emergency. This event provided an opportunity to understand how individual attitudes and perceptions to water supply failure may influence an individual's behaviour to water supply failure through the direct observation of comments on the social media platform Facebook.

This also provided an interesting insight into how customers and WSP's engage during an emergency situation to understand what information customers require to enable them to become more resilient to a failure of the water supply. What information can individual customers provide the WSP's to allow them to manage

an emergency situation more effectively? Can this interaction between customers and WSP's be used to increase future resilience to extreme events?

3.6.1 Thematic analysis of Facebook comment dataset

The social media platform Facebook was considered a source of information for this part of the research because it is accessible and was actively used by WSP and their customers to share and exchange information regarding water supply failure throughout the duration of the event. Twitter was also considered for analysis but the imposed word restriction provided a limited understanding of individual attitudes and perceptions of water supply failure. Facebook does not impose a restriction on the number of words an individual may post therefore allowing customers to freely express their attitudes and perceptions. This was considered to provide a much richer data set to explore individual attitudes and perceptions to water supply failure.

188 posts and 7873 comments were downloaded for the period 3rd March 2018 to 8th March 2018 for three different WSP's. Analysing Facebook provides only one source of data for analysis. The results of this analysis will be compared with the results of the individual questionnaires (presented in Chapter 5). This will be presented in Chapter 8, which undertakes a full triangulation of all the data analysis and findings.

Facebook posts are composed of two main sections. The first section is where the owner of the Facebook page will write a post. The second section is where

individuals respond to the original post by writing a comment or replying to a comment that has already been posted (Figure 3.14)

The posts were *'screen dumped'* as .pdf files and then converted into text files. The individual comments were anonymised and imported into the qualitative data analysis software package, NVivo (v.12) for analysis. The comments relating to each WSP were analysed independently of one another within a separate project within NVivo (v.12). This was to provide an element of validity in the coding process. The comments were read through repeatedly to enable familiarisation with customer attitudes and perceptions. Taking an inductive approach, a first level analysis was conducted to identify common discussion points within the data and comments were coded within the context of the original post and the theme of the responding comments.

We're really sorry to those customers who are without water this morning. The severe weather has had an unprecedented impact on our business this week, including a big increase in the amount of leaks and bursts on our network of pipes and those in our customers' homes. Our teams have been working through the night to complete as many repairs as possible, as well as putting more volumes of water into our pipes. We're doing everything we can in extremely challenging circumstances to get everyone back to normal as fast as we can.
We will post updates here and on our website as we get them. Our call centres will be very busy, with long call wait times. Please only call us if it is very urgent

Original Post

👍 Like   💬 Comment   ↗ Share

🤍😡 16   Oldest ▾

6 Shares

_____ Is there any chance you'll be sending out an alternative water supply at all? (Bottled/Bowsers) I bought some bottled water last night when it started but nearly all gone! In _____ - no water since around 7pm...

Like · Reply · 9w · Edited   👍 2

_____ apologies for the delay in getting back to you. We've got bottled water available at Homebase – _____

Like · Reply · 9w

_____ We need bottle water in ____ where the nearest pick up

Like · Reply · 9w

_____ Please.

Like · Reply · 9w

_____, apologies for the delay in getting back to you. We've got bottled water available at Homebase – _____

Like · Reply · 9w

Write a reply...   ☺ 🎁

_____ We were at the Sainsbury's local near a _____ an hour ago, there was water there and in the shop on the corner by Wyatt Park Road

Like · Reply · 9w

_____ has no water !

Like · Reply · 9w

_____ apologies for the delay in getting back to you. Are you still experiencing supply issues? – ____

Like · Reply · 9w

Comments and Replies

Figure 3.14: Example of the structure of a Facebook Post

180
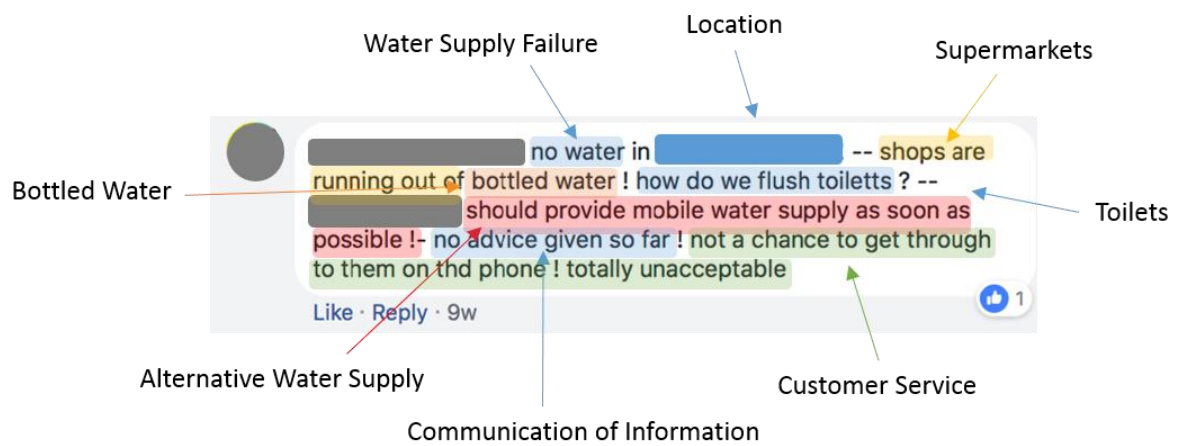
Figure 3.15: Example of coding a Facebook comment

Due to the nature of Facebook and the ability to post detailed comments, many of the responding comments contained information that could be coded within many different codes and were therefore coded accordingly (Figure 3.15). Comments consisting of emoji's were not considered as part of the analysis and comments used as a 'tag' to share information with another individual were also excluded. Comments that were part of a conversation were coded as both conversational and individual comments. Where comments were incomplete, they were coded according to the majority of the information provided within the comment. 59 codes were identified from analysis of the Facebook comments.

A number of different approaches could be applied to understand the attitudes and perceptions of customers from the Facebook posts. One approach would be to analyse the comments relating to each individual post. However, there were difficulties with this because there were many instances where customers would

post a comment relating to water supply failure that was not related to the information provided by the WSP in the original post.

There were also instances where the WSP provided a general information post, requesting customers to be patient while they investigate the ongoing situation. In response to these posts, customers would post comments relating to many different locations and difficulties they encountered as a result of water supply failure.   While each comment was analysed within the context of the original post and the thread of comments before and after the post, it was considered that in order to understand attitudes and perceptions throughout the incident all the comments would be analysed regardless of attachment to a specific post.
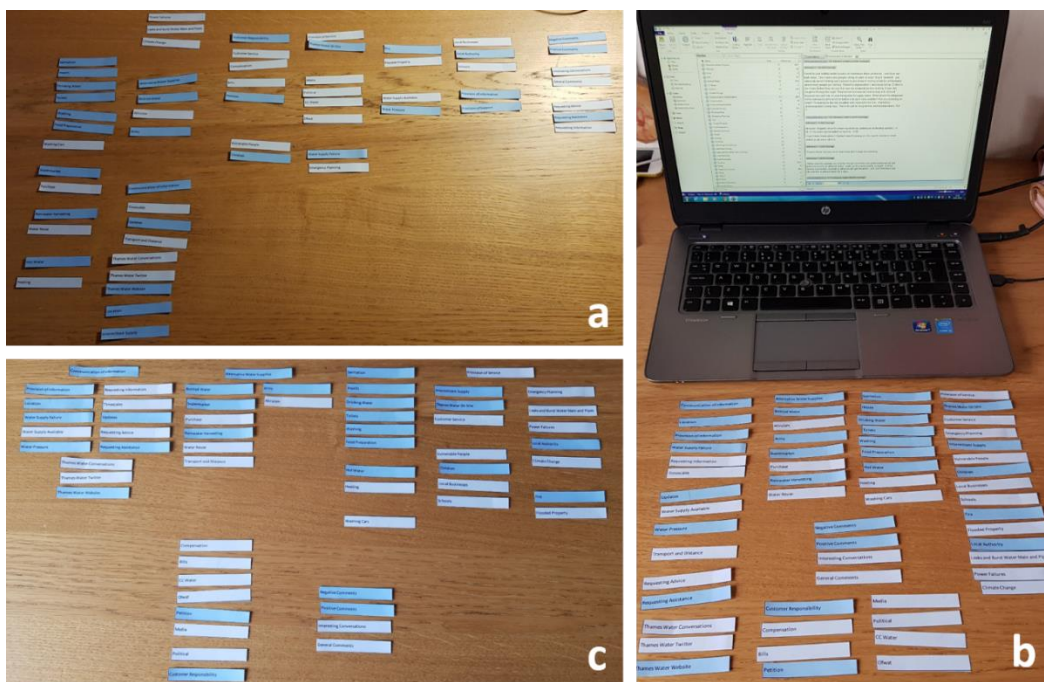
Figure 3.16: Identification of themes using a combination of NVivo and a manual approach.

	CODES
1	**COMMUNICATION OF INFORMATION**
	Provision of Information
	Requesting Information
	Conversations between the WSP and the Customer
	Customers Sharing Information
2	**ALTERNATIVE SUPPLIES OF WATER**
	Availability of Alternative Supplies of Water
	Contingency Planning
	Altruistic Behaviour
3	**LIVING WITHOUT A WATER SUPPLY**
4	**PROVISION OF SERVICE**
	WSP Customer Service
	Vulnerable Customers
5	**COMPENSATION AND BILLS**
	Complaints to the Regulator

Table 3.5: Interview codebook including themes (highlighted in blue) identified from related codes.

The second level of analysis involved understanding the context of the information contained within the codes and identifying themes. This is an iterative process and was conducted using both NVivo to explore the content within the codes and the manual manipulation of codes into relevant themes (Figure 3.16). An inductive approach using thematic analysis was considered appropriate for this analysis because it provided an opportunity to understand and explore individual attitudes and perceptions to water supply failure during an actual

emergency. This allowed the identification of themes within the context of a real event where individuals were actually experiencing the consequences of water supply failure. Five main themes were identified and developed into a codebook (Table 3.5). The results of the thematic analysis are presented within Chapter 6.

3.7 Research methods used to explore collaborative working partnerships (Objective 4)

An emergency presents an uncertain environment that is dynamic, and rapidly evolving. To achieve a greater resilience to an extreme event or an emergency situation requires the ability of a community and the responder organisations to be flexible and have the ability to adapt to unanticipated conditions (Comfort *et al,* 2010). Establishing integrated social networks prior to an emergency is important for a number of reasons. During the development process organisations and communities gain a greater understanding of the roles and responsibilities of each organisation, which helps to understand and manage realistic expectations. The process of attending regular meetings and establishing relationships helps to build trust and strengthen relationships, which in turn promotes more effective collective action before, during and after an emergency. Establishing the network also allows more effective communication of risk and during an emergency can be used effectively to improve situational awareness.

Social network analysis provides an effective method to identify both formal and informal relationships amongst a community and responder organisations. Analysis of the network structure and the strength of the relationship ties can be

used to understand how a community can achieve greater resilience to extreme events through collective action and learning. This can provide valuable information to understand how a community and the responder organisations will collaborate and respond during an emergency situation. The development of strong relational ties between the community and local organisations will not only strengthen the emergency response but also enable the development of a more resilient society (Comfort *et al,* 2010).

3.7.1 Social Network Analysis through participatory action research

Social network analysis is a method used to understand and analyse the connections, ties and relationships between different actors within a network (Wasserman and Faust, 1994. The measurement of relational data can be used to identify prominent actors within a network through centrality measures of betweenness centrality and degree centrality (Wasserman and Faust, 1994; Freeman *et al*, 1979). Betweenness centrality is a measure of the number of times an actor lies on the shortest path through the network. An actor with a high betweenness centrality is assumed to have a greater influence within the network because from a structural perspective they have access to more information passing through the network and occupy a positon enabling control over the flow of information (Hanneman and Riddle, 2011).

The degree centrality is a measure of the number of connections an individual actor has with other actors within the network (Wasserman and Faust, 1994). This is comprised of in-degree and out-degree. In-degree in a measure of the number of connections directed toward the actor and if an actor displays a high

in-degree they are considered prominent within the network (Hannemann and Riddle 2011). Out-degree is the number of connections directed away from the actor towards others in the network and it is considered that actors possessing a high out-degree are very influential within the network because they are able to share information with a large number of actors (Hannemann and Riddle, 2011). The density of a network provides an indication of the level of connectedness between actors within the network. This is simply the number of actual connections within the network divided by the total number of possible connections. Density also provides an indication of the level of connectivity within the network (Hannemann and Riddle, 2011).

Traditionally, social networks are analysed as static networks representing a specific moment in time (Choi and Brower, 2006). However, social networks are dynamic and evolve in response to influences within the socio-ecological-technical environment. The ability to understand the complexities and interactions require the application of both quantitative and qualitative methods. Quantitative social network analysis can be combined with qualitative semi-structured interviews and participatory action research (Kelman *et al,* 2016). These methods were used to explore the evolutionary development of a community-led Flood Group and a Local Authority-led Flood Board to understand the multi-agency approach to flood resilience.

Participatory action research allowed the practical exploration of the relationships within the network through a *'bottom up'* approach (McTaggart, 1991; Greenwood *et al,* 1993). This provided a realistic interpretation of how the network developed

and explored the benefits and difficulties of bringing community groups and practitioners together. Participatory action research involves the engagement and active participation of the community to work together in collaboration with the researcher to explore and understand problems affecting the community (Kemmis and Wilkinson, 1998; Minkler, 2000). The intention is for the practical application of this information to initiate change within the community to resolve problematical issues (Greenwood *et al,* 1993; McTaggart, 1991; Kemmis and Wilkinson, 1998; Minkler, 2000).

Within this research, the collaborative working partnership between the researcher and a community representative led to the development of a series of social network graphs. These were developed from the perspective of one individual within the local community who had direct experience of establishing a network of connections with local authorities and responder organisations. While analysis of social networks are used to identify prominent actors within the network it was also necessary within the context of this research to understand how and why the social networks were developed. It could be argued that a small sample size may restrict the level of understanding regarding community resilience and a comparative analysis with different community groups may be more reflective of how these groups are established (Yates, 2002). However, it takes a great deal of time to develop and establish a relationship between the researcher and the participant and it was considered that taking a pragmatic approach using participatory action research would provide an opportunity to explore and understand the contextual meaning of achieving resilience at the level of the community (Yates, 2002). This could then be applied as a foundation for further research.

The social networks developed as part of this research also included a direct connection with a representative from the local WSP. During past flood events the local community had experienced surface water flooding resulting from blocked drains and it was perceived by the local community representative, that a holistic approach to flood risk management also required the involvement of the local WSP. The original network was developed from the perspective of flood risk management however, there is an active connection within the network to the WSP. The Government 'top down' approach to community resilience places an emphasis on the development of community groups in relation to flooding (Twigger Ross *et al,* 2015; Cabinet Office, 2016). While this is recognised as one of the most prevalent hazards in the UK (National Risk Register, 2015), this research seeks to explore whether the networks developed within local community groups can also be utilised for the distribution of alternative supplies of water during water supply failure incidents.

The social network graphs were developed throughout a process of interviews held within the home of the community representative from November 2017 to March 2018. The interviews were semi-structured to enable the development of the social network graph and to explore and understand how the relationships were established between the local community groups and the responder organisations. During the initial interviews all of the information was recorded in written form and imported within R Studio for analysis using the social network package, igraph. This was used to develop an adjacency matrix of undirected and directed relationships for each social network graph representing a specific moment in time during the development of the Flood Group and the Flood Board. The development of the social network graphs was an iterative process over a

period of several interviews where the relationships identified within the graphs were discussed and annotated to ensure accuracy. These are presented and discussed within Chapter 7.

The social network graphs explore the evolutionary development of the community-led Flood Group and the Local Authority-led Flood Board to understand how a *'bottom up'* approach to emergency planning can help to achieve resilience through collaborative working partnerships as defined within Objective 4.

The community representative presented the social network graphs at the Environment Agency Flood and Coast Conference, 2018 and at local Environment Agency workshops to demonstrate the importance of including the community within the multi-agency approach to flood risk management.   This demonstrated how participatory action research was used to stimulate change in approach with regard to including communities within flood risk management decisions.

3.7.2 Case study area

The case study area was chosen because the West Somerset region is comprised of small rural isolated communities susceptible to flash flooding. These communities could easily become isolated during a flood event and may have to wait a considerable period of time before they would receive any assistance from the emergency services.

The district of West Somerset covers an area of approximately 320 sq km (Environment Agency, 2009b) comprising 42 Parishes and Towns with a combined population of approximately 34,000 (Office for National Statistics, 2011; West Somerset Flood Board, 2014). West Somerset is predominately rural with the majority of the region located within Exmoor National Park to the west and bordered by the Quantock Hills to the east. The main urban areas of Minehead, Watchet, Williton, Dunster and Porlock are located to the north along the Bristol Channel (Figure 3.17).

Figure 3.17: Location of West Somerset courtesy of Google map data, 2019.

The south of the region is characterised by a very steep topography with streams and rivers flowing from their source in the upland areas of Exmoor and the Quantocks towards the low lying coastal plains along the Bristol Channel. Flash fluvial flooding and surface water flooding are particular hazards within this region. The steep topography combined with the low permeable nature of the

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underlying geology (Devonian sandstones, siltstones and mudstone), contributes to high surface runoff and rapidly responding rivers during periods of high rainfall (West Somerset Council, 2009: Environment Agency, 2014b). There are approximately 1600 properties that have a 1% chance of fluvial flooding in any given year (Environment Agency, 2014b) however, this is set to increase to over 2,040 properties by 2100.

To the north of the region Porlock, Minehead and Williton are susceptible to tidal flooding as a result of high tides resulting from a storm/tidal surge. The main transport link within the region, A39 is also susceptible to fluvial and surface water flooding with the potential consequence of isolating communities and preventing emergency responders providing assistance during an emergency. In terms of critical infrastructure there are 3 electricity substations and 1 water treatment works at risk of flooding (Environment Agency, 2014b).

Many of the communities at risk of flooding in West Somerset have developed community flood plans and flood warden schemes. This has been conducted independently or with the assistance of the Local Authority and the Environment Agency. Through the development of these schemes they have developed social networks with many of the responder organisations and the development of these networks is explored within Chapter 7.

3.8 Research methods used to explore the system of emergency management in the UK (Objective 5)

Objective 5 takes a systems based approach to investigate the impact of the failure state and explore how resilience can be achieved through effective emergency planning. This requires exploring the elements that comprise the emergency management system in greater detail to understand how they are interconnected and how they enable the purpose of the system to be achieved (Meadows, 2008; Senge 2006; Arnold and Wade, 2015). However, even though the purpose of a system may be clearly defined, the actual intrinsic behaviour of the system may reveal something different. In order to determine whether the purpose and behaviour of the system are aligned it is necessary to explore and understand the structure of the system.

The literature review revealed the purpose of the UK emergency management system is the protection of human welfare from *'an event or situation which threatens serious damage'* (CCA, 2004). This is to be achieved through the application of resilience and is defined as:

> *'The ability of the community, services, area or infrastructure to detect, prevent and if necessary to withstand, handle and recover from disruptive challenges'*
>
> (Cabinet Office, 2013c)

This definition highlights that resilience is to be applied at different stages within the emergency management system from the level of community to the level of infrastructure.

Within this research it is proposed that the application of quantitative and qualitative research methods can be used to explore and understand the perception and application of resilience within different elements of the UK emergency management system. This is through semi-structured interviews, questionnaires, analysis of Facebook comments and Social Network Analysis. Each individual analysis will provide an indication of how resilience is interpreted and applied within each element of the system. However, this represents a silo approach to understanding resilience. If the effective application of resilience requires contextualisation and a wider understanding with regard to resilience *'of what, to what'* (Carpenter *et al,* 2001) then it is also necessary to take a holistic approach to understand resilience within the context of the overall system.

Data triangulation is traditionally applied where validation is sought through the analysis of difference research methods (Robson, 2011; Bryman, 2006). Within this research, the process of triangulation is used to bring all of the results together and develop a deeper understanding of the meaning of resilience within different elements of the emergency management system. This enables the identification and exploration of interconnections between different parts of the system and a greater understanding of how these influence the function and behaviour of the system.

However, as demonstrated within the literature review (Chapter 2), the system of emergency management in the UK is complex with regard to legislation, the organisations involved in emergency planning, response and recovery and the perceptions, attitudes and behaviour of individuals within society. While the application of quantitative and qualitative methods provide an opportunity to explore the characteristics of resilience within each structural element of the system, these methods represent a linear approach to analysing and understanding a system that is complex, dynamic and multi-dimensional.

In order to explore these complexities and understand the dynamic behaviour of the system requires the application of a systems based approach. This applies the principles of system thinking which is defined as:

> *'Systems thinking is a set of synergistic analytical skills used to improve the capability of identifying and understanding systems, predicting their behaviours, and devising modifications to them in order to produce desired effects. These skills work together as a system'.* (Arnold and Wade, 2015)

Systems thinking explores how the influence of interconnections and relationships within a system determine the system behaviour (Meadows, 2008). This requires an understanding of the overall structure of the system and the identification of causal processes operating within the system. This approach recognises the complexity and non-linearity of systems and allows the analysis

of systems at different scales. For instance, systems may be part of other systems. This approach also allows a more complete evaluation of whether the behaviour of the system contributes effectively to the overall function and purpose of the system (Meadows, 2008; Arnold *et al*, 2015). An example of this approach was demonstrated within Chapter 1 (Section 1.3) in relation to the causal processes influencing the failure of the water supply during the severe flood event of 2007 in Gloucestershire.

In Chapter 1 (Section 1.3, Figure 1.5), the main structural elements of the emergency management system were identified. Section 3.1 (Figure 3.1) discussed how each structural element of the system will be explored using the Objectives defined within Chapter 1, (Section 1.4). This systems based approach provides an opportunity to understand how resilience is interpreted, applied and operationalised within and between each element of the emergency management system. The triangulation of these results using the quantitative and qualitative research methods applied within Chapters 4, 5, 6 and 7 (Chapter 1, Figure 1.6) will provide a greater understanding of how resilience operates within the emergency management system. Once this has been achieved, the Safe and SuRe intervention framework will be applied to the emergency management system to identify the main threats to the system and the potential impact and consequence of these threats on the ability to achieve resilience to water supply failure (Figure 3.18). This analysis will also include an exploration of the intervention measures, mitigation, adaptation, coping and learning to understand how these can be applied to the system of emergency management to achieve overall system resilience to water supply failure (Chapter 8).
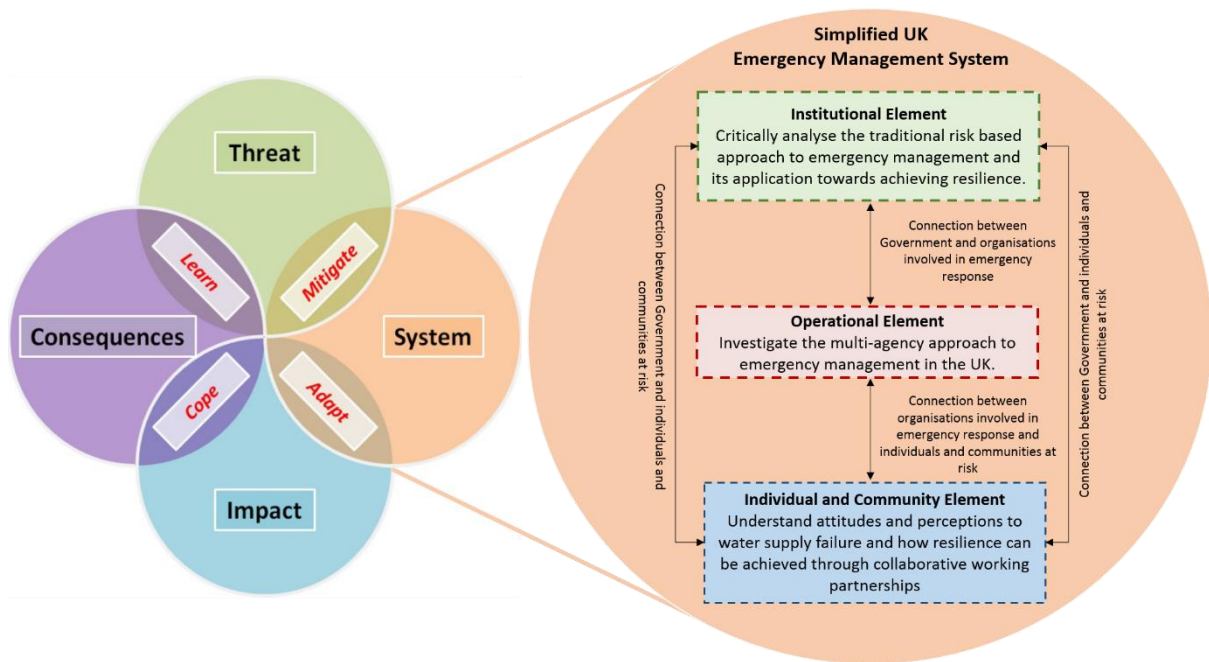
Figure 3.18: Relating the systems based approach to emergency management with the Safe and SuRe intervention framework (Adapted from Butler *et al,* 2016).

4   CHAPTER 4 - THE MULTI-AGENCY APROACH TO EMERGENCY MANAGEMENT

Chapter 3 explored how the application of qualitative and quantitative research methods could be applied to understand characteristics of resilience within the context of the UK emergency management system. Using the methodology described within Chapter 3 (Section 3.4 and Section 3.7.1), this Chapter presents the results of a Social Network Analysis to understand how the Category 1 and Category 2 responders are connected and the results of semi-structured interviews to explore characteristics of resilience within the system. The results will be used to investigate the multi-agency approach to emergency management as defined within Objective 2 (Chapter 1) and explore whether the CCA, 2004 allows for the differences amongst multiple organisations to promote resilience within the UK water sector. This will be explored using the research questions presented in Chapter 1, (Section 1.4, Objective 3).

The Chapter will proceed as follows: Section 4.1 will explore how Category 1 and Category 2 responders are connected within the emergency management system. This is followed by Section 4.2, a thematic analysis of the semi-structured interviews to understand characteristics of resilience. Finally, Section 4.9 will provide a summary of the key findings to answer these research questions.

4.1 Preliminary analysis of the community risk registers

A preliminary analysis was conducted to understand if WSP's and LRF's could manage risk and resilience as part of a multi-agency approach using the methodology described within Chapter 3, Section 3.4.1. This was conducted through a comparative content analysis of Chapter 4 – Local Responder Risk Assessment Duty of the Emergency Planning Guidance (Cabinet Office, 2013a), the WSP Water Resource Management Plans, Drought Plans, Sector Resilience Plans and the CRR's produced by each LRF within England. The results were collated within an excel spreadsheet and are presented within Appendix 9.

Chapter 4 of the Emergency Planning guidance aims to encourage consistency in the risk assessment process so that the risks identified within each individual LRF area can be easily compared. Either to inform decision making during an emergency or to compare the risks between adjacent LRF areas (Cabinet Office, 2012). However, analysis of the 38 CRR's within England, demonstrate that there is a great deal of variation in the structure, style and the level of detail provided within each individual register (Figure 4.1).

No	Ref	Likelihood	Impact	Rating	Descriptor
0	-	-	-	VERY HIGH	Combinations of risks (Low, Medium, High or Very High) being realised at the same time. Concurrency of impacts and consequences.
1	H23	4	5	VERY HIGH	Influenza type disease (pandemic).
2	HL19	4	4	VERY HIGH	Local fluvial flooding
3	H21	3	5	VERY HIGH	Flooding: Severe fluvial flooding affecting more than two UK regions
4	H55	3	4	VERY HIGH	Severe effusive (gas rich) volcanic eruption overseas
-	HL18	3	4	VERY HIGH	Local/Urban flooding (fluvial or surface run-off)

	Risk Ref. (*)	Type	Risk Categories	Outcome description	Likelihood	Impact	Risk rating	Mitigation	Preparedness	Risk Assessor
Industrial Accidents & Environmental Pollution										
SY1	H1	Fire / Explosion	Fire / explosion at a gas terminal	Up to 3km around site causing (from 50 up to 500) fatalities and (from 150 to 1500) casualties. Gas terminal likely to be of short duration once feed lines are isolated. Event at storage site could last for days if the explosion damaged control equipment. Gas shortage not expected but some disconnections of intensive users. Disruption to transport services (road and rail) locally for up to a week and to provision of health services locally	Medium Low	Moderate	Medium	• Commercial operators or land/building owners legislative compliance and Business Continuity Plan • HSE legislation	• Site operators – emergency procedures • Surry Major Incident Protocol (SMIP) • Temporary Mortuary Plan • Mass Casualties Plan • Emergency Assistance Centre • Vulnerable People Plan • Site Clearance Plan • Category 1 responders standard procedures • These sites would be subject to the COMAH legislation, details of which can be found at http://www.hse.gov.uk/comah/index.htm	SFRS
SY2	HL25	Fire / Explosion	Fire / explosion at a gas terminal as well as LPG, LNG, and other gas pipeline	Up to 1km around site causing up to 50 fatalities and 150 casualties	Low	Minor	Low	• HSE legislation • Commercial operators or land/building owners legislative compliance and Business Continuity Plan	• Site operators – emergency procedures • SMIP • Category 1 responders standard procedures • Temporary Mortuary Plan • Mass Casualties Plan • Emergency Assistance Centre • Vulnerable People Plan • Site Clearance Plan	SFRS

	Risk Descriptor	Plans in Place / Gaps Identified	Local Planning
PRIORITY 1 - VERY HIGH			
H23	Influenza type disease (pandemic)	• Experience of swine flu 2009 • Pandemic 'flu exercised Feb 2009 (Sixways) • National Pandemic Influenza Plans, DH, PHE • Local Influenza Plans NS England, CCGs • PHE & NHS Major incident plans • Joint Emergency Response Arrangements (JERA) • Acute Trust/NHS/PHE Business Continuity Plans	
HL21a	Land movement (tremors and landslides) Ironbridge Gorge, Shropshire	• Situation monitored at Silver level • Specific Pre-planning & multi agency contingency plans • Joint Emergency Response Arrangements • Public information provided on Telford's web site; specific local residents have been informed of the risk and the plans. • Stabilisation work has been undertaken in 2 key areas & further funding has been obtained to do further work • Inter-Agency Joint Emergency Response Arrangements (JERA)	

Risk ID	Risk Title	Risk Category	Likelihood	Impact	Risk Rating
HL1	Fire or explosion at a gas terminal or involving a gas pipeline	Industrial Accident	Medium-low (2)	Minor (2)	Medium
HL2	Localised industrial Accident involving large toxic release (e.g. from a site storing large quantities of chlorine)	Industrial Accident	Medium (3)	Significant (4)	Very High
HL3	Localised industrial accident involving small toxic release	Industrial Accident	Medium (3)	Moderate (3)	Medium
HL4	Major pollution of surface waters and groundwater	Industrial Accident	High (5)	Moderate (3)	High
HL7	Industrial explosion and major fires	Industrial Accident	Medium-Low (2)	Minor (2)	Medium
HL8	Fire, flooding, stranding or collision involving a passenger vessel in or close to UK waters or on inland waterways, leading to the ship's evacuation	Transport Accident	Low (1)	Minor (2)	Low
HL9	Aviation Accident	Transport Accident	Low (1)	Moderate (3)	Medium
HL10	Local accident on motorways and major trunk roads	Transport Accident	Medium-High (4)	Minor (2)	Medium
HL11	Railway Accident	Transport Accident	Medium (3)	Minor (2)	Medium
HL14	Local (road) accident involving transport of fuel/explosives	Transport Accident	Medium-Low (2)	Minor (2)	Medium
HL18	Local / Urban flooding (fluvial or surface run-off)	Natural Hazard	Medium (3)	Moderate (3)	High
HL19	Local fluvial flooding	Natural Hazard	Medium-High (4)	Minor (2)	Medium
HL20	Localised, extremely hazardous flash flooding	Natural Hazard	Medium-High (4)	Moderate (3)	High

Figure 4.1: Examples of the different structure, style and level of detail of the CRR's.

Whilst there is a statutory duty to publish the results of the risk assessment (Cabinet Office, 2013a), there is an element of discretion dependant on security issues, as to the amount of information the LRF has to provide. According to the guidance the information should be:

'…presented in such a way that informs and encourages members of the public to mitigate the consequences of the risks in their area.'

Guidance has been provided regarding the structure of an individual risk assessment however, the guidance relating to the format and style of a CRR is limited. The majority provide the risk category, hazard description, likelihood, impact and control measures for water related hazards. However, there were variations in the level of detail provided within each individual register. 7 risk registers contained a detailed assessment of each risk category describing the nature of the hazard, likelihood and impact scores, risk ratings, lead assessors and control measures that were in place. 6 LRF's opted to produce a glossy brochure detailing general information regarding hazards of the highest risk rating but did not contain information regarding the likelihood, impact or risk rating scores. However, a lack of consistency in the approach taken made it very difficult to assess the level of engagement of the WSP with regard to risk assessment.

Where the WSP was designated as a lead assessor for the risk category relating to water supply failure, a clear understanding of the risk was demonstrated and

information regarding control measures was provided. However, detailed information was not provided within the CRR's that stated the Category 2 responders had been consulted as part of the process. Further examination of the risk assessment group membership demonstrated that in some locations WSP's were not included as part of the group or designated as the lead assessor for water related hazards. It is unclear whether they were invited to participate in the process and declined to attend or were excluded. This provided further difficulties assessing the level of engagement of the WSP in the risk assessment process and requires further investigation during the semi-structured interviews.

As discussed within Chapter 1, WSP's operate over a wide geographical area that may encompass one or more LRF's. There was a great deal of variation regarding the risk matrix style that had been adopted in the risk assessment process. For many WSP areas it was discovered that the same risk category was being assessed by each LRF using a different risk matrix. In total 4 different risk matrices were identified from analysis of the CRR's with one risk matrix specifically designed by a LRF for their local area and not consistent with nationally published guidance (Figure 4.2). It may be argued that geographical variations exist within the areas covered by WSP's that will affect the likelihood and impact scores assigned to particular risk categories. However, it is difficult to compare the results of the same risk category and assess capability requirements if each LRF is using a different risk matrix.

First matrix — Relative Impact (vertical) vs Relative Likelihood (horizontal)

Relative Impact	Low (1)	Medium Low (2)	Medium (3)	Medium High (4)	High (5)
Catastrophic (5)				Pandemic Flu	
Significant (4)					Tidal Flooding — Fires involving scrap / recycling site
Moderate (3)		Major Industrial accidents - Fire or Explosion	Storms and Gales		
Minor (2)	Structural hazards/collapse and subsidence; Industrial Action—Emergency Services (Fire Only)	Major Industrial Accident - Very Large Toxic Chemical Release; Fire or explosion on an offshore oil/gas Installation; Low temperatures and heavy snow	Drought; Industrial action—Fuel Supplies; Transport Accidents—Railway; Human Health—Emerging Infectious Diseases; Outbreak of exotic notifiable disease in animals (including birds)	Industrial Action—Critical Services	Major Contamination—Food Chain
Limited (1)	Transport Accidents—Passenger Vessel; Coastal Pollution; National strike of Prison Officers	Plant Disease	Transport Accidents—Road/Rail Tankers; Severe Wildfire/Forest or Moorland Fire		

Key
Low
Medium
High
Very High

Second matrix — Relative Impact (vertical) vs Relative Likelihood (horizontal)

Impact	Low 1	Medium – Low 2	Medium 3	Medium – High 4	High 5
Catastrophic 5	*Fire/Explosion Fuel Distrib. Site; *Aviation Accident; *Major Reservoir Dam Failure		*Flooding: Severe (1in1000); *Mass Influx of Evacuees; *Countywide Loss of Electricity	*Influenza Type Disease; *Major Radiological Release	
Major 4	*Accidental Release of a Radioactive Material	*Railway Accident	*Severe Effusive (Gas Rich); *Fuel Shortage		*Local Accident inv. Hazardous Materials
Moderate 3	*Explosion at a MAHP; *Bridge Closure or Collapse	*Water Infrastructure Failure	*Local Outbreak of Infectious Disease; *Drought; *Large Toxic Chemical Release	*Flooding: Localised; *Heatwave; *Outbreak Ex. Animal; *Infectious Disease; *Low Temp/ Snow; *Storms and Gales; *Large Scale Public Disorder	*Major Fires incl Recycling Fires; *Telecommunications Failure; *Biological Substance Release; *Major Pollution of Controlled Waters
Minor 2		*Local Accident on Motorways and Trunk Roads; *Building Collapse	*Loss of Staff (ESs); *Industrial Action (Key Railway Staff); *Significant Disruption to Internal Gas Supplies	*Space Weather	*Food Chain Contamination
Limited 1	*Land Movement	*Influx of British Nationals	*Industrial Action (Emergency Services); *Unofficial Strike by Prison Officers	*Disruption to Aviation (volcanic ash)	

Key
6 Very High
14 High
12 Medium
10 Low

NOT RATED
*Failure of the Banking System
*Outbreak of Plant Disease

Figure 4.2: Examples of the different risk matrices used within the CRR's

Many of the CRR's were also in different stages of update ranging from 2012 to 2016. Of the 32 registers that provided information regarding the date of issue, 16 had not been update since 2014 and 1 register had not been updated since 2012. Of those that were updated from 2015 onwards, the same risk matrix is applied. Only one LRF adopted the style of risk matrix present within the Risk Assessment Guidelines (Cabinet Office, 2013). One of the recommendations of best practice from the guidance is that the CRR's should be updated on an annual basis following the production of the Local Risk Assessment Guidance. However, if this is occurring, the most recent information is not being made available to the public.

In terms of accessibility, 3 out of the 38 CRR's were not available and required an e-mail to the relevant LRF to obtain a copy and 1 was not available due to the content being of a sensitive nature. This particular LRF provides general information regarding the risks to that area on the LRF website. However, a google search for the latest CRR for this LRF revealed a CRR for 2006. This demonstrated a difficulty attempting to obtain the most up to date version of the CRR.

There were also instances where a likelihood and impact score had been assigned to a particular risk category with the caveat that *'risk assessment to be provided by the Utility Company'* and within another risk register '*work is ongoing to better understand the risk'*. This would suggest that there was limited engagement with the WSP prior to the register being published, though again it is difficult to determine why there was limited engagement.

Within many of the CRR's, risk category and outcome descriptions had been wrongly assigned for drought. The Local Risk Assessment guidance refers to a drought affecting London. Whilst the majority of CRR's tailored the outcome description to cover a drought within their local area, there were a number of registers that had assigned likelihood and impact scores to a drought occurring within London and not within their local area. Drought had also been assigned as low risk within one WSP area with the lowest likelihood of occurrence. However, analysis of the Water Resource Plan for this location indicated that the LRF was within a water scarce location and at particular risk of drought. Again, this would suggest there was limited engagement of the WSP in the assessment of this risk. However, this is very difficult to determine from analysis of the CRR's and requires further investigation through the process of semi-structured interviews presented within Section 4.2. The following Section will explore the multi-agency network in greater detail to understand difficulties applying a multi-agency approach to emergency planning.

4.1.1 The multi-agency network

The multi-agency approach to emergency management in the UK is conducted through the development of LRF's, which as previously mentioned in Chapter 2, are composed of Category 1 and Category 2 responders

While the concept of the LRF is relatively straightforward in terms of the organisations involved, the connections between each of the organisations within the LRF are highly complex. A social network diagram was developed using R Studio and the social network package, igraph as described within Chapter 3

(Section 3.4.2) to provide a visual representation of how these organisations are connected and demonstrate the complexities associated with the multi-agency approach to emergency management in the UK (Figure 4.3).

Within the social network diagram (Figure 4.3), each connection between the organisations is represented by a grey line (vertices) and each organisation is represented by a coloured node. Within the framework of the CCA, 2004, Category 1 and Category 2 responders are expected to engage and share information as part of the LRF within their local area. Therefore, it was assumed that being part of the LRF represented a connection with each of the organisations that comprise the LRF. While these organisations may not necessarily have formed a close relationship with one another, they are considered part of the LRF. The social network diagram only represents connections within the LRF and while many other connections exist between organisations outside of the LRF's, these have not been considered as part of this research because they were not investigated.
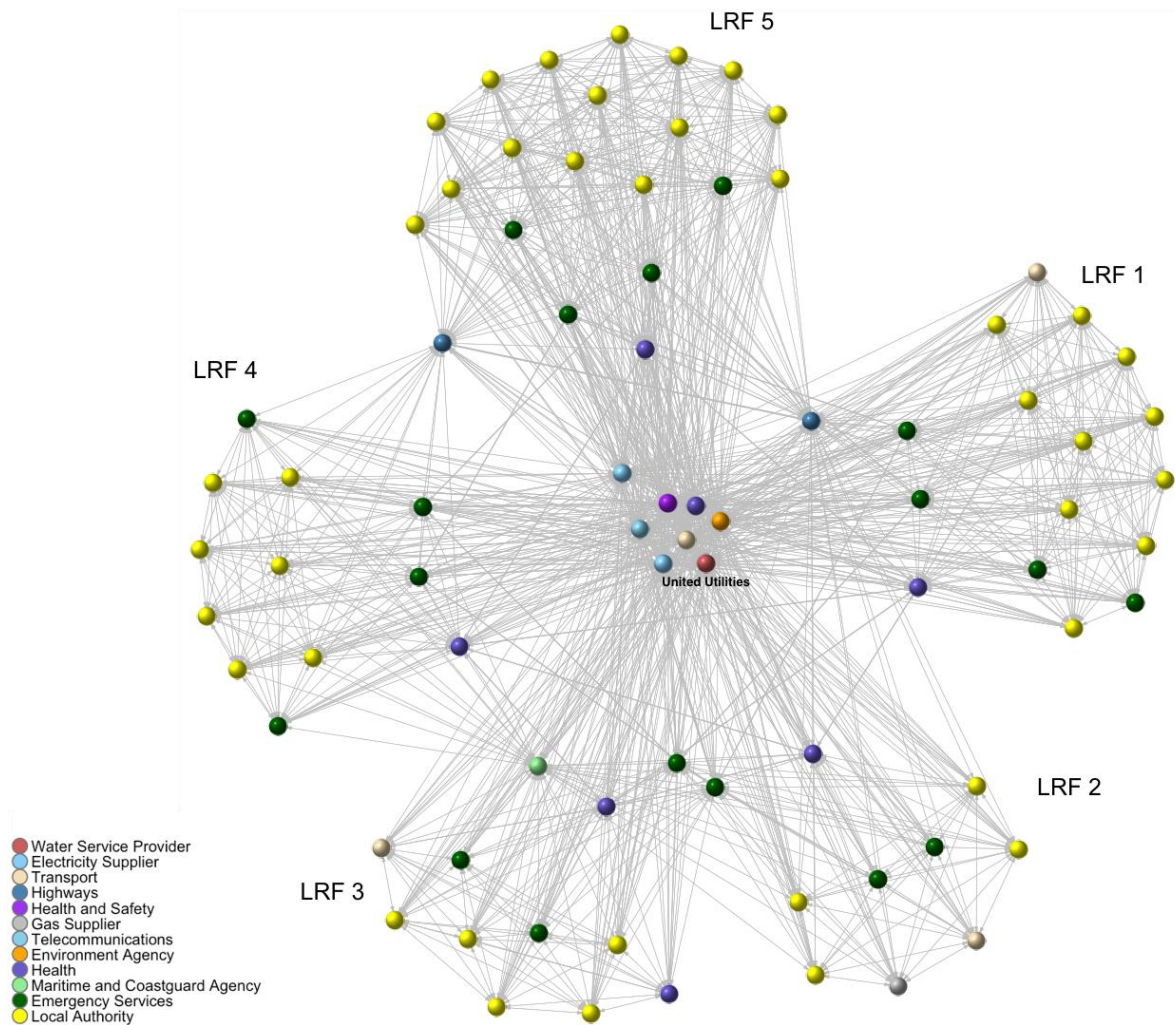
Figure 4.3: Social network diagram of the connections between organisations within the LRF's operating within the North West region of the UK.

The organisations that operate regionally and are connected to more than one LRF are represented within the centre of the social network diagram. This is because they have a greater number of connections within the network. A visual representation enables the complexity of connecting with multiple LRF's to be identified. However, this represents an organisational connection and does not consider the multitude of different communication methods this connection my represent or how many representatives within each organisation are involved in the establishment of this connection. It is possible to gain an understanding of

the complexities associated with developing good working relationships within the LRF's for organisations that operate over a wider geographically area but an understanding of the difficulties this may present requires further investigation and is presented within Section 4.2 as part of the semi-structured interviews.

As already mentioned, WSP's operate over a geographical area that may encompass more than one region and multiple LRF's. While Figure 4.3 demonstrates the complexity of the connections between the Category 2 responders and the LRF's within one region, a simplified social network diagram was also developed to demonstrate how many LRF's the WSP's are connected to (Figure 4.4). 9 of the largest water and sewerage providers in England were included within the analysis to provide an example of the complexity associated with being part of the LRF's. This was developed by creating a transparent version of the Ofwat, WSP boundary map and overlaying it with the HMIC map of the police operational boundaries. To ensure accuracy, this was combined with information obtained within the semi-structured interviews (Section 4.2). The original method chosen to identify which LRF's operated within WSP boundary areas was using a WSP GIS boundary layer. However, this information is only available under licence direct from the WSP and is not available to the public.

Within Figure 4.4, all the connections between organisations within the LRF are represented as a single node and the connections between the WSP and the LRF's are mapped as grey vertices. A simplified approach was taken because it was easier to visually identify how many LRF's each WSP was connected to. The names of each LRF were omitted to allow a clear visualisation.

It is evident that all of the WSP's are connected to more than one LRF with some WSP's connected to over 10 LRF's. As part of the CCA, 2004, WSP's are expected to share information and engage with each LRF that operates within their area. This may create challenges for both WSP's and LRF's and these will be explored throughout this Chapter.
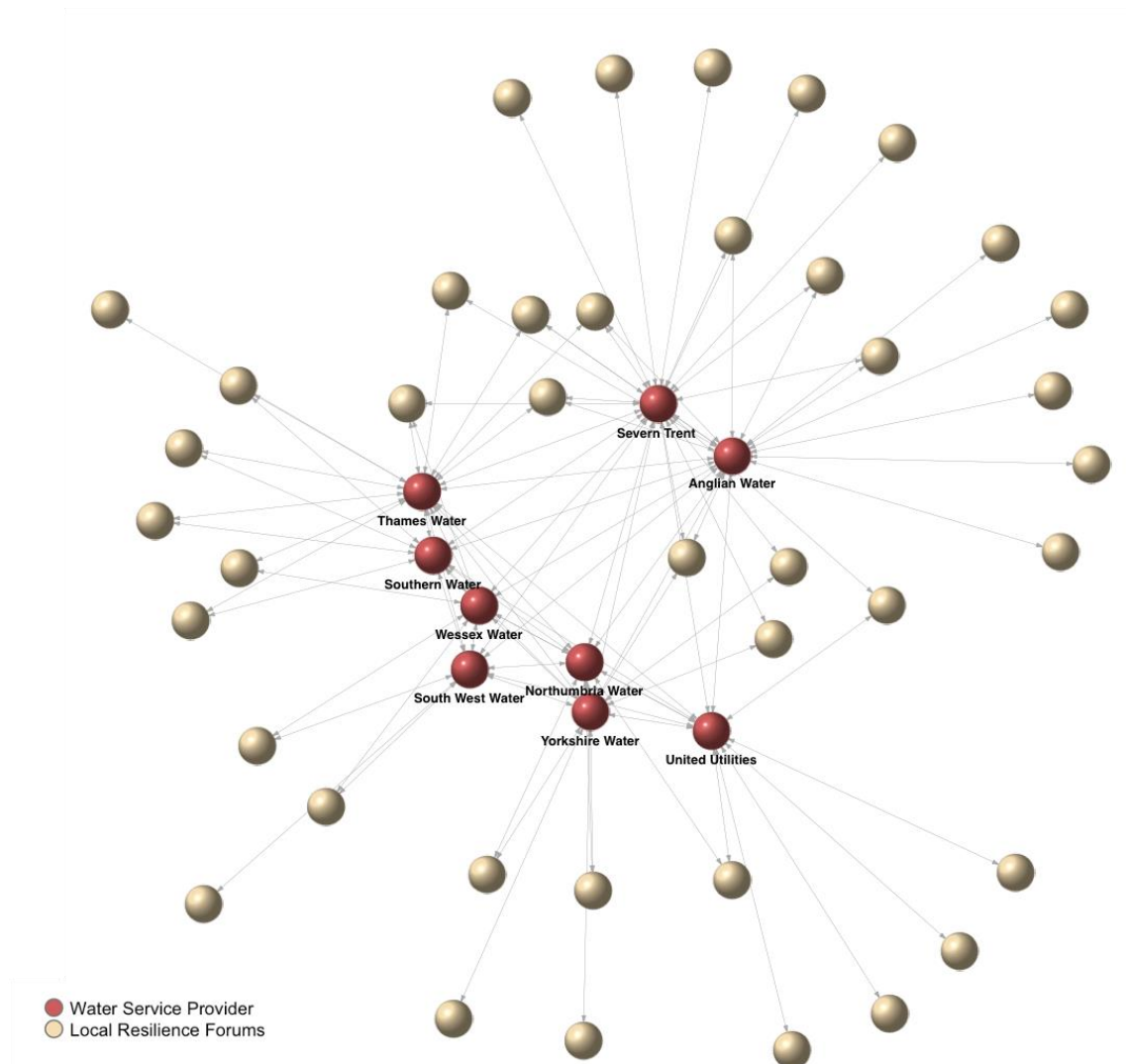
Figure 4.4: Social network diagram of the connections between 9 of the largest water and sewerage providers in England and the LRF's

4.2   Legislation and Governance

4.2.1 Practitioner interpretations of applying the principles of the Civil Contingencies Act, 2004

The majority of participants felt the introduction of the CCA, 2004 had a positive influence on the way in which emergency management was conducted within the UK.   It brought emergency responders and the utility and transport sectors together to operate within a single framework that encouraged collaborative working practices. Further supporting quotes for each section within this Chapter are provided within Appendix 11.

> *"…if you think about 2004, when the Civil Contingencies act came out before, there was nothing before that, well there was but it was very cold war style approach which didn't help anyone. So, when the Civil Contingencies Act came out, I think the last, what are we now 2017, say the last ten years I think it has definitely improved and people are working together more and I think actually as organisations we are better off…" – 01 Participant*

However, many participants reflected on the introduction of the CCA in 2004 and how the legislation and supporting guidance did not provide a clear set of operating guidelines as to how the LRF was to be structured and which organisation would take ownership of the LRF and the LRF manager.   This implies local government interpret this information within the context of their existing structures, which are variable. As a consequence each LRF has taken a slightly different approach.   Throughout the interview process participants highlighted differences regarding which organisation has taken overall responsibility for the LRF.   For instance, some LRF managers are part of the Police or Fire Rescue Service, others are part of the Local Authority and there are also Civil Contingency Units that consist of a larger team of people. This was recognised as creating a challenge for organisations that operate over a wide

geographic area. Not only are they expected to engage with multiple LRF's, each one is structured differently and as a consequence operates slightly differently.

> *"So potentially you have forty-three different ways of looking at things and each LRF has got their own autonomy and can set up how they wish to look at risk and mitigate it and work in partnership."* **– 07 Participant**

There is also another aspect to this and that is the way in which LRF's operate within the structure of the organisation that has taken responsibility of the LRF. The majority of LRF managers sit within the Police or the Fire Rescue Service and operate within a hierarchical structure of *'command and control'.* This is very different to the horizontal structure that exists within a WSP and other Category 2 responder organisations. One of the criticisms by the Army during the flooding of Mythe water treatment works was the flat structure of the WSP hindered the ability to manage the logistics of an alternative water supply (Pitt, 2008). However, this was not identified as a constraint within the interviews because it was recognised that some of the WSP's have started to incorporate the same principle of joint operational working that is used by the Category 1 responders during emergency response (JESIP, 2016). This allows for consistency in the multi-agency approach to emergency management and although the organisational structure may be different during the day to day operation within each organisation, during an emergency many of the Category 2 responders will switch to the hierarchical command and control approach.

> *"But in terms of JESIP we have started incorporating parts of JESIP into our response. Not everything in JESIP is relevant to a category 2 responder cause obviously a lot of it was blue light focussed but there is some other principles like the joint understanding model, joint decision making model and some of them examples are actually very good models that we can implement we started to but obviously we are still working towards implementing it."* **– 01 Participant**

This demonstrates how a greater understanding of inter-agency operational practices can enhance the multi-agency approach to emergency management through the process of inter-organisational learning. However, this also presents challenges regarding the ability to incorporate changes within a static legislative framework particularly with the rapid advancement of technology. Since the introduction of the CCA, 2004, many participants considered the resilience agenda had changed considerably and many participants questioned whether the legislation required reviewing. In particular, participants highlighted the need for performance measures, standards and a review of the CCA, 2004. This is to determine whether organisations are operating effectively within the framework of the current legislation and to incorporate any changes in working practices between the responder organisations. Another perceived challenge with the legislation is the lack of enforcement and duties placed on organisations to ensure they comply with the requirements of the CCA, 2004, in the sharing and exchange of information throughout the emergency planning process.

> *"So I think there's a lot missing there that needs to make sure that we don't end up in ten years' time facing the same reason why they brought in the Civil Contingencies Act of 2004 that they should have reviewed it and done something and definitely come round with the civil contingencies secretariat should be you know organising for example like every organisation has people coming in and does like the checks on them."* **– 06 Participant**

The challenges experienced by participants with the increased use of social media has also led participants to question whether the legislation is still fit for purpose. The use of social media has changed considerably since the introduction of the CCA in 2004, however the legislation has remained static and there is little guidance as to how Category 1 and Category 2 responders should manage the challenges of social media.

"Under the Civil Contingencies Act. Now for me that's no longer fit for purpose because we're very good at the big bang emergencies but because of social media the game has changed so you may have an incident that impacts on your community but it's not a big emergency but you still need to respond in every other way." – 07 Participant

The ability of the public to instantaneously *'post'* information regarding an emergency situation has placed both Category 1 and Category 2 responders under pressure to control the spread of information and misinformation (Bunney *et al,* 2018). Emergency responders develop an awareness of the emergency situation to determine the resources and capabilities required for emergency response. However, the speed at which information is spread across social media, makes it very difficult for the Category 1 and Category 2 responders to develop situational awareness, provide an immediate source of information to the public and manage public expectations. This is particularly challenging because there are limited resources available in terms of finances and trained people to manage responses on social media.

"I think the biggest issue I think is around social media and taking customers, meeting customers' expectations because before you used to have 6 o'clock news and or 6 o'clock and night news or 9 o'clock in the morning news, whatever time you had set deadlines, when now everything's 24/7. One wrong tweet, one wrong message could change customers perception very quickly and so it's very hard to stay on top of our comms and that's why we have a comms department who do all the social media and keep track of our social media because we realise that actually that this is an area we could slip up on and it might not be because the organisations not doing anything it's because it's the expectations a lot more's expected because everyone's expects everything with the click of a finger." – 01 Participant

Since the introduction of the CCA, 2004, there are a greater number of organisations actively involved in emergency management within the UK. For instance the Met Office and the Army are not considered as responders within

the CCA, 2004 and yet their assistance is required for warning, informing and emergency response, One participant considered that these organisations should also be included within the CCA.

> *"I think what it hasn't done I think the Civil Contingencies Act of 2004 was a great piece of legislation because it obviously give us duties, it give us Category 1, Category 2 and also some basic stuff. What it hasn't done is kept apace with changes and the fact is now that some people that aren't Category 1 or Category 2 were missed out and they haven't been included. For example the army is now forward leaning whatever that means and they engage more but to me they should be a category, they should definitely be given a category and not just stand outside it and there's others that you know have been missed out and haven't been included"* – *06 Participant*

It was also suggested that the organisations providing essential services to the public should be considered as Category 1 responders. Without the provision of essential services such as water and electricity, many of the responder organisations would not be able to perform their roles effectively. Therefore it was considered the legislation should take into consideration the importance of these sectors in terms of statutory duties.

> *"The tolerable threshold for living without water because not only are we looking at from the drinking water side but also from the sanitation and the public health side of things your thresholds drastically reduce compared to other Cat 2 responders especially in the utility areas. So it's quite difficult where we are as a Cat 2 responder when there's such a reliance from the Cat 1 responders on the industry."* – *13 Participant*

The legislation was designed to bring responder organisations together in a collaborative emergency management framework where Category 2 responders are expected to share information and provide support to the Category 1 responders. However, this is not a duty and according to the participants, the legislation and guidance does not specify a particular way in which this should be

conducted. Also, because there is no evidence of enforcement through the legislation, this has the potential to allow Category 2 responders to *'opt out'* of the process. Especially if their day to day operational activities within their organisation are considered more important.

> *"Unfortunately the driver for the LRF through the Civil Contingencies Act is a toothless tiger because if an agency decides actually I am not going to get involved in that because from a Cat 2 perspective it's very easy for us because actually we have two statutory responsibilities under the CCA, to share information which we don't have to physically be present to share information and to work with partners which we don't have to physically be there to do that and actually that's as far as it goes, there is no definition of sharing information or working with partners so in its broadest sense that could be a phone call once a year, it could be two emails a year." – 13 Participant*

This Section highlights that while the legislation has provided a framework and a structure for emergency management in the UK, the introduction of new technologies continually present responders with operational challenges. This has led participants to question whether the legislation written in 2004 remains fit for purpose in 2019 considering the rapid advancement of technology and its application through social media.

4.2.2 Government support and guidance

With the advent of social media it was perceived that the government is taking a more active role in the management of emergencies at a local level. However, the provision of support and guidance in preparing for emergencies was not considered to be so prevalent. The guidance provided by the government was not perceived as providing enough detail and direction as to how it should be implemented. Participants perceived the government was deliberate in not providing a 'step by step' approach to guidance documents because this would

allow autonomy at the local level. However, while participants accepted this, it also left them uncertain as to whether they were implementing the concepts within the guidance correctly:

> *"I think that's more down to social media and public perception because I think previously it was left to manage locally where now you tend to find a small incident or an incident the governments heavily involved because they want to be seen to be doing stuff, I'm not saying that's a good thing (laughs) but if you think about COBR and how many times COBR stepped up for incidents, there are stepping up a lot more than they used to, they used to do about three or four a year, I think they've done about ten this year"* **– 01 Participant**

> *"I don't think the guidance goes far enough. I don't think there's enough contextual information in the guidance."* **– 13 Participant**

Participants agreed the driving force for change and the implementation of good practice was achieved at the local level. However, they required support from the government to provide direction through the delivery of resilience standards, frameworks, benchmarking or performance indicators. They also required the government to formally identify and share examples of good practice rather than relying on the informal mechanisms of a peer to peer review.

> *"The, I suppose the government's pitch has been that they don't want to tell LRFs how to do their business so they want to encourage innovation and people to come up with their own ideas from the ground up but one of the frustrations for the LRFs is we'd also like the government not to say this is the only way to do something but we would like them probably to contribute best practice a lot more."* **– 07 Participant**

The National Capabilities Survey implemented by the government requests all members of the LRF to complete a series of questions every two years. This is intended to provide the government with an indication of the national capabilities

available for emergency response. This approach was criticised by participants as a '*tick box*' exercise because it did not explore whether there were adequate plans and procedures in place:

> *"We do a resilience capability survey where I answer some questions and they go into Whitehall, we don't get someone following us back up with a quick query it's and it's one of those ones it doesn't feel like there's any version of Ofsted in my area. I know Ofwat does have a look at resilience within the water industry I've been asked to sort of provide some peer input to Ofwat for one of the local providers so are they active members of the resilience forum de-de-de but I've not had that kind of from my side"* – **02 Participant**

> *"It tells you nothing [laughs] what it tells you is for example it says do you have a plan for flooding and you say yes or no and that's it and they come back with it with the benchmark saying twenty-five did, twenty-five didn't, twenty-five are considering doing it and I don't know instead of saying you will all do it in other words what you haven't got is you know if seventy-five percent of the local resilience forums have a plan for flooding"* – **06 Participant**

Many of the participants lament the loss of the regional government offices. These used to contain a team of people who would attend LRF meetings and provide a conduit of information to pass to and from government. These were replaced by the Department of Communities and Local Government, Resilient Emergencies Division (DCLG RED) in 2006. The semi-structured interviews were conducted between May 2017 and September 2017 and as of January 2018 the DCLG RED became the Ministry of Housing, Communities and Local Government. Participants discussed how the DCLG RED operated over a much wider area and a reduction in staff over the last few years due to reduced funding has resulted in a lack of attendance at LRF meetings. Many of the participants did not perceive they were receiving enough support to be able to share information back to Government.

"And that's what we're missing from I think the government offices when we used to have them when you know we'd have people who would look after three or four LRFs. We've got you know the resilience team but they're now getting smaller and smaller and every time I talk to [name] it's well I'm now looking after seven LRFs, I'm now looking after eight LRFs, don't ask us anything because we haven't got time to do anything. So we appear to be losing that regional pulling together which government I think should be doing because I think it's difficult for the LRFs to do it." – 10 Participant

It was perceived that the regional government offices provided a link to feed information back to government and contribute to an increase in the sharing of information between LRF's at a regional level. The following Section explores collaborative working partnerships within each LRF.

4.3   Collaborative working partnerships

4.3.1 Effective collaboration – proximity and empathy

The level of collaboration between Category 1 and Category 2 responders was perceived to be good where strong relationships existed. However, in the WSP interviews it was evident that there were some LRF's where the level of collaboration was high and other instances where there was little or no collaboration.

"It's just interesting to see how some LRFs are very much, let's work with Category 2 responders and other LRFs aren't as much favourable for that. But that's just from experience." – 01 Participant

"So you know I think there's a little bit about organisational sign-up to the LRF process but I think that the secondary bit is because LRFs are based on police force areas the issue that we have is the same issue that I've got it's you know I am now trying to service four LRFs successfully in some areas but unsuccessfully in others." – 13 Participant

Analysis of the interviews revealed a number of contributing factors to this. Having a very active LRF manager who is consistently engaged with the WSP through regular communication encourages greater collaboration.

> *"I think it's good, it could always be better. I think it depends on the LRFs, I think some LRFs are more proactive, and that is something that I've found a lot, is some LRFs is really proactive, they were great at sharing information with it and other LRFs unless we push ourselves to the meeting or get involved we probably wouldn't be invited so it depends what local resilience forum areas."* **– 01 Participant**

Also, proximity to the offices/location of the LRF's had an influence on the level of collaboration because it was considered easier to attend meetings if they were co-located in the same town or city. It was not always easy to justify attending meetings in terms of the amount of time that would have to be committed to travel and taking the WSP participant away from the daily work environment. None of the participants mentioned attending meetings remotely via skype or any other software that enables remote attendance at meetings:

> *"So as much as I'm on mailing lists for the other LRFs I'm not as engaged if I'm honest because I could spend each LRF tend to run this one day a month and I could so I could be four days a month, working days a month I could be just sitting at LRF meetings and unfortunately when there's only myself and one other full-time employee in my team we don't have the luxury to be able to do that."* **– 13 Participant**

> *"[name] are good because they collocate into the same city and that helps, it cuts down transport times and stuff but that's usually the issue with most other utilities they've got to trek a long way."* **– 05 Participant**

A couple of participants had either previously worked within the Local Authority or WSP where they had established relationships within the LRF during their previous role. This also influenced the level of collaboration between the LRF

and the WSP because there was a greater understanding of the challenges faced by each organisation and it was easier to maintain established relationships:

*"…if I'm speaking on behalf of the [Name] because I've been here nearly five years and then I've got ten years of [Name] experience from the other side of the fence, I've seen it from the other end." – **05 Participant***

*"…I used to be when I was, before I took over here and my job sort of like expanded I used to be the capability lead for training and exercising for the LRF so I used to put together all of the training and exercising programme, how it linked into all of the plans, the validation process, we did a little bit on modularisation so if we exercise that plan actually it exercises a little bit of that one as well …" – **13 Participant***

Good collaboration is influenced by the ability to attend LRF meetings and establish good relationships. However, this is not very practical for WSP's with a small emergency management team that have to engage with multiple LRF's. To overcome this difficulty WSP's conduct LRF engagement days to provide LRF's with consistent information regarding how the WSP operates during an emergency and when support from the LRF would be required.

*"I'd stop short of problems I think so it might cause a few issues. We obviously we can't have nine different ways of working with another further nine on the periphery so the reason we have the engagement days is and we try and adopt standard approaches to let them all know this is the way we work and this is what we will need from you in these incidents if it's a water incident so that they all know the same thing if you like. They might try and deliver it in a different way and some of them we find that if we do have an incident and we engage with them that some of them are very responsive to put it politely, they want lots of information, they want a lot of engagement they stand up at a TCG or an SCG whereas some of the other LRFs will be a little bit more laid back I think you know well if you need more help just tell us we're not going to alert you know stand up unless you tell us it's necessary, those sorts of things so they all respond in a different way, I think we're coming to terms with that." – **11 Participant***

But does this top down approach allow for the ability to establish good working relationships? This will be explored within the following Section.

4.3.2   Building relationships

The building and establishment of good working relationships was considered to be fundamental in the emergency management process particularly for emergency response.   In many instances this was considered to be more important than the plan itself.   It was perceived that the LRF provided a good opportunity to bring different organisations together to plan and prepare for an emergency situation.   This approach encouraged the development of relationships with individuals that would also be present in the incident room during an emergency.   It also provided an opportunity to discuss the resources available within each operating organisation.

> *"I think it's a really good opportunity for building relationships and networks between partners from the various agencies. LRFs generally we actually run on relationships so you can have all your plans, policies and procedures as far as you like but actually fundamentally as long as you've got those relationships in place then the rest of it will come together so I think the networking and the building relationships is sort of one of the top priorities." – 14 Participant*

> *"….. it's investing in those relationships so that we don't come together in an emergency and not know each other and how we work so to me that's the real key is putting some collateral in the bank around relationships ……" – 16 Participant*

The process of building and developing relationships helps to build a shared understanding of each organisation, how they operate during an emergency and the capabilities available in terms of resources and organisational needs. This

helps to build trust and realistic expectations of what an organisation is able to provide during an emergency situation. These are important considerations for effective multi-agency collaboration and emergency response.

> *"…..but also one of the key things we think from that is building relationships and making sure we understand how each other work and how you're going to respond so that again for interoperability you're not at, you shouldn't be at odds with each other."* **– 11 Participant**

> *"It gives, it allows us an avenue into sort of having relationships with people who we would be reliant on in a multiagency response. That's one side of it, the other side of it is it's understanding expectations so they get an understanding of what they can expect from us and vice versa we get an understanding what we can expect from them and the different partners and agencies and I think that's probably the two biggest things. There's obviously lots of other things like you know sharing risk assessment and knowledge and everything else and exercising and learning but those two are probably the biggest things."* **– 09 Participant**

Examples were provided from both an LRF and a WSP perspective demonstrating the importance of a shared understanding of organisational capabilities. One example involved the Fire Rescue Service who were required to extract large volumes of water from the water supply system to respond to a very serious fire. However, there was little understanding of the effects on the water supply system of using high volume pumps. This resulted in the WSP having to provide their customers with bottled water because there was not enough pressure in the system to pump water to second floor flats located within the same local area as the fire. Following the incident, a number of workshops were conducted to improve understanding, not just of the water supply system but also to understand the requirements of the Fire Rescue Service during an emergency situation.

"The fire service didn't necessarily understand how the water network works and the water production side of thing works. So for example if we have five fire appliances tap into our water mains to start drawing of hydrants for a fire that causes significant pressure issues on our customers. We don't have a duty, we don't have a statutory duty to supply water to the fire service, we have a statutory duty to supply water to customers for which if we don't do that we can get heavily fined so without that understanding of the network and understanding the potential challenges to that. For that fire incidence for example we had there was quite a few properties because urban planners now decide that they're going to put student accommodation on top of all the shops in the town so in city centres you very rarely, years ago you very rarely had residential properties." **– 13 Participant**

The consequences of critical infrastructure failure are very difficult to understand due to the complex interdependencies that exist between many sectors. While there have been many attempts to formally identify these through traditional risk assessments, there are still a large number of unknowns. This is of particular concern regarding the potential for cascading failures. The process of bringing organisations from different sectors together to share stories and perspectives through the multi-agency approach to emergency planning, may allow for the greater identification of potential failures within the system.

Building effective relationships not only allows for managing expectations but can also lead to greater communication between organisations during emergency response. One participant provided an example of where the LRF had made operational decisions on behalf of the WSP, regarding the provision of an alternative supply of water during a water supply incident. The expectation of the LRF was not matched by the WSP's operational procedures and decisions were made without prior communication to the WSP. This was largely attributed to a lack of attendance by the WSP to the multi-agency incident room. Establishing

good working relationships between the WSP and the LRF may encourage a shared understanding of organisational roles and responsibilities.

> "Whereas if we're in the room then we find that it's much easier to talk to people to talk them through the issues so that they've got a clearer understanding of what it is that we normally do and what sort of things we're going to need." – *11 Participant*

Establishing good working relationships can also help to develop a shared understanding of risk. One of the risks identified for effective emergency response was the provision of adequate resources in terms of available people to manage an incident. The development of good relationships allows each organisation to understand the resources available and the capabilities of each organisation. This is of particular importance when determining the availability of mutual aid.

4.3.3 Regional collaboration

The capability of a WSP to establish good working relationships with numerous LRF's was identified as a difficulty within the majority of interviews. However, it was also recognised that this was not just a problem for WSP's but for electricity providers, NHS Ambulance Service, telecommunication operators, NHS England and other organisations that operate regionally or over a wider geographical area.

To overcome this many of the LRF's have either taken a more regional approach to multi-agency collaboration or developed specific Category 2 groups. The problem identified by participants with the latter approach was that many of the

Category 2 responders had little in common other than the fact they were categorised as Category 2 responders within the framework of the CCA, 2004.

> *"….I think part of the problem with that is again labelling a whole variety of agencies that bring various disciplines, expertise and specialisms to the table as Category 2s when in fact some of them have got nothing in common at all with others is a challenge you know so again you'd have to ask why would a CCG want to sit down with a utility company and just say your Category 2 have a meeting so I think we need to be more smart than that and that's why I think it's the way it's sort of done locally but in a tailored way that supports local need…"* **– 16 Participant**

It was considered more appropriate if a regional approach was taken and the Category 2 responders were invited to collaborate on emergency planning relevant to their particular sector. This would save time in the development of plans and would encourage the sharing of information through a collaborative approach. However, it was perceived that this may also lead to a loss of 'local ownership' with regard to developing plans with local communities.

> *"it is difficult I mean I think people realise that now and think you know because you're working in a bound, within a confined boundary like police and fire do your actual utilities and others work across it like north west ambulance service and they don't want to keep doing five different documents or four it just makes more, it makes it more effective and efficient and it saves people time and that's what I think you know time's precious nowadays and there's not enough resources to do it so it's about time we worked collaboratively and across the borders and not be oh yes this is [Location] we do it different in [Location] and do it different in [Location]. Why the hell are we doing it differently? It just doesn't make any sense at all."* **– 06 Participant**

The regional approach has extended to include the risk assessment process and emergency exercises. These will be discussed throughout the following sections.

4.4 Sharing information – sensitivities and timing

Participant's views on the sharing of information between Category 1 and Category 2 responders revealed there are still difficulties sharing information during emergency planning. While all the participants understand the importance of sharing information and to a certain extent are happy to share and exchange information, there are still problems associated with security of information and data protection. This is largely because of the perception that fines will be imposed if information is shared inappropriately. This is largely an issue for the Category 2 responders that are private companies and do not wish to share information that may be considered *'company sensitive'.*

> *"I think there's far better understanding of why it might be required. I think there are still concerns around that interface between security and resilience so and I mean it's the same across all sectors of we have people whose remit in life is take the governance and they will not release that information, they will not release that information because of significant fines or the legislation which might be in place. That all changes a hundred and eighty degree in the event of an incident…" – 02 Participant*

> *"….it's almost the Act puts us in the same box as Category 1 responders who are by and large public services or non-government organisations that act in the same manner as public services whereas a lot of the majority of the Cat 2 responders are private companies." – 11 Participant*

These difficulties with sharing information have a tendency to occur during emergency planning. It was generally agreed throughout the interviews that when information is requested during emergency response it is released more readily.

> *"I think it becomes, I think it's if I'm honest I think it's more of an issue during the actual response, sorry during the planning phase rather than it necessarily being an issue during the response phase because I think if*

you get to the point where it's all hands on deck and all hands to the pump then you know people will bend over backwards and do whatever they can do to make things work. To share that information in the planning stage that's where it becomes difficult because of the company sensitivities and the confidentiality of contract." – 11 Participant

The sharing of information regarding vulnerable people was of particular concern for participants. This information is not shared during the planning process because organisations need to ensure the information they provide is up to date. Participants also perceived that a lack of standards and a common approach made it difficult to easily share this information between organisations. The introduction of Resilience Direct may provide necessary improvements to this process and will be discussed in Section 4.5.1.

"Their position is that they won't share information in advance, quite rightly so I would say because they say the list of vulnerable people changes so often and so regularly that if I gave you that list now it would be out-of-date by tomorrow. So what they say is they will share that information but only when there's actually an emergency taking place so that they know the information is current, that's the only sort of exception I can think of really, other than that we share information quite efficiently." – 15 Participant

"I'll tell you the smaller things are that they all have their own information sharing agreements, there's no standard which we've signed, there's no real standard around how information is shared across the UK so if you need to share vulnerable customer information there isn't a single procedure for sharing vulnerable customer information so you know [Loaction] might want it in one form and [Location] might want it in another form." – 11 Participant

It was also generally recognised that there are relatively few problems sharing information where there are good relationships between the Category 1 and Category 2 responders. But this is not consistent across the country.

"We have never but I am very conscious that this is a discussion elsewhere and but whenever we've asked for anything I can personally say we've not

had a problem and I think sometimes at the planning stage there seems to be more talk and people being precious about information which can create a little bit of uncertainty and perhaps ill feeling would be too strong but I can't think of a better way of saying it when actually when it comes to deploying in anger I've not found that people are precious and they will share information appropriately but I am very aware of that sort of national conflict if you like there because I hear it very often but I can only say from a personal perspective we've not had that problem." - 16 Participant

There were examples where WSP's identified a difficulty responding to requests from LRF's for specific information regarding the resilience of their assets. WSP's were reluctant to share this information because they perceive the LRF's will then take it upon themselves to install flood defences around their assets. When this information is not provided by the WSP, the LRF perceive the assets are not being protected.

"We struggle a little bit with the question that you usually get from things like the Pitt Review and other flooding which is what level of resilience does critical infrastructure offices have in terms of flood protection and we struggle to get I would say anything other than sometimes a very generic answer to that but sometimes there are, can be generic answers."– 05 Participant

In some instances the participants from the LRF provided examples where the WSP had not provided information regarding an incident and the LRF was notified by members of the local community.

"And I suppose our worry is we'll start seeing some community impacts on the ground before it gets to that point so there is a little bit of that in terms of the concern that when it, that there's still a little bit of keeping it within the organisation even though there's the CCA, even though there's the you know the duty to share information and even though that we've got a plan in place that has triggers.." – 05 Participant

There were also concerns that the WSP's do not share enough information at an earlier stage of the incident. This has important implications for the building of

situational awareness and effective emergency response. A couple of examples were provided during the interviews of the WSP requesting assistance from the LRF when the emergency situation was perceived to be beyond the capabilities of the WSP.

> *"So certainly some feedback centred a little bit why did you not escalate that because there was certain things that we could have at least helped with the co-ordination of some of the responses and the communications and even if it's just a teleconference to say that everyone knows exactly what the situation is." – 05 Participant*

Sharing information at an earlier stage of the incident would allow the LRF to provide additional resources and capabilities to assist the WSP. But if this is left too late, there is a danger of the emergency situation becoming out of control.

4.4.1 Resilience Direct

Resilience Direct is a situational awareness tool that was introduced in April 2014 to alleviate some of the difficulties with sharing information within a multi-agency environment. All of the Category 1 and Category 2 responders that are part of the LRF have been provided with access to the system and are able to upload and view documents that may assist with effective planning and emergency response.

> *"So I think the sharing plans in peace time it's a really good tool and it means that everything's in one place, we have to store less on our own systems, we are less likely to have something out-of-date if we ever need to refer to it because we can go to Resilience Direct and get their most up-to-date copy so for those things I think it's great. In an incident when we're trying to use it it's I think we're still in the early stages so it's, we don't think it's quite so good and also the way we're structured we haven't yet identified who in an incident would need to be sat full time at a computer uploading and downloading information." – 12 Participant*

Resilience Direct was in the early stages of adoption during the time of the interviews and while many of the participants acknowledged the benefits of a multi-agency tool for the sharing of information they did not have enough people to operate the system, particularly during an emergency. This resulted in many of the Category 1 and Category 2 responders using the system as a document store or to post minutes of LRF meetings:

> *"Which is absolutely amazing software but the issue we have is, you've got this amazing software but who runs it in an incident because you've got so many different organisations who have got their own priorities just as much as multi-agency priorities and I lot of it I think is resources. How to actually physically man this. If you have an incident lasted two weeks for example, how do you man two weeks of staff for that incident as well as deal with your own operational incidents and I think that's probably the key thing but I think there is always going to be the key challenge I mentioned at the beginning is resources. Is where do we get the resources to manage it when everyone is being stretched, it's not, all organisations have got limited resources how do they keep going when things get kicked off …" – 01 Participant*

For planning and preparation, Resilience Direct was perceived to be a useful method to share information regarding emergency plans and procedures but there was concern that during an emergency WSP's wouldn't have enough people to operate the system. Not only that, the Category 2 organisations already have their own technical systems in place that they are familiar with and are experienced in using during an emergency.

4.4.2 Good practice and lessons learned using Resilience Direct

Many of the participants commented on the need for greater support from government to share good practice and lessons learned. This is becoming increasing important as resources in terms of finances and people are continually being stretched. Resilience Direct provides a formal mechanism to share this

information but again networking and building relationships between organisations allows for a greater sharing of good practice and lessons learned because the information comes from a trusted source. Organisations such as the DCLG RED also provided an effective opportunity to share good practice and lessons learned, however as previously mentioned, these teams are declining in size and there are not enough people to attend LRF meetings. So, this information is no longer being shared as much as it used to in the past.

> *"So rather than us trying to do the work laboriously you can actually go on this what they call this joint organisational learning platform on RD and access that information so it's been very, very good. That combined with the forum you know the chairs forum we get talking to people, networking and you meet people from all the different forums which is good.* **– 06 Participant**

One participant also mentioned that although there may be mechanisms in place to share good practice there was *'no driver for it'.*

> *"If you look at JESIP you've got the joint organisational learning part of JESIP that comes so if you have an incident you're supposed to share your organisational learning so what didn't go so well and what have you done to rectify that so that's all really good stuff but again there's no driver for it."* **– 13 Participant**

All of the participants discussed attending formal debrief sessions to identify lessons learned from emergency events, training and exercising and incorporate these into the development of future plans and emergency management procedures. This was embedded within the emergency management process and considered to be important in terms of building resilience to future events. This was a standard approach across the country within each organisation.

> *"a real world event of any size or if we have an exercise then we seek to learn the lessons out of that event by holding formal debrief sessions and we have a process that we follow and we identify those lessons and then*

we play those lessons into any planning developments that we need in the future." – 15 Participant

Many of the regional groups established between the local LRF's provide opportunities for the LRF's to share examples of good practice, but it was difficult to identify examples of cross organisational learning or learning regarding the multi-agency approach. Many of the examples of sharing good practice and lessons learned were focused on individual organisations rather than across the multiple agencies. While it could be argued cross organisational lessons are learned and shared within the LRF this was not clearly identified within the interviews.

> *"So you could have I mean like the flooding we did pick up, we have picked up quite a lot of stuff about the flooding events in [Location] through [Name] cascading that information and through a couple of other workshops that have sent stuff out but it had to be something that big to cascade some of that stuff out, does that make sense? So as the stuff that happens all over the country doesn't get cascaded down so that you could go oh that could happen here, what have we got in place for that so you kind of do operate in a county looking at well what's happened within the county." - 05 Participant*

There were also inconsistencies regarding whether lessons learned were adequately shared throughout the country and how lessons were only shared regarding extreme events.

4.5 Planning and preparing for extreme events

Effective collaboration, building relationships and sharing information are important components in planning and preparing for an emergency, but all of these require strategic direction during multi-agency emergency response. This

direction is provided in the form of an emergency plan. Participants were asked what they perceive to be the purpose of the emergency plan.

4.5.1 The purpose of the emergency plan

The purpose of the emergency plan is to provide a structured and strategic approach to emergency response. Participants highlighted it allowed them to identify the resources and capabilities required for effective emergency response, ensure roles and responsibilities were clearly defined and provide a framework for command and control. While all of these aspects were considered important, investing in people and the process of developing the plan, building relationships and sharing information was considered of greater value. Many of the participants recognised the plan as a reference document, but the real value of the plan was recognised in training and exercising people so they were experienced in providing effective emergency response.

> *"So what I'm saying there is effectively the plan, the three inches of paperwork that we've put together to tell us what to do is very nice, it's very nice but the real preparation was in actually creating the plan and sharing the information as we did to get us to the point where we could sign off the plan and say we've got one. So it is the process more than the plan that is important I would say and that process if you understand your risk, if you prepared around that risk, if you shared information about that risk, if you've worked out what do I do if, that's where you've actually got the value and that is the value of the plan but the plan itself is of little value, it is an enabler for other things." – 15 Participant*

Emergency situations are rapidly changing, dynamic environments that are challenging in that each emergency situation will present a different set of challenges. The capability to respond effectively requires a flexible and

adaptable approach and is not provided within a structured emergency plan. Participants considered this is provided by investing in well trained and exercised personnel.

> *"….the people who rely on plans totally I think are doomed to fail because that's when professional judgement has to come in, experience et cetera, dialogue with other agencies and all the things and if you think that you can have all the answers in a plan I think people will be sadly mistaken because I think uniqueness of each incident."* **– 16 Participant**

4.5.2 The Multi-Agency Assessment of Risk

The multi-agency assessment of risk is conducted through the development of the CRR, as discussed in Chapter 2, (Section 2.7). All of the LRF's have developed a system to enable them to complete these CRR's using a multi-agency approach. However, each LRF may have a slightly different method of conducting the risk assessment process and again this creates difficulties for WSP's and other organisations that operate over a wide geographical area. Examples were also provided where each CRR was developed using a different software package.

> *"No I think now we need to have you know … Civil Contingencies Act and I think we just need a bit more sophistication in it as I said earlier you know regionalised a little bit, resources are limited so why are we writing forty-seven community risk registers so I think you know we need some way of being a bit more sophisticated now."* **– 08 Participant**

Every two years the Government publishes the National Risk Assumptions and these are used to inform the risk assessment process at a local level. Many participants identified there were difficulties with this approach because some of the national guidance was not relevant for their particular area so they would re-evaluate the risk based on their local planning assumptions.

"…interpreting the national risks in the local context, some of the national ones are a bit extreme but we do adjust them." – 03 Participant

A lack of resources was also identified as a potential difficulty for Category 1 and Category 2 responders and having the time and people available to attend multiple LRF risk assessment meetings. This has led many LRF's to take a regional approach to the multi-agency assessment of risk.

"Generally I think what we've done is looked at the risk assessment, we've done our, at the national risk register sorry, we've done our own risk assessments for the ones that we think affect us. We've drafted a generic response again so that we're not doing it [number] different ways or [number] different ways, those are published on Resilience Direct and we've shared them, we did a booklet as well for all the LRFs." – 12 Participant

Participants discussed how the national risk assumptions provide the foundation for assessing risk but there are some risks that are not considered to be as relevant at the local level.

4.5.3 Working collaboratively in the development of a multi-agency emergency plan

Participants discussed a number of different approaches to the development of a multi-agency emergency plan. There were examples of a multi-agency working group where all of the organisations involved in emergency response for a particular incident would develop the multi-agency plan together through a series of meetings and workshops. There were also examples where a critical infrastructure group or the lead organisation was responsible for the development of a multi-agency plan and would consult with the other organisations rather than develop the whole plan together.

*"So we've got a critical infrastructure group and that the [Name] chair and that means they as a general rule it doesn't always work like this but we, as we chair the group we sort of also lead on writing the plans and then we'll call together meetings with [Name] and [Name] and [Name] and the others when we need to and sort of work on the plans together on that basis. Yes, so yes I think we get generally speaking we get the sort of involvement of everyone when needed." - **10 Participant**

*"So if it's a multiagency plan you would generally have a lead agency so what they call the sort of lead responder principle so the lead responder would actually be kind of responsible for writing the plan on behalf of and in consultation with the other agencies in the LRF." – **14 Participant**

Examples were provided where the LRF and Local Authority participants had not been involved in the consultation process but instead received plans from a utility company detailing at what point assistance would be required for effective emergency response.

*"For most of the utility plans what we tend to see is their plan and then sort of this is where you guys fit in. I think there'd maybe be, there's been quite a lot of work done to try and support wider partners in understanding red liners for utilities those kind of, at this point we failed because we've drawn on mutual aid, it's beyond us now." – **02 Participant**

There were also examples where assumptions had been made regarding the capability of the Local Authority and the resources that would be provided during an emergency. In some instances roles and responsibilities were assigned to the Local Authority that they were unable to deliver.

*"We've seen it a few times yes, yes or things which have been agreed under almost a different age on there or there's some I mean sometimes it's industry agreed but it's not clear or it's not been fully explored as to right, what exactly does that mean, what's your expectation of that versus ours because just because it says local authority will doesn't mean that we can and it doesn't mean that we can do it to the level that you would expect necessarily so let's have some discussion about this in advance rather than just a line saying we will." – **02 Participant**

"Some agencies are like that, they have empire builders and they think well this is our plan and so this is our plan and you know we'll tell everybody else what they need to be doing and actually then they make decisions on behalf of other agencies without consultation with those agencies, so … " **– 15 Participant**

These examples demonstrate how effective collaboration, the sharing and exchange of information and a greater understanding of roles and responsibilities is required in the development of a multi-agency emergency plan.

4.6   Building resilience

Throughout the interview process there were many perspectives regarding how resilience was perceived and how resilience could be achieved for low probability, high consequence events through multi-agency training and exercises. These will be explored within this section.

4.6.1 Perception of resilience

All of the participants were asked how they would define resilience and what it means for their organisation. All of the participants considered resilience as the ability to be prepared, to respond effectively and for the organisation to be able to recover to a *'normal'* level of functioning.

> *"Right, to me it's you know it's a number of things for me. It's making sure that you are fully prepared, able to respond, able to recover, keep the public warned and informed and engage with the community so all that to me is resilience."* **– 06 Participant**

Once a general definition had been provided, the participant would then add further information to reinforce their perception of resilience. This provided insight into how resilience is perceived. For multi-agency emergency response, resilience was perceived to be about having strong leadership, managing expectations and organisations adopting the same procedures for communicating to the public.

> *"But I think it's about leadership, it's about communication, it's about robust business continuity plans that's what I think creates resilience and I think it's also again about in the multiagency arena about you know who can do what to support another organisation and I guess again in the multiagency around this message it's consistency of approach, we have found many times that you know you cannot have one organisation almost going rogue and putting out a message that's not consistent so we have to agree consistent lines to take around communication."* **- 16 Participant**

> *" …. in emergency planning we are more focussing on if we lose these assets or these assets get flooded how do we manage customers expectations but also ensuring that customers remain on water and still get the best service that we can actually provide during the circumstances … "* **– 01 Participant**

During an emergency it is very important to have a good, clear understanding of the emergency situation to allow for effective emergency response and this was highlighted by participants as necessary to achieve resilience.

> *"…..and I think and that's probably the constant struggle is are people, two things, one is do people fully understand what they think the risks are and what they almost in their heads accept they should be able to deal with and then can they resource that but I mean there's people that have that think you know we should be able to deal with X, Y and Z but actually the reality is we've lost the people to be able to do it."* **– 05 Participant**

> *"I think where things have failed it's because people haven't understood what's really important and so yes you might be very, very busy, you might*

be stretched but you've not actually understood what's most important at that time and what resources you've got to deal with it and then that ability to adapt …" – 02 Participant

However, emergency response will only be effective if there are enough people available to provide assistance and respond. The availability of resources for emergency response is discussed in greater detail in Section 4.71.

"So we are looking at from our point of view performance of our assets but in terms of resilience its making sure there are plans in place or resources in place to deal with whatever can come across because I've been in [Name] for the last four or five years and I've never had a, we've had similar incidents but they've always had different outcomes and so it's you had to be resilient to ensure you can get, you have the right capability in place."
– 01 Participant

"I mean we've had I mean the simple terms is I suppose is it's the capability to sort of respond and adapt to an adverse event and that's the basic sort of response I suppose but we'll have lots of assets in terms of the business I mean how, how resilient we are as individuals in the business…" – 09 Participant

This will be explored in greater detail within Chapter 8 and within the context of the wider system of emergency management.

4.6.2 Multi-agency exercising and training

Training and exercising was considered to be extremely important in terms of achieving and building resilience within emergency management. This is because every emergency situation will present a different set of challenges that may not have been considered within the emergency plan. Therefore it is important that everyone who is involved in dealing with an emergency is fully trained and exercised. This provides flexibility within emergency management

because responders are able to think around a problem if they are confident and understand the system of emergency management.

> *"…one thing is you will never say in the [Name] is that will never happen inevitability it always does you know you can't do too much pre-planning you know that is one of the things we need to do, we need to do that more, to test our procedures and test our plans to make sure we have got it right."* **– 04 Participant**

> *"On the other side of things if we can't predict what it's going to be then so we can't say it's going to be this widespread power outage again I think the reason we focused on the training I spoke about earlier is that we want managers who've got the ability to plan and run an incident on the hoof and to respond to the information they've got to hand. So we want them to be able to make decisions based on the information they've got in an incident rather than say right I'm going to pick up this plan and just work through the plan. So we've focused more heavily on the training than we have on the plan development I think so that we've got that capability in the organisation rather than a plan which might not be appropriate."* **– 11 Participant**

Within the context of multi-agency training and exercising, this presented another opportunity to build relationships, collaborate effectively and meet the people that would be involved in the multi-agency emergency response.

> *"So training is a good one to get people together to learn the faces, to make contacts and then when you know the sherbet hits the fan you pick up the phone and you're talking to X you probably already know that person and you've already established some form of rapport with them."* **– 03 Participant**

> *"Well obviously it's having that relationships with the LRF and other people and again working then with people who you know and you know what their expectations are and what they can do and what they expect from us et cetera so it's having all that knowledge and the relationships and then obviously we do multiagency debriefs post an event or an exercise and again those learnings are then sort of shared and actioned upon and again that's sort of then managed by the training and exercising group as part of the LRF so it's quite tied together."* **– 09 Participant**

This also ensures there is the right capability in place for emergency response because when people are together in the exercise they will share information regarding the resources they have available. This process helps to manage expectations and reinforce the roles and responsibilities of each responding organisation. However, with austerity and the cost of designing effective exercises in terms of time, resources and finances, the process of training and participating in multi-agency exercises is not always possible.

> *"Yeah cause I think maybe some see it as like organising something quite intensive in terms of resources organising a big exercising takes quite a bit of time … when you sit down and start to think about things there's all sorts to think about and I think sometimes people are organising and think have I got enough resource to put to that maybe not and maybe it gets put to the back of the pile on the bottom of the pile you know in terms of whatever else is going on in the [Organisation]." – 04 Participant*

> *"We monitor the sort of response capabilities we have to that exercise and then implement I don't think we've ever run an exercise whereby we haven't had some learnings …" – 09 Participant*

There are many different approaches that are taken with how an exercise is conducted. Participants commented that austerity measures and a lack of finance have meant that they need to look at *'smarter'* ways to provide training and exercise. This may be table top exercises looking at a particular scenario or using one big exercise to test many different components of the emergency plans.

> *"But it's very much a low level tabletop exercise this one but clearly they're really quite important players and we're looking to develop with [Location] again a very low level exercise to test our water distribution plan which we haven't needed to sort of test but it would be more a low level sort of walk through tabletop as opposed to a you know getting people out and about live." – 16 Participant*

*"Yes so in the LRF we aim to have a multiagency sort of large exercise every three years but between sort of exercise to exercise you know we do sort of multiagency training and exercising on various issues and aspects as well so." – **14 Participant***

Participants also provided examples of regional exercising and training groups that look at low probability high consequence events in terms of the level of disruption the region could withstand if a major highway was destroyed or a reservoir failed. This allowed participants to form a comprehensive understanding of the resources and capabilities required for emergency response:

*"But they do a lot of training and exercising on big incidents so they have done plane crashes over big road networks, they've done flooding, they've done avian influenza, they done some of the key incidents and basically they've got, whoever the lead organisation is they end up leading the exercise and it's not specifically to look at that incident it's more to look at the wider consequences as a team as individual organisations that as a group what would be the main issues. So, for example if an aeroplane hit one of the major road networks, forgetting about how to deal with that on the ground, we don't look at that, that is more to look at what are the wider consequences of losing that road for say six weeks, seven weeks, eight weeks." – **01 Participant***

The Category 1 responders are very experienced in dealing with emergency situations because it is an essential part of their day job. For the Category 1 responders, command and control is very much part of their organisational culture. However, this is not the same for Category 2 responders or the WSP's. One participant perceived this to be quite intimidating and attending emergency exercises and training provides an opportunity to overcome concerns working with the Category 1 responders.

"So I think we want to get over the fear factor of our people being asked to work with other organisations whose day job is responding to incidents. So I think there's a little bit of, well we'll still get nervous if you've got to go to the local resilience forum GCG then it's better if you know what you're

*going to find when you get there rather than go along thinking right, there's going to be the chief superintendent running it, there's going to be senior managers from all of these other organisations like fire and ambulance and I'm going to be sitting there representing [Name] so you want people to know what it's going to feel like." – **11 Participant***

4.7   Achieving effective emergency response

Effective emergency response is supported through good situational awareness and this needs to be achieved very early in the incident to allow emergency responders time to assess the capabilities and resources required to manage the incident. Many participants highlighted the need for Category 2 responders to share information regarding their incidents at an earlier stage of the emergency and how communication is essential throughout the process of emergency management. This is usually developed and enhanced though good working relationships.

*"I think there's something around that from the wider perspective of a lot of incidents we're only notified of once they've reached a certain level and it's there might be something more from our side of a better awareness early on or with those smaller incidents so it becomes business as usual. The nightmare for me would be a utility failing and saying we've done as much as we can, over to you now. OK right, where do I even start so I think there's maybe some more, more work to be done around getting those links in earlier." – **02 Participant***

*"…you know how are we going to, what plans do we need, are those plans fit for purpose or what do we need to train and exercise on and it's ticking those boxes and then when you actually have an incident you're dealing with the same people who have been sat round a table discussing the problems before so it's that relationship building and it's being confident that when you respond that you know you will be able to deal with whatever's in front of you because if you get the right people around the table with the right resources and the right will and focus then you can drive it forward and a lot of the JESIP principles come into that." – **07 Participant***

Participants also mentioned potential difficulties accessing mutual aid if each organisation has a different approach to emergency response. Multi-agency collaboration during the planning process is important so that organisations are familiar with working practices and there is a standardised consistent approach.

> *".....are you capable of doing the plan having proved that you've got both the assets in place and the staffing to make it work because anything less than that you're putting yourself under more pressure and more relying on mutual aid and if you are relying on mutual aid have you actually thought through where those people are coming from because it's easy to say oh we'll just bring people in from another county but then you started to realise but they don't know the plans, they have different ways of working." – 06 Participant*

Providing effective emergency response to low probability, high consequence events can be very challenging in terms of understanding the resources and capabilities required for an uncertain situation. There are very good mechanisms in place for known threats and hazards that occur on a daily basis and both the Category 1 and Category 2 responders are very experienced at dealing with these incidents. However, participants considered low probability, high consequence events required a different approach, utilising a different set of skills where increasing resources may not provide an effective response. The command and control methodology also places a restriction on the ability to recognise this because it is not flexible in its approach.

> *"......and the intention was that you would just then replicate that and multiple that a number of times depending on how severe the scenario was and they said it just that didn't work you couldn't just multiple your response up ten times sort of thing it just became a completely different sort of response requirement. So I think that was one of the big learnings for a lot of the water companies that came out of that." – 09 Participant*

Two participants expressed concern regarding the availability of mutual aid and

WSP's potentially using the same contractor to provide an alternative supply of water during an emergency. WSP's did not actively share information regarding the contractors they used because this was considered sensitive information. However, many of the participants have made the assumption they are using the same one. This raises the question as to whether the contractor will be able to fulfil their contracts if there is more than one incident requiring an alternative supply of water. This has encouraged many of the WSP's to assess how they can provide their own supply during an emergency.

> *"No, there is no sort of, there is no sort of like contract manual that says here's a list of all the contractors that [Name] use and this is what they do for them and [Name] don't provide the same and [Name] and [Name] so nobody feeds into this massive sort of like you know contractor supply list so I could be sitting here saying well we use this company delivering that but I don't know if five other companies do as well."* **- 13 Participant**

> *"So, it's actually making sure that there is other resilience, so we've got our own measures in place with other companies and we are looking at other stuff, in terms of bottling our own water ourselves, potential business case, just to see what's out there and see if we can do it for our own resilience purposes because we realised if everyone relies on this one company, it's not going to have, and it's not just water companies that have a contract with them, local authorities have contracts with them other companies have contracts with them…"* **– 01 Participant**

4.7.1 Resources and availability of personnel

The availability of personnel to be able to deliver an effective emergency response was a dominant theme throughout the interview process. Every organisation participant mentioned challenges and difficulties associated with a lack of available personnel. This was not just related to emergency response, many of the participants discussed how emergency management teams were becoming smaller and yet they were expected to produce the same amount of work. Participants also expressed concern regarding the number of people

available to provide a support role during an emergency. A lack of available people would require organisations to rely on mutual aid. However, the organisations they rely on, are also experiencing the same issues. The capability to respond to emergency situations is perceived as becoming greatly reduced.

> *"I think my measure for everything ideally would be you find a way of working out what your structure's going to be, how many people you need to make that structure, to populate that structure, can you do it over multiple shifts, have you got any slippage for extra people, have you thought mutual aid i.e. the practical ability to do what the plan says." – 05 Participant*

The loss of emergency management staff has a knock on effect because the emergency planning teams are also losing essential experience and knowledge.

> *"…in recent times austerity has affected that where we've had you know fewer people to do those things and the turnover of staff means turbulence and turnover in the knowledge base and that becomes quite an issue in matters of resilience and planning the knowledge just drifts away and you have to prepare other people and that's a constant battle." – 15 Participant*

This also has implications regarding the ability to work with external organisations and local community groups if there are not enough personnel to be able to engage in collaborative working partnerships.

4.8 Working with Communities

Working together with local communities was considered to be of great benefit throughout the process of emergency management because it strengthens the emergency response. Working collaboratively with a local community gave the

participants access to local knowledge and the potential for additional resource during an emergency depending on the skill set. It was also perceived as allowing for greater communication, a shared understanding of risk, the ability to manage expectations and a shared understanding of the roles and responsibilities of the responder organisations.

> *"Oh communication, identified skills, local knowledge, it's all of those things and you know I see it from both sides because I'm part of the community that gets flooded in [Location] so again you know we, our community, I'm only new to it but it's quite clear when the emergency services turn up they'll be told what to do by the community group because they've got flood wardens who have been flood wardens for forty years and know how to read the sea so it is a, it's really interesting you see that has been an absolute perfect model through to probably what we've got in [Location] which we haven't had the major incidences recently so therefore we keep talking about what each agency would do but we're not absolutely certain how it would come together because we haven't been able to put it into practice, exercises are OK but they don't actually get to the real thing." – 07 Participant*

> *"Oh it strengthens it because generally speaking when you get involved with communities and you start planning around risks that affect those communities you will find that you've got an awful lot of expertise in the area because people know it and they understand it." – 14 Participant*

Where strong collaboration exists, participants are moving towards developing response structures within the community and actively incorporating the community within the emergency management process. This will be explored in greater depth in Chapter 7.

> *"We're trying to train, so we have basically a response structure very small scale and a list of what the risks are in the community and a list of community assets so have you got church halls, village halls, pubs things that you can use and what we say to them as a community group is effectively because we're such a large county it can take a while for emergency services to get there, even the ability to deal with certain incidents in the first, until such time the support gets there." – 05 Participant*

Within the multi-agency environment of the LRF, it is usually the Local Authority and Environment Agency that take a lead role in engaging with communities in the development of flood plans. WSP's are not involved in the development of community flood plans although, they do engage and educate communities in water related issues. This may involve visiting a local school to teach children about the water cycle.

> *"We don't work with community plans, we do stuff in the communities, [Location] works with communities, we won't, we don't get involved in any community plans because obviously a lot of it's down, just to do with our water network assets. I know local authorities do, local authorities do their local flood plans along with the EA but we do do education, educating people in communities."* **– 01 Participant**

> *".yes community resilience is key it's one of our strategic objectives and I think again it's building bridges and after the flooding it was for us it was strike while the iron's hot and go into communities and say right we'd like you to have this template which we give them for community resilience plan ."* **– 07 Participant**

Participants also mentioned difficulties collaborating with communities in large urban areas because there is a perception that these communities are not so well connected as those in a rural environment.

> *"We've got quite high urban population at risk of flooding and we've tried engagement, we've tried a number of ways and what we've found is that traditional community emergency plan really doesn't lend itself within those sort of environments. We've got a number of community plans for smaller, more rural locations where it's not even socioeconomic some of them they're not the wealthiest villages by any chance but they've got a good network in there, everyone knows everyone else …. "* **– 02 Participant**

While it is recognised that working collaboratively with local community groups strengthens the emergency management process, a different approach may be

required to identify and engage with community groups within an urban environment.

4.8.1   Social Media

The introduction of social media has added another dimension to emergency response that was of concern to many of the participants. This is because of the speed at which members of the public can upload information to the internet. This instantaneous supply of information has presented a number of challenges for emergency responders in terms of controlling misinformation and being able to establish an authoritative social media presence.

> *"I think the biggest issue I think is around social media and taking customers, meeting customers' expectations because before you used to have 6 o'clock news and or 6 o'clock and night news or 9 o'clock in the morning news, whatever time you had set deadlines, when now everything's 24/7. One wrong tweet, one wrong message could change customers perception very quickly and so it's very hard to stay on top of our comms and that's why we have a comms department who do all the social media and keep track of our social media because we realise that actually that this is an area we could slip up on and it might not be because the organisations not doing anything it's because it's the expectations a lot more's expected because everyone's expects everything with the click of a finger …"* **– 01 Participant**

Social media has also challenged public perception of the emergency responder's and WSP's ability to attend an incident within an appropriate timescale. Information is instantly uploaded, which creates a perception that there should also be an instantaneous response. However, it takes time to develop situational awareness and determine the capabilities required for effective emergency response.

> *"…you know if you're going to use it you need to get in early and get the right hashtag on it so people refer to that rather than anything else and you*

can actually control you know, well have some influence on it because you know people will believe in conspiracy theories and all the rest of it and as you've already said you know anyone can be Twittering anything and it could be the wrong message." – 03 Participant

4.8.2 Reliance on the WSP

Many participants recognised that the utility companies are facing a difficult challenge because people are so reliant on the provision of essential services that they may not prepare for a failure of the water supply which may make them less resilient should a failure occur.

> *"I think we're entering a bit of a new phase where that expectation there's going to be work done around trying to manage that public expectation and the whole community resilience side from the water industry I think there's probably some messages starting to come out around what you can do for yourself that I think people are so used to utilities not failing now that when it does come it comes as a, it's seen as a surprise and maybe there's not that resilience there used to be even the design of water boilers used to have quite a bit of water inside them but everyone's moved towards combi-boilers where you ain't going to have any spare capacity in your systems and you just sort of think some of the ways we used to operate had some redundancy in them." – 02 Participant*

The expectation of a continuous supply of water or electricity is very high and because people pay for these services they may not consider the need to develop resilience to failure. This will be explored in greater depth in Chapter 5**.**

4.9 Summary

The aim of Objective 2 was to investigate the multi-agency approach to emergency management. This was achieved through semi-structured interviews with LRF, WSP and Fire and Rescue Service emergency managers and contextualised using the following research questions.

4.9.1 Does the CCA, 2004 support the multi-agency approach to emergency management?

The CCA, 2004 was perceived by participants as a positive approach to emergency management in the UK, by encouraging multi-agency collaboration before, during and after an emergency. However, the legislation was also considered to be in need of review to reflect changes in current working practices. For instance the increasing use of social media by the public during an emergency. This is creating difficulties for emergency responders and WSP's because the public are providing an instantaneous source of information regarding the emerging situation. However, this information may not be correct and is issued before participants are able to develop situational awareness and establish the resources and capabilities required for emergency response. Participants identified the ability to provide an authoritative presence on social media as a challenge without government guidance and the finances to hire and train specific personnel to maintain and manage social media.

As part of the CCA, 2004, participants also identified the need for government regulation of emergency management in the form of audits, benchmarking or performance measures. Every two years all members of the LRF are required to complete the National Capabilities Survey to provide the government with information regarding emergency capabilities at a local level. However, participants did not consider this to be an effective approach because it does not explore how emergency management is conducted in enough detail or explore whether the emergency plans that have been developed are fit for purpose.

Participants require more direction from government and in particular the sharing of good practice. This would allow participants to identify strengths and weaknesses in the approach they have taken to emergency management. It also promotes and encourages learning if good practice includes examples where an approach was not successful.

Within the framework of the CCA, 2004, multi-agency collaboration and the sharing of information at a local level is conducted though the LRF. However, this is difficult for organisations that operate over a large geographic area that may encompass one or more LRF's. This is complicated further with each LRF operating autonomously at a local level. It is not possible for WSP's and other utility companies to engage effectively with every LRF and this has led many participants to take a regional approach to multi-agency collaboration rather than operate at a local level.

The lack of statutory duties or evidence of enforcement, created the perception that Category 2 responders have the ability to *'opt out'* and provide the minimum in terms of engagement. This led one participant to term the CCA, 2004 as a *'toothless tiger'*. It was suggested by participants that utility companies providing essential services to the public should also be considered as Category 1 responders with a legislative duty to share and exchange information. This would reinforce the emergency management process and prevent organisations from being able to *'opt out'*.

Many organisations that comprise the LRF operate within a different organisational culture. However this was not considered by participants as a barrier to effective multi-agency collaboration because during an emergency they operate within the same principles of joint operational working practices as defined within JESIP (JESIP, 2016).

4.9.2   How do the Category 1 responders and the WSP's perceive the multi-agency approach to emergency management?

Building and establishing relationships was a dominant factor attributed to the effectiveness of each theme and collaboration was perceived to be enhanced where strong relationships existed between organisations.   A multi-agency approach to emergency planning encourages organisations to share information regarding the resources and capabilities required for effective emergency response and promotes the development of a shared perception of risk. This allows participants to determine and assess the ability to achieve resilience both within their own organisation and through a multi-agency approach. If organisations are relying on one another to provide mutual aid during an emergency, it is necessary to have a realistic expectation of what an organisation is able to provide.

The process of building relationships also helps to establish trust between organisations. However, this also relies on the sharing of information and many participants identified difficulties sharing information between organisations. This was a particular problem regarding vulnerable people because formal

mechanisms had not been established for sharing this information across different organisations.

Effective collaboration through building relationships and sharing information to develop a greater understanding of how each organisation operates during an emergency, is essential for effective emergency response. Throughout the interviews, participants discussed how this was reinforced through multi-agency training and exercising. This enabled a shared understanding of the roles and responsibilities of each organisation and provided participants with the opportunity to gain experience of working together during an emergency. Knowledge and experience gained from both exercising and responding to actual emergencies was perceived to contribute towards achieving resilience. This is because every emergency is different and requires responders to be flexible and adaptable in their approach. This can only be achieved if participants are trained and competent within their roles. These skills are necessary to determine and assess the resources and capabilities required when responding to an extreme event.

Throughout the interviews limitations of finance and resources was perceived to be a great challenge for emergency management professionals. This was of great concern for participants because they perceived they were expected to provide the same level of service with less resources. The introduction of software such as Resilience Direct was widely recognised as beneficial to improve multi-agency collaboration. However, participants did not have enough people to train and use the system effectively. While participants recognised the

importance of multi-agency training and exercising, these were also considered expensive in terms of finance and available resource to implement.

4.9.3 How do LRF's and the WSP's collaborate with local community groups in the multi-agency approach to emergency management?

Working together with communities was considered to strengthen emergency management because participants were provided with local knowledge and the potential for additional resource. The sharing and exchange of information with communities also contributed to a shared perception of risk and the realistic determination of how responder organisations operate during an emergency.

Participants perceived the use of social media by the public during an emergency as a particular challenge. This is because they perceived the instantaneous upload of information difficult to manage. There were examples where information regarding an emergency situation had been uploaded before the emergency responders arrived at the scene. There were concerns regarding a public expectation that information should be provided immediately by participants on social media. This does not allow participants enough time to develop an awareness of the emergency situation and to determine how emergency response should be delivered. Managing public expectations regarding the continual provision of a centralised supply of water was also considered by participants. It was perceived that the public were not prepared and were not resilient to a failure of the water supply. This will be explored in greater depth within Chapters 5, 6 and 7.

5 CHAPTER 5 - GENERAL ATTITUDES AND PERCEPTIONS TO WATER SUPPLY FAILURE

5.1 Introduction

Chapter 4 sought to understand the multi-agency approach to emergency management within the framework of the CCA, (2004) and how this contributed to achieving resilience within the UK water sector. However, this only represents one aspect of the emergency management system. It was demonstrated within Chapter 1 (Section 1.3) that in order to achieve resilience to extreme events it is necessary to understand the structural elements that comprise the system and how they are connected to identify where resilience measures should be applied.

As discussed within the literature review (Chapter 2, Section 2.6) there is an increasing emphasis to encourage the resilience of communities and individuals to emergency situations. In order to develop effective resilience based strategies that engage and encourage individuals to achieve resilience requires a greater understanding of individual attitudes and perceptions of water supply failure. This was explored using an individual homeowner questionnaire developed using the methodology presented within Chapter 3 (Section 3.5) using the research questions identified within Chapter 1, Section 1.4 (Objective 3). The results of the individual homeowner questionnaire represent a partial contribution to achieving Objective 3 (Chapter 1, Section 1.4) by exploring general attitudes and perceptions to water supply failure whereas Chapter 6 explores attitudes and perceptions to water supply failure during an extreme event.

This Chapter will proceed as follows: Section 5.2 will examine the demographic profile of the questionnaire respondents, Section 5.3 and 5.4 will discuss attitudes and perceptions to hazards within a respondent's local area. Section 5.5 explores attitudes and perceptions to water supply failure followed by a Chapter summary in Section 5.6.

5.2   The demographic profile of questionnaire respondents

There were 131 responses to the individual home owner questionnaire. The majority of respondents were male (60%), 38% of the respondents were female and 2% did not provide a response. The 18 to 24 age range was under-represented compared with the other age range categories and there was a greater proportion of males within the 65 years and over age range. This has resulted in a skewed dataset (Figure 5.1).
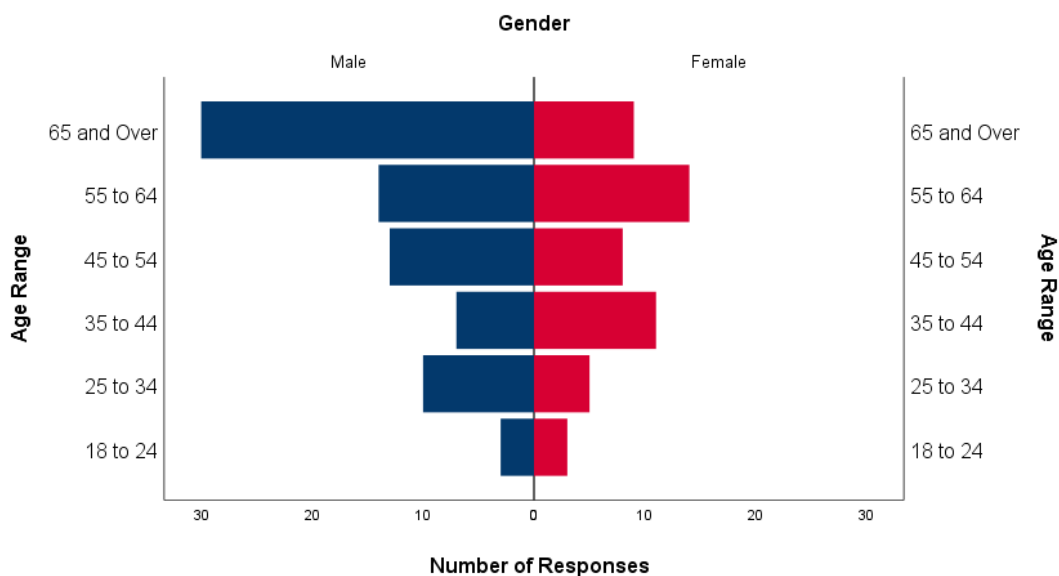
Figure 5.1: Population pyramid demonstrating age range and gender of questionnaire respondents.
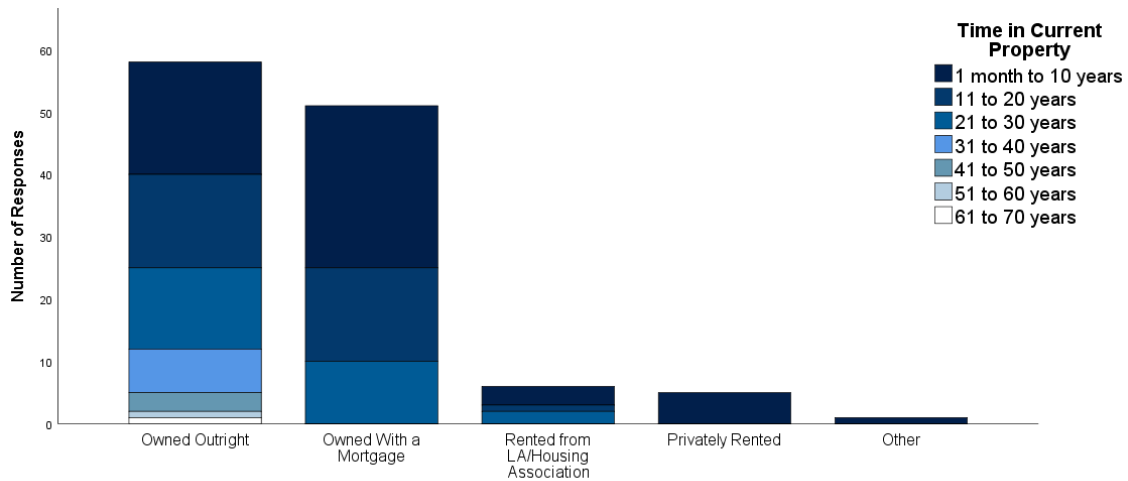
Figure 5.2: Property ownership and the length of time respondents had lived within their current property.

With regard to property ownership (Figure 5.2), the majority of respondents either owned their property outright (48%) or owned their property with a mortgage (43%). Of the respondents that owned their property outright, there was a range of response regarding the length of time respondents had lived within their current property. This information was of interest because it may enable a greater understanding of how a respondent perceived the hazards within their local area. The majority of respondents (32%), had lived within their current property for under 10 years, 25% had lived within their current property between 11 to 20 years, 23% between 21 to 30 years and 20% of respondents had lived with their current property for over 31 years including one respondent who had lived within their current property for 63 years.

Of the respondents that owned their property with a mortgage, 51% had lived within their property for under 10 years, 29% had lived within their current

property between 11 to 20 years and 20% had lived in their current property for 21 to 30 years.

5% of respondents rented their property either from the Local Authority or from the Housing Association. The majority of these (50%) had lived within their current property for under 10 years. 1 respondent <1% had lived within their current property between 11 to 20 years with the remaining respondents occupying their current property between 21 to 30 years. All of the respondent living in privately rented accommodation had lived within their current property for under 10 years.

In terms of current working status, 49% of respondents, are employed full time, 33%, are retired, 14%, are employed part time, 2%, selected house wife/house husband, 1%, are students, <1%, were unemployed not looking for work and <1% selected the 'other' category.

5.3   Thinking about your local area

This section of the questionnaire relates to the general hazards that may affect an individual within the local village, town or city where the questionnaire was delivered. Respondents were asked a series of questions relating to the hazards considered to be of most risk to residents within the UK (Appendix 2, Section 1). The hazards were taken from the 2015 NRR (National Risk Register, 2015). This was developed by the UK Government to provide a national assessment of risk that members of the public can access. This research will predominately

concentrate on the response to questions relating to water supply failure. However, questions relating to other hazards were included to understand how water supply failure was perceived within the context of other hazards that are considered a risk within the NRR (National Risk Register, 2015).

It was not the intention of this research to assess whether a respondent had correctly identified these as hazards within their area. River flooding, coastal flooding and gas supply failure are location specific hazards. These hazards were included to provide context for respondents when answering questions but are excluded from the analysis because they are location specific and some of the respondents do not live in a location that would be affected by one of these hazards. The questionnaire responses were anonymous so it is not possible to request this information from respondents. The following analysis will consider water supply failure in the context of general hazards that potentially affect all locations. These include, surface water flooding, sewer flooding, drought, heatwaves, low temperatures, heavy snow, storms and gales, pandemic influenza, widespread electricity failure and water supply failure.

The range of hazards was included within four questions to enable respondents to contextualise water supply failure in relation to other hazards that may affect them. These questions explored risk perception, experience of hazards, perceived importance of preparing for hazards and whether respondents actively prepared.

5.4 Understanding attitudes and perceptions of general hazards

The first question asked respondents, when thinking about your local area, do you think any of the following hazards are a risk to you? This question was intended to provide an indication of how individual respondents perceive the risk of hazards within their local area. Understanding individual perception of risk, and the factors that may influence it, may help to inform risk awareness and communication programmes. This will also provide an insight into how respondents perceive the risk of hazards and whether this influences attitudes toward preparedness and perceived responsibility to take action.
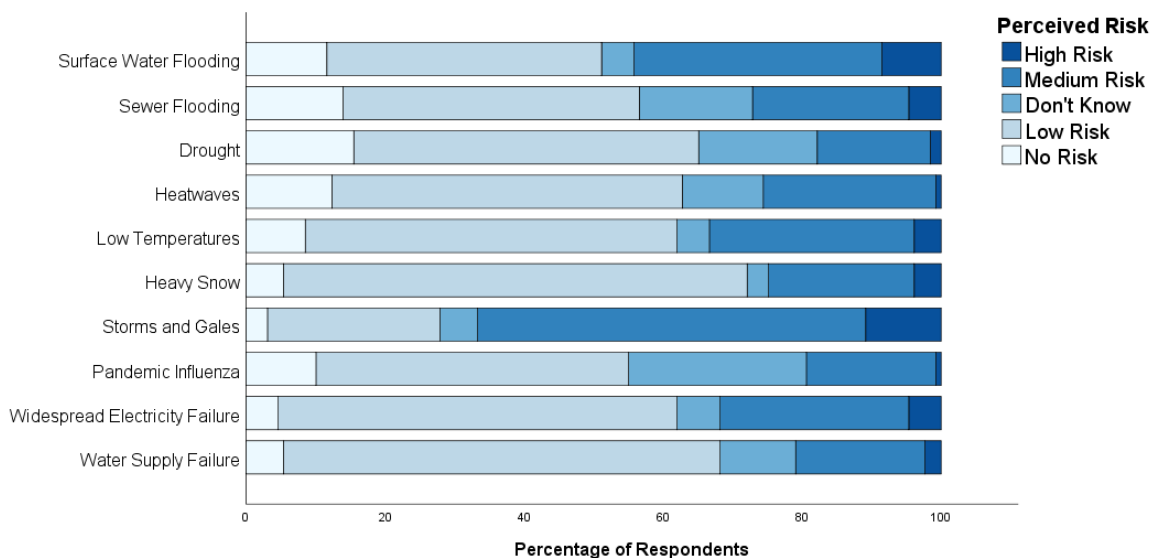
Figure 5.3: Respondents perception of the risk of hazards within their local area.

The majority of hazards were perceived to be low risk with the exception of storms and gales (Figure 5.3). This hazard received the greatest response within the *'high risk'* and *'medium risk'* category. Storms and Gales represent one of the most prevalent hazards in the UK and occur frequently during the winter months. Since 2015, the Met Office has been naming storms to raise awareness of each event and promote more effective communication of information. Storm names

are also used extensively by the media which reinforces awareness of each storm event. The last severe storm affecting the UK was Storm Desmond. This occurred during the winter of 2015-2016, and brought severe gale force winds and heavy rainfall to northern parts of the UK. This resulted in the closure of main arterial roads, disruption to the UK rail network and widespread flooding of over 5,000 homes. The flooding of an electricity substation also resulted in the loss of electricity to over 60,000 homes (van Oldenborgh *et al,* 2015).

The highest response attributed to the category *'don't know'* was for pandemic influenza. According to the National Health Service (NHS) in the UK, there have been 3 instances of a flu pandemic throughout the last century. The most serious outbreak of influenza occurred during 1918 resulting in the deaths of over 50 million people across the world (Johnson and Mueller, 2002). A pandemic on this scale has not been experienced since 1918, although there have been pandemics on a smaller scale occurring in 1957 and 1968. This may have contributed to the high response within the category *'don't know'* for this hazard.

The greatest response attributed to the category of '*low risk',* was in response to snow and the greatest response attributed to the category *'no risk'*, was in response to drought. Drought is considered to be a relatively rare event within the UK and compared to storms and gales, there have been relatively few episodes of drought over the last 50 years (Watts *et al,* 2012; Marsh, 2007).
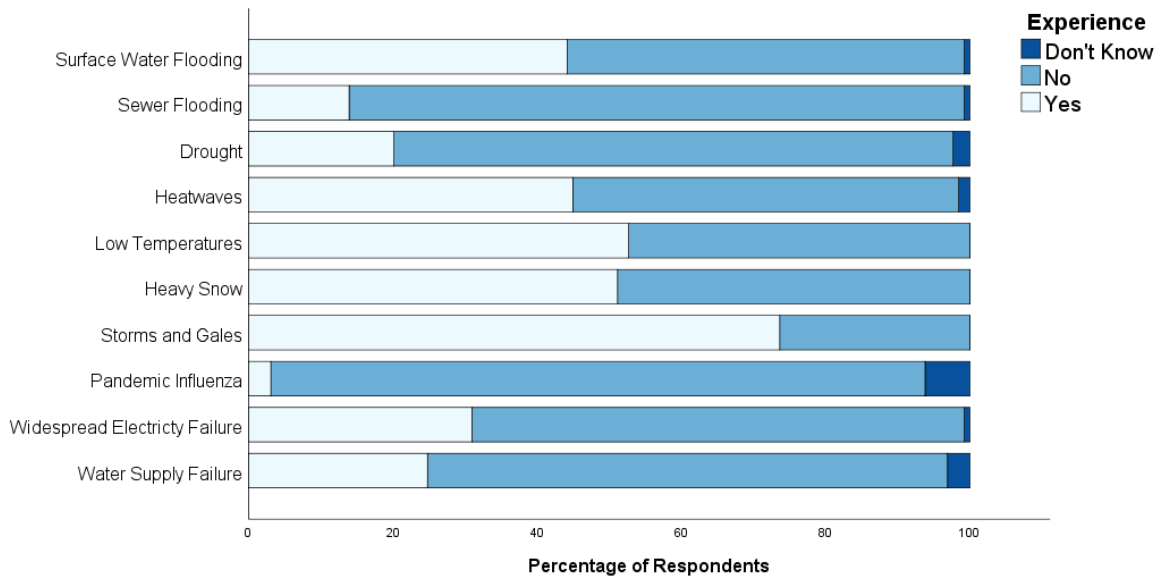
Figure 5.4: Respondents experience of hazards within their local area.

In order to gain a greater understanding of risk perception, respondents were asked whether they had experience of any of the hazards within their local area. Storms and gales, low temperatures, heavy snow, heatwaves and surface water flooding received a higher response compared to sewer flooding, drought, pandemic influenza, widespread electricity failure and water supply failure.

Storms and gales were experienced by the majority of respondents and were perceived to be 'high risk' and 'medium risk' hazards. While many respondents had experience of low temperatures and heavy snow, these were perceived as 'low risk'. It is possible that a lack of experience with regard to sewer flooding, drought, pandemic influenza, widespread electricity failure and water supply failure may have contributed to the perception of these hazards as 'low risk' within the context of this questionnaire (Figure 5.4). However, as discussed within the literature review (Chapter 2, Section 2.4), it is also important to acknowledge that risk perception is a complex process influenced by many factors. These may

include the possession of knowledge, trust, perceived control, cultural identity, societal expectations and the complexities associated with the personality traits of an individual (Dobbie *et al*, 2016; Slovic *et al,* 2004; Slovic and Webber, 2002) and may not be dependent on one single factor such as experience of a hazard.
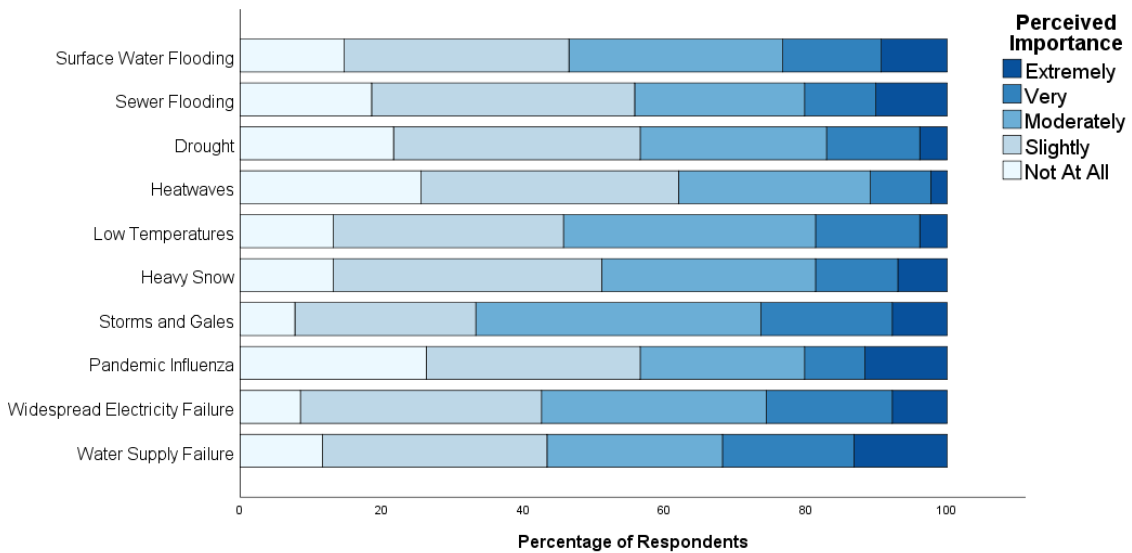
Figure 5.5: Respondents perception of the importance of preparing for hazards within their local area.

To explore the relationship between individual risk perceptions and experience, respondents were asked to provide information regarding whether they perceive it to be important to prepare for hazards (Figure 5.5). For the majority of hazards, respondents perceived it was *'slightly important'* to prepare and this is consistent with the perception of many of the hazards as *'low risk'.* This with the exception of storms and gales and low temperatures. The highest response for these hazards was attributed to the category *'moderately important'* to prepare. Storms and gales and water supply failure also received the highest response to the category *'very important'* to prepare. As previously mentioned, storms and gales represent one of the most prevalent hazards in the UK and have been

experienced by a greater proportion of respondents. This hazard also received the highest response for perceived risk in the *'high risk'* and *'medium risk'* category supporting the perception of this hazard as *'very important'* to prepare.

The greatest response attributed to the category *'not at all important'* was attributed to pandemic influenza. This response is consistent with the answers to the previous questions. As the majority of respondents do not know if this hazard is a risk and do not know if they have had experience of this hazard then it would be reasonable to assume that respondents would perceive the importance of preparing for this hazard as *'not at all important'*. The highest response attributed to the category, *'extremely important'* to prepare was for water supply failure and this will be explored in greater detail in Section 5.5.
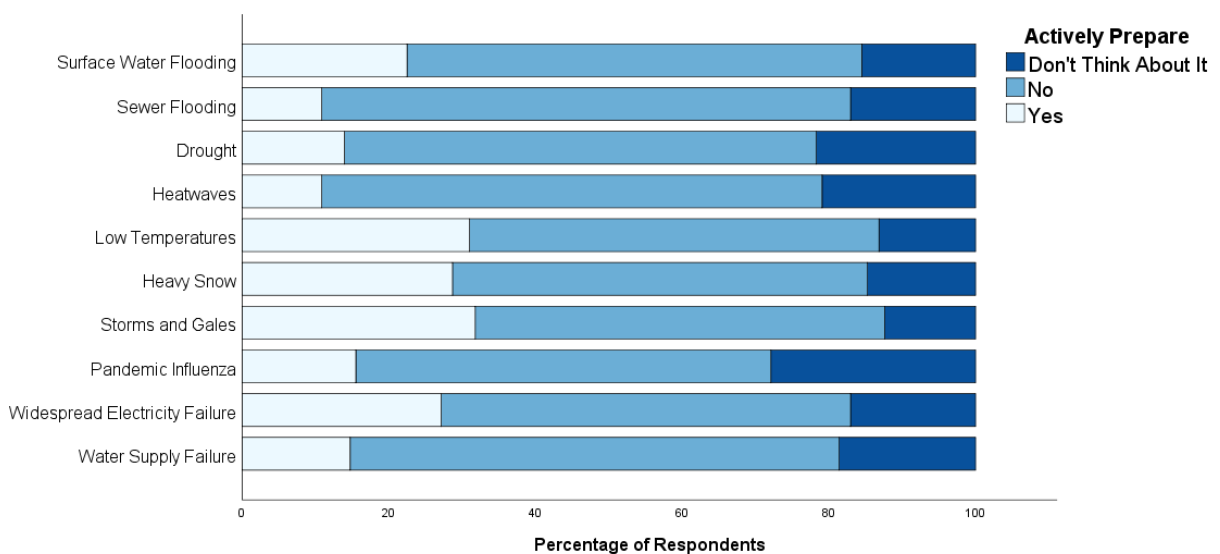
Figure 5.6: Response regarding whether respondents actively prepare for hazards within their local area.

In order to contextualise how respondents perceive the importance of preparing for hazards, they were also asked if they actively prepare for hazards within their local area. It is considered that the act of being prepared enables an individual

to achieve a greater resilience to emergency situations and extreme events (Paton *et al,* 2008). However, the results of the individual householder questionnaire demonstrate the majority of respondents do not actively prepare for hazards within their local area (Figure 5.6).

The greatest response attributed to the hazards respondents actively prepared for, were storms and gales, low temperatures, heavy snow, widespread electricity failure and surface water flooding. Storms and gales, low temperatures and heavy snow were experienced by the majority of respondents. However, only storms and gales were perceived as *'very important'* to prepare, yet despite this, the majority of respondents do not actively prepare for this hazard.

Surface water flooding and widespread electricity failure were perceived as '*low risk'* and only *'slightly important'* to prepare by the majority of respondents and this was supported by a low response regarding experience of these hazards. The results demonstrate that a small proportion of respondents actively prepare for these hazards.

These results demonstrate the relationship between risk perception, experience of hazards and whether an individual will actively prepare is complex and as discussed within the literature review (Chapter 2, Section 2.4) may be determined by other factors. To explore the response to these questions in greater depth, respondents were provided with a series of statements with Section 3 of the questionnaire. These were related to emergency preparedness and respondents

were asked to select a response from a 5 point Likert scale composed of *'strongly agree', 'agree', 'don't know', 'disagree', 'strongly disagree'*. Respondents were asked to provide a response to the statements:

'I have a responsibility to prepare for an emergency' and

'I take action to prepare for an emergency'.
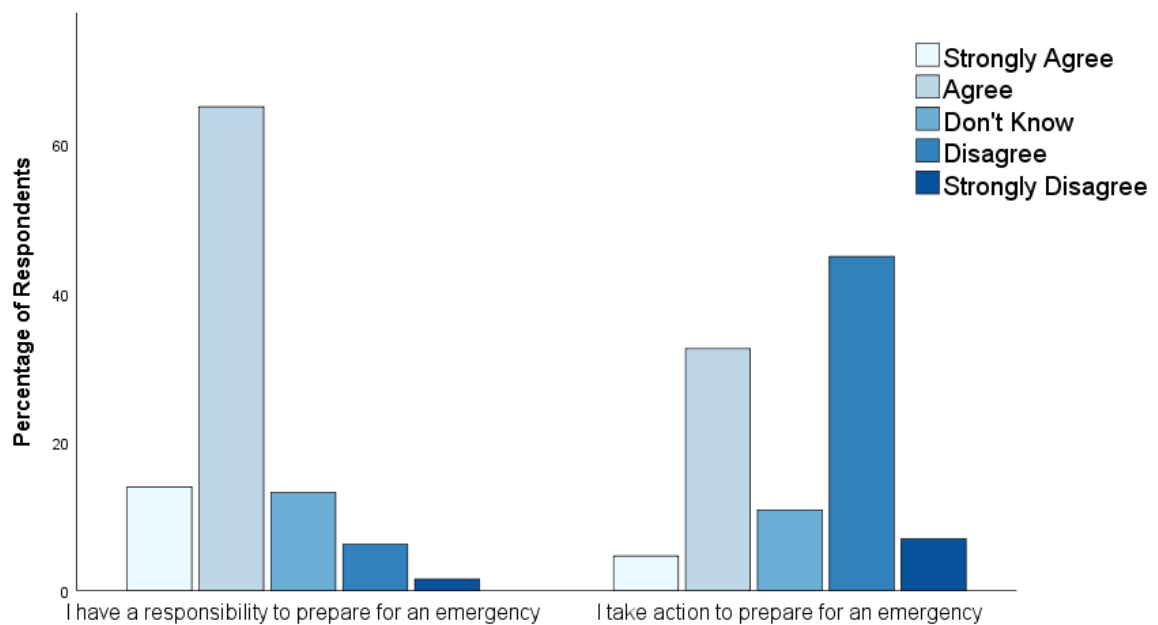
Figure 5.7: Response to statements regarding whether a respondent perceives it is their responsibility to prepare for an emergency and whether they take action to prepare.

The results demonstrate (Figure 5.7) the majority of respondents *'agree'* (65%) they have a responsibility to prepare for an emergency. However, the response to the statement, *'I take action to prepare'* is mixed, with 45% of respondents

selecting they *'disagree'* with this statement and 33% of respondents selecting they *'agree'* and do take action to prepare for an emergency. In response to the question regarding whether respondents actively prepare for hazards within their local area, the majority of these respondents stated they did not actively prepare (Figure 5.7). Again this conflicting result would suggest there are other factors that influence decisions regarding whether an individual will take steps to actively prepare for a hazard.

It was discussed within the literature review (Section 2.4) that preparedness is also influenced by perceived responsibility. If an individual does not perceive it to be their responsibility, they may not take steps to actively prepare for an emergency. This may provide an indication of why 45% of respondents do not take action to prepare for an emergency. Questions were included within Section 3 of the questionnaire, to explore perceived responsibility.
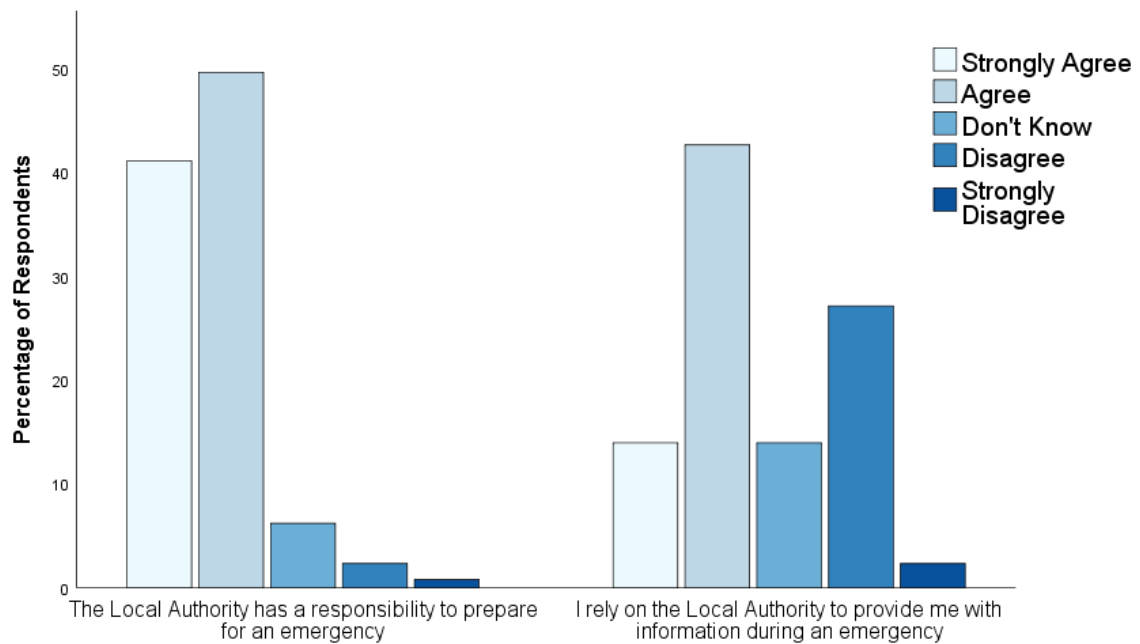
Figure 5.8: Response to the statements regarding whether respondents perceive the Local Authority has a responsibility to prepare for an emergency and whether respondents rely on the Local Authority to provide information during an emergency.

Respondents were asked to respond to the statement:

'The Local Authority has a responsibility to prepare for an emergency'

This was to provide a greater understanding of whether respondents also perceive the Local Authority to be responsible for preparing for an emergency. The majority of respondents *'agree'* (50%) and *'strongly agree'* (41%) that the Local Authority has a responsibility to prepare (Figure 5.8). This is also supported by the response to the statement:

'I rely on the Local Authority to provide me with information during an emergency'.

42% of respondents *'agree'* with this statement. However, there is also a large proportion of respondents (27%) that *'disagree'* with this statement. It is possible these respondents do not rely on the provision of information from one source but take a more active approach to access information from other sources. To explore this further, respondents were asked to respond to the statements:

'I have been provided with information about how I can prepare for an emergency'

'I know where to obtain information about how I can prepare for an emergency'

These statements were included to explore the 'top down' approach to the communication of hazard information as discussed within the literature review (Section 2.6). The UK Government has a dedicated website providing information to the public regarding how they can prepare for an emergency. The website contains a great deal of information regarding individual preparedness However, all of this information relies on the individual having knowledge regarding the availability of this information and gaining access to the website.
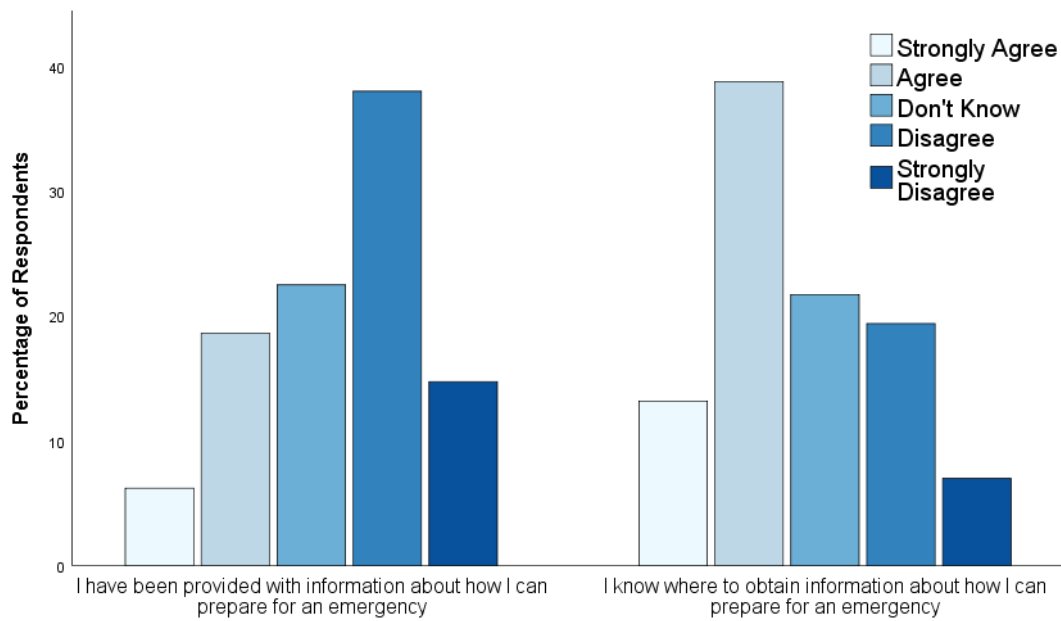
Figure 5.9: Response to the statements regarding the provision of information during an emergency and whether a respondent perceives they know where to obtain information.

While the majority of respondents *'disagree'* (38%) with the statement regarding the provision of information, 39% *'agree'* to knowing where to obtain information regarding emergency preparedness (Figure 5.9).

It was discussed within the literature review (Chapter 2, Section 2.7), how information regarding national and local hazards can be obtained through the government website, the NRR and CRR's produced by the LRF's. To understand if this information contributed to a greater understanding of local hazards, respondents were asked where they obtain information regarding hazards in their local area (Figure 5.10). The results demonstrate, the majority of respondents

obtain information regarding hazards within their local area from the television, family and friends, radio and the Met Office.
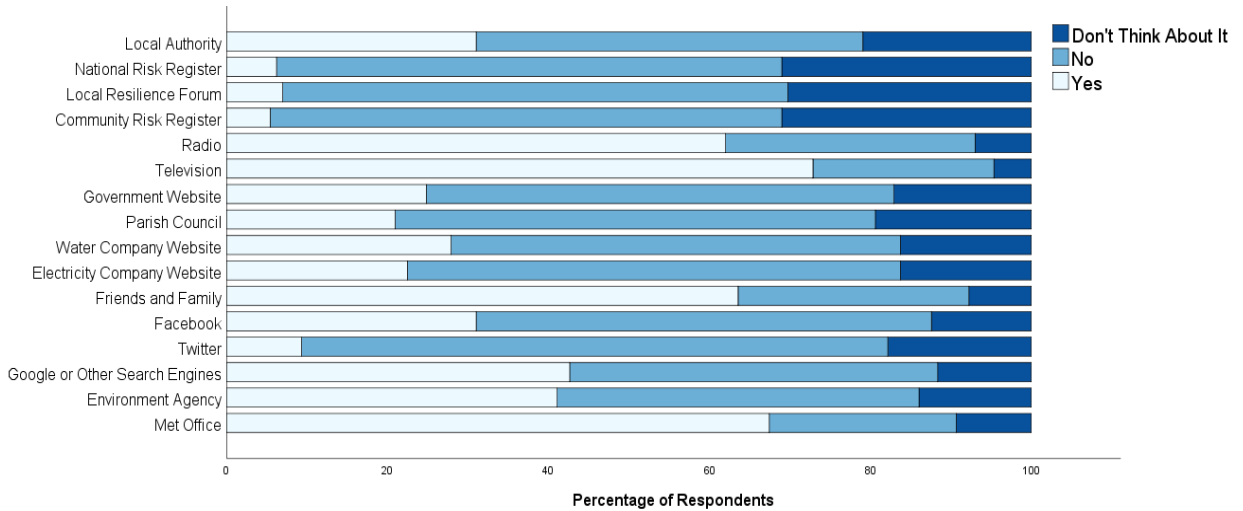
Figure 5.10: Respondent perception of where they would obtain information regarding hazards within their local area.

There was a low response regarding Local Resilience Forums, the NRR or the CRR and these sources of information also received the greatest response in the category *'don't think about it'*. This may suggest that respondents are not aware this information is available and it is not being used by respondents to find out about hazards within their local area.

Social media is increasingly used by utility companies to provide customers with information regarding the provision of essential services. WSP's use Facebook, Twitter and their company webpage to provide customers with information regarding water supply issues. However, the majority of respondents within this

questionnaire do not use Twitter or Facebook to find out about hazards within their local area.

5.5   Understanding attitudes and perceptions of water supply failure

The previous section explored attitudes and perceptions to general hazards identified within the NRR. This section aims to explore and develop a greater understanding of individual attitudes and perceptions to water supply failure.
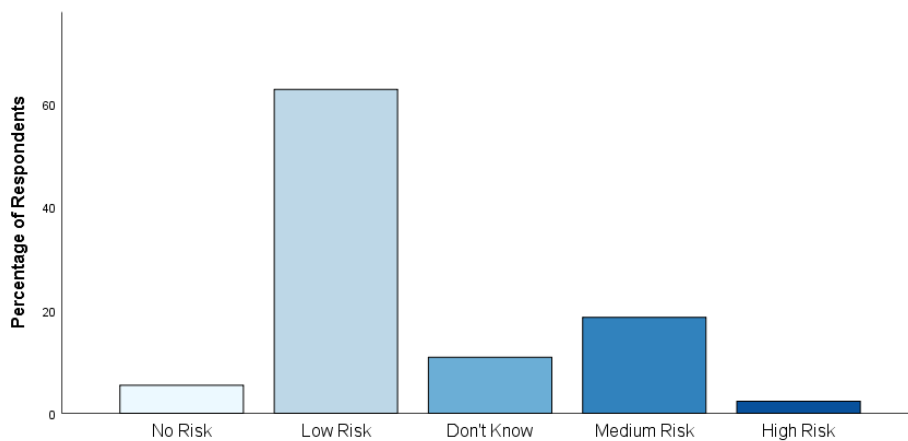
Figure 5.11: Risk perception of water supply failure

The results of the individual homeowner questionnaire indicate the majority of respondents (63%) perceive water supply failure to be *'low risk'* within their local area. 19% of respondents perceive water supply failure to a *'medium risk'*, 11% *'didn't know'*, 5% of respondents perceived it to be *'no risk'* and 2% of respondents perceived water supply failure to be a *'high risk'* (Figure 5.11).

Further analysis was conducted to explore if there were any influencing factors that may contribute to the perception of water supply failure as *'low risk'.* These included questions relating to experience of water supply failure and the length of time respondents had lived within their current property. The majority of respondents indicated they did not have experience of water supply failure (Figure 5.12). A comparison of the perceived level of risk and whether respondents have experience of water supply failure was conducted within SPSS (Table 5.1) to gain a greater understanding of how risk was perceived compared to experience.
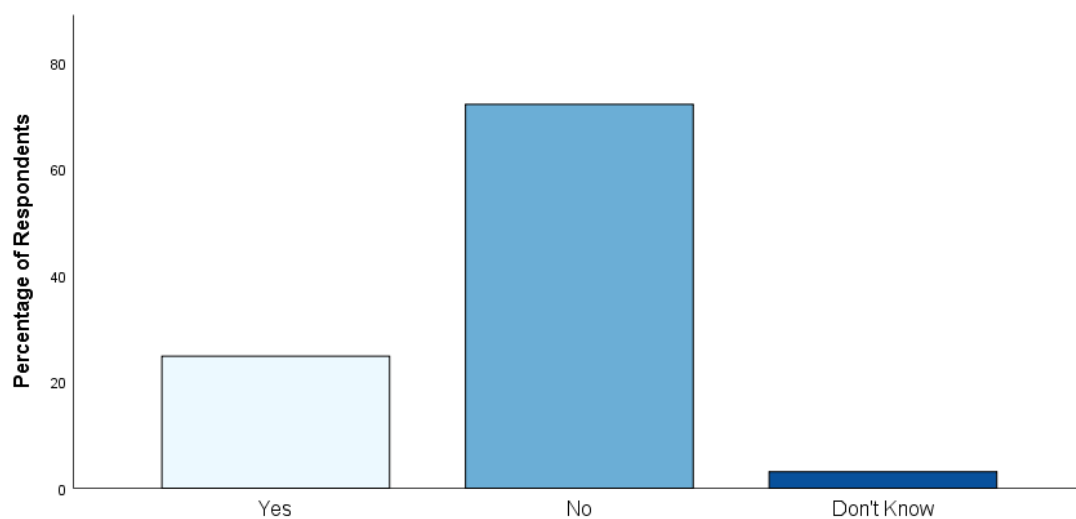
Figure 5.12: Response to the question regarding experience of water supply failure.

		Experience of Water Supply Failure (%)		
		Yes	No	Don't Know
At Risk of Water Supply Failure	High Risk	1	2	0
	Medium Risk	9	9	1
	Don't Know	1	9	1
	Low Risk	13	48	2
	No Risk	2	4	0

Table 5.1: Comparison of how respondents perceive the risk of water supply failure against experience.

The results indicate that 48% of respondents that did not have experience of water supply failure also perceive the risk of water supply failure to be *'low risk'*. Of these, 51% of the respondents that perceive water supply failure to be *'low risk'* have lived in their property for over 10 years. If respondents have lived within their current property and have not had any prior experience of water supply failure, then it is possible they would perceive water supply failure as *'low risk'*.

However, as previously mentioned in Section 5.4 and within the literature review (Chapter 2, Section 2.4), it is important to acknowledge this may not be the only factor influencing the perception of water supply failure. The possession of knowledge, trust, perceived control and perceived responsibility were some of the factors considered to influence an individual's perception of risk (Dobbie *et al*, 2016; Slovic *et al,* 2004; Slovic and Webber, 2002). Questions were included within Section 2 and Section 3 of the questionnaire to explore these factors in relation to water supply failure (Appendix 2, Section 2 and 3).

Section 3 of the questionnaire included statements to explore individual perceptions with regard to perceived responsibility and to provide an insight regarding individual attitudes and perceptions to the WSP. Respondents were asked to select a response from a five point Likert scale composed of *'strongly agree', 'agree', 'don't know', 'disagree'* and *'strongly disagree'* in response to each statement. The statements included:

"The water company will provide water if there is a failure of the water supply."

"I rely on the local water company to provide water in all circumstances."
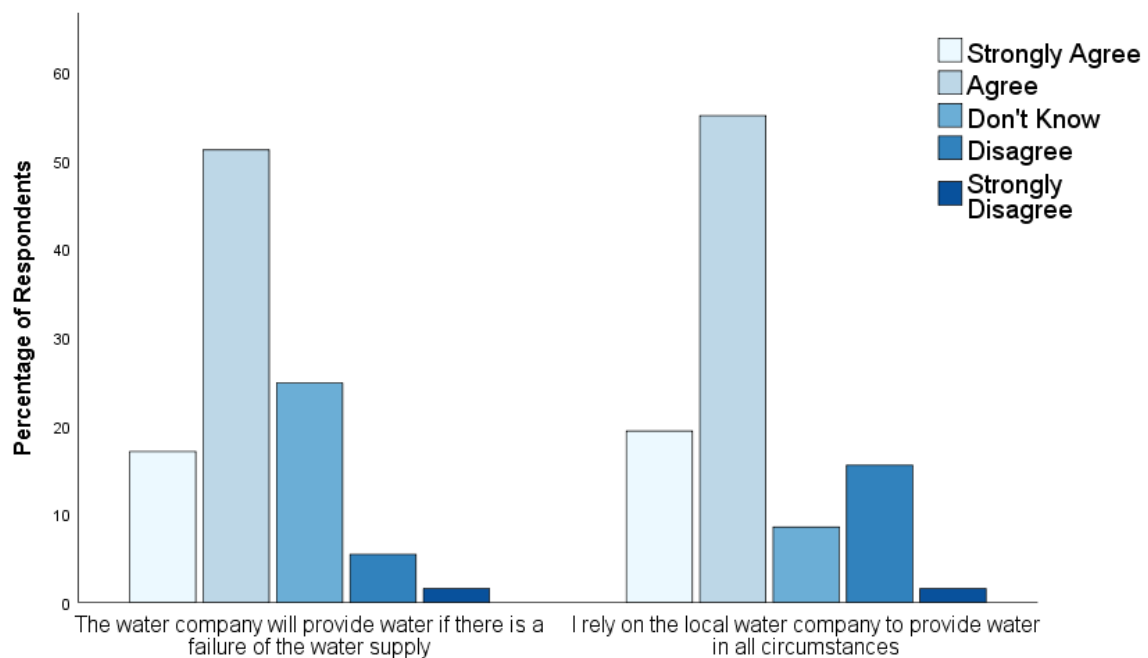
Figure 5.13: Response to statements relating to the provision of water and perceived reliance on water provision.

It was perceived by 51% of the respondents that the WSP will provide water if there is a failure of the water supply. 25% of respondents, *'don't know'*, 17% of respondents *'strongly agree'*, 5% '*disagree'* and 2% *'strongly disagree'* (Figure 5.13). These results demonstrate, the majority of respondents have a great deal of confidence that the water service provider will provide water if there is a failure of the water supply. This may influence how the risk of water supply failure is perceived and whether respondents perceive it necessary to prepare. It is possible that respondents do not perceive the risk to be high because they have confidence and trust in the WSP to provide a supply of water during periods of failure. This perception is also supported by 55% of respondents indicating they *'agree' and* 19% of respondents indicating they *'strongly agree' w*ith the statement *'I rely on the local water company to provide water in all circumstances'* (Figure 5.13). This would suggest a high level of confidence and trust in the WSP.

This was explored in greater depth through a series of questions asking respondents to indicate how confident they were receiving a reliable, continuous and safe supply of water from their local water company (Figure 5.14).
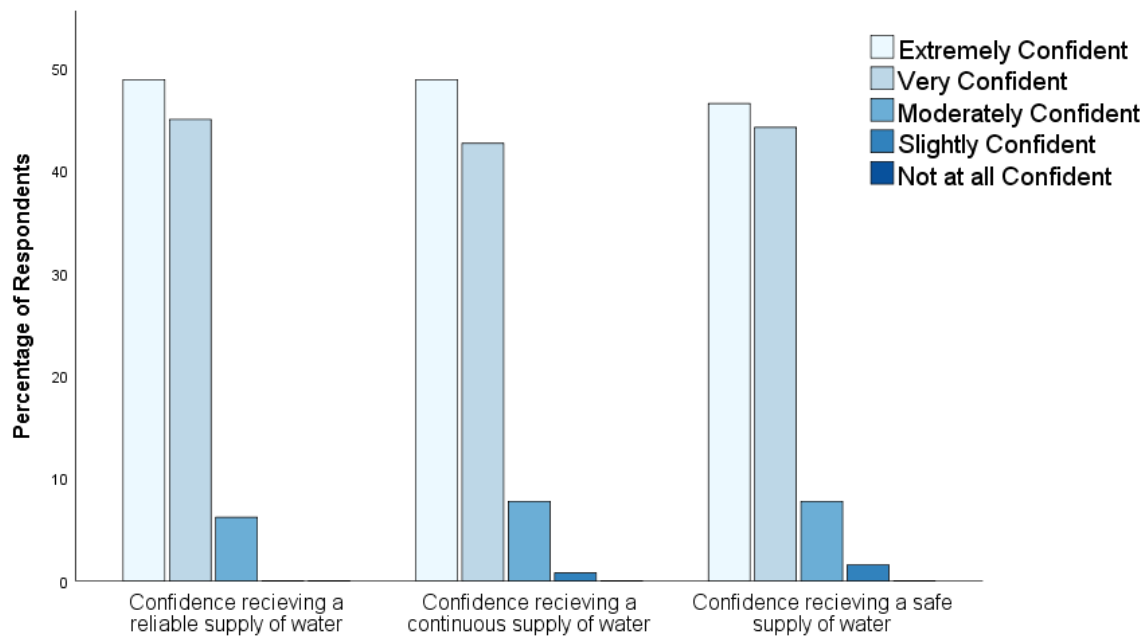
Figure 5.14: Perceived confidence of respondents receiving a reliable,

continuous and safe supply of water.

The majority of respondents are '*extremely confident'* (49%) receiving a reliable

supply of water from the local water service provider and this was supported by

45% of respondents indicating they were '*very confident'*. A high response was

provided with regard to the perceived level of confidence receiving a continuous

(49% *'extremely confident')* and safe supply of water (47% *'extremely confident')*.

These results demonstrate that respondents have a high level of confidence in

the provision of a reliable, continuous and safe supply of water. In the event of

water supply failure, a high proportion of respondents perceive the WSP will be

able to provide an alternative supply of water and respondents rely on the WSP

to provide water in all circumstances. These perceptions are also reinforced by

a lack of experience of water supply failure for the majority of respondents and may influence a respondent's perception of water supply failure as *'low risk'.*

While the majority of respondents within table 5.2 have no experience of water supply failure, 13% expressed how they did have experience of water supply failure but they also perceive the risk of water supply failure to be low. In order to understand why this had not resulted in a greater perception of risk, it is necessary to explore the response provided within another question (Appendix 2, question 7). Respondents were requested to provide further information regarding their personal experience of any of the hazards presented in question 6 (Appendix 2) and included water supply failure. This question asked respondents to include a brief description of what happened, who was involved and how the emergency situation was resolved? Of the 13% of respondents that had experienced water supply failure, there were 11 responses regarding water supply failure with some respondents providing a detailed account of the incident and other respondents providing more general information.

The first respondent (YWHX002) currently resides in Halifax in the North East of England and provided a brief account of water supply failure as a result of drought. The information provided corresponds very closely with the drought experienced during 1995, where the reservoirs levels were so low, water was transported by a convoy of tankers to provide the affected population with a centralised water supply. Although the respondent had direct experience of an event where there was the potential to lose the water supply, the risk of water supply failure was still considered to be low. The respondent (male, 65 years of

age) had lived in his property for over 45 years and did not mention experiencing water supply failure at any other time. It is therefore possible this was his only experience of water supply failure in over 45 years.

> *"Drought in the 70's due to a heatwave on top of our Council selling water abroad. This was resolved by having water transported from other parts of the country at a very high cost financially." – **Respondent YWHX002***

There were a few respondents that provided very limited information, for instance:

> *"Suppliers of electricity and water which were cut off contacted households and then dealt with the problem" – **Respondent SWEX009***

> *"Burst water main in the road led to water failure, 10 yrs or so ago. Repaired by [Name]." – **Respondent WWBW003***

> *"Mains water pipe burst" – **Respondent UUYE008***

> *"Water supply failure – water given out in village by [Name]" – **Respondent UUYE004***

These examples did not provide any indication of the amount of time the respondents were without a water supply. However, some of the responses did provide an indication that the matter was resolved by the WSP either through repair or by providing respondents with an alternative supply.

The remaining respondents provided further information regarding the amount of time they were without a water supply. In these examples the water supply failure

did not exceed a 24hr period with 2 respondents stating the situation was resolved and they were able to continue as normal.

> *"There have been odd occasions when we have been without water for hours but that's been due to a burst pipe so it's resolved soon enough."* **– Respondent UUYE006**

> *"Water supply was not accessible for a 10 hour period [Name] resolved the situation and carried on as normal."* **– Respondent UUYE003**

> *"No gas for 48hrs due to excavator at local development damaging main 2017. No water for 24hrs."* **– Respondent WWBW005**

There was no indication in any of these examples that the experience of water supply failure was a negative one. Respondents indicated that the matter had been resolved quickly or that an alternative supply of water had been provided. It is possible that this may have influenced each respondent's perception of water supply failure as '*low risk'* because it was resolved quickly and was not perceived to be a negative experience.

The following respondents experienced a loss of the centralised water supply for a greater period of time as a result of the flooding of Mythe water treatment works during the 2007 floods.

> *"We lost our water supply for a couple of days due to a problem at a pumping station. Arrangements for an alternative were poor initially as was communication."* **– Respondent AWPD004**

While the respondent stated a loss of water supply for a *'couple of days'* the respondent did not provide any further information regarding their ability to cope. However, the respondent did perceive the provision of information from the WSP regarding an alternative supply of water during the initial stages of the incident as *'poor'*. It is possible this respondent may perceive water supply failure as *'low risk'* because they have not encountered a problem of this scale since 2007 and the water supply was restored within a couple of days.

The final two respondents experienced a loss of their centralised water supply for over two weeks. However, they both found an alternative solution with one respondent going to live with their partner for a couple of days and the second respondent able to obtain an alternative supply of water. Having the ability and resources to cope and overcome an adverse situation may have contributed to the perception that water supply failure was *'low risk'*.

"Water supply cut off for two weeks – used bowsers spent part of the time with partner who lived in a village where water supply ok. Bottled water supplied for use." **– Respondent STBC004**

"With water problems, I am referring to the summer floods in Gloucestershire due to heavy continuous rainfall for several days. Mythe water works near Twekesbury was entirely flooded with river water leading to contamination of the domestic and sewerage water supplies. Bottles of water and water tankers were soon disposed so that relief was soon provided. I was glad I had an old fashioned heating and water system with water tanks in the loft, so that I had a reservoir of my own, plus 3 water butts in the garden from which I topped up the loft tanks on a daily basis. The water works has since been completely protected by high, efficient floodwalls." **– Respondent STBC006**

Within table 5.2, there were also a small percentage of respondents (9%) that have no experience of water supply failure but perceive water supply failure to be 'medium risk'. The majority of these respondents are over the age of 55 and have lived in their property for under 30 years. There may be personal circumstances as to why these respondents perceive the risk to be medium. For instance, within the pilot questionnaire a number of respondents expressed the importance of having a provision of water to assist with medication.

Also, parents of young children and babies that require regular sterilisation of bottles emphasized the need for water to be able to perform these duties. However, it is not understood from the results of this questionnaire why these respondents perceive the risk to be medium because they did not provide any further information.
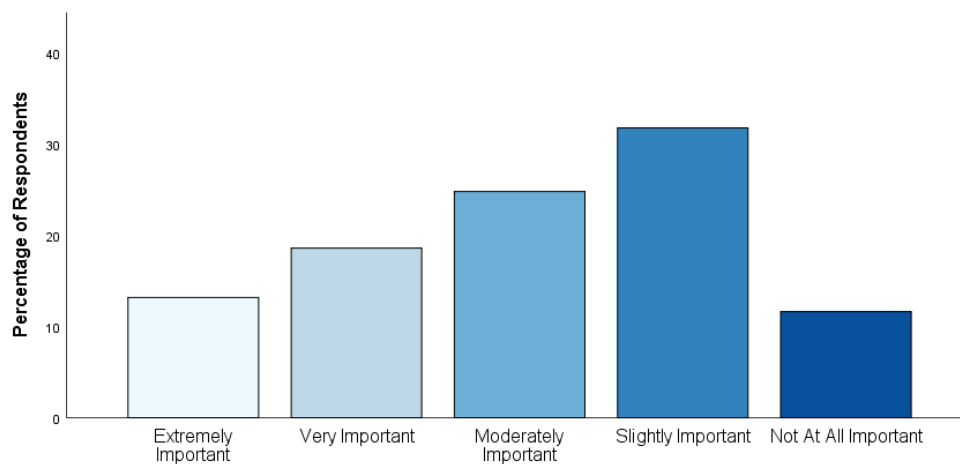
Figure 5.15: Response to the question regarding whether respondents perceive it to be important to prepare for water supply failure.

The questionnaire also included questions to explore whether respondents perceived it to be important to prepare for water supply failure. The results demonstrate that 32% of respondents perceive it to be *'slightly important'* to prepare for water supply failure (Figure 5.15). 25%, of respondents perceived it to be *'moderately important'* to prepare, 19%, perceived it to be *'very important'*, 13%, perceived it to be *'extremely important'* and 12%, perceived it to be *'not at all important'* to prepare for water supply failure.

Further analysis within SPSS reveal the majority of respondents that perceive it to be *'slightly important', 'moderately important'* and *'very important'* to prepare, also perceive the risk of water supply failure to be low (Table 5.2). These respondents do not have experience of water supply failure (Table 5.3) and are confident the WSP will provide a reliable, continuous and safe supply of water (Table 5.4).

		Importance of Preparing for Water Supply Failure (%)				
		Extremely Important	Very Important	Moderately Important	Slightly Important	Not At All Important
At Risk of Water Supply Failure	High Risk	2	1	0	0	0
	Medium Risk	5	5	3	4	1
	Don't Know	2	2	4	2	0
	Low Risk	3	10	16	25	9
	No Risk	1	0	2	1	2

Table 5.2: Comparison between respondent's perception of risk and preparing

for water supply failure

		Experience of Water Supply Failure (%)		
		Yes	No	Don't Know
Importance of Preparing for Water Supply Failure	Extremely Important	5	8	0
	Very Important	5	13	0
	Moderately Important	4	20	1
	Slightly Important	7	22	2
	Not At All Important	3	9	0

Table 5.3: Comparison of the importance of preparing for water supply failure

and experience.

		Confidence Recieving a Reliable Supply of Water (%)				
		Extremely Confident	Very Confident	Moderately Confident	Slightly Confident	Not at all Confident
Importance of Preparing for Water Supply Failure	Extremely Important	6	5	2	0	0
	Very Important	6	10	2	0	0
	Moderately Important	10	15	0	0	0
	Slightly Important	17	12	2	0	0
	Not At All Important	9	2	0	0	0

		Confidence Recieving a Continuous Supply of Water (%)				
		Extremely Confident	Very Confident	Moderately Confident	Slightly Confident	Not at all Confident
Importance of Preparing for Water Supply Failure	Extremely Important	6	5	2	0	0
	Very Important	8	8	2	1	0
	Moderately Important	10	13	2	0	0
	Slightly Important	17	12	2	0	0
	Not At All Important	8	4	0	0	0

		Confidence Recieving a Safe Supply of Water (%)				
		Extremely Confident	Very Confident	Moderately Confident	Slightly Confident	Not at all Confident
Importance of Preparing for Water Supply Failure	Extremely Important	6	5	2	0	0
	Very Important	7	9	2	1	0
	Moderately Important	9	14	1	1	0
	Slightly Important	16	14	2	0	0
	Not At All Important	9	3	0	0	0

Table 5.4: Comparison of the importance of preparing for water supply failure and confidence of the WSP providing a reliable, continuous and safe supply of water.

The results suggest that although respondents rely on the WSP to provide water in all circumstances and have a high level of confidence in the provision of a service, it is still perceived as important to prepare for water supply failure. A

question was included within the questionnaire to explore whether this translates into a need for respondents to actively prepare and respondents were asked if they 'actively prepared' for water supply failure (Figure 5.16)
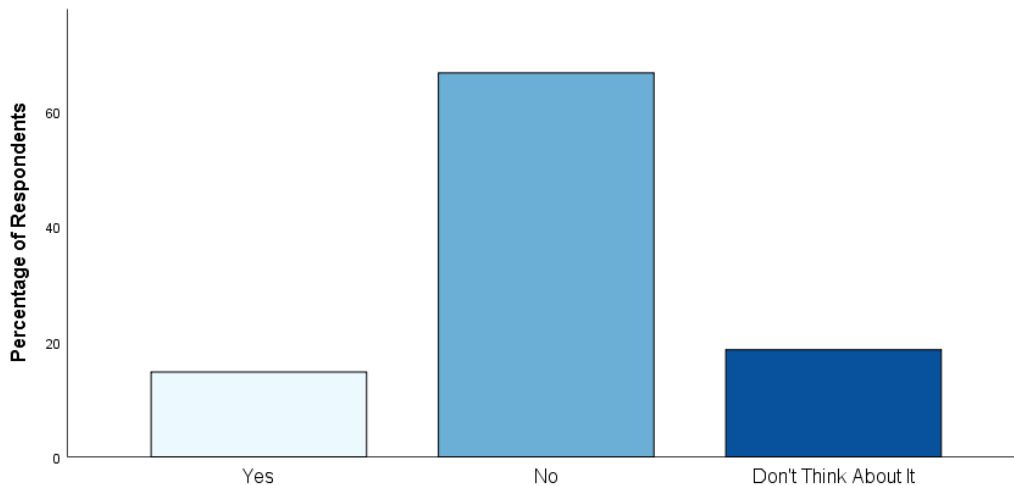
Figure 5.16: Response regarding whether respondents actively prepare for water supply failure.

67% of respondents *'do not actively prepare'* for water supply failure. 19%, of respondents *'do not think about it'* and only 15% of respondents *'actively prepare'* (Figure 5.16). Even though the majority of respondents perceive it to be important to prepare for water supply failure, they do not actively prepare (Table 5.5). Again this could relate to the confidence respondents have in the provision of a service from the WSP and a perceived responsibility that the WSP will provide water if there is a failure of the water supply. This may reinforce trust in the WSP to provide water in all circumstances.

		Actively Prepare for Water Supply Failure		
		Yes	No	Don't Think About It
At Risk of Water Supply Failure	High Risk	0	3	0
	Medium Risk	7	13	4
	Don't Know	4	6	4
	Low Risk	8	59	14
	No Risk	0	5	2

Table 5.5: Comparison of response between whether respondents actively prepare for water supply failure and the importance of preparing for water supply failure

As discussed within the literature review, the water sector financial regulator, Ofwat published 'Resilience in the Round' to encourage the development of innovative resilience based strategies to provide customers with a resilient service. The guidance also encouraged the consideration of customers as active participants in the future delivery of water services. To explore customer attitudes and perceptions to preparing for water supply failure, respondents were asked if they considered a failure of the water supply as a hazard they should prepare for now or a hazard they may have to prepare for in the future (Figure 5.17).

The results demonstrate, 47% of respondents, do not consider water supply failure as a hazard they should prepare for now and 37% of respondents, *'don't think about it'*. However, 45% of respondents, do consider it to be a hazard they may have to prepare for in the future and 33%, '*don't think about it'*. This suggests that a greater understanding of customer attitudes and perceptions to water supply failure is required to enable the active participation of customers in water service delivery.
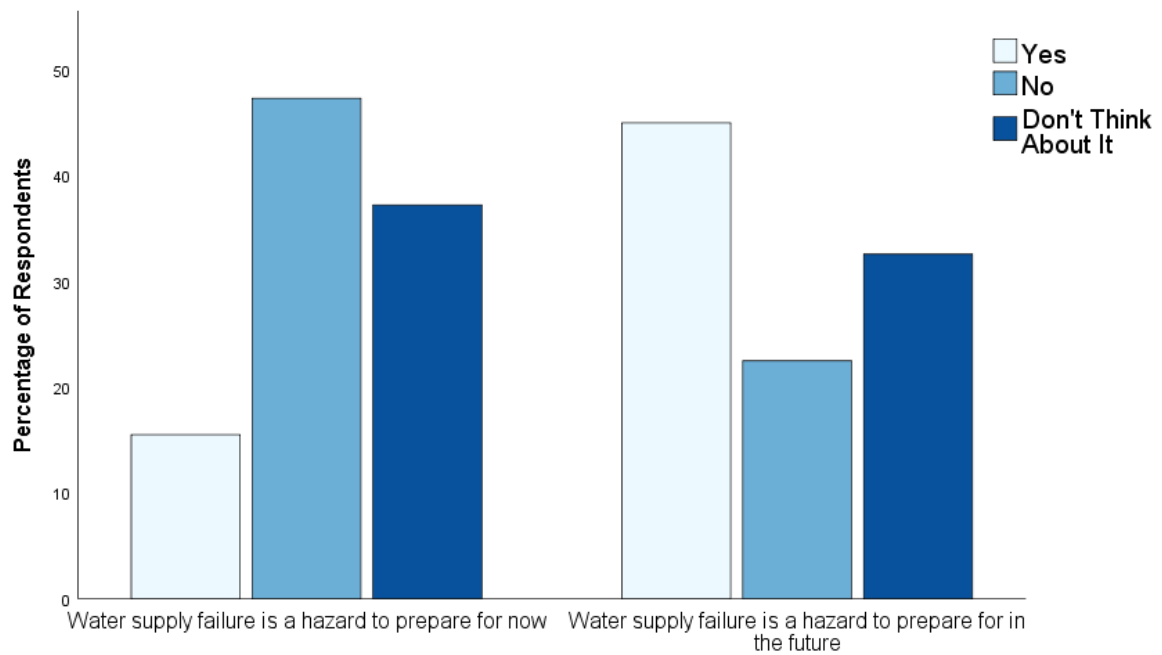
Figure 5.17: Response to the question, do you consider a failure of the water supply as a hazard you should prepare for now or in the future?

To provide a greater understanding of preparing for water supply failure, respondents were asked, in the event of serious failure of the water supply. How confident are you that the water company will provide you with a supply of water from an alternative source? The majority of respondents were *'moderately confident'* (38%) with the WSP. With 29% and 19% of respondents *'very confident'* and *'extremely confident'* the WSP will provide them with an alternative supply of water (Figure 5.18).
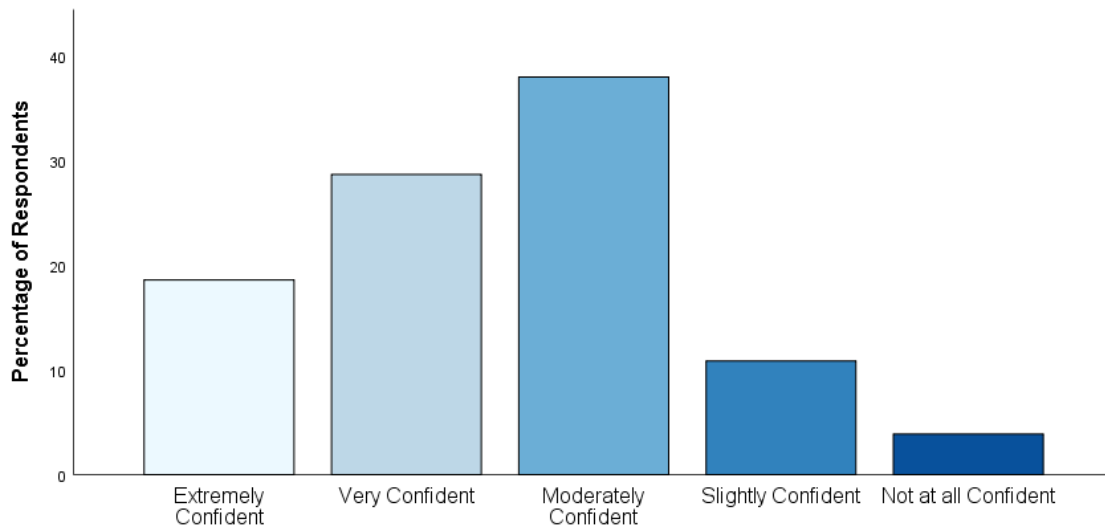
Figure 5.18: Perceived confidence in the water company providing an alternative supply of water.

However, when respondents were asked, in the event of a serious failure of the water supply, how likely are you to purchase water from your local supermarket? A large proportion of respondents (44%) perceived it to be *'extremely likely'*. With 39% perceiving it to be *'very likely'* and 13% perceiving it to be *'moderately likely'* (Figure 5.19). So while respondents have confidence in the WSP supplying them with an alternative supply of water during an emergency, they will also purchase a supply of water from the supermarket.
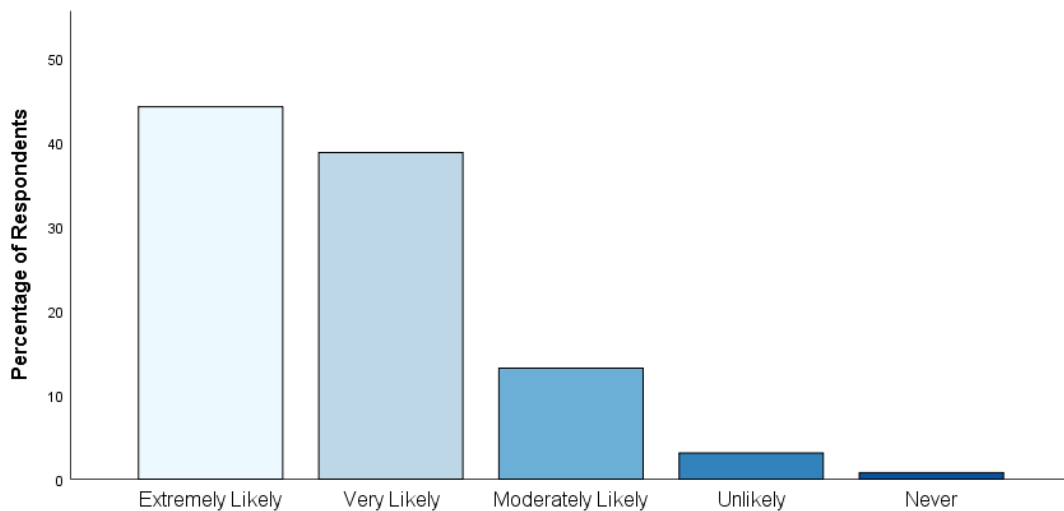
Figure 5.19: Perceived likelihood of purchasing water from the supermarket during a water supply failure incident.

While the majority of respondents do not *'actively prepare'* for water supply failure, they perceive they will actively respond in an emergency situation and purchase water from the supermarket. It is interesting that these respondents will purchase water even though they are confident the water service provider will provide an alternative supply of water during a serious failure of the water supply. It is possible this anomaly is associated with the amount of time respondents perceive they could cope without a supply of water direct from the tap.

Respondents were asked if there was a serious failure of the water supply, how long could they cope without a fresh supply of water direct from the tap? (Figure 5.20). 21% of respondents perceive they would be able to cope for 24hrs. The same proportion of respondents (16%) selected 7 to 12 hours and 48 hours. With the response for 3 to 6 hours as 14%.
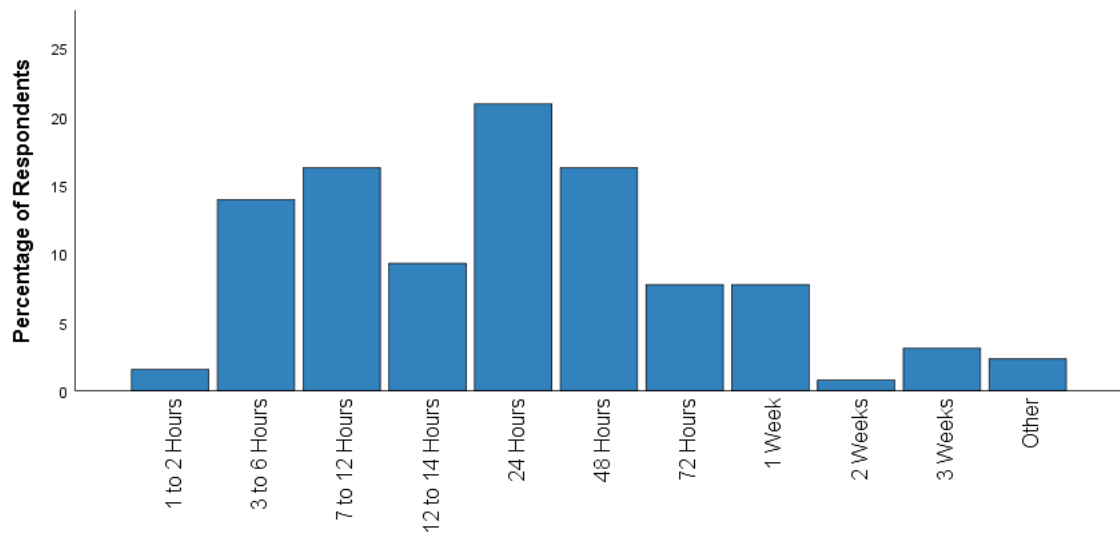
Figure 5.20: Perceived timescale that respondents could cope without a supply of water direct from the tap.

There was a range of responses for this question and this may be related to a respondent's individual need for water. Four of the respondents provided extra information within the *'other'* category for this question and each response was related to the timescale they had selected in response to the question.

'As long as water was available from bottles, containers or tankers.'-**Respondent STBC006** *(*perceived ability to cope, 1 to 2 hours)

'Depends if there is water available in the shops.' **Respondent STCW005** (perceived ability to cope, 7 to 12 hours)

'Not long, I have children.' **– Respondent STME010** (perceived ability to cope, 12 to 14 hours)

'As long as we had to.' **– Respondent UUYE001** (perceived ability to cope, 2 to 6 hours)
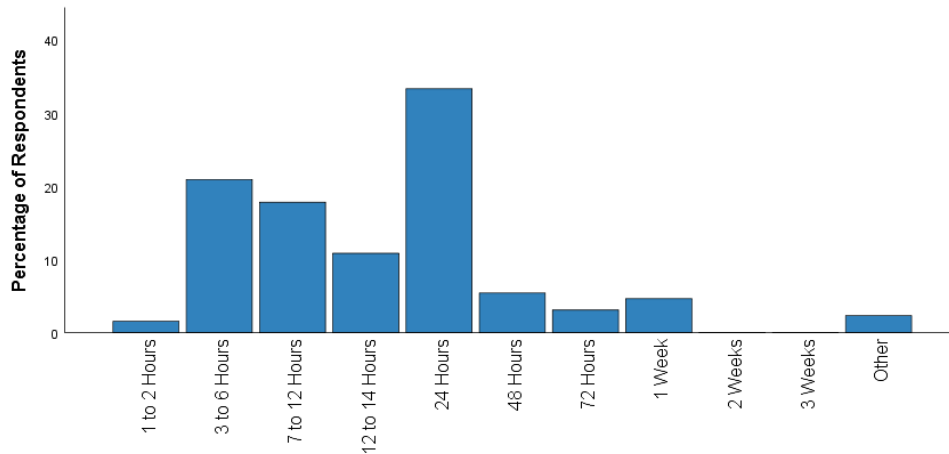
Figure 5.21: Perception of an acceptable timescale to be without a supply of
water direct from the tap.

Respondents were also asked, what is an acceptable amount of time to be left
without a fresh supply of water direct from the tap? (Figure 5.21). While the
majority of respondents perceived this to be 24 hours or less, many respondents
perceive they are able to cope beyond 24 hours.
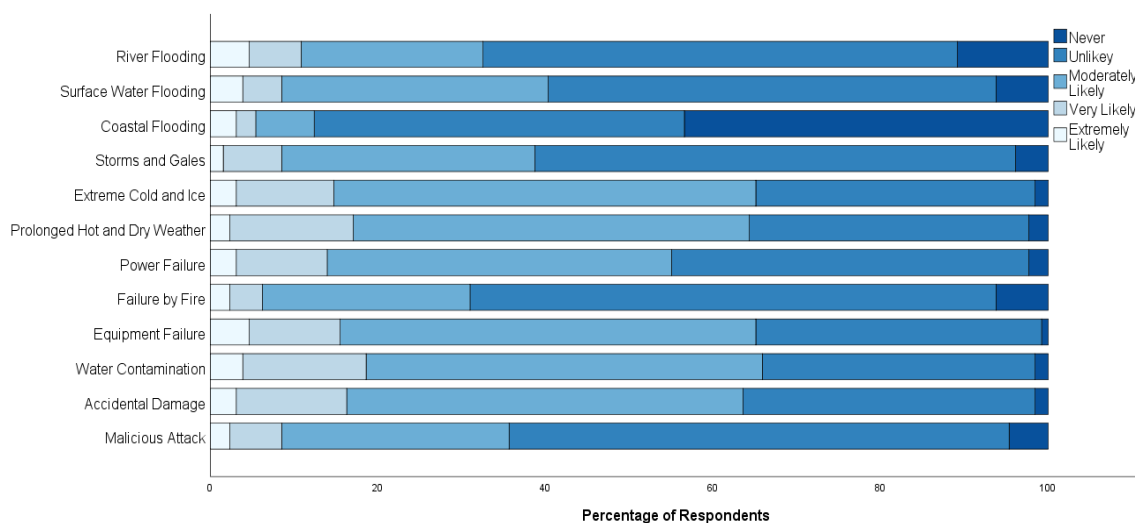
Figure 5.22: Respondents perception of hazards that could cause a failure of
the water supply.

In order to understand the perception of water supply failure, respondents were asked to determine the likelihood of a list of potential hazards that could cause failure of the water supply to their home (Figure 5.22). For the majority of hazards, it was perceived '*unlikey*' they would cause a failure of the water supply. This is with the exception of extreme cold and ice, hot and dry weather, equipment failure, water contamination and accidental damage. Many of the respondents perceived these hazards as '*moderately likely*' to cause failure of the water supply to their homes.
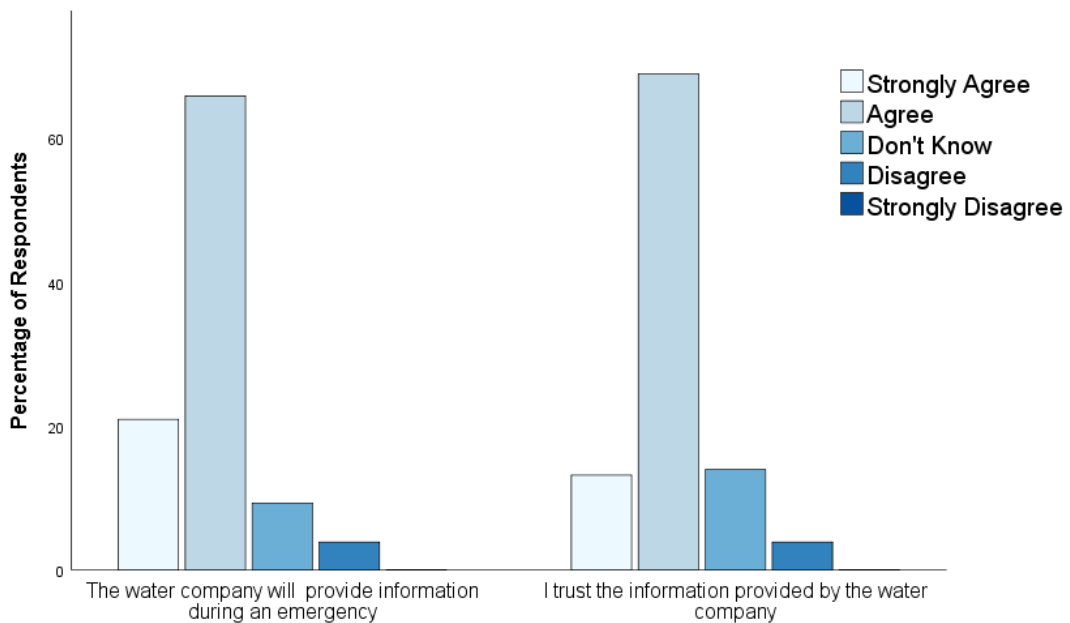
Figure 5.23: Response to statements reading the provision of information from the WSP and whether this is perceived to be trusted information.

Another factor considered to influence risk perception is the availability of knowledge. The sharing and exchange of information during an emergency will also have an influence on the ability of individuals to respond effectively achieve

resilience. This was demonstrated within Chapter 1 (Section 1.3) with regard to customer behaviour during the flooding of Mythe water treatment works. A lack of information regarding the provision of an alternative supply of water contributed to a negative reinforcing feedback loop (Figure 1.4) with regard to the ability of the WSP and the customers to achieve resilience. To explore attitudes and perceptions to the availability of information, customers were asked to respond to the following statements:

'The water company will provide information during an emergency'

'I trust the information provided by the water company'
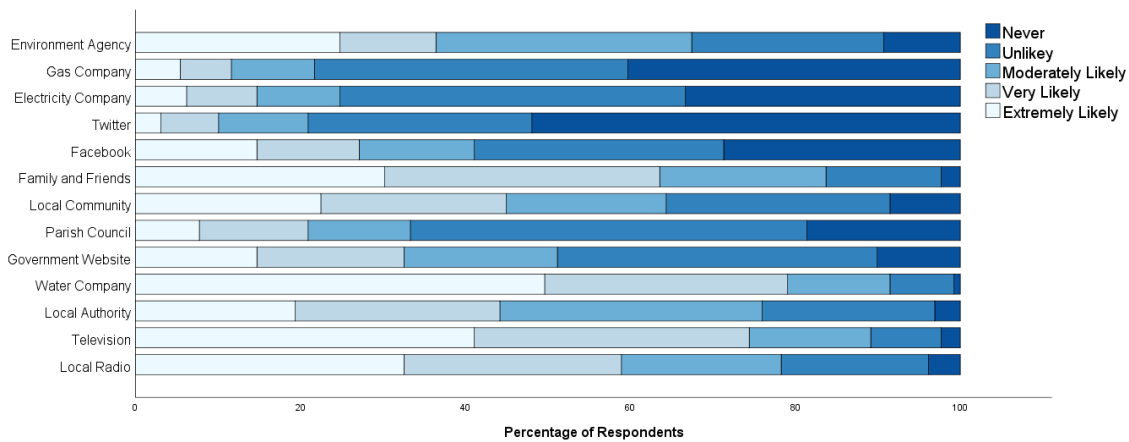
Figure 5.24: Organisations perceived as an information source during water supply failure.

The results demonstrate that the majority of respondents (66%) *'agree'* the WSP will provide information if there is a failure of the water supply and 69% *'agree'*

they trust the information provided (Figure 5.23). This is supported by the response to the question, in the event of a serious failure of the water supply, how likely are you to obtain information from the following sources (Figure 5.24). The majority of respondents perceived it to be *'extremely likely'* (50%) they would obtain information from the WSP.   Respondents also perceived it would be *'extremely likely'* they would obtain information from the TV, radio, friends and family and the Environment Agency.

A large proportion of respondents also selected they would *'never'* obtain information from Twitter, the gas company, the Electricity Company and Facebook. The results for Twitter and Facebook are interesting because WSP's are increasingly using social media platforms such as these to warn and inform customers of issues related to water supply. This was supported by the results provided in Section 5.4 with regard to general hazards.

5.6   SUMMARY

The results of the individual home owner questionnaire present a partial contribution to the achievement of Objective 3 and is discussed in the context of the research questions presented within Section 5.1.

5.6.1 How do respondents perceive water supply failure compared to other hazards?

The majority of respondents within this questionnaire do not have experience of water supply failure and it is perceived to be *'low risk'*   Surface water flooding,

sewer flooding, drought, heatwaves, widespread electricity failure and pandemic influenza are also perceived to be *'low risk'* hazards and most respondents do not have experience of these hazards. Storms and gales, low temperatures and heavy snow have been experienced by a higher proportion of respondents with storms and gales perceived to be *'high risk'* hazards partly because they represent one of the most prevalent hazards in the UK.

In terms of preparedness, most of the respondents perceive water supply failure as *'slightly important'* to prepare. This is consistent with the majority of hazards with the exception of storms and gales and low temperatures. Water supply failure also received the greatest response within the category of *'extremely important'* and *'very important'* to prepare. However, the majority of respondents do not *'actively prepare'* for water supply failure and again this is consistent with the response for the majority of hazards.

5.6.2 What are the general attitudes and perceptions to water supply failure?

Most of the respondents rely on the WSP to provide water in all circumstances and there is a great deal of confidence in the provision of a reliable, continuous and safe supply of water. In the event of a failure of the water supply, the majority of respondents perceive they will be provided with an alternative supply of water from the WSP. However, many respondents perceive it to be *'extremely likely'* that they will purchase a supply of water from the supermarket. While a large proportion of respondents perceive they would be able to cope for 24hrs without

a supply of water direct from the tap, they also perceived that less than 24hrs was an acceptable amount of time to be without a fresh supply of water.

While respondents perceive it to be important to prepare for water supply failure, the majority of respondents do not *'actively prepare'*. Respondents also, do not perceive water supply failure to be a hazard to prepare for now but a hazard to prepare for in the future.

5.6.3   Where do respondents obtain information regarding hazards within their local area if there is a serious failure of the water supply?

Many of the respondents within this questionnaire obtain information regarding hazards within their local area from the television, family and friends, radio and the Met Office. They do not obtain information from the NRR, CRR's or from social media platforms such as Facebook and Twitter. If there is a failure of the water supply, respondents will obtain information from the WSP, television, radio and friends and family. The majority of respondents within this questionnaire do not use social media to obtain information regarding a failure of the water supply. However, social media is widely used by WSP's to communicate information to the public during an emergency and this will be explored within the following Chapter.

The individual homeowner questionnaire provided an opportunity to explore attitudes, perceptions and personal experience of water supply failure within the demographic identified within Section 5.2. The following Chapter 6, explores

attitudes and perceptions to water supply failure during an actual incident from analysis of comments made on the social media platform, Facebook. The application of a different research method (thematic analysis of Facebook comments) provides an opportunity to explore perceptions of water supply failure within a different cohort of people that use social media to obtain information about their water supply direct from the WSP Facebook page.

6 CHAPTER 6 – ATTITUDES AND PERCEPTIONS TO WATER SUPPLY FAILURE DURING AN EMERGENCY

6.1 Introduction

The previous Chapter (Chapter 5), explored general attitudes and perceptions to water supply failure using the results of individual householder questionnaires. The majority of these respondents did not use social media to find out about hazards within their local area. However, social media is increasingly being used by responder organisations and the WSP's to provide information to the public during an emergency situation (Bunney *et al,* 2018). This only provided a partial contribution to the achievement of Objective 3. This Chapter examines a different cohort of people who do use social media to share and exchange information with the WSP during an emergency. This Chapter builds upon the results of Chapter 5 and explores attitudes and perceptions to water supply failure during an extreme event, the *'Beast from the East'*. To enable this, a thematic analysis was conducted of the comments posted by the customers of three WSP's on the company's Facebook pages throughout a period of water supply failure; the full methodology is described within Chapter 3. This provided an opportunity to understand individual perceptions, attitudes and behaviour to water supply failure during an emergency. It also enabled the development of a profile into how customers and WSP's engage during an emergency situation. Consequently, Chapter 6 answers the research questions presented in Chapter 1, (Section 1.4, Objective 3).

To answer these questions this Chapter will proceed as follows: Section 6.2 will explore how individuals perceive information was communicated by the WSP

throughout the incident. Section 6.3 examines the provision and distribution of alternative supplies of water and Section 6.4 investigates attitudes and perceptions to living without a water supply. The provision of a service was explored within Section 6.5 and Section 6.6 sought to understand attitudes to compensation and bills.

6.2   The communication of information

There were over 485 comments relating to the communication of information from WSP 1 during the event, 268 comments for WSP 2 and 142 comments for WSP 3. In general the comments were of a similar nature. Customers relied on the WSP to provide accurate information at regular intervals, regarding the location of water supply failure, the cause of the problem and an estimated timescale of when the water supply would be restored. Further supporting quotes for each section within this Chapter are provided within Appendix 12.

> *"It's the lack of information provided by [Name]. If you could give any indication of how long this would go on for this would help. Any indication would help people to make provisions. Just to ignore your customers is an example of a poor service. I'm sure if you sent out an FAQ to customers that would slightly appease people rather than being disregarded." –* ***Reference 11, WSP 1 2018 03 04 28***

There were many comments regarding a lack of information from the WSP. The WSP's were criticised for providing standard general replies, which created difficulties for customers attempting to obtain information regarding water supply failure within their local area. However, analysis of the WSP posts demonstrated that while some posts did provide general information regarding the ongoing

situation, there were also notification posts containing location specific information, posts providing customers with advice and posts requesting information or action from customers to use water wisely:

General information post
"We're really sorry to those customers who are without water this morning. The severe weather has had an unprecedented impact on our business this week, including a big increase in the amount of leaks and bursts on our network of pipes and those in our customers' homes. Our teams have been working through the night to complete as many repairs as possible, as well as putting more volumes of water into our pipes. We're doing everything we can in extremely challenging circumstances to get everyone back to normal as fast as we can. We will post updates here and on our website as we get them. Our call centres will be very busy, with long call wait times. Please only call us if it is very urgent" **– Reference WSP 1, 2018 03 04 05**

Notification post
"Huge apologies to customers in [Location] who may be having supply issues. We're working hard to move water around the network and get things back to normal as soon as possible. Please bear with us." **– Reference WSP 2, 2018 03 06 01**

Advice post
"Be prepared for the thaw - as temperatures rise, we are likely to see a rise in the number of burst pipes both on our customers' own pipework and across the mains network. Check out what to do if you discover a problem: [Website]. Be prepared for the thaw What to do if you discover a problem" **– Reference WSP 3, 2018 03 03 01**

Request for information
"We want to say sorry to all of the people across our region who have no water or low pressure tonight. The thaw has caused unprecedented amounts of leaks & is causing problems across our network. We've got plenty of water and we're pushing it out into the network, but a lot of it is leaking out and not getting to customers. We were prepared for the thaw and so have lots of teams out finding and fixing leaks, but our big ask is for customers to help us out by reporting leaks to us as soon as possible at [Website address]. The sooner we know where the leaks are, the sooner we can fix them. In the meantime we're working hard round the clock to get everyone back on supply but this is going to take some time."

– WSP 2, 2018 03 05 02

Request for action
"We're asking customers to use water wisely as we continue to meet the challenges of the thaw. Please bear with us as we locate and repair an unprecedented number of burst water mains following the severest weather in the region for many years. We're sorry if it's taking longer than normal to contact us through the phone, for up to date information in your area please visit our website [website] Customers can help themselves and us by identifying whether the problem is inside their house or not. If the leak or burst is on your own pipes, the best thing to do is to call a plumber. However if you and your neighbours are out of water or losing pressure, that could be a sign of a burst or leaking mains pipe and we need to hear about it to start helping you." – WSP 3, 2018 03 05 05

The provision of specific information was perceived by customers as necessary to enable them to make alternative arrangements with regard to staying with relatives or purchasing an alternative supply of water from the supermarket. Customers provided the WSP with their location and the timescale of water supply failure in order to gain specific information for their local area however, they became increasingly frustrated with the WSP when this information was not provided. While the majority of the Facebook posts provided by the WSP were notifications informing customers they were aware of a problem with the water supply at a specific location, the scale of the incident meant there were also other locations that were affected by water supply failure. However, these were not mentioned in any of the posts provided by the WSP and this created frustration for customers because they were not being provided with information regarding their local area. In response to this lack of information, customers posted comments requesting further information for their location within the original post even though this was relating to a different location.

"I agree [Name] This is outrageous, again with no water in [Location], and no way to get up to date information on expected time of resolution. Is anyone at [Name] actually reading these messages? Please can you let us know what is happening and when we can expect the water to be back on?" **– Reference 8, WSP 1 2018 03 03 02**

An example of the WSP notification posts are provided below. Many of the posts are location specific and include a brief description regarding the nature of the problem for instance repairing a burst pipe or there is fault at a booster station.

"We're aware of a potential problem in the [Location] area affecting customers in the postcode [Location] and surrounding areas. We have a team en route to investigate as we speak. Sorry for the inconvenience caused." **– Reference WSP 1 2018 03 03 02**

"Our teams are still out working hard to fix as many leaks as possible following the rapid thaw we've experienced. If your water is affected, we're really sorry and we're doing everything we can to fix the leaks and get things back to normal as quickly as possible." **– Reference WSP 2, 2018 03 05 07**

"We're aware that customers in the [Location] area are experiencing interruptions to their water supply. Thank you for your patience, we'd like to reassure you that we're doing everything we can in this situation. For updates [Website address]" **– Reference WSP 3, 2018 03 02 13**

However, the majority of posts did not provide any indication of expected timescales. When this information was provided, it was for specific locations and as indicated within the previous comments, this led to frustration because customers did not understand why they were not provided with information regarding all of the locations affected.

WSP post

"Customers in [Location] (and surrounding areas) who have been without water should see supply starting to come back. Pressure is rising, but we need to do it carefully so we don't cause any bursts. We expect all customers in these postcodes to have water back before 10pm" **– Reference WSP 1, 2018 03 05 16**

Customer response

"*What about [Location]??????"*

The provision of timescales also created difficulties for the WSP managing the

expectation of customers when the water supply was not restored within the

timescale indicated and this is illustrated within the customer's replies:

"*It's 10.40pm and NO WATER in [Location].. you expected to have water by now? Please update"* **– Reference WSP 1, 2018 03 05 16**

"Well it's 2:30am and there's still none in [Location]!! 3 days and counting......." **– WSP 1, 2018 03 05 16**

The WSP provided an update within the thread of customer comments but this

led to further negative comments from the customers. Throughout the incident

customers used Facebook to hold the WSP accountable for a failure of the water

supply and a perceived failure to communicate accurate information regarding

timescales:

WSP post

"Our engineers are repairing another burst main that is affecting the water supply in your areas, our engineers are working hard to bring back your

water supply soon as possible. So sorry for the inconvenience" **– WSP 1, 2018 03 05 16**

Customer responses

"Almost 60h since we've been without water. When are you finally adding water stations that are more convenient for people that live in [Location]? At the moment our nearest ones are all more than 2 miles away." **– WSP 1, 2018 03 05 16**

"You know what I have had enough of your bloody apologies! We still don't have water, how is this even possible in 2018!!!! What the hell are you doing?? And frankly I don't have the time to go and pick up your bottled water as we need to go to work!!! And how about older people that can't carry water!!! You need to tell them exactly when the pipe will be fixed and deliver water door to door, you absolute clowns." **– WSP 1, 2018 03 05 16**

"Shouldn't this be a new public post rather than a comment a long way down on a previous public post ?" **– WSP 1, 2018 03 05 16**

Additionally, when the WSP did not provide specific information regarding timescales there were also negative comments from customers:

WSP post
"We've done further work in the [Location] area and shut in a large pipe. Pressure is now building and we expect water to return over the next few hours." **– Reference WSP 1, 03 05 09**

Customer responses
"Did you copy and paste this post from the same post 6 hours ago? Or the one 12 hours before that?"

"Define "FEW"!!!!!! 36 hrs and counting now...."

> *"I really hope you actually mean it this time. How many times are we going to be told that the problem is now fixed and the water will be back soon??!"*

This also led to conversations on Facebook between the WSP representative and the customers:

Customer response

"You said that at 6.30am this morning!!! Please please just be honest with us-id rather know if it's going to be 24/48 hours, then at least we can plan. What does a few hours mean?"

WSP response

"I'm sorry for the inconvenience this is causing. Our techs have repaired the pipe that was causing the issue however the pressure can take some time to build up throughout the network.

Customer response

"Does this mean the repairs are actually completed now? At the same time as you posting this, I was speaking to one of your agents on the phone who said he had no idea of the timetable for the 12" main being repaired"

WSP response

"Hi [Name], the burst pipe that was causing the no water/low pressure issue has been repaired. The pressure has started to build up throughout the network however this can take some time to reach you."*

Throughout the event WSP's also provided customers with information regarding the difficulties they were experiencing due to the adverse weather conditions.

> *"[Location]: We're increasing the amount of water being fed into the system,but we are still not seeing pressure build up as much we'd like - but pressure is increasing. We believe that there is air trapped in the system and we're currently working to bleed the air out. We're also working to fix a number of leaks in the local area, which will help improve our position. We know this is frustrating, but we're working as quickly as we can to resolve this and return your water supply."* **– Reference WSP 1, 2018 03 05 01**

However, as the incident progressed and the number of locations affected by water supply failure increased it became increasingly difficult for customers to access information direct from the WSP. Each WSP experienced a large volume of calls to their call centre which left many customers frustrated because they could not get direct access to the WSP to either report a problem with the water supply or find out when the problem would be resolved:

> *"The communication from [Name] is utterly abysmal, I'm shocked how they can treat customers like this - I've tried to communicate via telephone, online chat and through social media and have been fobbed off, dismissed and guided to websites that are never updated. All I want to know is what they plan to do to help villages with no water for more than 15 hours now, people are panic buying so bottled water is running out in shops and some have babies and very young toddlers like myself but they are just not communicating whatsoever. This is ridiculous customer service." –* **Reference 45, WSP 2 2018 03 05 07**

Customers also highlighted instances where there was a perceived lack of consistent information regarding whether the water supply had been restored. This is because in some instances the WSP issued conflicting information stating the problem had been fixed when customers were still experiencing water supply failure. This created a great deal of confusion and angered many customers because the lack of information made it difficult to ascertain whether they should make their own preparations for continued water supply failure. The quotes provided below are illustrative of the confusion regarding the provision of conflicting information from the WSP.

> *"It's not a potential problem. It's an REAL PROBLEM. [Location] here. What's the cause of the problems? Blocked roadside gullies? Electrical fault at a pumping station? Burst water main? We've not received any coherent information. No lead time on repairs! Do we rush to the supermarket for water to cook and make tea with? Do we arrange to go*

out for dinner? Or do we wait for the water to come back on soon? Never mind the need to wash and flush toilets!! Comes on [Name] there are a lot of families, individuals and vulnerable people without water today - we need and DESERVE more of an update! Should we start boiling snow?"
– Reference 2, WSP 1 2018 03 03 02

All of the WSP's used a variety of different social media platforms to provide information to their customers. These included Facebook, Twitter and the company webpage. However, WSP 2, customers were left confused because there was a perceived lack of consistency in the information provided on each media platform. Customers used Facebook to ensure the WSP was informed of conflicting information on social media. They also informed the WSP that this was very confusing because they did not know which information source to believe and respond to.

"I'm not sure who [Name] is but we are [Location]. Twitter says you "may" do a drop at some point but I have read so many contradicting posts on your website and social media it is difficult to work out what is going on now." **– Reference 25, WSP 2 2018 03 06 05**

"We have not water in [Location]. Used Twitter no response, your website shows no problems. Your news section has nothing. Your telephone lines ring engaged and I am number 33 on live chat. How do i know what the problem is or when I can expect resolution or how don The vulnerable old people in my village get looked after??" **– Reference 2, WSP 2, 2018 03 06 02**

Customers also mentioned conflicting information from WSP 1, regarding where information was to be posted. WSP 1, had directed customers to the *'main social media pages'* but customers were confused as to what these were because they had not been clearly defined.

"No one on this thread is reporting that they have water. Any further updates from [Name]? Isn't this a major health and safety issue? Your company website offers no updates and neither does your Twitter feed or Facebook page. Some of your people keep responding that we should check your "main social media" pages...if not Twitter or Facebook or even your own website, what are these "main social media" pages?" – **Reference 2, WSP 1 2018 03 04 18**

There was a great deal of criticism for each WSP because customers were trying to access up to date information from the company website. In many instances customers stated they were not able to obtain information regarding their local area from the website or the website did not contain up to date information. Customers also complained because they did not perceive the website was being updated regularly enough throughout the emerging situation.

"Our street has been trying to get hold of [Name] this evening to report no water in [Location]. We've been kept on hold for nearly an hour. Their website still shows "no problem" in our area. This is disgraceful. Exactly the same lack of response we had last time the water went down last year. What are they allowed to get away with such poor customer service?" – **Reference 3, WSP 1 2018 03 04 26**

"[Name], This is how [Name] customers are informed. On Facebook [Name] has been promising that supply would be back to normal by this evening. More than 48h without water supply now and still nothing. The latest update available from [Name] on their website is from 7.38 am this morning ("We are working on it. Sorry for the inconvenience"). [Name] this is abysmal beyond believe. People can accept that leaks/bursts happen. But we cannot accept how we are not proactively informed or not informed at all. SHOCKING! Management should not blame exceptional circumstances for not being able to cope, but take responsibility for not having adequate planning in place for their customer service to deal with these kind of situations." – **Reference 16, WSP 1 2018 03 05 16**

WSP 3 also experienced criticism from customers regarding posts informing customer's they were unable to identify leaks or provide customers with bowsers because the ground was covered in snow and unsafe for travel. However,

because the WSP had not specified the locations that were affected by the snow, customers assumed this applied to their local area. This created a great deal of frustration because the snow had melted in their local area and customers perceived the WSP was using the snow and icy conditions as a reason not to provide an alternative supply of water or to repair leaks and burst pipes:

> **WSP post**
> *"The snow and icy conditions in [Location] are making it difficult for us to get to some bursts. Our people have been working around the clock, often on foot, to identify where these burst are."* **– WSP 3 2018 03 02 10**
>
> **Customer responses**
> *There is no snow! It all melted last night and if you don't know that it means you haven't been here to see."* **– Reference 2, WSP 3 2018 03 02 10**
>
> *"you are all lying [obscenity] because all the snow melted overnight and was entirely gone by this am. Pleas stop blaming the snow THERE IS NONE!!!! It makes you look like lying idiots and stretches peoples patience to snapping point!!!"* **– Reference 1, WSP 3 2018 03 02 11**

Customers also provided WSP 1 and WSP 3 with suggestions for improvement with regard to their future communications during an emergency. This included providing customers with relevant, up to date information using a variety of different methods of communication. It was perceived that many people do not have access to the internet or have a reliable mobile signal in rural locations. Therefore, the WSP should consider providing customers with information via local radio. There were many comments regarding timescales and how the WSP could improve their communications by including estimated timescales rather than a vague response of *"some time".*

> *"YOU NEED TO ISSUE TIME ESTIMATES FOR AFFECTED AREAS. "SOME TIME" DOES NOT CUT IT."* **– Reference 32, WSP 1 2018 03 04 12**
>
> *"I will await to see when it happens. WHY are we the customers forced to*

contact you. As a commercial service supplier you should have a constant flow communication being sent out through all channels. Many people do not use social media. It really isn't acceptable. Tell you executives in their livory tower' to reinvest in infrastructure and not line their and your share holders pockets!" **– Reference 21, WSP 2 PS 2018 03 05 07**

WSP 3 customers also mentioned how they had to join Facebook to gain access to regular updates because the company website did not contain the information customers required regarding an alternative supply of water.

"Quite right. The [Location] site has been without water for 24 hours and there has been no instruction on how to get a bottled water supply. We do seem to have been forgotten. Also I have had to join Faceache to get any news at all – why is the news not on the website?" **– Reference 5, WSP 3 2018 03 05 06**

Customers used the company websites to obtain up to date information regarding water supply issues within their local area. This will be explored in greater detail within the next Section 6.21, the Provision of Information.

6.2.1 The provision of information

There were 1883 references related to the provision of information for WSP 1, 793 references for WSP 2 and 705 references for WSP 3. For WSP 1 and WSP 2 (62%, 51% respectively) the majority of these references included the provision of information regarding water supply failure occurring at a particular location. This information was provided in the form of a postcode, road name or reference to a specific identifiable location related to the original post. Many of the posts contained very limited information, only detailing location and water supply failure

as a statement. Some of the comments included a timescale as to how long the water supply had been off and some of the comments requested further information regarding when the supply would be restored.

"No water in [Postcode]" – **Reference 6, 2018 03 03 13**

"[Postcode] No Water for 3 days!!!" – **Reference 4, 2018 03 04 15**

"No water here in [Postcode]" – **Reference 11, 2018 03 04 24**

For WSP 3, only 30% of the references included information regarding location of water supply failure. This was provided in the form of a postcode or place name. However, the majority of posts did not contain any reference to location but provided the WSP with notification that the water supply had failed. Analysis of the WSP 3 initial posts and the replies, indicate that customers posted replies within the specific post relating to their location. This may be why these customers did not provide a postcode or location reference, whereas, WSP 1 and WSP 2 customers provided information regarding their local area, irrespective of the information contained within the original post.

"No water atm [Postcode] thanks" – **Reference 6, WSP 3 2018 03 02 07**

"We still have no water" – **Reference 2, WSP 2018 03 02 07**

"No water now for 24 hours !! This is a joke" – **Reference 29, WSP 2018 03 02 07**

WSP 1 customers also used Facebook to inform the WSP of other locations that had been affected by water supply failure but had not been included within social media posts or on the company website. There were many instances where

customers informed the WSP when the information they had posted regarding specific locations was not correct and when the website was not working properly. Within each of the comments, customers provided the location of water supply failure and detailed the exact nature of the problem so that it could be corrected by the WSP. There were many examples where Facebook was used as the primary method to inform the WSP because customers were not able to contact the WSP direct by any other means.

> *"This message is not accurate [Name]. Still nothing in [Location]. It would help us if you could say what you mean by a "few hours". Then we would know whether to continue to report no supply issues. Does it mean 1/2 hours or that if i still dont have water by lunchtime or 4pm that is still within your self defined "few hours". This is a really poor level of information for a company the size of [Name] you really need to get a grip on your communications to your customers." – Reference 32, WSP 1 2018 03 05 02*

WSP customers were very active using Facebook as a method to provide information to the WSP regarding water supply failure, leaks or burst pipes, problems with the water pressure and to inform the WSP when the water supply was restored. Within the majority of these comments, customers provided the location and information regarding the nature of the problem. Further supporting quotes are provided in Appendix 12.

> *"There seems to be a burst pipe between [Location], right off the main road." – Reference 22, WSP 1 2018 03 04 12*

There were many examples where customers from each WSP provided information regarding their personal circumstances within the responding comments to the WSP. These were used to reinforce the difficulties some

customers were experiencing with water supply failure and the difficulties accessing an alternative supply of water. There were differences in how this information was presented to the WSP on Facebook. Some customers provided very limited information consisting of a statement, for example:

"No water pressure in [Location] either" **– Reference 6, WSP 1 2018 03 03 1**

"[Location] has water" **– Reference 1, WSP 1 2018 03 07 12**

Whereas other customers provided a more detailed account including location, timescales of water supply failure and how it was affecting their daily routines, for example:

"NO WATER IN [Location] 7-disabled mother and baby, been on hold for 1h 30 minutes - absolutely shocking! You should have a communal tap in the street operating or delivering water to vulnerable people like me who can't actually leave sleeping, sick children at home to get water." **– Reference 49, WSP 1 2018 03 04 12**

Customers became increasingly frustrated with the lack of information provided by the WSP. Many of the customers had attempted to access information via the call centre, the company website, Twitter and Facebook hoping that at least one source would provide up to date information regarding the cause of water supply failure within their local area or when the water supply was to be restored. However, for many customers, this information was not provided by the WSP within any of these media. This created a great deal of tension within the thread of comments directed towards the WSP. This was also a particular frustration for customers that had been asked by the WSP to provide their phone numbers so they could receive up to date information via text. When the WSP did not reply,

customers became increasingly frustrated with the perceived lack of information. The majority of customers wanted the WSP to provide information regarding when the water supply would be restored. All of the customers provided their location so the WSP would know which area was affected and could respond with specific information for their local area.

> *"Still no water in [Location]. No update from [Name]. Your website does not provide any details on my area. Terrible communication. Terrible service." – Reference 109, WSP 1 2018 03 04 12*

Customers also provided information to the WSP regarding the availability of alternative water supplies. Customer perceptions regarding an alternative supply of water will be discussed in greater detail in Section 6.3, the intention of this Section is to provide examples of the information customers provided to the WSP though the social media platform Facebook. WSP 1 had provided information regarding the location of bottled water stations:

> *"For customers impacted by no water in [Location] (and nearby) - we have set up a water station where you can come and pick up bottled water. It's located in the [Location] - we're very sorry for the disruption." – Reference WSP 1, 2018 03 04 11*

However, when customers arrived to collect an alternative supply of water, they observed people had taken large quantities of water. This resulted in some people leaving the bottled water location without an alternative supply of water because the alternative supply was depleted. Customers used Facebook to inform WSP 1 of the perceived lack of restrictions regarding how much water each person was allowed and to inform the WSP they were still without an alternative supply. This resulted in negative comments regarding an inadequate

provision of service to customers and an increased level of anxiety for customers unable to obtain water from the distribution centre or from their local supermarket. This also led to the perception that the WSP was not adequately prepared for a large scale failure of the water supply. This demonstrated a lack of trust and confidence in the WSP to provide an alternative supply of water during an emergency with customers stating they could no longer rely on the WSP to provide a supply of water.

> *"I went to your bottled water location at homebase twice yesterday - you'd run out both times. There were also people sitting on piles of water they'd 'claimed' - you obviously weren't limting each person to any amount inciting a free for all mentality where most people got nothing. Shameful organisation. I was lucky to buy 2 litres in the shops before they ran out that saw my pregnant partner and my 2 year old daughter through the night. They've had to move out now to stay with a friend because we can't rely on your being able to supply water. What about the old people in the community who aren't on twitter and don't have mobility? Are you checking on them? I'm waiting for the first headline with hospital in the title. Shamefully underprepared in every way. There should be resignations and recriminations. FIX IT."* **– Reference 13, WSP 1, 2018 03 03 10**

Customers also informed the WSP where water restrictions had been put in place at water distribution centres. However, these restrictions were not perceived to be acceptable because customers were only allowed 1 litre per person. This created a great deal of contention because this was not perceived to be enough water to wash, prepare food or keep a person hydrated throughout the period of water supply failure.

> *"Every time you post there is water at one of your collection points by the time we can get there I see a post to say that it's all gone and only 1 litre each, come on [Name] this is not good."* **– Reference 5, WSP 1 2018 03 05 04**

There were also examples of customers sharing their experience and difficulties collecting water for their vulnerable neighbours. While they had attempted to inform the WSP of the requirement for an alternative supply of water for vulnerable people, they were unable to contact the WSP directly due to a high volume of calls to the call centre. Within these posts customers provided information of the location of the distribution centre and the help they received from the WSP representatives.

> *"Went to [Location] last night to collect water asked for some for my neighbors as they didn't drive and was told"if they contacted [Name] they will deliver" I said I spent 2 hours on the phone with no answer how are they going to organise delivery?? Poor guy looked at me and said your joking and gave me extra to give to my neighbors"* **– Reference 7, WSP 1 2018 03 05 03**

WSP 2 customers provided information informing the WSP of difficulties obtaining an alternative supply of water because the roads were gridlocked preventing access to the water distribution centre. Customers also provided suggestions for a greater number of distribution sites because one centre was not adequate to provide enough water for the entire location affected. While the majority of these comments were negative in their tone, implying the WSP could provide a better service, there were also positive comments thanking the WSP for their hard work.

> *"It would have been helpful if you'd have had more than 1 water distribution centre in the [Location] area! It caused the roads to gridlock up to [Location] Sainsburys so that people could get free bottled water from you! Ridiculous and very bad organisation on your part [Name]!"* **– Reference 1, WSP 2 2018 03 05 06**

For each WSP, customers provided information regarding difficulties obtaining an alternative supply of water because the supermarkets and local shops had all sold out. Customers expressed concern because they were unable to obtain an alternative supply of water and many had been without a supply of water for over 24hrs. The majority of these posts contained a reference to a location and a timeframe detailing how long customers had been without a supply of water. Within many of the comments customers had used multiple exclamation marks to reinforce the importance of the information provided within their post.

> *"We are just up the road in [Location] and our local shops all sold out of water too. Luckily we managed to get our hands on some, but it's a worry how long this will continue for. [Name] should be supplying us with all these bottles of water. Hasn't [Location] been without for over 24hours?"* **– Reference 90, WSP 1 2018 03 04 12**

There were many examples where customers posted comments detailing how water supply failure was affecting their ability to conduct their daily routines. This will be explored in greater detail within Section 6.4, Living without a Water Supply. However, it is interesting to understand how this information is presented to the WSP using Facebook. Many customers provided very personal information regarding their health and the difficulties they were experiencing living without a supply of water. Customers provided this information to enable the WSP to understand the consequences of water supply failure from the perspective of the customer.

> *"Im currently on my way to my docters get more diazpam as this has really affected me I suffer with severe anxiety on the best of dsys.. I did get some water tgis morning but not enough to wash and now I have none again ;(I know yiur trying your best to sort this but the distress it's causing so many ppl.. sorry to moan I know there are ppl worse off I just really hope it's all sorted for tonight I need a shower or bath"* **– Reference 42, WSP 3 2018 03 04 22**

Customers also provided information regarding the inability to wash dishes or to shower for school and work. There were also instances where customers informed the WSP that they were unable to provide adequate care for vulnerable family members who required water for medication or for hygiene and sanitation purposes. There were also posts from parents who were unable to sterilise baby bottles and prepare formula. For customers with anxiety, water supply failure contributed to greater levels of anxiety and a few customers informed the WSP they had to book appointments with their local doctor to request medication. Some customers informed the WSP that they would have to leave their homes and stay with friends and relatives because they were unable to live in their current property without a supply of water.

> *"No water in [Location], nearly another hour has gone and after 3 day still the same situation. We need water, we can't stay without. We need to shower for work and school and so on. Could you please give us some accurate informations?! It is so frustrating, I had to wash dishes like my granny was used to do in 1915! That's a terrible situation." – Reference 20, WSP 1 2018 03 05 14*

The majority of these comments started with the name of the WSP making the comment more personal. They also contained a reference to a specific location and the timescale of water supply failure. The timescale was used to reinforce the difficulty customers were experiencing particularly if the customer had been left without a water supply for a considerable amount of time. Within the majority of these posts customers also requested accurate information relating to the cause of the water supply failure and estimated timescales to allow them to prepare for water supply failure, make alternative plans regarding an alternative supply of water or to stay with friends and family. However, as the timescale increased it became increasingly difficult for customers to obtain water from the

supermarkets because they were sold out.

6.2.2 Requesting information

For WSP 1, there were 850 comments requesting information. Of these, 62% of these comments contained a reference requesting information about water supply failure. For WSP 2, there were 325 comments and WSP 3, there were 272 comments requesting information. Of these, 80% and 76% respectively, contained a reference to water supply failure. Each WSP experienced a great deal of criticism within the comments for not providing adequate information on Facebook, Twitter and the company website.

> *"We need more frequent updates. The lack of updates is making it difficult for us to manage living without water in the short term. [Location] has not had water for almost 24 hours."* **- Reference 7, WSP 1 2018 03 04 12**

Customers required information to be provided at regular intervals detailing the locations affected, the cause of the problem, how the WSP was proposing to fix the problem and the approximate timescale they could expect their water supply to be restored. This would enable customers to determine what preparations would be necessary if the situation were to persist. Also, providing customers with information regarding the nature of the problems would help them to understand the difficulties experienced by the WSP in locating burst pipes, leaks and the potential difficulties fixing them. However, the perceived lack of information from the WSP was contributing to negative comments regarding the provision of service by the WSP as illustrated within the following quotes.

"How about you actually tell us why it's taking so long, this 'few more hours' has been going on since Saturday. Did another pipe burst? You said the pressure was rising and would take a few hours, people like explanations, reasons, it's basic customer service. People might actually abuse you less... how do you not know this??" **– Reference 14, WSP 1 2018 03 05 17**

Once again customers provided the WSP with the location of water supply failure. Many customers used the WSP name to emphasize their disgust with the situation or to reinforce the need for up to date information.

The requirement for specific information regarding timescales is presented within this example. WSP 1, provided an update on Facebook stating that it would take *'some time'* before the reservoir levels would recover. However, customers did not perceive this to be an adequate description of the timescale.

> *"March 4. [Locations] Update: We've repaired a burst pipe which should help our reservoir levels recover but this will take some time. Meanwhile, bottled water is available from our station at [Location address]"* **– Reference WSP 1 2018 03 04 20**

The response to this update suggests that customers wanted definite timescales and to be regularly updated regarding the situation. Without this information it is very difficult for customers to make any preparations for continued water supply failure.

> *"How much "some time" are we talking about? Hours or days? Cos this situation is becoming to much now. Like we can't even take a shower or flush the toilet! We can't keep going on with no water at all! Some of us (i am a student abroad just saying) don't even have a car to get the water bottles so..please make it work for at least tomorrow morning."* **– Reference 1, WSP 1 03 04 20**

> *"You already announced 10 hours ago that you repaired a burst pipe. Can you please provide an estimate when you expect water to return to [Location] Midnight, 7am, couple of days? It's been close to 24 hours, you must know by now the extent of the problem and when you can fix it. The lack of any meaningful communication has been appalling."* **– Reference 2, WSP 1 03 04 20**

Eventually, WSP 1, provided a response to the comments. However, this occurred at the same time as the water supply was restored.

> *"Hi, I'm really sorry we haven't got a timescale yet. We're working as quickly as we can to get this fixed. We have a bottled water location at [Location]."* **- Reference WSP 1 2018 03 04 20**

This led to positive comments from customers thanking the WSP for restoring their water supply, even though they were without information throughout the majority of the period of water supply failure.

> *"Water is back in [Location] Thank you."* **– Reference 17, WSP 1 2018 03 04 20**

> *"Water is back in my flat too!!"* **– Reference 19, WSP 1 2018 03 04 20**

There was evidence within some of the comments that customers were using this information to determine whether they should remain at home or stay with friends and family. There were also instances where customers stated they were requesting information to determine whether they should obtain alternative supplies of water from the shops and how much would be required depending on the estimated timescale. While this provided evidence that customers were actively seeking information so they could effectively plan for water supply failure**,**

they became increasingly frustrated by a lack of information from the WSP. The lack of information was making it difficult for customers to prepare.

> *"We have had no water for 26 hours. We reported the major burst main on [Location] at 7.30am on Friday, [Name] finally arrived to investigate on Sunday morning after many chaser calls where on hold for over an hour, and after many homes had lost water supply. Surely you can provide an estimate for repair time so we can try and make alternative arrangements in the meantime?"* **– Reference 18, WSP 1 2018 03 04 28**

Customers used the words *"honest"* and *"realistic"* when requesting information regarding timescales. This suggests that customers do not trust the information provided by the WSP. However, if the WSP provided customers with further information regarding the nature of the problem, regular updates and estimated timescales it would enable customers to understand the difficulties experienced by the WSP under these challenging conditions. A lack of information prompted negative comments because customers were not able to plan or prepare for prolonged water supply failure.

> *"What about [Location] we have not a drop coming out of our taps and I have two small children in the house. Please give us an honest timeline so we can decide whether or not to stay with friends/family."* **– Reference 25, WSP 1 2018 03 05 17**

There were also requests for information regarding alternative supplies of water. Some of these comments were related to posts made by the WSP notifying customers of locations where they could obtain bottled water. However, there were also instances where customers were requesting information from the WSP as to why they weren't providing an alternative supply of water in their location. Especially as some customers were without a water supply for over 24 hours and were not able to obtain an alternative supply from the local supermarkets because

they had sold out. This was a particular problem for vulnerable customers who needed water to take medication or to prepare food.

> *"My postcode [Location] In the two photos I have uploaded above, it says there should be a phone number we can ring, I've tried many times to ring for advice and not managed to actually speak to someone, it says you should be providing us with an alternative supply which we haven't heard or been told anything about, it also says if you need it for medical reasons you should talk to your supplier, how do we speak to you when it's just pre recorded messages, my child is registered disabled and has to medicated through day and night most medicines and special foods she is on has to mixed with water, which I haven't had any of for 26 hours now! And haven't been able to speak to anyone about just listen to pre recorded messages, I have been and bought bottled water from he shops which I am already running low on due to using the water to wash pots, wash my children, mix with medication etc and all the rest of our local shops are now out of water, I know burst pipes can't be helped but you should have something in place for when things like this happen to help, not leave people without water for 26 hours especially vulnerable people like the elderly and disabled! Please update us and let us know where we can get our alternative supply from ASAP"* **– Reference 75, WSP 2 2018 03 05 08**

Customers requested further information regarding how to register as a vulnerable person and whether customers were considered to be vulnerable if they were elderly or infirm. These requests included questions regarding how vulnerable customers were prioritised, why they were not receiving regular updates and why they were not provided with an alternative supply of water delivered direct to their homes.

> *"Please can you advise what constitutes a vulnerable customer? We are in the same building as two very elderly and immobile people. We have delivered them water but they are still very concerned and I wonder how we get them prioritised? Who can I speak to?"* **– Reference 1, WSP 1 2018 03 04 14**

In many instances a representative from the WSP would post a comment within the thread of comments requesting customers send further details via a private message:

> *"…..can you private messages the full address of these residents?"* **– WSP 1, 2018 03 04 14 01**

> *"we're asking for any customer's who are vulnerable or their family members to contact us. We need full names, address's and contact number's and we'll be in contact with these customer's"* **– WSP 1, 2018 03 05 07**

There were also examples where customers used Facebook to remind the WSP that despite sending a private message, they had not received a response. This led to further conversations between customers and the WSP:

> **Customer post**
>
> *"Sent a private message a couple of hours ago as requested, to get help to vulnerable clients in [Location], and [Name] have not even read it yet!"* **– WSP 1, 2018 03 05 07**
>
> **WSP response**
>
> *"Hello [Name], Sorry for the delay in responding to you. We have separate teams working on the private messages and we have a lot people to communicate with. Your message will be read and responded to as soon as we can."* **– WSP 1, 2018 03 05 07**

Customers also requested information regarding compensation from the WSP. In some instances it was perceived that the WSP had failed to provide customers with a water supply they had already paid to receive and they had also failed to provide an alternative supply of water. This had resulted in customers having to purchase water from the supermarket. This created a great deal of frustration

because customers perceived that the WSP should provide compensation for the failure to provide a service and reimburse customers for water they had to purchase from the supermarket.

> *"Where should we send the bills for the water supply bought at local supermarkets [Name]? It's 2018 and we actually had to go buy water before it was even made available to do the simple tasks of flushing our toilets or 'showering' to be presentable at work. Please let us know as it's clear water won't be back on anytime soon! #[Location] #48hourswithoutwater"* **– Reference 1, WSP 1 2018 05 17**

The majority of these comments were of a negative tone with customers describing the service provided by the WSP as *"disgraceful"* and *"pathetic".*

6.2.3 Conversations between the WSP and the customer

There were many examples where a representative of the WSP was engaged in the sharing and exchange of information with customers within the thread of comments on Facebook. Some of the replies were in direct response to a question posed by a customer and resulted in the WSP representative asking the customer to provide further information via a direct message. The information provided by the WSP included: a general update of the situation, notifying customers of the location of a water distribution station, explaining measures taken to restore the water supply, directing customers to other social media sites for further updates and requests for vulnerable people to register with the WSP. However, this exchange of information was intermittent with some posts containing a greater number of exchanges. WSP 1 did not respond to as many customer requests for information compared to WSP 2 and WSP 3. The following examples illustrate the exchange of information.

Customer comment 1

"They tried to tell us that everyone in our postcode now HAS water, which is not true, and the cause might be an airlock or grit."

WSP response 1

*"….so sorry about this, we are still on site trying to get things resolved. Burst main has been fixed but we are now in route again as there has been a power outage and the water pump has tripped. So sorry for the inconvenience again." – **Reference 6, WSP 3 2018 03 03 02***

Customer comment 2

"What about [Location]? I don't have any water at all."

WSP response 2

"I'm sorry to hear this. Can you DM your full address, contact number and property type please so I can take a look into this for you?" –
Reference 1, WSP 1 2018 03 05 08

In general, customers responded positively to the comments provided by the WSP representative.

Customer comment

"Water came back on and now gone again, update please, just outside [Location]."

WSP response

"We have repaired the mains in the area and have now experienced a power outage which has caused the water pumps to trip. So sorry for this! We are on site trying to resolve this further issue. Thanks."

Customer comments

*"[Name] thanks for replying." – **Reference 12, WSP 3 2018 03 03 02***

"Another BIG THANK YOU from [Location] for getting us back on so quickly." **– Reference 7, WSP 2 2018 03 05 07**

However, there were examples of customers responding negatively if the WSP was perceived to have replied to one customer and did not reply to another. There were also examples of negative comments if the WSP had requested a customer to provide the location of a particular problem and did not respond with either an update or a proposed solution.

> *"[Name] can you stop picking and choosing who to reply to. We are all customers and all deserve acknowledgement!!"* **– Reference 1, WSP 1 2018 03 05 04**

Customers responded negatively because they perceived they were being ignored by the WSP. However, this could have been alleviated if the WSP had informed customers they were not able to respond individually to all requests for information because there were too many requests.

6.2.4   Customers sharing information

Customers were also very active sharing information they had obtained from other social media platforms, the company website or direct from the WSP. The information they shared included updates provided by the WSP, conversations with the WSP or the Local Authority, requirements for alternative water supplies, location of supermarkets with supplies of bottled water and links to complaint procedure information.

> *"I have just spoken to [Name]. For [Location] at least, there are still repairs ongoing (to a 12" main)and they do not know when they will be completed. I have pointed out that they are posting conflicting information and apparently they will resolve this, not at all impressed."* **– Reference 6, WSP 1 2018 03 04 10**

Customers shared information to provide support and information to others and to receive confirmation that they were not alone experiencing difficulties without a supply of water.

6.3   Alternative supplies of water

The provision of alternative supplies of water by the WSP created a great deal of contention and there were a number of reasons for this.   The locations of the bottled water distribution stations were perceived by many customers to be of great distance to travel. Many did not have their own transport and were unable to carry large quantities of water either because they travelled on the bus or because they had to walk long distances with young children. Customers used Facebook to inform the WSP's of the need to provide more bottled water distribution stations in more accessible locations for those that were not able to travel long distances*.*

> *"appreciate that these events will occur and take time to fix but having water collection points in far flung places is not satisfactory. I purchased water locally yesterday, but without a car it's hard work carrying back. We need a collection point for [Location] where upwards of 250 homes plus local flats have been without water for over 2 days. I have cancer/ chemo and the worry of infection risk is quite real when we have to reduce hygiene standards due to having to eke water supplies. Army bowsers?" –* **Reference 20, WSP 1 2018 03 04 12**

> *"Not much use for customers 9 miles away in [Location] is it really. Luckily the local community is looking after vulnerable residents for you but ignoring smaller villages is not really good enough." – **Reference 36, WSP 2 2018 03 06 05***

Customers also threatened to call the emergency services in one location out of concern for vulnerable residents who were not able to obtain water from an

alternative source because they were unable to travel:

> *"I rang and advised the customer advisor that [Location] was still without water and if they don't act we will call the emergency services as we have quite a few pensioners that have No water and no way of travelling to get any, we bought all the bottled water Asda had and dished it out but not sure how long we have to self service ?"* **– Reference 2, WSP 3 2018 03 02 13**

This contributed a lack of resilience for many of these customers because they were unable to obtain an alternative supply of water making it difficult to cope under circumstances of prolonged water supply failure. As discussed within Section 6.2.1, as the incident progressed it became more difficult for customers to contact the WSP to inform them they were unable to obtain any water. This will be discussed further within Section 6.3.3. Difficulties were also experienced by customers who were able to travel long distances to the water distribution stations and these are presented in the following Section 6.3.1.

6.3.1 Availability of alternative supplies of water

Customers reported instances of arriving at the bottled water station to find they had run out of water or they were only allowed 1 litre each. This was not considered an adequate volume of water for customers to drink, let alone fulfil their basic needs for flushing, washing and preparing food. Customers that were experiencing difficulties attending the water distribution station expressed frustration when they finally arrived to find there was no water.

> *[Name] parts of [Location] haven't had water since Saturday night. No water to wash, drink, or cook. You have finally added a Water Station at [Location], but how is 1 litre of water going to help after over 30 hours of no water? With no sign of water yet, and a family house hold, what is 1 litre of water going to do? Especially when [Location] 1 1/2 miles from*

where I am in [Location]. How are all the old age pensioners going to get down there?" **- Reference 7, WSP 1 2018 03 05 07**

There were also conflicting comments regarding chaos at the bottled water station and descriptions of it being a '*horrible experience'*. It was perceived that some customers did not wait patiently or queue for a supply of bottled water but there was a great deal of pushing and shoving to get to the front of the queue. However, the lack of information provided by the WSP regarding timescales may have contributed to the chaos experienced because customers were unsure when their water supply would be restored. The chaos described at the bottled water distribution station suggests that customers did not have confidence or trust in the ability of the WSP to provide an alternative supply of water if the situation persisted over a longer period of time.

> *"You had a Manager on site and ten team members who stood around with their hands in their pockets. There was no protocol or organisation at all why? It turned into a Lord of the Flies scenario / almost riot, the Police then had to be called, all because your Manager and team did not marshal the crowds / use common sense, it was dangerous, badly handled and very irresponsible of you. If you are doing emergency distribution then you need to marshal people - you obviously thought of it, as you sent a team of 10, but they did ZERO. Do you not train them how to deal with such situations? Someone should be sacked / demoted for the incompetence...."* **– Reference 23, 2018 03 04 15**

Customers did not perceive the location of water distribution stations to be adequate. This led to suggestions and requests for the WSP to provide bowsers or tankers in more convenient and accessible locations. This would allow more customers access to an alternative supply of water. It was also perceived that the WSP had access to a large provision of alternative water in the form of

tankers, bowsers and bottled water. However, customers did not understand why

the WSP's were not actively distributing these to the locations that were affected.

> *60 hours with no water. United Nations guideline for water is a minimum of 5 litres per person per day. So my household needs 20 litres a day (weighs 20 kilograms). How I am supposed to get that without a car? We need bowsers or standpipes every half mile, minimum."* **- Reference 4, 2018 03 06 01**

6.3.2 Contingency planning

There were also instances where customers expressed frustration at the

perceived lack of contingency or emergency planning by the WSP:

> **"***Where are the water stations? I'm [Location], no water at all and no info on water stations that I can find, other than [Location] which is too far away, these need to be every couple of streets. Realistically I suspect [Name] have insufficient resources for that. No excuse though, surely there is a Crisis Management Plan for major incidents like this that kicks In? I see no evidence of this unfortunately".* **– Reference 7, 2018 03 04 18**

> *"Tell the truth! What are your contingency plans? Will we have water tonight or not? How can anyone believe what you say? You said it was fixed earlier and surprise surprise it clearly wasn't! Putting aside I see you have run out of bottled water at your sites in [Location] and [Location], a few bottles is not enough when toilets are overflowing and we can't wash!"* **– Reference 1, 2018 03 05 09**

Customers did not understand why the WSP was not prepared for such an event.

Customers wanted answers to their questions, particularly with regard to the

provision of more water distribution stations. There were even suggestions

regarding a more effective method of distributing alternative supplies of water.

The continued lack of information as the event progressed contributed to an

increasing lack of trust and confidence in the information provided by the WSP. This also led to customers to doubt the ability of the WSP to provide an alternative supply of water.

> *"[Name] Do [Name] have a contingency plan in place to provide water bowsers to people in effected areas some people still can't get out due to the snow/Ice and shops are running out of bottled water plus it's expensive we have been without water for 24 hrs many people even longer families and elderly people." – Reference 11, WSP 3 2018 03 02 07*

6.3.3 Altruistic behaviour

There were many examples of altruism throughout the event with customers providing information to one another regarding which supermarkets still had a stock of water:

> *"I managed to get some water from the [Name] in [Name] this morning. Also got some For my neighbour who is old and doesn't have a car (we live in [Name]). The guys were super nice and doing their best but not everything is within their power (I was quite upset how rude some people were towards them). Really hope it can be sorted soon; not having our daily shower is unpleasant but will not kill anyone." – Reference 1, 2018 03 04 15*

> *"Anyone in [Location] needing water I'm in [Location] and water is fine, so if you have bottles/buckets you're welcome to fill them up here" – Reference 1, WSP 2 2018 03 05 05*

A local sports centre was offering its facilities for people to shower for free, even though they were not members and there were many examples of customers obtaining alternative supplies of water for their elderly or disabled neighbours. There were also examples of conversations between friends offering water and showering facilities within their homes and there were some customers who still had a water supply offering to fill containers for those without a supply.

"We have bottled water as well as running water here at the leisure centre. You are more than welcome to come down to use our shower facilities as well as fill up any empty water bottles at our water fountians." **– Reference 2, WSP 1 2018 03 04 12**

"I have water - if you still need it tomorrow come and get it from me. PM me" **– Reference 3, WSP 2 2018 03 05 02**

While the failure of the water supply was a challenging and difficult experience for many customers, there were also examples of customers reusing water in an attempt to conserve as much as possible. Customers mentioned using water from water butts to flush their toilets throughout this event providing examples of adaptation to achieve resilience to water supply failure.

"Still not a drop of water in [Location]. More than 50 hours without water supply. Used the water butts for the loo and an awful lot of plastic bottles going out with this week's recycling. I can't blame the guys who're trying to fix the problem, but a bit more frequent and accurate information would be helpful." **– Reference 1, WSP 1 2018 03 05 17**

"We are OK - I have a tank with 300 gallons which I use water the plants in the loft. I'll just divert that." **– Reference 1, WSP 1 2018 03 05 04**

"Storing up dirty bath water back in to the empty bottles so I have some water to flush the toilet with. Come on [Name], i'm grateful for your hard work but how much longer do I have to live like this? Been 5 days now and not even a drop, [Location]." **– Reference 1, WSP 1 2018 03 06 11**

"Use water butt for flushing loo" **– Reference 2, WSP 2 2018 03 05 08**

The freezing weather conditions had made it difficult for WSP 3 to provide customers in rural locations with an alternative supply of water because of the dangers transporting water on icy roads. However, many customers did not

perceive this to be an adequate response because the weather warnings within their local area were no longer active. These customers did not understand why the WSP could not deliver bowsers to their local area when their roads were free of ice.

> *"Some of us have been told that the reason for the lack of water delivery by truck is that the inspectors can't get out to assess if the roads are safe. The roads in the area concerned have largely been clear since this morning, and will certainly be clear tomorrow, Sunday and Monday - using this as an excuse is an an extremely distasteful exploitation of the weather situation." – Reference 15, WSP 3 2018 2018 03 02 14*

> *"……or telling people that you can't supply them with bowsers because the roads aren't safe, some 5 hours after all weather warnings in the area have ceased…" – Reference 7, WSP 3 2018 03 02 14*

All of the WSP's were experiencing difficulties providing alternative supplies of water to all of the customers that were affected. However, the WSP's did not provide customers with any further information as to why. It is possible from the information provided within the semi-structured interviews in Chapter 4, that the WSP's did not have enough resources in terms of people to establish multiple water distribution points or deliver water to all of their vulnerable customers. The following conversation between a customer and WSP 3 on Facebook provides an indication there were not enough people within the organisation to distribute an alternative supply of water to all of the customers affected.

> **Customer post**
> **"**[Name] ... aren't you supposed to provide alternative water (eg Bowser / Bottled water) after 12 hours????? "

> **WSP Response**
> *"……unfortunately due to the adverse weather conditions we have experienced and a number of issues our customers are currently experiencing with frozen pipes, low pressure, no water etc we are unable*

to provide an alternative water resource to all those affected. We are encouraging customers who currently have water supplies to store some water so they can use until the usual supply is restored." **Reference 8, WSP 3 2018 03 03 02**

This is also supported through customer comments relating to the provision of water for vulnerable customers. WSP 3 customers were sharing information from the WSP that only vulnerable customers would be receiving bottled water due to the large number of affected customers. There were also examples of customers providing information to the WSP regarding the need for an alternative supply of water however, they had not received one.

"Just had a message from [Name] and they are only supplying bottled water to vulnerable customers due to the vast amounts without water." **– Reference 4, WSP 3 2018 03 03 02**

"Over 24hrs still no water. I understand burst pipes and engineering problems on site but for you not to be able or capable to provide us with an alternative water supply is not acceptable in this day and age. So what are you going to do fix the pipe or alternate water supply..!!!" **– Reference 17, WSP 3 2018 03 03 02**

"You promised me a water delivery last night and it has not arrived. I am looking after a terminally ill Mum. WE HAVE NO WATER. [Name]." **– Reference 28, WSP 3 2018 03 04 02**

While there was a great deal of frustration and negativity directed towards each of the WSP's, however, there were also examples of positive comments and praise. Customers posted comments in support of the WSP and they asked other customers to be more understanding and patient. This was particularly evident within the customer comments for WSP 2. They received a great deal of support from customers compared to WSP 1 and WSP 3. However, these comments

were relatively few compared to the negative comments posted throughout the event.

> *"Well done to all the team working to get it fixed and provide alternative supplies"* **– Reference 1, WSP 3 PC 2018 03 04 24**

6.4   Living without a water supply

Living without a water supply was extremely challenging for many customers and was exacerbated by a lack of information from the WSP.   This is because customers did not know how long they would be without a supply of water and were not able to prepare or adapt to a different way of living.   Customers with babies were struggling to prepare their bottles and customers wanted to know if they needed to purchase water on their way home from work.   Even if this was only a temporary situation.

> *"Any news of [Location] live in [Location], need to know if I will come home to water or not, got work uniform to wash and need showers! Or will I need to stock up on water, stayed away last night, need to come back to my house!!"* **– Reference 7 WSP 1 2018 03 06 11**

> *"Wish they would have an update having to wash baby Freddie's bottles in shop bought water so | can sterilise them is proving expensive."* **– Reference 1, WSP 2 2018 03 05 04**

The failure of the water supply created a great deal of frustration for customers particularly when there was no indication of the supply being restored after a couple of days. Some customers had sent their children to stay with relatives but were left with no information regarding how long it would take to restore the water supply. There were also examples were the water supply had been restored for a brief period of time and customers had missed the opportunity to obtain water.

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"Still no water, I've had none since Saturday, haven't seen my daughter since Saturday, she's had to stay with her grandparents, because it's too unsanitary to keep her here!! Dishes and clothes piling up, boiling the kettle just to have some sort of wash... Oh and funny enough had a letter from my council today letting me know of the increases this year... your one of them" **– Reference 25 WSP 1 AP 2018 03 05 16**

Customers used Facebook to post comments informing the WSP of the difficulties they were experiencing without the ability to wash themselves, wash dishes, clothes, preparing food for cooking and flushing the toilet. Customers complained a lack of water had led to unsanitary conditions within their homes. Customers also expressed distress because they were not able to wash and did not want to go to work feeling dirty or *"smelly".*

"Oh no. That's the thing that's getting to me most, being unable to clean things properly. I can wash myself in a small amount of water but what about the dishes, clothes... you can't clean a kitchen or bathroom properly with antibacterial wipes" **– Reference 2, WSP 1 2018 03 06 03**

Not being able to flush the toilet was a particular concern because it was considered to be unsanitary, particularly for those who were unwell. There were also concerns as to how a family would be able to cope:

"Any idea of how much longer? Water purchased today all ran out. With 4 in house problems with pots and toilet. Thxs" **– Reference 6, WSP 2 2018 03 05 08**

This was a particular problem for customers that had to purchase an alternative supply of water from the supermarket because it was perceived to be expensive to flush the toilet and required too much water that customers were unable to carry.

> *"A pound for a bottle of water from the local shop at [Location], going to the loo is getting very expensive. Not water since Saturday eve." –* **Reference 9, WSP 1 2018 03 05 17**

Many customers reported how their toilet had become blocked as a result of not being able to flush it properly. In order to conserve as much bottled water as possible there were comments informing the WSP and other customers of the minimum amount of water required to adequately flush the toilet but customers also expressed concern that they were using bottled drinking water to flush the toilet.

> *"toilet now blocked, no water for 26 hours and none in shops and no car, thanks [Name]." –* **Reference 2 WSP 1 2018 03 04 9**

Customers also provided information regarding the amount of water required to flush the toilet and the difficulties they experienced without a supply of water.

> *"Bottled water is Ok to drink but quite difficult to shower / clean with. It takes 5l to flush a toilet and that weighs 5kg. A kettle holds about 2l. You will be surprised at how much water you need per day for basics. I have taken a couple of days off work and have been ferrying water to residents in my area." –* **Reference 9, WSP 1 2018 03 06 03**

This event did provide customers with a greater appreciation of the importance of water in their daily lives and how accessible it is under normal circumstances. Flushing the toilet with drinking water was a particular concern for some customers as they were pouring bottled water in the cistern or down the toilet. They had not previously considered the water they flush down the toilet was drinking water standard. This event also provided customers with a greater understanding of how much water they use on a daily basis. However, whether

experience of this event will change attitudes and behaviour to water use would require further research.

6.5   The provision of a service

Customer attitudes and perceptions of the provision of service were generally negative. This was largely a result of the perceived lack of communication and information provided by the WSP throughout the whole event. This had left customers frustrated and angry, especially as they were paying for a service that they considered to be inadequate.

> *"Disgusting service! My poor disabled dad has been without water all day! I really hope it's all fixed ASAP and compensation is made." – Reference 2, WSP 1 2018 03 03 07*

There was also a perceived lack of contingency planning for severe weather events, which led many customers to lose confidence and trust in the ability of the WSP to provide an adequate service. The lack of an adequate provision of an alternative supply of water reinforced the negativity directed towards the WSP's. Customers felt *"disappointed", "ignored", "dismissed"* and *"disregarded"* by the WSP. This led to many customers describing the provision of a service by the WSP's as *"disgusting", "abysmal", "shocking"* and an *"absolute disgrace".*

> *"The communication from [Name] is utterly abysmal, I'm shocked how they can treat customers like this - I've tried to communicate via telephone, online chat and through social media and have been fobbed off, dismissed and guided to websites that are never updated. All I want to know is what they plan to do to help villages with no water for more than 15 hours now, people are panic buying so bottled water is running out in shops and some have babies and very young toddlers like myself but they are just not communicating whatsoever. This is ridiculous customer service" – Reference 19, WSP 2 2018 03 05 07*

Customers of WSP 2 and WSP 3, expressed their frustration on Facebook when they were asked to conserve water on the WSP website. These customers did not have a supply of water and were therefore not able to conserve any. There were also posts from WSP 1 requesting customers not to wash their cars throughout this period. This was met with a great deal of criticism because customers were experiencing freezing conditions and did not have any water to be able to wash a car.

> *"how can we save water if we don't have any??? [Postcode], last in cul-de-ac to go without!! cannot believe it in 2018, shocking!!!!! do we ge a rebate????"* **– Reference 37 WSP 2 2018 03 05 08**

> *"We have no water in [Location] - honestly, I really don't think the problem is through people washing cars! Do you have any idea of the timescale for this? Also, is [Location] really the only place you're giving the water out? We're by [Location]."* **– Reference 1, WSP 1 WC 2018 03 04 12**

All of the WSP's were criticised for not anticipating the consequences of the freezing cold weather and as already mentioned, not having adequate plans in place. There was also a great deal of criticism regarding infrastructure. It was perceived by some customers that part of the failure to supply water was the result of a failing or deteriorating infrastructure that was not being adequately maintained by the WSP. Some customers perceived this was because the WSP was sharing profits with the shareholders rather than investing in an aging infrastructure.

> *The situation has been caused by a lack of investment in the water supply infrastructure. The high profile investments, [Location] ring etc. give the illusion that all is well but in reality, the services which supply water to houses and businesses, which in effect tap into the main supply have not been updated in some considerable time. It is these that continue to fail…….."* **- Reference 31, WSP 1 2018 03 06 03**

However, there were some positive comments. Previous employees posted comments in support of the WSP explaining how difficult it was to locate leaks and burst pipes and customers posted comments thanking the WSP for all their hard work.

> *"Sometimes bursts happen and having previously worked for [Name] for 14 years I understand the situation from both sides . Regrettably bursts may show themselves but the leak /burst may be coming from another section of pipework and it can be a process of elimination .. (quote finding a needle in a haystack) to locate the source. So just trying to say it is not always easy as with those with no water equally"* **– Reference 5, WSP 1 2018 03 04 28**

> "*Trust me with over a decade of working in the water industry from replacing to leak repair I can honestly say new pipes or old pipes when the ground freezes and thaws out you have movement in the ground pipes expand and contract due to different weather conditions there will always be leaks. It is not ideal but the area that is to be searched to find such leaks is very large and takes many man hours then comes the repair of said bursts this could depend on timescale due to location and pipe size and material. The guys will have been working none stop throughout from the moment of the first call of no water. Everyone who has been working on these jobs to try and restore water asap to all affected areas have been working flat out and will still be be in work as per tomorrow. I know it's not easy and we all have to pay the bills even us who fix them. Please have patience it's hard for us all those without water and for those who are trying to restore that water* for you." **– Reference 5, WSP 3 2018 03 04 24**

There were also comments thanking the WSP when the water supply was restored. Although many of these comments also contained advice for the WSP to ensure they provide their customers with information during an emergency or upgrade and invest in their infrastructure.

> *"Hurrah! Water is back on in [Location] - well at least where I am. I'm really grateful to the engineers who have probably been having an appalling time in these conditions. However as a company you should have been giving*

*us regular information and estimated times for repair especially given the road conditions in the affected areas." – **Reference 1, WSP 3 2018 03 03 02**

Customers were very active reporting leaks and burst pipes on Facebook. Within the comments, customers provided information regarding the location, timescales and any damage that had been caused.

"*Tried to report burst water main [Location] just up from [Location] junction. Coming up from under the tarmac next to the gutter. Not sure if anyone else has notified you. Totally appreciate how busy your emergency line is so hopefully you will be able to action this." – **Reference 1, WSP 3 2018 03 05 01**

They were also very active commenting on leaks and burst pipes that had been reported with no evidence that the problem had been resolved by the WSP or if the problem had not been adequately dealt with.

*"The burst water main at the junction of [Location] and [Location] has been leaking for months. It was reported, nothing done about it so the council just resurfaced the road over it ! Total waste of time and money. To add insult to injury our water rates have just gone UP" – **Reference 3, WSP 1 2018 03 03 02**

Customers were using Facebook to report when they had seen WSP engineers working on site and also where there was a perceived lack of engineers working on a problem.

"Thank you very much! Seen them from here" - **Reference 3, WSP 1 AP 2018 03 03 01**

*"[Location] also - no water at all, except from the gushing mains on [Location] and not a soul there repairing..." – **Reference 4, WSP 1 AP 2018 03 04 26**

Customers also commented on the timescales involved with investigating and repairing leaks. They did not perceive the WSP engineers were working with enough speed to rectify the situation. This was of particular annoyance for customers without a water supply.

> *"I wonder why it takes so long... on Sunday there were two [Name] workers in [Location] sitting in the van next to the leak. Repairing it - by the power of telepathy Finally few hours later the digger arrived! Speed of light repairs!! Wait wait wait.... Tuesday morning still no water. Completely unprepared for emergency situations!"* **– Reference 59, WSP 1 AP 2018 03 06 03**

6.5.1 WSP customer service

Customer service throughout the event was not favoured with many positive comments. Customers complained of being held on hold for long periods of time and were not able to speak to someone from the WSP to report water supply failure, request further information or to register as a vulnerable person.

> *"Your customer service is atrocious. I have messaged numberous times. We have had no water since Saturday night [Location]. Our water comes through [Location] so I can't register with priority service. I have a disabled person in the house!!!!!!"* **– Reference 30, WSP 1 2018 03 05 11**

The majority of customers were not able to speak directly with a representative from the WSP because they had been cut off by the WSP telephony system or they gave up waiting. This also created difficulties for customers who were trying to register as vulnerable because they were not able to inform the WSP of their situation so they used Facebook instead. There were also examples where customers had requested assistance online and were told the need to telephone the WSP direct but were unable to get through.

"I've been online to speak to someone who said they cnt help so I've got to ring up so I'm now on hold after an hour of trying to get through got put on hold and have been on hold for 30mins now! I bet I'll go to sleep and still wake up b4 they answer." **– Reference 3, WSP 2 2018 03 05 02**

Customers were also frustrated by the lack of response when they had left direct messages via Facebook. On some of the Facebook posts the WSP requested a customer to direct message them and many customers expressed frustration when they had done this but did not receive a response to their query. In some instances this prompted customers to contact the local MP and the local media. Customers also shared links to the website of the regulator Ofwat regarding standards of service to encourage others to complain.

"[Name] my private messages have not been answered either its ok though i have contacted my local M.P who has written to [Name] C.E.O i am not holding my breath for a reply though" **– Reference 26, WSP 1 AP 2018 03 06 04**

"OK when are you contacting me!! Pmd you as you asked 25 mins ago you've now had our phone no total 10 times "Oh someone will rig you back/be in touch???? Hahhhaaaa No one has and still NO water and no one from waterboard to bee seen anywhere, !!! No water delivered either being Disabled i need water asap!!!" **– Reference 6, WSP 3 2018 03 04 03**

When customers asked questions on Facebook they expected the WSP to reply. However, in many instances this did not occur because the WSP was inundated with requests and were not able to reply to everyone. Customers experienced a similar situation when they telephoned customer service throughout the event. Customers were not happy about being placed on hold for long periods of time and then being cut off without an opportunity to speak directly to the WSP. The majority of customers wanted to know when the water supply would be restored.

This was very difficult for vulnerable customers because they were not able to register with the WSP using any of the methods to contact the WSP.

6.5.2 Vulnerable customers

The majority of comments relating to vulnerable people were related to the provision of alternative supplies. Customers were requesting information regarding how vulnerable people could obtain an alternative supply of water if they were not able to travel to water distribution stations or carry water from the supermarket. Customers made suggestions to the WSP to increase the water distribution stations or deliver water to each vulnerable customer.

> *"Can someone at [Name] start using their common sense and supply the water in the [Location] are closest to those affected around [Location], and not 2 miles away. Most [Name] don't have cars, and there are many people unable to get there (elderly, disabled, those who can't carry water etc)."* **– Reference 1 WSP 1 2018 03 04 15**

Customers also informed the WSP where the local community had taken responsibility to ensure vulnerable customers had been provided for.

> *"Not much use for customers 9 miles away in [Location] is it really. Luckily the local community is looking after vulnerable residents for you but ignoring smaller villages is not really good enough."* **– Reference 5, WSP 2 2018 03 06 05**

There were also examples where customers posted a comment on behalf of their neighbours or relatives to request an alternative supply of water from the WSP. Customers demonstrated a great deal of altruism particularly with regard to those perceived to be vulnerable.

"I have 2 severely disabled people at home that that cannot carry the water let alone get their can we please arrange someone to drop some off." – **Reference 1, WSP 1 2018 03 05 12**

"What about the elderly who can't get there? My neighbour has been locked in since Tuesday because of the weather, no way she'll make it there for any. Is this the only place? It's miles for us!" – **Reference 1, WSP 1 2018 03 04 11**

Vulnerable customers used Facebook to post individual requests for an alternative water supply if they did not receive water from the WSP or had not registered themselves as vulnerable. Some of these comments also included personal information regarding a customer's medical situation including their frustration and distress because they were unable to obtain an alternative supply of water. This information was provided to ensure the WSP understood the importance of providing these customers with an alternative supply of water. Customers also suggested the WSP provide communal taps for the local community to access.

"NO WATER IN [location]-disabled mother and baby, been on hold for 1h 30 minutes - absolutely shocking! You should have a communal tap in the street operating or delivering water to vulnerable people like me who can't actually leave sleeping, sick children at home to get water." – **Reference 2, WSP 1 2018 03 04 12**

"Weve had NO WATER since 2pm yesterday made 7 calls to you and all we get is fobbed off !! Surely it should be back on now. Were disgusted weve had no water to wash, shower, kettle wash machine wash machine !! I have a disability and this is so STRESSING me out. Please hurry up and tell us at least when to expect it to be back on!!!" – **Reference 1, WSP 3 2018 03 04 05**

There were many instances where customers informed the WSP of the stress caused by not having a supply of water and no information to tell them when the supply would be restored.

6.6   Compensation and bills

All of the WSP were criticised for not providing customers with an adequate provision of service throughout the event. This is because customers perceived the lack of information regarding water supply failure and poor communication did not allow them to make preparations for an alternative supply of water. Not only that, poor communication meant that some customers did not perceive the need to find an alternative supply of water because they considered the water supply would be restored relatively quickly and the WSP would provide an alternative supply.

> *Over 12 hours without water in [Location] No bottle water handed out. Had to buy bottled water. No updates on work on there web site can't get through on the phone just recorded message then cuts you off. They would soon come knocking on the door if we owed them money. What about a refund on our bill [Name]"* **– Reference 13, WSP 1 AP 2018 03 03 07**

However, it was difficult for many customers to travel to the bottled water stations, they were unable to carry enough water home and in many instances customers were forced to purchase their own supply of water. This situation created a great deal of frustration for customers and as a result many demanded compensation and were not happy about paying for a service that did not meet their needs.

> *"[Name] its been ALL day. Why isnt it sorted yet. For god sake its just a joke. Are you going to refund everyone thats had to go out and buy bottled water?"* **– Reference 49, WSP 1 AP 2018 03 03 02**

"We have been running the water to clear it and the tap water is improving but the cistern is pretty disgusting. As we are on a meter is there going to be any reimbursement on our bill? This will, no doubt, apply to a great many people." **– Reference 1, WSP 3 2018 03 05 02**

6.6.1 Complaints to the regulator

There was a perception that because customers have to pay for their water supply the WSP should ensure a provision of water at all times. Even during an emergency. Customers did not perceive it to be acceptable that they had to purchase water from the supermarket and they used Facebook to remind the WSP of their obligations to provide an alternative supply of water by attaching a link to the Ofwat website.

"[Name], a gentle reminder of your legal obligations: https://www.ofwat.gov.uk/.../supply.../standards-ofservice/" **– Reference 1, WSP 1 2018 03 04 05**

"21 hours and still no water in [Location] - completely unacceptable and have reported to OFWAT" **– Reference 1, WSP 2 2018 03 05 08**

Customers also informed the WSP when they had decided to report the WSP to Ofwat because they were not provided with water and perceived the provision of service to be *"unacceptable".*

6.7 Summary

This Chapter sought to explore the attitudes and perceptions of individual customers to water supply failure during an emergency, how information is shared between the WSP's and their customers and what information is required

to enable resilience to an extreme event. Chapter 8 will explore these attitudes and perceptions within the context of the academic literature discussed in Chapter 2, alongside the results of the semi-structured interviews with emergency managers from the LRFs and the WSPs (Chapter 4) and the individual homeowner questionnaires (Chapter 5). However, to finalise this Chapter the findings are discussed in relation to the research questions posed at the beginning of this Chapter.

6.7.1 What are the individual attitudes and perceptions to water supply failure during an extreme event?

In general customer's attitudes and perceptions to water supply failure were negative, which was largely a result of a lack of communication and information from the WSP. Customers did not know how long they would have to cope without a supply of water and this made it very difficult for them to prepare. The supermarkets quickly sold out of water and the provision of alternative supplies by the WSP was not perceived to be adequate. Customers within both rural and urban locations struggled to collect water from water distribution stations. This was partly because the water distribution stations were located too far away and customers were not able to carry water home. Some customers were not able to access an alternative supply because there was no water left when they arrived at the water distribution station or they were rationed to 1 litre per person. Vulnerable customers also struggled to inform the WSP if they needed water to be delivered and many had to rely on the assistance of family of members of the local community. The WSP's received a great deal of criticism for not providing

enough water distribution stations which customers perceived, would reduce the distance they would have to travel to obtain an alternative supply of water.

Customers used Facebook to complain about the unsanitary conditions they were having to endure as a result of water supply failure and actively informed the WSP of the difficulties experienced because they could not shower or wash. This was perceived to be a particular problem for customers because they did not want to go to work or school dirty or *"smelly".*

Customers also expressed concern because they were not able to flush the toilet and they perceived this to be very unsanitary. There were also instances where customers reported their toilet was blocked as a result of not being able to flush it properly. This was perceived to be unacceptable and customers complained because the WSP had not fixed the problem or provided them with an alternative supply. Although, there were also instances where customers demonstrated an appreciation of the difficulties faced by the WSP.

6.7.2 How is information shared between WSP's and customers during an extreme event?

The WSP's shared information on Facebook, Twitter and the company website. Customers used Facebook and Twitter as the main methods of communicating with the WSP and were actively involved in providing information, requesting information from the WSP and sharing information with other customers.

The WSP's provided customers with general information regarding the ongoing situation, notification posts containing location specific information and posts providing advice. However, the scale of the incident meant there were also other locations that were affected by water supply failure that were not assigned a specific Facebook post by the WSP.

All of the WSP's were criticised for not providing customers with accurate and regular information throughout the event and many customers found it difficult to obtain any information regarding their local area. Customers provided the WSP with the location and timescale of water supply failure within the Facebook comments to encourage the WSP to provide specific information regarding their local area. However, the WSP was not able to respond to all of the requests for information and this generated a great deal of negativity toward the WSP's. Customers complained because they perceived the WSP's were responding to some customers and not others. This made customers feel as though they were being *"disregarded"* and *"ignored"* by the WSP's and there were comments from customers suggesting how improvements could be made with regard to future communication from the WSP.

Customers also reported examples of conflicting information provided by the WSP on Facebook, Twitter and the company website. This created a great deal of confusion because customers did not know which source of information was correct and made it very difficult for customers to prepare for water supply failure. Customers also reported a number of difficulties when attempting to telephone

the WSP to request further information or to inform the WSP of a problem. Many customers complained they had been cut off or were on hold for long periods of time without being provided with the opportunity to speak directly with the WSP. This was a particular problem for vulnerable customers because they were not able to inform the WSP that they needed water to be delivered.

Customers also actively shared the difficulties they were experiencing conducting their daily routines and living without a supply of water. The majority of these comments also included a request for further information regarding the nature of the problem, how it was being fixed and estimated timescales when the water would be restored. The majority of notification posts by the WSP did not provide timescales regarding when the water supply would be restored. When this information was provided by the WSP, it was very difficult to manage customer expectations if further difficulties were experienced increasing the amount of time before the water supply could be restored.

Customers used Facebook to request alternative water supplies in the form of bowsers, tankers and bottles. All of the WSPs provided information regarding the location of water distribution stations and customers were very active on Facebook informing the WSPs of their experience visiting these locations. This often included the difficulties customers experienced obtaining an alternative supply of water.

6.7.3 What information is required by customers and WSP's to enable resilience during an extreme event?

Analysis of the Facebook comments revealed how many of the customers demonstrated a propensity to achieve resilience to water supply failure by taking steps to actively prepare. This included the purchase of alternative supplies of water from the local supermarket, travelling to obtain water from the water distribution station, staying with friends and relatives or arranging for the distribution of alternative supplies of water for vulnerable friends and family. However, in order to ascertain how much water would be necessary to sustain a prolonged period of water supply failure, customers required accurate, specific and timely information regarding the location, cause of the problem, what the WSP was doing to rectify the situation, estimated timescales when the water supply would be restored and whether an alternative supply of water was going to be provided.

While many of the WSP's did provide specific information regarding the location of water supply failure, this did not include all the locations that had been affected and the majority of posts did not include estimated timescales when the water supply would be restored. This made it difficult for people to plan and prepare for prolonged water supply failure. There were examples of adaptation and resilience where customers used water from water butts or storage tanks within the loft to flush their toilets but these were few and many customers did not have access to an alternative supply of water.

In order to increase resilience to water supply failure and determine necessary preparedness measures, customers provided the WSP with a great deal of information throughout the event. This included information regarding the location and timescales of water supply failure. They also informed the WSP if the information they provided was not accurate with regard to the locations of water supply failure, including leaks and burst pipes and if there were inconsistencies with the information they were providing to customers on different media platforms.

Customers also required information regarding the provision of alternative supplies of water including, the location of water distribution stations, how much water was available per person and reassured there was adequate provision in place for all customers. This information would enable customers to make informed decisions regarding the provision of alternative supplies of water related to their individual needs and requirements. If customers are adequately informed regarding the availability of alternative supplies, this may reduce 'chaos' at the water distribution stations and the purchase of all available water within the local supermarkets. As demonstrated within Chapter 1, (Section 1.3) while some customers are able to achieve resilience to water supply failure through the provision of alternative supplies, this may also reduce the ability of other customers to achieve resilience if supplies are rapidly depleted. This was demonstrated at the water distribution stations when customers arrived to discover there was no water available.

There were many examples throughout the Facebook comment dataset of vulnerable customers that had not registered with the WSP. Many of the WSP's requested vulnerable customers to contact the WSP. However, because of the scale of the event and a large volume of calls, vulnerable customers were unable to register. Many of these customers were also unable to attend the water distribution station and were not able to purchase an alternative supply of water from the supermarket. This resulted in a loss of resilience for these customers and highlighted the need for WSP's to ensure there is greater awareness of the need for vulnerable customers to register prior to any event.

Objective 3 sought to understand individual attitudes and perceptions of water supply failure. This was achieved through the analysis of the individual householder questionnaire which explored general attitudes and perceptions to water supply failure (Chapter 5) and analysis of the Facebook comment dataset to explore attitudes and perceptions during an extreme event (Chapter 6).

The results of the individual homeowner questionnaire demonstrate how the majority of respondents perceive water supply failure to be low risk. This was partly due to a lack of experience of this hazard but also because respondents expressed a great deal of confidence in the ability of the WSP's to provide a reliable, continuous and safe supply of water. While many of the respondents did not perceive they actively prepare for water supply failure, it was perceived as *'extremely likely'* they would purchase water from the supermarket. This was supported through the analysis of the Facebook comments where many of the

customers stated they had purchased an alternative supply of water from the supermarket.

The results of Chapter 5 indicated a high level of trust in the provision of a service by the WSP. However, the results of the Facebook comment analysis demonstrated negative attitudes and perceptions towards the WSP and the provision of a service. This was largely the result of a perceived inability of the WSP to provide customers with accurate and timely information regarding the location of water supply failure, estimated timescales when the water supply would be restored and information regarding the provision of an alternative supply of water. A failure to provide this information prevented customers from being able to achieve resilience to water supply failure and take adequate measures to prepare.

7 CHAPTER 7 – ACHIEVING RESILIENCE TO EXTREME EVENTS THROUGH COLLABORATIVE WORKING PARTNERSHIPS

7.1 Introduction

Chapter 4 explored the relationship between LRF's and local community groups. It was perceived that working collaboratively with local communities strengthens the process of emergency management through the development of strong relationships. These allow for the sharing and exchange of local knowledge and information, the development of mutual trust, the provision of an additional resource and a shared perception of risk. But how are these relationships formed and how can they be sustained over a long period of time?

Within Chapter 5, customers perceived they were more likely to obtain information regarding hazards in their local area from friends or family and during an emergency (Chapter 6), there were many examples of altruism with friends, neighbours and the local community providing assistance to vulnerable customers. Having a route into the community may provide WSP's with access to additional resources during periods of water supply failure. The local community may be able to provide information regarding access routes and suitable locations for water distribution stations, as well as provide assistance in the distribution of alternative supplies of water to vulnerable customers.

The evolutionary development of an isolated rural, community-led Flood Group and a local authority-led Flood Board was explored through a series of semi-structured interviews using the methodology described within Chapter 3 (Section

3.7.1). Throughout the interview process it became evident the participant had developed an extensive social network. This involved establishing connections with other isolated rural communities, local authorities and responder organisations to develop a sustainable collaborative working partnership focussed on the mitigation and alleviation of flooding. Through participatory action research, the evolutionary development of the flood action group was documented through a series of social network graphs using the methodology described within Chapter 3 (Section 3.7.1).

The social network graphs were developed from the perspective of one individual within the local community who had direct experience of establishing a network of connections with local authorities and responder organisations (Chapter 3, Section 3.7.1). They were developed to understand how communities use relationships and connections with other organisations to build resilience to emergency situations. The social network graphs include a connection with the local WSP. As discussed within Chapter 3, (Section 3.7.1), this relationship was developed so the local community could work together with the WSP to alleviate the consequences of surface water flooding. The analysis of Facebook comments Chapter 6, (Section 6.3) highlighted the difficulties encountered by WSP's in the distribution of alternative supplies of water. This research explores whether these relationships could be used to support WSP's during water supply failure incidents in the distribution of alternative supplies of water. A greater understanding of how these networks are formed may also provide insights regarding the effective communication of information during a water supply failure incident.

This Chapter documents the development of a flood group to investigate how the bottom up approach to emergency management can help to achieve resilience to extreme events through collaborative working partnerships (Objective 4, Chapter 1) and whether these social networks can be utilised by WSP's to improve resilience to water supply failure. This will be explored using the research questions presented in Chapter 1, (Section 1.4, Objective 4).

7.2   The development of a Social Network

The development of a community-led Flood Group and a Local Authority-led Flood Board is documented within the following series of social network graphs. The graphs are in chronological order with each graph representing an action toward the establishment of the group. The process of developing the Flood Group and the Flood Board is documented to understand the challenges integrating the community in the emergency management system.

7.2.1 Phase 1 – Response to the postal questionnaire

During February 2014, a Parish Councillor contacted Councillors within the County and District Local Authority to propose the development of a Flood Group. This was partly to ensure local Town and Parish councils at risk of flooding were actively involved in the flood risk management process but also to ensure adequate preparedness for future flood events. It was proposed the Flood Group should comprise members of the County and District council together with representatives from the local Town and Parish Councils, the Environment Agency and Emergency Responders. The group would be developed to share

knowledge and information regarding the cause of flooding within the local area and to collaborate in the decision making process regarding future flood risk management. This would include working in partnership to campaign for government funding and share good practice in the development of flood plans and future flood groups. It was perceived by the Parish Councillor that because flooding is location specific, flood risk management decisions need to be made at the local level involving the local community. While the local community may not perceive themselves to be *'experts'*, they possess local knowledge and experience of flooding within their local area and should be involved within local flood risk management decisions:

> *"..risk management needs to have a relationship with the location"*

> *"More important if you are looking at sets of civil disasters ….. public expectation of experts requires experts to have a link to it…. the community think experts are experts and don't acknowledge themselves as experts….. key thing communities want is the organisation to have local knowledge"*

The ability to obtain government funding for local flood protection schemes was also discussed throughout the interview process. In order to obtain funding for certain community schemes the participant was required to attend community workshops. It was perceived this represented a standardised *"one size fits all"* approach to community preparedness and did not allow for the heterogeneity that exists between different community groups and the different challenges they may face in terms of flood risk. It was also discussed within the literature review (Chapter 2, Section 2.5) that communities are naturally heterogeneous and susceptible to different threats and hazards depending on location, community

structure, community cohesion and socio-economic status (Gilchrist, 2009; Paton, 2003; Paton *et al,* 2001). It was perceived that through the development of collaborative working partnerships this may enable a greater understanding of the challenges faced by community groups.

Recent flood events had also raised awareness at a national scale of the difficulties experienced by communities at risk of flooding. Members of Parliament and the Prime Minister were visiting locations that had been affected by flooding and with widespread media attention were proposing measures to increase funding for flood mitigation. This was perceived by the Parish Councillor as a good opportunity to highlight the difficulties within their local area.

> *"Now that there is likely to be a national re-think on approaches to flood mitigation, it seems absolutely the right time to try and make the voice of [Location] heard and to influence the way in which funding is allocated to help protect our communities as far as we can from flooding. However important major flood-defence schemes are for some areas, not least in our own county, flood-mitigation in [Location] depends far more on inspection and maintenance of main rivers and ordinary watercourses by the relevant authorities, on finding ways of dealing with run-off and surface-water into our rivers and onto our roads and on addressing the sewage and drainage infrastructure which cannot cope with current demands. These may not be as exciting as major schemes but they would keep a lot of households in this area dry and free from the misery of flooding."*

It was 7 months before a meeting was arranged to discuss the formation of the group. During this period the Parish Councillor who resides within the local community TP008 (Figure 7.1), contacted all of the Town and Parish Councils within the district to request information regarding flood risk within their local area.

This was in the form of a postal questionnaire and included questions relating to whether the community had a local flood plan, the source of local flooding, current and future mitigation measures and the number of properties at risk. The response to the questionnaire also included the organisations that each Town and Parish Council had a connection with regarding flood mitigation measures. This information provided the initial starting point of the social network analysis and defined the boundary for analysis (Figure 7.1).

However, not all of the Town and Parish Councils responded to the questionnaire despite two follow up procedures including email and telephone. There may be other connections and relationships between organisations and the Town and Parish Councils that have not been included because they are unknown. From direct conversation with Clerks from the Town and Parish Council that did not respond, the participant stated within the interview that:

> *"Some Clerks I didn't get an answer from, some didn't care and others didn't think they had a problem"*

One Parish Council was very interested in resilience but did not want to be part of the Flood Group because they were already part of a Resilience Forum Group. It was perceived by the participant that Resilience Forum Groups were developed around a *"command and control'* approach to emergency situations and were more effective during the actual emergency:

"Flood groups aren't interested in this approach. They concentrate on flooding and helping people prepare. They do all the prep and planning. A lot deploy before and go home before the river rises. Other types of resilience concentrate on during the emergency whereas flood groups are the before and after people."

The participant also perceived that Resilience Groups and Flood Groups attracted different types of people because they need to perform a different role:

"Not about floods themselves, it is about the circumstances currently for flooding…..a lot more groups have to be lobbying groups and a different type of person is attracted to lobbying than action groups. Because flood groups have had to lobby so much and people who are in resilience groups don't necessarily have to do it, but flood groups live in locations at risk."

It was perceived that members of a Flood Group understand the risk of flooding to their property because they reside within locations at risk of flooding and may have had direct experience of a flood. This may drive individuals to become actively involved in *'lobbying'* for flood mitigation within their local areas.

The social network graph presented in Figure 7.1, represents the initial stage in the development of the Flood Group and is loosely representative of the local government structure within the UK. OR003 and LA002 are directly connected to the local Town and Parish Councils because they represent local authorities at the district level and LA001 represents the County Council. The social network also includes connections that have been established between local Town and Parish Councils and other organisations involved in flood risk management as indicated in response to the questionnaires. The local community TP008 is included within a cluster of Town and Parish Councils within the centre of the

social network graph and connected to organisations involved in flood risk management through the sharing and exchange of knowledge, information and advice related to flood mitigation. However, these connections have resulted in a loose and sparsely connected network with large structural holes where Town and Parish Councils act as bridging connections between the district local authorities (OR003, LA002), the County Council (LA001) and organisations involved in flood risk management (OR001, OR004) There was no evidence within the questionnaires of a local community working together with a group of organisations or local authorities, instead each community indicated they worked together with one organisation to alleviate a specific flood related matter for which that organisation is responsible. It is not possible to assess whether these organisations work together to discuss the requirements for each individual community as this information was not available within the questionnaires.
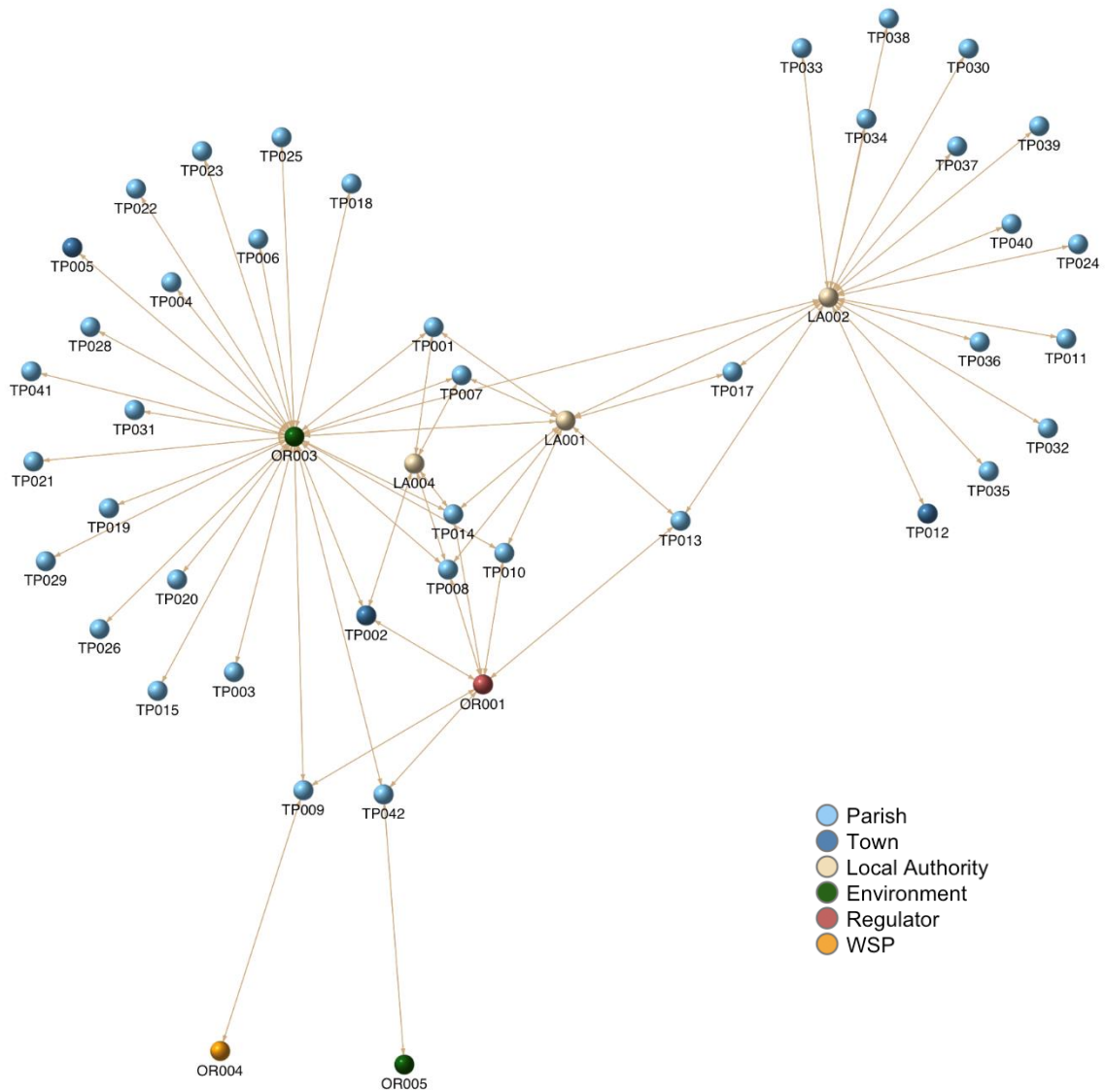
Figure 7.1: Social network graph showing the connections between local Towns and Parish Councils, Local Authorities and organisations involved in flood risk management.

The social network graph can be used to present a visual representation of the connections that exist between local Town and Parish Councils and the organisations involved in flood risk management. However, they do not provide any indication of the difficulties that were experienced by local communities when working together in collaboration with these organisations. How these

relationships develop and the strength of the relationship can have a strong influence on how the social network develops over time and the ability of a community to access resources (Aldrich and Meyer, 2015: Murphy, 2007: Dynes, 2002). Community representatives have established strong and trusted relationships with members of the Local Authority and responder organisations. However, organisational changes have affected these relationships to the detriment of the local community. For instance, there were examples where the responsibility for particular flood risk management issues were moved to different departments and although they were within the same organisation, this was very confusing for the local communities. This was because they did know who they needed to contact regarding specific issues within their community.

Difficulties were also experienced when a technical representative from an organisation was promoted and ceased to be the point of contact for the local community. It was very difficult for the local community to establish a new relationship within the organisation because the promotion also resulted in an organisational change and it was not confirmed if there would be a replacement. The local community felt they were being ignored by the organisation because there was no longer a point of contact to assist with technical flood risk management advice and information. This was further reinforced when the local community attempted to contact the organisation and were informed community engagement was no longer considered to be a top priority. The local community had invested a great deal of time establishing what they perceived to be, a strong and trusted collaborative working relationship and were left confused and disappointed with this response. When the local community were eventually provided with a point of contact into the organisation, this was no longer a

technical representative but a post that had been specifically created for community engagement. This was perceived as a lost opportunity because it was the technical aspects of flood risk management that the local community required assistance with. In order to gain technical information the local community perceive they now have to go through many different departments which requires a great deal of time and resource both for the local community and the responder organisation. Aside from the difficulties that were experienced there were also examples where relationships between different organisations were re-established:

"When [Name] heard [Name] was involved, she asked to come as well because it worked so well in the 90's she remembered and invited [Name] to rekindle the relationship."

Representatives from different organisations were eager to re-establish collaborative working relationships they perceived to be very effective in the past. This demonstrated the importance and effectiveness of these relationships despite an organisational re-structure resulting in their decline.

The returned questionnaires did not provide information regarding whether Towns and Parish Councils were connected to each other. This information was provided within the semi structured interview from the perspective of the participant and is therefore subject to confirmation bias. There may be other connections and relationships that were not included because they are unknown.

7.2.2   Phase 2 – post questionnaire

The provision of information from Town and Parish Councils allowed the participant to understand how many communities were affected by flooding and were involved in measures to actively prepare. It also allowed the participant to assess the need for a community driven flood group. The majority of communities that responded had developed a community flood plan for their local area. They were aware of the source of flooding, the approximate number of properties at risk and were actively engaged in flood mitigation with local authorities and responder organisations. This indicated that awareness of flood risk was high among these communities.

The Town and Parish Council's that did respond to the questionnaire are perceived within the social network graph (Figure 7.2) as weak connections to TP008. This is because the connection represents the sharing of information in response to a questionnaire and does not assume that a relationship has been formed at this stage. The act of responding to the questionnaire has resulted in a more connected network reducing the presence of large structural holes and increasing the density of the network (0.080).
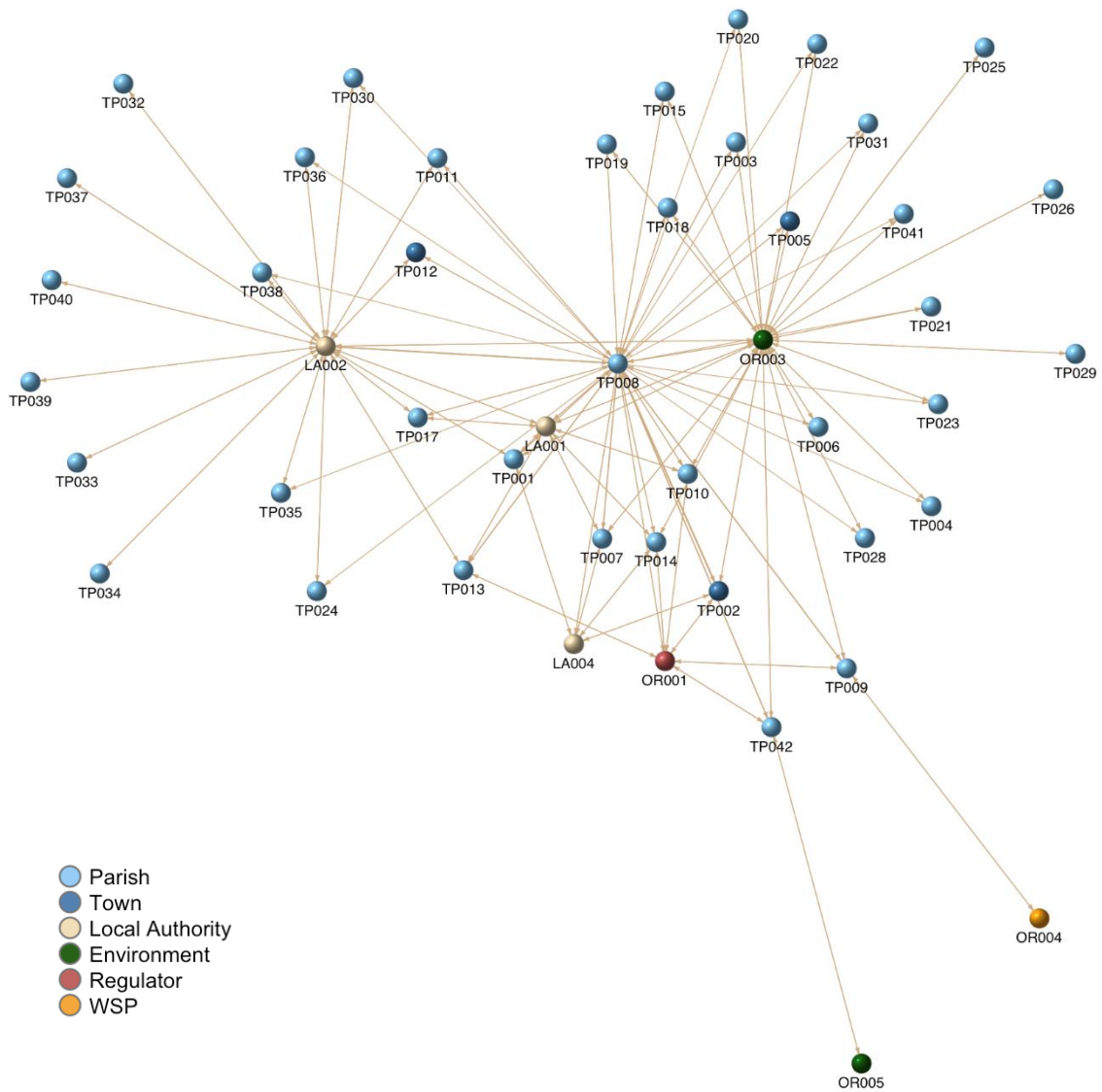
Figure 7.2: Social network graph showing connections with local Towns and Parish Councils that responded to the questionnaire.

The structure of the network has changed as a result of the distribution of the questionnaires and the resultant response. This initiated the development of weak connections between TP008 and many of the Town and Parish Councils within the local area. The connection was based on the sharing and exchange of information related to flood risk management. This resulted in an increase in prominence of TP008 who now occupies a more central position within the

network. The presence of bridging Town and Parish Councils are no longer as prominent within the visual representation of the social network graph because these are now also connected to TP008.

7.2.3 Phase 3 – Formation of the Flood Group
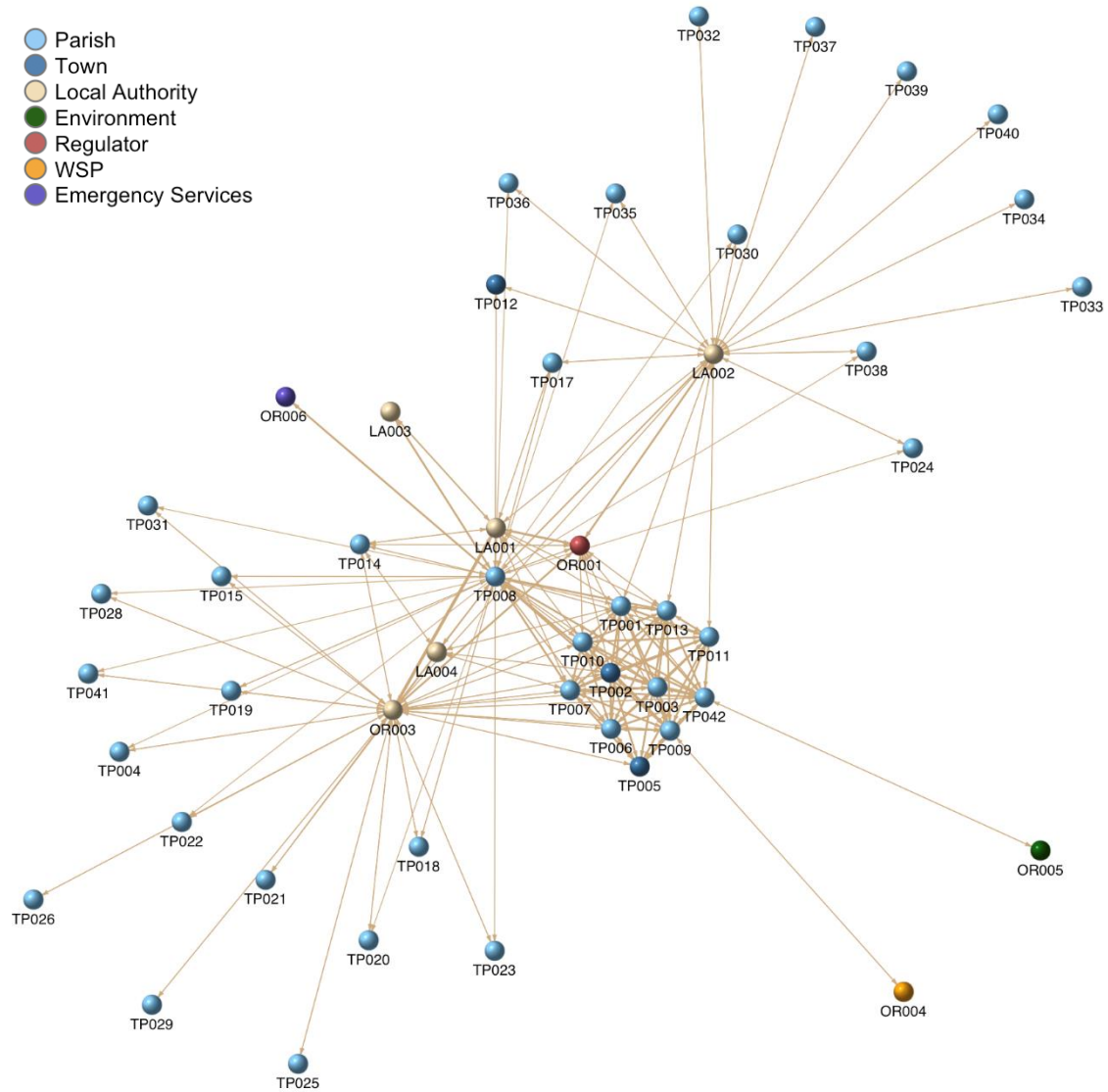
Figure 7.3: Social network graph showing connections developed during the formation of the Flood Group.

Following the return of the questionnaires, all of the local Town and Parish Councils were invited by TP008, to a meeting to discuss the formation of the Flood Group (Figure 7.3). It was intended that volunteers from each Town and Parish Council would represent their community regarding flood risk management decisions within their local area. However, not all of the Town and Parish Councils responded and many did not attend. Of those that did attend, there was an agreement to continue with the formation of the Flood Group.

During June 2014, the intention of the Flood Group was developed into a discussion document which contained information regarding the purpose of the group, the cause of flooding within the local area, the results of all of all of the returned questionnaires, the current approach to flood risk mitigation and future requirements for flood mitigation. This was developed by the Town and Parish Councils that agreed to participate in the Flood Group.

The Town and Parish Councils that participated in formation of the Flood Group are perceived as strong connections within the social network graph (Figure 7.3). These represent the development of relationships because they agreed the aims and objectives of the Flood Group and worked together in the formation of the discussion document. The local Towns and Parish Councils that did not respond are still connected but are represented as satellites on the edge of the network. Although these communities were invited to attend the discussion group, they did not respond.

The Flood Group is evident in the visual representation of the social network graph as a dense cluster of highly connected Town and Parish Councils (Figure 7.3). These connections contribute to an increase in the density of the network (0.125) and start to occupy a more central position. The Town and Parish Councils that did respond to the questionnaire but did not wish to participate in the formation of the Flood Group are perceived as weaker connections to TP008. These communities remain connected because it was perceived by the participant that these communities could also be requested to assist the Flood Group even though they did want to become active members. Organisations such as LA003, OR005 and OR006 have been pushed toward the periphery of the network because they are only connected to one or two local communities.

7.2.4 Phase 4 – Establishing relationships between the Flood Group, Flood Board and local communities

During September 2014, the Local Authority invited the Town and Parish Councils to discuss the formation of a local authority-led Flood Board. This would comprise local authorities, responder organisations, the WSP for the local area and representatives from the Flood Group. In order for the Flood Group and the Flood Board to work together in partnership, it was necessary for both of these groups to become a formal entity. During October 2014, the Flood group held its first Annual General Meeting (AGM) with elected members designated formal roles and responsibilities. This also provided a strategic direction to the group in the form of an agreed schedule of regular meetings and agreed representatives to attend the Flood Group with matters requiring discussion and attention from the local communities.
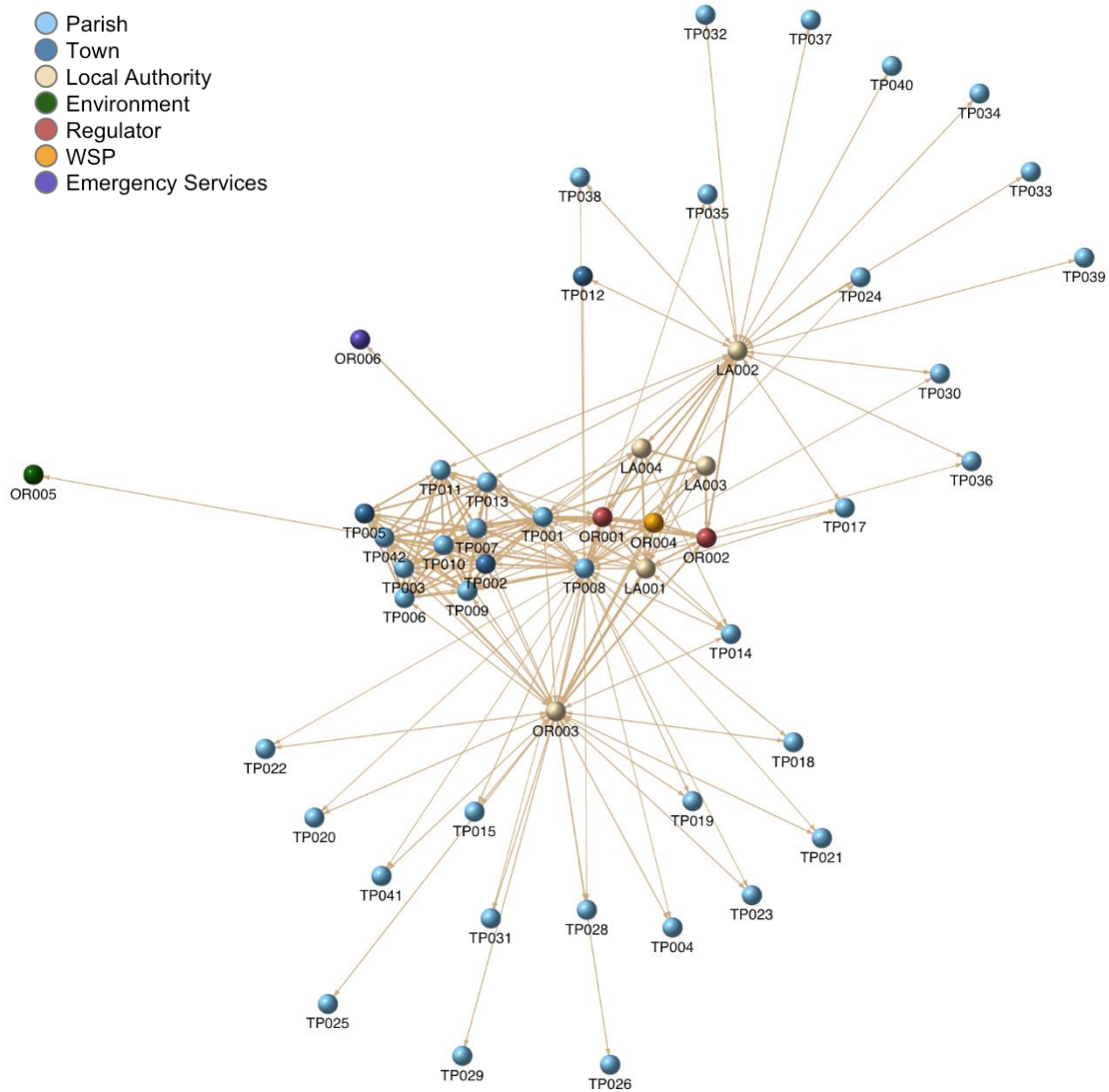
Figure 7.4: Social network graph showing connections between the Flood
Group and the Flood Board

The formation of the Flood Board and the Flood Group is represented as a highly
connected cluster of local authorities, organisations involved in flood risk
management and Local Town and Parish Councils (Figure 7.4). While this part
of the network has become more highly connected, it was perceived by the
participant that connections also exist with the local communities on the periphery
of the network and they can be called upon for assistance if it is required in the
future. The formation of the Flood Group and Flood Board provides an example

of how a local community may become partially integrated within the emergency management system through the development of a collaborative working partnership that requires both a '*bottom up*' and a '*top down*' approach.

The evolutionary development of the social network demonstrates how an active member of the local community can strategically influence the development of an effective network, increasing access to resources providing the local community with the opportunity to participate in decisions relating to flood risk management. The formalisation of relationships between the local Town and Parish Councils and the Local Authority and responder organisations through the development of a Flood Group and a Flood Board provides an opportunity to develop a network that is sustainable throughout periods of organisational change and changes within the local community. The development of collaborative working partnerships also demonstrates the application of a '*bottom up*' and a '*top down*' approach to achieving resilience within the emergency management system.

It could be argued that this represents an ego centric network that relies on the presence of one individual to ensure the network remains active. However, the process of making the Flood Group a formal entity with a terms of reference, strategic integration and inclusion within the Flood Board and the requirement of an AGM ensures sustainability of the group over a period of time.

Having a community representative present on the Flood Board provides an opportunity for the community to discuss the challenges involved with effective

emergency management within their local area. These may result from the physical dynamics and characteristics of their natural environment. For instance, there is the potential for main arterial roads to be flooded which could result in the isolation of communities during periods of heavy rainfall and prevent access to emergency vehicles. The sharing of this information within a collaborative partnership may help in the development of practical solutions and allows the local community to actively participate in decisions relating to flood risk management within their local area.

Working collaboratively with the local community, allows the organisations involved in flood risk management to discuss the challenges they face during periods of high activity. This contributes to managing expectations through a greater understanding of roles and responsibilities and a shared perception of risk which is of particular benefit during an emergency.

7.3   The evolution of actor prominence within the network

As discussed within Chapter 3 (Section 3.7.1) social network analysis may also be used to understand actor prominence through the centrality measures of betweenness centrality and degree centrality. These were also calculated throughout the development of the social graphs using the social network package, igraph and used to demonstrate the change in actor prominence throughout the development of the Flood Group and the Flood Board (Table 7.1).

| | Stage 1 | | Stage 2 | | Stage 3 | | Stage 5 | |
	Degree Centrality	Betweenness Centrality	Degree Centrality	Betweenness Centrality	Degree Centrality	Betweenness Centrality	Degree Centrality	Betweenness Centrality
OR003	54	1559	54	1054	56	869	60	903
LA002	34	1056	38	813	40	812	46	852
LA001	18	155	18	56	22	49	28	43
TP009	6	96	7	93	28	99	28	9
TP042	6	96	7	93	28	99	28	101
OR001	14	42	14	48	20	30	28	36
TP013	6	30	7	10	28	39	28	34
TP014	8	26	10	9	10	4	10	2
TP008	8	26	52	610	61	685	63	636
TP002	6	20	7	8	28	14	28	11
TP001	6	16	10	14	28	52	36	63
TP013	6	30	7	10	28	39	28	34
TP011	2	0	4	0	24	35	24	30
LA004	10	8	10	8	10	2	18	16

Table 7.1: Results of degree and betweenness centrality calculations throughout the development of the Flood Group and the Flood Board
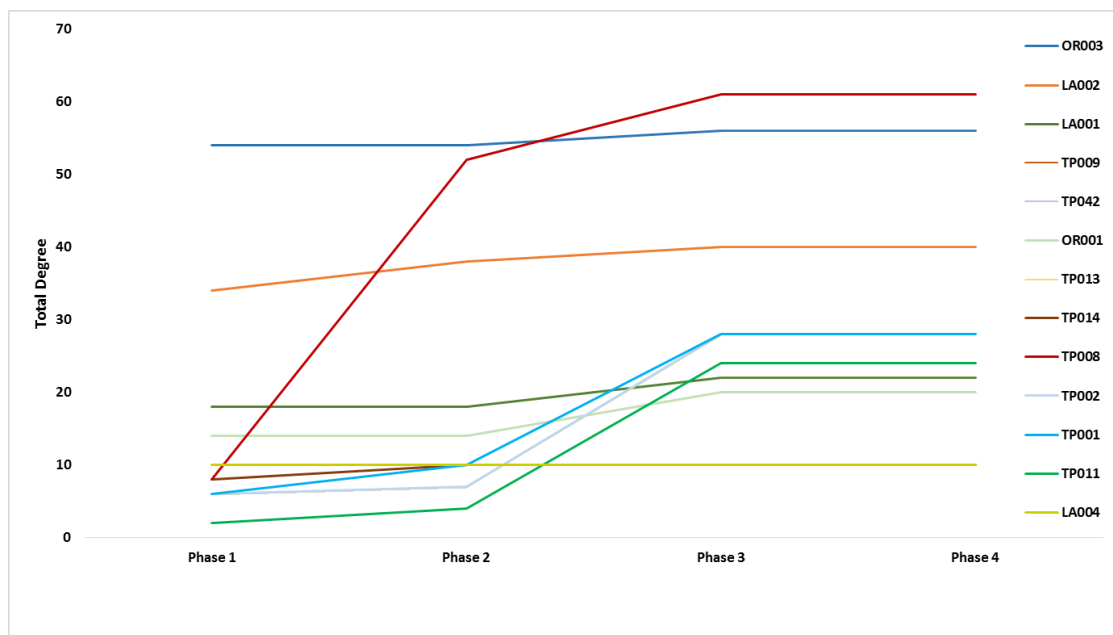
Figure 7.5: Graph demonstrating the change in degree centrality of Town and Parish Councils throughout the development of the Flood Group and the Flood Board.
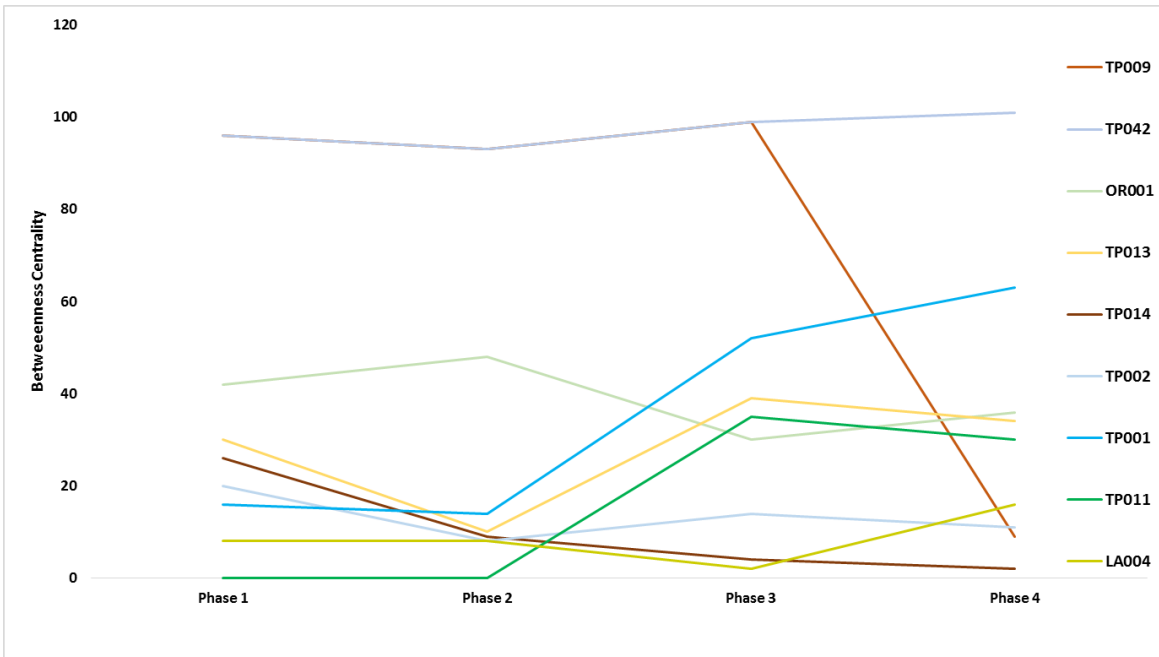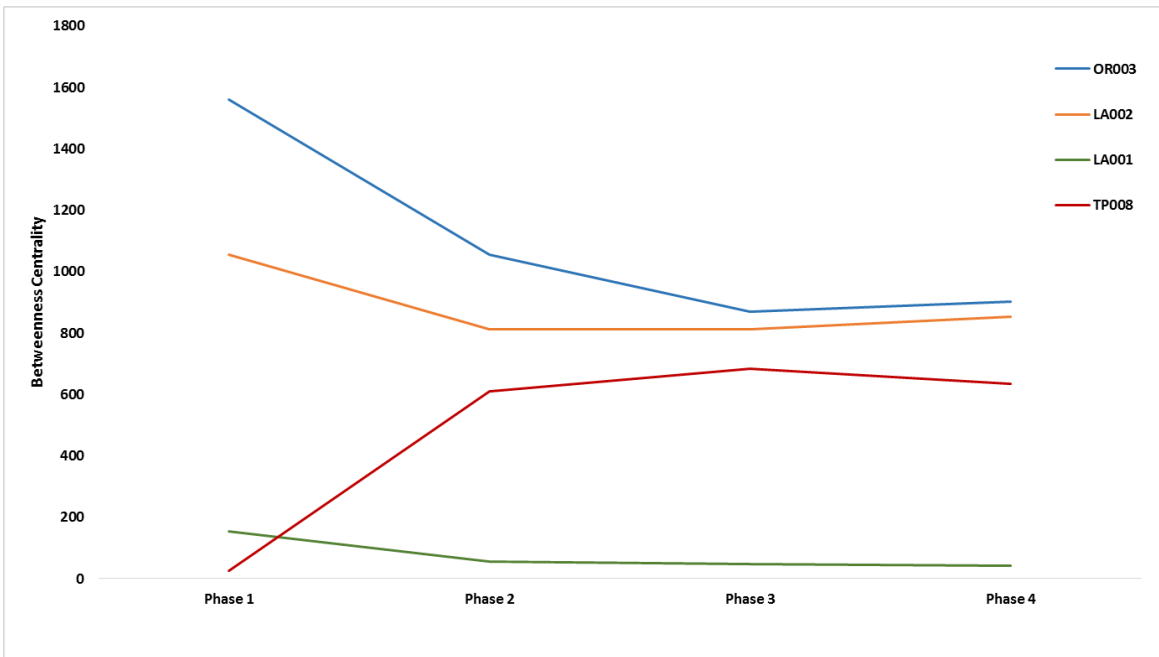
Figure 7.6: Graph demonstrating the change in betweenness centrality of Town and Parish Councils throughout the development of the Flood Group and the Flood Board.

During the initial phase (Phase 1) and prior to the development of the Flood Group it is evident that the Local Authorities had the greatest degree centrality (OR003, 54; LA002, 34 and LA001, 18) and betweeness centrality (OR003, 1559; LA002, 1056 and LA001, 155). Whereas, the local community TP008 had a relatively low degree centrality of 8 and a betweenness centrality of 26

It is evident (Figure 7.6 and Figure 7.7) that throughout the development of the Flood Group and the Flood Board there was an increase in the degree centrality and betweennness centrality of many of the local Town and Parish Councils. This increased as they became part of the Flood Group and worked as part of a collaborative working partnership.

As a prominent actor throughout the process, TP008 demonstrates a rapid increase in degree centrality (Figure 7.6) following the distribution of the questionnaires and the formation of the Flood Group. A high degree centrality would suggest that TP008 is very influential within the network because they are able to share information with a large number of actors within the network.

Although there was an increase in the betweenness centrality of TP008 throughout the development of the Flood Group, it is the Local Authorities OR003 and LA002 that have the greatest betweenness. This is because they are directly connected to a greater number of Town and Parish Councils within the network. This suggests that the Local Authorities have a greater influence within the

network from a structural perspective and occupy a more central position enabling control over the flow of information within the network.

7.4   Application to Water Supply Failure

This case study represents the partial integration of local community groups within the emergency management system and was analysed to understand how these networks may be used to strengthen resilience during periods of water supply failure.   This may be through the sharing and exchange of information between the WSP and an affected community or to support the distribution of alternative supplies of water.

However, while the local community groups are in contact with the Local Authorities and responder organisations there is no evidence within the case study of how these relationships can be integrated within the wider system of emergency management at the level of the LRF's.   If the Local Authority is represented at the LRF this may provide the opportunity for the existence of these relationships to be known.

There was a great deal of discussion within Chapter 4 relating to the difficulties sharing information between organisations regarding vulnerable customers. During events of water supply failure this information is vital to ensure vulnerable customers who are unable to attend a water distribution station are able to receive an alternative supply of water.   It was perceived that many of the organisations had the same information but were not able to share this because of data

protection. This is detrimental to effective emergency management and has the potential to prevent assistance being provided to people that need it the most.

Within Chapter 6 (Section 6.5.2), customers posted examples on Facebook of local community groups that were providing assistance to vulnerable members of the community. However, this information was being provided by the local community to the WSP's. If the WSP's had access to established links within the local community either through the LRF, or the Local Authority, this would enable WSP's to work together with the local community to provide an alternative supply of water to those affected. The local community would be able to provide the WSP with information regarding access routes and provide an additional resource in the distribution of alternative water supplies. Within this case study the WSP is represented within the Flood Group and this is partly the result of relationships that had been established direct with the local community to alleviate problems of drainage and surface water flooding. These relationships are not necessarily present within other community flood groups.

Rural communities have an identifiable structure in the form of a local Town or Parish Council and it is arguable as to whether there is a greater sense of community within rural locations. There were also examples within the Facebook comment dataset provided by customers (Chapter 6) of a sense of community within urban locations. However, this case study demonstrates there are also difficulties establishing links between the local community, local authorities and responder organisations. Particularly during periods of organisational restructure and when representatives become promoted within their organisation. When

established relationships cease to exist, it can become difficult for community groups to re-connect with the organisation. It is also difficult for local authorities and other organisations involved in flood risk management to establish a relationship with a local community in a flood risk area if they do not perceive their community to be at risk because they have not experienced flooding and perceived their community is protected by a flood defence. This reinforces the importance of having an engaged local community ('*bottom up*') and an engaged local authority ('*top down*').

While it may be more difficult to identify urban community groups, it is important that these are explored because they may also provide access to a wider resource, particularly with regard to the distribution of alternative supplies of water to vulnerable customers. There were many examples of altruism during the March 2018 water supply failure event with WSP customers offering to deliver alternative supplies of water to those in need.

Another difficulty encountered by customers during the March 2018 event (Chapter 6) was a lack of information regarding the cause of water supply failure and when the water supply would be restored. While this research focussed on the attitudes and perceptions of customers throughout this event, there were also many examples of misinformation being posted by customers on Facebook. If WSP's have access into the local community this may provide an opportunity to control the spread of misinformation more effectively. This is important because there are many customers who do not have access to social media and as evident from the response to the individual householder questionnaire (Chapter 5), will

seek information from family or friends. If this information is obtained direct from the WSP, it will reduce the opportunity for misinformation to spread.

7.5   SUMMARY

This case study has highlighted the benefits of local communities working together with local authorities, and organisations involved in flood risk management. While the development of these relationships require a great deal of time and resource they provide a source of additional resource and allow the sharing and exchange of information and knowledge. These relationships also allow for collective decision making and building trust between local communities, local authorities and responder organisations.

7.5.1 How did the local community within the case study develop and establish relationships with the Local Authorities, Responder Organisations and the WSP?

The development of relationships between the Local Authority and the local Town and Parish Councils were originally an example of a *'bottom up'* approach, initiated by a highly motivated group of volunteers within the local Town and Parish Councils. However, the Local Authority formalised these relationships integrating representatives of the Flood Group within the flood risk management system, through the establishment of a Flood Board. This provided an example of a *'top down'* approach and demonstrates the successful integration of local

communities within the emergency management system requires both a *'top down'* and a '*bottom* up' approach.

A highly connected network of Local Town and Parish Councils, local authorities and organisations involved in flood risk management was established throughout the development of the Flood Group and the Flood Board. These relationships have the potential to increase social capital and collective action towards the alleviation and mitigation of flooding within the local area. However, difficulties were also experienced when established relationships were lost as a result of organisational restructure and within organisation promotion. This resulted in the loss of expertise required for effective flood mitigation and left community groups feeling isolated and ignored. Strong and established relationships promoted the development of trust between the local community and organisations involved in flood risk management. However, this is very easily lost if these relationships are not maintained.

7.5.2 How does the process of building collaborative working partnerships contribute to improving resilience for local communities?

The ability to provide an effective emergency response during extreme events required the collaboration and cooperation between multiple different agencies including local community groups, local authorities and responder organisations. This can be achieved through the process of building collaborative working

partnerships and provides an opportunity to combine local knowledge and technical expertise to develop innovative solutions to complex problems.

Throughout the development of the social network the increase in connections and relationships provided additional support through the sharing of knowledge and information. Support was also provided between the local Town and Parish Councils through the development of the Flood Group. This increased the potential access to resources in the form of assistance during a flood situation depending on the extent of the flood and how many communities were affected. Also, the act of meeting regularly and sharing information and knowledge related to their local area enhances the ability to offer and provide assistance if it is required during an emergency.

Local community groups required technical expertise from Local Authorities and other organisations to initiate flood mitigation strategies within their local community. In return they were able to share local information and knowledge regarding the flood characteristics of their local environment. This sharing and exchange of knowledge and information promoted the development of strong and trusted relationships. These encourage a shared perception of risk because the Local Authorities, the organisations involved in flood risk management and the local Town and Parish Councils have a greater understanding of roles and responsibilities, resources available and the local environment. There is the potential to perform collective *'lobbying'* for increase flood mitigation funding and less attribution of blame if everyone is working collaboratively towards a common

goal. However, in order to build resilience, this process must be dynamic and sustainable.

7.5.3 What are the challenges integrating the community into the emergency management process?

For any community driven or local authority-led group, it is important to ensure sustainability over time. This was achieved within this case study through the formalisation of the Flood Group and the Flood Board. However, the development of these groups was resource intensive and required the motivation and determination of individuals within the community supported by the Local Authority. This is relatively easy to achieve where good relationships exist and would be difficult to achieve if relationships are strained. The ability to work together collaboratively towards a common goal is very important and must be clearly defined within the terms of reference for Flood Groups. This would encourage collective action and prevent the breakdown of relationships. Also as this case study demonstrated, in order to effectively integrate the community within the emergency management process requires both a *'bottom up'* and a *'top down'* approach.

Establishing integrated social networks prior to an emergency, increasing social capital, provides many advantages for both the community and the responder organisations (Aldrich and Meyer, 2015; Murphy, 2007; Dynes, 2002). The process of attending regular meetings and establishing relationships helps to

build trust, strengthen relationships and allows for the development of a shared perception of risk. This is enhanced through a greater understanding of the roles and responsibilities of the responder organisations and the ability of the community to cope without external support. This helps to manage realistic expectations of what is achievable during an extreme emergency situation by promoting more effective collective action before, during and after an emergency.

Establishing a network through a collaborative and participatory approach may also allow for more effective communication of information before, during and after an emergency. If used effectively this can be used to improve situational awareness particularly in situations where there is considerable strain on resources available for emergency management. The ability to share resources is more accessible through a collaborative and coordinated network and if WSP's are able to access this network this may strengthen emergency response during periods of water supply failure.

This Chapter sought to investigate how the bottom up approach to emergency management can help to achieve resilience to extreme events through collaborative working partnerships. This was achieved through the process of participatory action research to understand the evolutionary development of a community-led Flood Group and its integration with a local authority-led Flood Board.

The following Chapter will explore how resilience can be achieved within the wider context of the emergency management system in the UK through the triangulation of results obtained within this Chapter and Chapters 4, 5 and 6.

8   CHAPTER 8 – A SYSTEMS BASED APPROACH TO EMERGENCY MANAGEMENT

8.1   Introduction

The concept of resilience is a complex and dynamic process that operates on many different levels within society from the resilience of the individual (Paton, 2006; Luthar *et al,* 2000), community resilience (Patel *et al,* 2017; Gilchrist, 2009), inter-organisational resilience (Boin and McConnell, 2007; Smith and Dowell, 2000), and institutional resilience at the level of government (Djalante, 2012; Aoki, 2016).   This categorisation of resilience demonstrates that resilience is often interpreted within the contextual confines of one particular element of society and the relationship between different categorisations of resilience is rarely explored. However, this approach may create difficulties with the practical application of resilience and the ability to achieve societal resilience to extreme events.

It was proposed by Carpenter *et al,* (2001), that in order to achieve resilience it is necessary to contextualise resilience in terms of *'resilience of what … to what'*. This approach is useful when attempting to understand resilience within the context of a particular problem for instance, the resilience of a local community to water supply failure.   However, this only explores the context of resilience within one particular part of a system.   It is also necessary to explore resilience within a wider context to understand whether achieving resilience in one part of the system will influence the ability to achieve resilience within another. Chapter 1, (Section 1.3) demonstrated how a lack of understanding with regard to the consequences of water supply failure within the context of a wider system led to a negative reinforcing feedback loop and the perpetuation of water system failure.

This reinforces the complexities associated with applying the concept of resilience and because it operates on different levels within society, it is necessary to explore and understand these complexities if societal resilience to extreme events is to be effectively applied in practice. This requires an integrated approach involving individuals and communities, organisations, industry and government institutions. However, in order to develop an integrated approach a greater understanding of the system structure is required (Pagano *et al,* 2017; Franchin 2018). This involves understanding how each element of the system is connected and the influence these connections have on achieving the overall function or purpose of the system (Meadows, 2008).
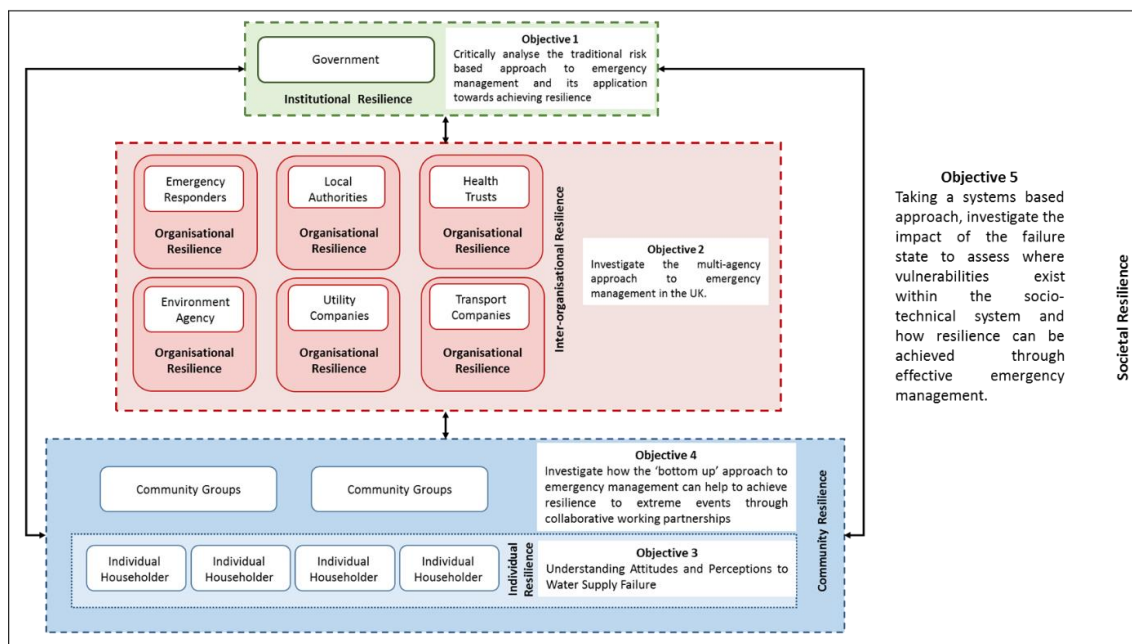
Figure 8.1: Simplified system of emergency management in the UK and the Objectives used to examine each element of the system. (The colour scheme will also be applied within Chapter 9, Section 9.3: Recommendations)

This research sought to explore how improved resilience to water supply failure can be achieved through effective emergency management. A simplified structure of the UK emergency management system was proposed within Chapter 1, (Section 1.3, Figure 8.1) and resilience within and between each structural element of the system was explored using qualitative and quantitative social research methods through a series of objectives as defined within Chapter 1, (Section 1.4).

Chapter 1 and 2 explored the academic and empirical literature to understand the concept of resilience, the traditional risk based approach to emergency management and how the UK emergency management system integrates the concept of resilience within the legislative framework of the CCA, 2004. This is operationalised through a multi-agency approach to emergency management at the local level.

Chapter 4 explored the multi-agency approach to emergency management in greater detail through semi-structured interviews with emergency management professionals from WSP's, LRF's and the Fire and Rescue Service. Participants discussed how building strong collaborative working relationships strengthened the process of emergency management. However, this approach was not supported within the framework of the existing legislation. This is because organisations that operate over wide geographical areas were not able to develop strong working relationships with multiple LRF's with different operational working practices.

Chapter 5 explored individual homeowner's general attitudes and perceptions to water supply failure. The majority of respondents had a high level of confidence in the ability of the WSP to provide a safe, continuous and reliable supply of water at all times. They did not have experience of water supply failure and perceived it to be *'low risk'* and only *'slightly important to prepare'*. While the majority of respondents did not actively prepare for water supply failure, it was perceived that during a water supply failure incident, they would take actions to purchase a supply of water from the local supermarket. This was reinforced in Chapter 6, which explored attitudes and perceptions to water supply failure during an actual emergency. It was demonstrated that customers were prepared to take action to increase their resilience to water supply failure. This included the purchase of alternative supplies of water from the local supermarket or staying with friends and relatives. However, the ability to achieve individual resilience required the provision of specific, accurate and timely information from the WSP.

In Chapter 7 the integration of communities within the emergency management system was explored to understand how resilience is enhanced through collaborative working partnerships. It was recognised that the active process of building social networks between responder organisations and the local community strengthens emergency management at a local level. The sharing and exchange of information and expertise helps to build trust and a shared perception of risk. However, these relationships take a great deal of time to develop and are vulnerable to organisational change.

This Chapter presents a systems based approach to investigate the impact of the failure state to assess where vulnerabilities exist within the socio-ecological-technical system and how resilience can be achieved through effective emergency management as detailed within Objective 5 (Chapter 1, Section 1.4). This will be achieved through the triangulation of quantitative and qualitative results presented within Chapters 4, 5, 6 and 7 to understand how the system of emergency management is connected and how this contributes to achieving resilience to water supply failure. This will be conducted using the methodology presented within Chapter 3, Section 3.8.

8.2   Understanding how the system of emergency management is connected

8.2.1 Exploring resilience within the institutional element of the emergency management system

As discussed within the literature review (Chapter 2, Section 2.5) the process of emergency management is traditionally defined by the stages categorised within the emergency management cycle.   While there are many different interpretations of this (NGA, 1979; Neal, 1997; Alexander, 2002b; Cabinet Office, 2011), each stage is driven by the prior anticipation of known threats and hazards and the assessment of risk through the cyclical transition of mitigation, planning, response and recovery. While this approach may be effective to determine the resources and capabilities required for effective emergency response to known threats and hazards, it is difficult to determine for low probability, high consequence events (Meyer, 2005; Boin and Hart, 2010; Paltrinieri *et al,* 2011).

As discussed within Chapter 1, (Section 1.1) these events are typically characterised by a rapidly changing dynamic situation where many of the threats and hazards are unknown (Park *et al,* 2013; Linkov *et al,* 2014; Butler *et al,* 2014). This requires the application of a resilient based approach (Comfort *et al,* 2010; Boin and McConnell, 2007) to understand the dynamic processes that contribute to achieving resilience within the overall context of the emergency management system. This involves understanding the structural elements of the emergency management system, how it is connected and the influence of these connections on the ability to achieve or inhibit resilience. Continually defining the process of emergency management into a series of cyclical actions or stages may contribute to the over simplification of a complex process that is not defined by a set of actions but the operational process relating to how they are delivered.

Examination of the empirical literature demonstrates how a system based approach provides an opportunity to understand how the physical and social system is connected (Bruneau *et al,* 2003; Pagano*, et al,* 2017; Franchin, 2018). However, as demonstrated within Chapter 2, (Section 2.3) there are limitations with this approach because many of these models do not fully explore how resilience operates as a complex dynamic process within the emergency management system. This is because many of these models concentrate on understanding the physical structure of the system (Bruneu *et al,* 2001; Pagano *et al,* 2017; Franchin, 2018) or the interactions within one part of the system (Kim *et al,* 2012; O'Sullivan *et al,* 2015). To understand resilience as a complex dynamic process also requires understanding the complex social interactions between organisations, individuals and communities and how these contribute to achieving resilience within and between the structural elements of the emergency

management system. This research applies a systems based approach to identify the structural elements of the system with the application of qualitative and quantitative social research methods to understand and explore the complex social interactions within and between each element of the system and how these contribute to achieving resilience to water supply failure (Figure 8.1).

8.2.2 Exploring resilience within the operational element of the emergency management system and the connection with the institutional element

Chapter 4 explored the relationships between LRF's and WSP's in the multi-agency approach to emergency management in the UK and how this is supported through the delivery of the CCA, 2004. The multi-agency approach is designed to strengthen the process of emergency management by encouraging collaboration and the sharing of information between the responder organisations (CCA, 2004; Cabinet Office, 2011). This contributes to the delivery of effective emergency response because all of the responder organisations have a shared perception of risk and understand the roles and responsibilities of each responder organisation (Perry and Lindell, 2004; Boin and McConnell, 2007). As discussed within Chapter 1, (Section 1.1 and Section 1.3) a lack of collaboration and an inability to share information regarding the failure of critical infrastructure may result in serious consequences for society (Luiijf and Klaver, 2005; Boin and McConnell, 2007; Pitt, 2008; Ofwat, 2018).

The results of the semi-structured interviews (Chapter 4) support these findings. Throughout the semi-structured interviews, WSP and LRF managers recognised

the importance of working in collaboration to share and exchange information required for effective emergency management. Participants discussed how the development of trust and building strong working relationships was enhanced though the process of emergency planning. This is through active participation in the multi-agency assessment of risk, collaboration in the development of emergency plans, attendance at multi-agency exercises and during emergency response and recovery. Throughout this process participants were able to gain a greater understanding of the complex interdependencies that exist between different sectors at an operational level. This in turn contributed to a shared understanding of risk, reinforced the roles and responsibilities of each operating organisation and enhanced collaboration through the building of trust. It was recognised by participants that these contribute to building inter-organisational resilience and the effective delivery of emergency response (Perry and Lindell, 2004; Boin and McConnell, 2007). However, lessons learned reports and multi-agency exercises have demonstrated persistent difficulties in the development of effective multi-agency collaboration and the sharing of information required for effective emergency response (Pitt, 2008; Watermark, 2011; Environment Agency, 2016; HM Government 2016; Ofwat 2018). The results of the semi-structured interviews (Chapter 4) support these understandings by exploring how current working practices within the framework of the existing legislation influence the ability to achieve effective collaboration and the sharing of information.

Within the semi-structured interviews, many of the respondents perceived there had been many changes with regard to understanding and applying the concept of resilience since the introduction of the CCA, 2004. However, because there were no defined performance measures or standards it was difficult for

respondents to assess whether resilience was being achieved. The increased use of social media by the public was also perceived as a challenge for respondents and because the legislation has remained static, there is no provision or guidance for how respondents should manage the challenges presented by social media use. While the legislation was perceived to drive the process of achieving resilience through a multi-agency approach to emergency management by bringing responder organisations together, a lack of support, direction and guidance regarding good practice was creating difficulties in the ability to achieve this.

As demonstrated within Chapter 4, effective collaboration is difficult for WSP's to achieve within the framework of the CCA, 2004. While the legislation allows for autonomy at the local level this has resulted in each LRF interpreting the legislation within the context of their existing organisational structure and taking an idiosyncratic approach to emergency preparedness. This has created difficulties for organisations expected to engage with multiple LRF's because they are not able to accommodate multiple different ways of working. To overcome the difficulties associated with multiple different ways of operating, many of the WSP's engage with the LRF's on a regional scale rather than locally. The WSP's invite all of the LRF's operating within their region to 'LRF days' where the WSP will provide information to all of the LRF's at the same time regarding their emergency operational procedures. This was perceived as an effective approach to enable WSP's to engage with multiple LRF's.

A focus on improving inter-operability between the Category 1 responders with the introduction of JESIP may alleviate some of these difficulties but problems still persist regarding the sharing and exchange of information with Category 2 responders (JESIP, 2016) This is because they are expected to engage with multiple LRF's and the focus is on understanding the command and control approach to emergency response rather than developing an integrated approach incorporating the culture of the Category 2 responders to facilitate the sharing of technical information during an extreme event.

Category 1 emergency responders typically operate within a command and control structure with an established hierarchy of command and designated roles and responsibilities. This approach is very different to the daily operational culture of critical infrastructure owners and operators. The integration of different organisational cultures has the potential to create difficulties during the multi-agency emergency response if each organisation is operating differently and does not understand how another organisation delivers emergency response (Curnin *et al,* 2015).

The command and control approach is extremely effective for routine emergencies but it has been demonstrated that this approach is not so effective when dealing with extreme events that may require an innovative approach to solve a complex problem (Alexander, 2002a; Anderson and Adey, 2012; Boin and Bynander 2015). While it is necessary to have a designated operational structure to multi-agency emergency response, it is also necessary to have flexibility to identify where a new approach or innovation may be required to

improve the operational delivery of emergency response. Participation in multi-agency exercises provides the opportunity to explore these complexities in a safe environment where an alternative approach can be developed and tested. According to participants, this also provides the opportunity to share examples of good practice and establish a common method of working that recognises how different organisations apply their expertise to resolve complex problems during emergency situations. This enhances the process of shared organisational learning, the development of trust and also contributes to a greater understanding of roles and responsibilities.

A lack of awareness and understanding by WSP's in the incident management process was identified as a problem within the Pitt report, (2008). This has encouraged many WSP's to develop a greater awareness of Category 1 operational processes and where they can be incorporated within emergency management procedures. However, as demonstrated within the *'Beast from the East'* example, this is not a consistent approach applied by all of the WSP's (Ofwat, 2018). The principles of JESIP were developed to encourage greater cooperation, collaboration and improve the sharing of information between the Category 1 responders (Chapter 2, Section 2.6). However, this did not include the Category 2 responders and while they are able to incorporate the principles within their emergency response procedures, it does not provide an opportunity to understand how emergency response is delivered within the context of their organisational culture. It was identified within the semi-structured interviews that difficulties persist regarding the sharing of information that is considered to be sensitive in terms of security. A greater understanding of the challenges

regarding the roles and responsibilities of Category 2 responders may provide opportunities to develop an innovative solution.

While the command and control approach enables the provision of a strategic direction to the operational delivery of emergency response, it is also necessary to recognise the importance of incorporating specialist knowledge and expertise to respond effectively to complex socio-ecological-technical issues involving the failure of essential services. This may require a flexible operational approach that incorporates both the principles of command and control to provide strategic direction while allowing collective innovative decision making using multi-agency expert knowledge.

Many of the respondents also discussed the loss of regional government offices. Representatives from these offices would attend LRF meetings and act as a conduit of information between the LRF's and the government. According to respondents this provided a strong connection allowing the two way flow of information between the LRF's and the Government. It also provided an opportunity to share and learn about good practice from other LRF's via the regional office representative. However, since these have been replaced by the DCLG RED (now the Ministry of Housing, Communities and Local Government) it was perceived that the flow of information back to government from the LRF is now weak.

Legislation, policies and supporting guidance need to be developed within the context of how the system actually operates under normal and extreme conditions to support multi-agency collaboration and the sharing of information (Perry and Lindell, 2004; Boin and McConnell, 2007).   However, in order to achieve this requires identifying and developing a more complete understanding regarding the complex inter-connections operating within the system of emergency management and not relying on the simplistic approach provided within the emergency management cycle. The application of a systems based approach and systems dynamic modelling demonstrate a transition toward this approach (Bruneau *et al* 2003; Pagano *et al*, 2017; Franchin, 2018).   However, as demonstrated within Chapter 2, (Section 2.3) these models do not explore the influence of legislation and social interactions to understand how these may influence the ability to achieve resilience within the system.

This research demonstrates (Chapter 1, Section 1.1; Chapter 4) that effective multi-agency emergency response relies on the sharing and exchange of information throughout the emergency management process to encourage the building of strong relationships, development of trust and a greater understanding of organisational roles and responsibilities. All of these contribute to effective multi-agency collaboration and the development of resilience within the operational element of the system. However, it is difficult for this to be achieved within the confines of the current legislation.

This would suggest the institutional element and the operational multi-agency element are connected through the 'top down' delivery of information in the form of legislation, policies and guidance documents. These may have a negative

influence on the ability to achieve resilience within the system if these are not in accordance with current operational practices and there is no process to allow lessons learned or good practice to be fed back into the system.

8.2.3 Exploring how individual people can achieve resilience within the emergency management system.

It was demonstrated within the literature review (Chapter 2, Section 2.4) that the ability to achieve individual, personal resilience to critical infrastructure failure requires a greater understanding of the relationship between an individual's perception of risk and the factors that influence preparedness (Paton 2003; Dobbie *et al*, 2016). This would enable the development of effective communication and knowledge provision strategies to encourage preparedness before an emergency and effective action during an emergency situation (Levac *et al,* 2012; Paton, 2003; Shrubsole, 2000).

The individual householder questionnaire (Chapter 5) was designed to explore individual perception and attitudes to water supply failure under normal circumstances and whether this influenced an individual to actively prepare as discussed within Chapter 2, (Section 2.4). While this provided an indication of general attitudes and perceptions it was also necessary to understand attitudes and perceptions in response to an actual event. This would provide a greater understanding of the relationship between individual attitudes and perceptions to water supply failure and whether they actively respond during an emergency.

It was discussed within Chapter 2, (Section 2.4), that attributed responsibility and societal expectations of governments, utility providers and responder organisations may influence whether an individual perceives it necessary to prepare for a hazard such as water supply failure (Levac *et al,* 2012; Paton, 2003; Shrubsole, 2000). This was supported by the results of the individual homeowner questionnaire. It was demonstrated that the majority of respondents perceive water supply failure to be *'low risk'* and *'slightly important'* to prepare. The majority of individuals have a high level of confidence in the WSP's ability to provide a reliable and continuous supply of water in all circumstances. It was also perceived that during an emergency situation the WSP would provide an alternative supply of water. This perception of attributed responsibility combined with a societal expectation of the WSP to provide water may have influenced the perception that water supply failure was *'low risk'* and therefore perceived as only *'slightly important'* to prepare (Levac *et al,* 2012; Paton, 2003; Shrubsole, 2000).

It was also discussed within Chapter 2, (Section 2.4) that an individual's perception of their surrounding environment is influenced by societal interactions and hazards (Dobbie *et al*, 2016; Paton, 2006; Paton, 2013; Donahue *et al,* 2014). This was supported by the results of the individual homeowner questionnaire (Chapter 5). The majority of respondents did not have experience of water supply failure and for those that did, the incident was reflected upon positively. This is because the situation was resolved relatively quickly and an alternative supply of water had been provided. This may also have contributed to the perception that water supply failure was *'low risk'* and only *'slightly important to prepare'*.

Although the expectation of the WSP to provide an alternative supply of water was high, a large proportion of respondents perceive they would obtain water from a supermarket in the event of water supply failure. While respondents do not perceive they *'actively prepare'* for water supply failure by storing alternative supplies of water, this response demonstrates a perceptual and attitudinal change from a passive to reactive response during an actual emergency. The transition from risk perception to taking action is complex and was examined within Chapter 2 (Section 2.4) using the framework provided by Dobbie *et al*, (2016) and the social cognitive preparation model developed by Paton, (2003). While risk perception may be influenced by an awareness of hazards within the local environment, experience, and perceptions of attributed responsibility, this does not necessarily result in the transition to take action (Paton, 2003). However, within the context of water supply failure, the results of the individual questionnaire challenge this theory because during an emergency the majority of individuals perceived that they would seek to increase their resilience to water supply failure through the purchase of alternative supplies of water. This was also supported in the analysis of Facebook comments in Chapter 6.

Chapter 6 explored attitudes and perceptions to water supply failure during an actual event, the *'Beast from the East'*. Customers from all three WSP areas demonstrated a desire to take action to alleviate their situation and become more resilient to the potential consequences of prolonged water supply failure. This included the purchase of water from the local supermarket, obtaining water from the water distribution station, staying with friends and relatives or obtaining water for vulnerable friends and neighbours. It was demonstrated within Chapter 5 and Chapter 6, the perceived responsibility to respond to water supply failure was

attributed to the WSP. However, where resources were available, individuals perceived they would take action to obtain an alternative supply of water. This was supported by the purchase of alternative supplies of water during a water supply failure incident (Chapter 6). According to Paton (2003) the intention to prepare is partly determined by an individual's perception regarding the availability of resources enabling them to respond and this is partly supported by the results of Chapters 5 and 6. While the perceived responsibility for providing an alternative supply of water is attributed to the WSP, the ability to purchase an alternative supply of water from the local supermarket increased the intention to prepare while resources are available. Once these resources became depleted or were no longer available, the intention to prepare shifted from being a responsibility of the individual to that of the WSP. This demonstrates a complex relationship between the intention to prepare and the perceived availability of resources.

However, it was not just the availability of resources that influenced an individual's intention to prepare. Individual resilience to water supply failure was difficult for many customers to achieve during the *'Beast from the East'* event because they required accurate, specific and timely information from the WSP regarding the location of water supply failure, estimated timescales when the water supply would be restored, whether an alternative supply of water was to be provided and how this would be distributed. This information would enable customers to make decisions regarding the preparations required for prolonged water supply failure and the lack of information prevented customers from being able to achieve resilience. It was demonstrated within this research that the availability of information was an important contributory factor influencing the ability to achieve

individual resilience. This was not included within the social cognitive preparation model developed by Paton, (2003) and yet, as demonstrated within this research, was an important requirement to achieve individual resilience to water supply failure.

8.2.4 Exploring resilience within the community element of the emergency management system

It was discussed within Chapter 2, (Section 2.5) how a consensus regarding community resilience was difficult to achieve (Patel *et al,* 2017; Ostadtaghizadeh *et al,* 2015; Norris *et al,* 2008) and how this may have created difficulties in the operationalisation of resilience by practitioners. The systems based approach taken by Bruneu *et al,* (2003) may provide a methodology for practitioners to measure resilience against performance based targets. However, this takes a homogenous approach to the measurement of community resilience and may not be in accordance with how a community perceives their level of resilience. To contribute to this debate, it was highlighted within Chapter 2 how communities are heterogeneous and subject to many different challenges in terms of their location, structure, connectivity and socio-economic status (Gilchrist, 2009; Paton 2003; Norris *et al,* 2008). Therefore the application of a homogenous set of performance based targets may not be applicable to understand resilience within and between different communities (Patel *et al,* 2017). O'Sullivan *et al, (*2015) applied the structured interview matrix approach to explore community resilience through the process of building collaborative working partnerships. This approach demonstrated how improved engagement between responder organisations and the local community can enhance the development of

resilience and strengthen emergency management through sharing local knowledge and information during the formation of social networks (Gilchrist, 2009; Norris *et al,* 2008). The results of Chapter 7, support these understandings and is discussed in the following section.

Chapter 7 explored the development of relationships between a community led Flood Group and a local authority led Flood Board to understand how community resilience could be enhanced through collaborative working partnerships. It was recognised within the semi-structured interviews that working collaboratively with local communities strengthens the emergency management process through the sharing and exchange of information, sharing local knowledge, the development of mutual trust and a shared perception of risk (Chapter 4). This also provided an opportunity for local communities to understand the roles and responsibilities of responder organisations and the capabilities available for effective emergency response.

An exploration of the literature (Chapter 2, Section 2.4) highlighted how community resilience is the collective ability of a community to cope, adapt and recover from an adverse situation (Faas and Jones, 2017; Cox and Hamlen, 2015; Cutter *et al*, 2008). However, the ability of a community to achieve this requires the support of external organisations to share and exchange information, knowledge, expertise and provide support through access to resources (Aldrich and Meyer, 2005; Murphy, 2007; Lin *et al*, 2001). This increases the collective ability of communities to achieve resilience to extreme events.

The results of Chapter 7 support these understandings, but also demonstrate how the successful integration of community groups within the UK emergency management system is a complex process requiring a great deal of time and a high level of engagement from the local community and responder organisations to develop and establish strong relationships. This was also highlighted in the approach taken by O'Sullivan *et al* (2015). While a great deal of time was invested in the development of these relationships, they were difficult to sustain through organisational restructures, if the organisation representative was promoted or if the representative left the organisation. This demonstrated the fragility of these relationships when built around individual personalities.

It was demonstrated within this research that in order to develop sustainable relationships, it was necessary to formalise the relationships within an integrated framework. This required a clearly defined structure, terms of reference and regular meetings chaired by an elected representative from the local community and Local Authority. This ensured the continuity of collaborative working partnerships despite organisational restructures and individuals moving away from the local community.

A greater awareness of the development of these relationships with local communities within the extended LRF may provide the potential to explore how these networks could be used to strengthen resilience within the wider emergency management system. For instance, WSP's may be able to access these networks to work collaboratively with local communities in the determination of locations for water distribution stations, the identification of

vulnerable people within the community and potentially assist in the distribution of water within the community during water supply failure incidents.

8.2.5 Exploring the connection between government, individuals and communities

The connection between government and the public relies on the provision of information regarding potential threats and hazards. These may be provided through educational awareness programmes, campaigns, guidance documents, and the NRR and at a local level through the CRR.

During 2004, the government distributed the 'Preparing for Emergencies' booklet to each home within the UK. The document contained information regarding what individual homeowners should do in the event of an emergency and actions they could take to prepare for an emergency. While a reprint of the booklet has not been provided to the public since its original distribution in 2004, this information is now available on the government website (Cabinet Office, 2018). This includes links to the NRR, CRR's and guidance documents relating to increasing individual resilience through community involvement. The website provides access to guidance on developing community emergency plans and a framework for developing community preparedness. However, the guidance represents a general approach to the provision of information and as discussed within the previous section, this does not allow for the heterogeneity that exists between different communities.

The results of the individual homeowner questionnaire (Chapter 5, Section 5.4, Figure 5.10) highlighted a lack of awareness regarding the existence of the LRF, the NRR and the CRR. The majority of respondents indicated they did not obtain information from any of these sources regarding potential hazards within their local area.

The guidance provided by the Government on the "Preparing for Emergencies" website encourages individuals and communities to prepare for emergencies. A greater understanding of known threats and hazards within the local environment, working in partnership with responder organisations and using local knowledge and resources to *"prepare for, and deal with, the consequences of emergencies"* (Cabinet Office, 2016) may improve the ability to achieve resilience to emergencies. However, this is based on a risk management approach and while the ultimate aim is to achieve resilience to emergencies, resilience is about preparing for the unknown.

The connection between government and individuals is based on the 'top down' approach to the provision of information to encourage individual emergency preparedness and response to known threats and hazards. This approach is dependent on individuals knowing where to obtain information and using this information to increase preparedness. However, it was demonstrated within (Chapter 2, Section 2.4) that it cannot be assumed this 'top-down' approach will translate into action in the form of preparedness (Donahue *et al,* 2014; Brodie *et al,* 2006). This research supports these understandings and demonstrates how an individual's perception of attributed responsibility may also influence whether

they consider it necessary to prepare (Levac *et al,* 2010). A greater understanding is required regarding individual attitudes and perceptions to hazards in general to explore whether these encourage effective action in the form of preparedness.

8.2.6 Exploring the connection between the operational multi-agency element and individuals and communities

The connection between the operational multi-agency element of the emergency management system and individuals and communities is quite complex. Within the semi-structured interviews (Chapter 4) and the context of this research, WSP's demonstrated a tendency to communicate information to individual customers rather than adopting collaborative working partnerships with local communities (Chapter 6). However, within the structure of the multi-agency approach of the LRF, a connection does exist through local authority involvement with local community groups (Chapter 7). As discussed within Chapter 2, (Section 2.5) establishing relationships through building social networks between community groups and responder organisations may provide access to resources and encourage collective action (Aldrich and Meyer, 2015; Norris *et al,* 2008; Murphy, 2007; Dynes, 2002). This was supported by the analysis conducted within Chapter 7. If WSP's were integrated within collaborative working partnerships this would increase the opportunity of the WSP's to understand the complex relationship between the provision of information by the WSP and how this may influence the behavioural intention of the customer. This may also support WSP's during an extreme event because it may provide access to an extended network of resources and capabilities by working collaboratively with

local communities in the determination of locations for water distribution stations, the identification of vulnerable people within the community and potentially assist in the distribution of water within the community during water supply failure incidents.

Within the semi-structured interviews (Chapter 4, Section 4.8), while all of the LRF's agreed working collaboratively with local communities strengthened the emergency management process, it was generally regarded that this connection would be provided through the Local Authorities rather than directly through the LRF. This was supported by the analysis of community structure within Chapter 7. This is largely a result of resources in terms of finances and personnel, because in many locations the LRF is strategically operated by a single LRF manager. However, government guidance relating to the development of community resilience encourages communities to contact the LRF for further information relating to community preparedness and response (Cabinet Office, 2016). This highlights an inconsistency in the approach determined within the guidance, the actual capabilities of the LRF manager to be able to provide this resource and how the system operates in reality.

It was demonstrated within Chapter 2, (Section 2.4) that there is a complex relationship between individual risk perception and whether this translates to an intention to prepare. Even in locations where hazards frequently occur, individuals do not always actively engage in preparedness activities (Donahue *et al,* 2014; Levac *et al*, 2012; Eiser *et al,* 2012; Johnson *et al*, 2014*;* Lane *et al,* 2003; King, 2000; Ballantyne, 2000). As demonstrated in Chapter 6, during an

emergency individuals may change from passive to active participants to increase their resilience and having access to *'at risk'* communities through the extended network of the LRF may provide an opportunity for WSP's to access these communities during periods of water supply failure.

It was demonstrated within Chapter 7 that collaborative working partnerships between local responder organisations and local community groups were an effective approach to understanding and achieving resilience to local threats and hazards. However, in order for this to be effective, active engagement is required between personnel within the responder organisations and members of the local community. Within the semi-structured interviews participants discussed how resources in term of finance and personnel within local emergency management teams were being significantly reduced. It was perceived that at a local level emergency managers were expected to *'achieve more with less'*, with regard to providing the same level of service with reduced personnel and government funding (Chapter 4, Section 4.7.1). This will limit the ability to provide community support through the development of collaborative working partnerships which naturally require a great deal of resource in terms of personnel, time and funding. The government guidance encourages individuals and local communities to prepare for emergencies and develop resilience through developing networks and working together with local responder organisations (Cabinet Office, 2016). However, the government is also reducing the funding available at a local level to enable this to be achieved (Chapter 4, Section 4.2.2).

The final connection in the system is influenced by the availability of government funding to enable resilience to be achieved at a local level. It was demonstrated within Chapter 2, Section 2.5 that working collaboratively with local communities strengthens the emergency management process and encourages the development of resilience at a local level (Aldrich and Meyer, 2005; Murphy, 2007). However, this is constrained by a lack of available funding from the Government to develop collaborative working partnerships between responder organisations and the local community (Chapter 4, Section 4.7.1). The application of legislation that is not consistent with actual operational working practices will also reduce the ability to achieve resilience between the multi-agency operational level and the individuals and communities affected by an emergency.

As discussed within Chapter 2, (Section 2.3) systems thinking and systems based models are effective methods to understand how the physical and social systems are connected. However, these models do not explore the complex interactions between organisations, individuals and communities. This research demonstrates how taking a systems based approach to understand the structural elements of the emergency management system, combined with a pragmatic approach incorporating action research, participant observation methods and social research methods, can be used to explore these relationships and understand resilience as a dynamic process operating within a complex socio-ecological-technical system.

8.3 Applying the Safe and SuRe Intervention Framework to the UK Emergency Management System.

The previous Section used the empirical research presented in this thesis to explore how the emergency management system is connected and how this influences the ability to achieve resilience to water supply failure within the UK emergency management system. Within this Section, resilience of the UK emergency management system is explored using the Safe and SuRe intervention framework. This will enable the identification of the main threats to the system and how the impact and consequences of these threats may affect the ability to achieve resilience to water supply failure. The use of intervention measures including mitigation, adaptation, coping and learning will also be explored to understand how these can be applied within the system of emergency management to achieve system resilience to water supply failure.

The Safe and SuRe approach has traditionally been applied to explore the resilience of physical systems (Mugame *et al,* 2015; Butler *et al,* 2016). This research explores the use of the Safe and SuRe Intervention Framework within the context of a social system, the UK emergency management system (Figure 8.2). This framework has not previously been applied to an emergency management system.
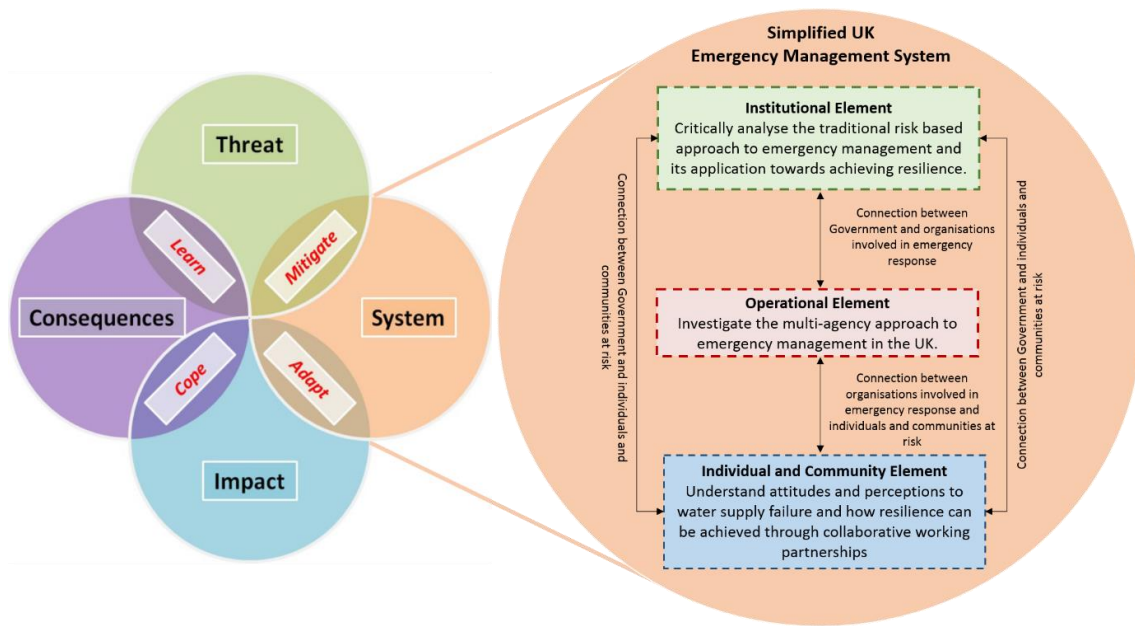
Figure 8.2: Applying the Safe and SuRe Intervention Framework to the UK Emergency Management System (Adapted from Butler *et al,* 2016).

The Safe and SuRe approach defines resilience *as "the degree to which the system minimises level of service failure magnitude and duration over its design life when subject to exceptional conditions".* As discussed within Chapter 2, (Section 2.3) it is not the intention of this research to develop further definitions of resilience because there are hundreds of definitions within the academic literature (Patel *et al,* 2017). However, in order to understand how the Safe and SuRe intervention framework can be applied within the context of an emergency management system, it is necessary to examine how this definition can be applied to the process of emergency management. The main principles of emergency planning are to reduce the severity of an event (Figure 8.3) through adequate preparedness and mitigation and to minimise the event duration

through effective emergency response and recovery. Within the Safe and SuRe definition, failure magnitude is synonymous with incident severity (Figure 8.3) and '*the duration over its design life*' is synonymous with the event duration.
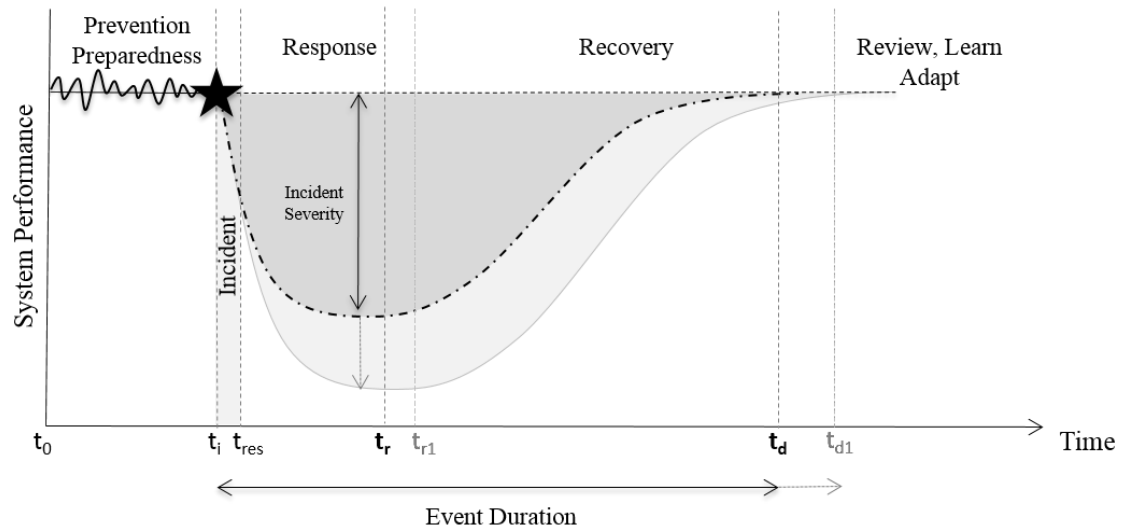
Figure 8.3: System performance relating to emergency planning. Adapted from McDaniels *et al,* 2002 and Mugame *et al*, 2015.

As discussed within Chapter 1 (Section 1.2) and Chapter 2 (Section 2.3) the Safe and SuRe Intervention Framework is one approach that can be used to explore how the resilience of a system can be improved through the application of intervention measures. These include mitigation, adaptation, coping and learning (Butler *et al,* 2016). However, to develop this approach required understanding the structural elements that comprise the emergency management system, how the system is connected and what these connections mean in terms of achieving resilience to water supply failure. A holistic understanding of the system will allow a more accurate determination of the impact and consequence of threats to the system and how these may influence the ability to achieve resilience.

The framework can be evaluated in four different ways, these are described within Chapter 1, (Section 1.2). The traditional 'top down' approach relies on the same methodology as the traditional risk management approach and this is one approach taken within this research. The analysis is conducted clockwise through the framework and starts with the identification of known threats that may cause a failure of the system. Within the context of this research, it is the identification of threats to building resilience within the emergency management system. The next element of the framework involves analysis of the *'impact'* of system failure and the resultant societal or environmental *'consequence'*. At the intersection of each element are the intervention measures, mitigation, adaptation, coping and learning. Mitigation involves the application of strategies to reduce the *'frequency, magnitude or duration of a threat'* (Butler *et al,* 2016). Adaptation measures include specific actions taken in response to a threat and are applied when actions to mitigate the threat cannot be applied. When mitigation and adaptation measures cannot be applied to reduce the impact of the threat, coping strategies are applied. According to Butler *et al,* (2016) coping includes *"any preparation or action taken to reduce the frequency, magnitude or duration of the effects of an impact on a recipient."* The final intervention measure of learning is applied to ensure lessons are learned from past experience.

As discussed within this Chapter and Chapter 4, (Section 4.2) the main threats regarding the ability to achieve resilience within the emergency management system are legislation, the availability of adequate funding and differences in organisational culture. These are institutional and social threats as opposed to physical threats such as pipe failure (Butler *et al,* 2016). Within the framework of the legislation (CCA, 2004), it is considered that resilience is achieved through

multi-agency cooperation and collaboration in the assessment of threats and hazards, emergency preparedness, mitigation and response. However, the legislation is creating a constraint in the ability of WSP's to manage risk and resilience within the context of a multi-agency framework defined by LRF's because it is difficult for WSP's to engage effectively on a local level with multiple LRF's and multiple ways of operating. A lack of government funding has also resulted in a reduction in emergency management personnel, the resources available for multi-agency training and exercising and the ability to deliver resilience building initiatives within the local community. Differences in organisation culture also influence the operational delivery of emergency management. The 'command and control' approach is effective for routine emergencies but is not necessarily effective in extreme events where a flexible approach to complex decision making is required.

The potential impact of these threats may include a reduced ability to provide effective emergency response and an increase in the incident severity (Figure 8.3). The consequences may also contribute to an increase in the event duration and an increase in the time taken to recover. However, in the context of social systems there is a possibility that the system may not recover depending on the incident severity. Without the application of intervention measures, it is possible there may be recurrent problems within the system. This has been demonstrated with the difficulties experienced between WSP's and LRF's in the sharing and exchange of information during the flooding of Mythe water treatment works and the recent 'Beast from the East'. As discussed within Chapter 1 (Section 1.2) the intervention measures include, mitigation, adaptation, coping and learning.

It was demonstrated within Section 8.2.2, that effective emergency response and the ability to achieve resilience to unknown threats and hazards is enhanced through the process of multi-agency collaboration. Building relationships and the sharing and exchange of information all contribute to a greater understanding of the roles and responsibilities of each operating organisation, the development of trust, good practice, the assessment of resources and capabilities required for effective emergency response and an increased awareness of the interdependence between each operating organisation (Perry and Lindell, 2004; Boin and McConnell, 2007).

Many of the WSP's have developed an alternative method of operating by applying the intervention measure of mitigation to overcome the difficulties associated with applying the legislation (CCA, 2004) within the multi-agency framework of the LRF. This includes working together with LRF's at a regional level through the development of LRF days. This approach has also applied intervention measures of adaptation where current working practices have been adapted to enable WSP's to share information more effectively during emergency response through applying the principles of JESIP (JESIP, 2016). However, the legislation has remained static and the system itself is still constrained within the confines of the legislation. In order to achieve resilience within the system, there needs to be a review of legislation to incorporate current working practices.

The intervention measure of coping may be applied at the local level to build and achieve resilience to extreme events within individuals and local communities at risk. Within Section 8.2.3, it was demonstrated how individual customers may

change from passive to active response during an extreme event. While this is also a form of adaptation, in order to be able to cope and achieve resilience required the provision of accurate and timely information regarding the nature of the hazard, estimated timescales when the water supply was to be restored, whether a provision of alternative water was to be provided and where it would be distributed. However, this information was not adequately provided during the flooding of Mythe water treatment works or during the recent '*Beast from the East'* event (Pitt, 2008; Ofwat, 2018). This places a responsibility on the WSP to assess how this information should be effectively delivered throughout a water supply failure event to enable customers to make decisions regarding the preparations required for prolonged water supply failure. Another approach that could be taken to improve the ability of the WSP to cope with the distribution of alternative supplies of water, could be through the utilisation of local community networks or established collaborative working partnerships within the extended LRF.

There have been many examples where learning has occurred throughout the system of emergency management. Traditionally, following an event there will be a period of reflection and the development of a lessons learned report. Examples include the Pitt report (Pitt, 2008) following the 2007 flood event and the lessons learned following the *'Beast from the East'* (Ofwat, 2018). However, while these reports provide recommendations for improvement, it is also necessary to take a holistic approach to understand whether the difficulties experienced during an incident are a consequence of interdependencies within the wider context of the system.

The application of the principles of JESIP by some of the WSP's also provided evidence of learning with regard to the adoption of the command and control approach to emergency response (JESIP, 2016). This enables a consistent approach to be applied to multi-agency emergency response following the difficulties experienced during the flooding of Mythe water treatment works (Pitt, 2008).

Within Chapter 1, (Section 1.2) the application of a middle-based analysis was discussed. This approach recognises that it is impossible to identify every possible threat to the system and focuses on the impact and consequences of failure modes. This approach also acknowledges how different threats may result in the same failure of the system so the analysis commences at the system element of the intervention framework (Chapter 1, Figure 1.3). The application of the middle-based analysis was applied to the emergency management system to identify failure modes contributing to water supply failure.

In the context of emergency management, failure modes may include a lack of participation in the multi-agency anticipation of threats and hazards and assessment of risk. This may impact the system because there will be a lack of understanding regarding resources and capabilities required for effective multi-agency emergency response for an extreme event. A failure to provide accurate and timely information to the public and a lack of understanding regarding the behavioural intentions of customers also represent potential failure modes in the ability to achieve effective emergency response during an extreme event. This

is demonstrated within Chapter 1 (Section 1.4) when the consequences resulted in a negative reinforcing feedback loop.

8.4   Summary

Objective 5 sought to apply a systems based approach to investigate the impact of the failure state to assess where vulnerabilities exist within the socio-technical system and how resilience can be achieved through effective emergency planning. This was achieved within this chapter through the triangulation of results presented within Chapters 1, 2, 4, 5, 6 and 7. Each of these Chapters explored the perception and application of resilience at different levels within the emergency management system. This information was used to identify the main structural elements that comprise the system and how they are connected to understand where resilience intervention measures should be applied.

Within the context of this research, the main structural elements of the UK emergency management system comprise an institutional element at the level of government where legislation, policy and guidance documents are developed to ensure the operation of the system in the delivery of effective emergency management. This is delivered through the operational multi-agency element in the development of LRF's at the local level through the introduction of the CCA, 2004. Individuals and communities affected by an extreme event represent the final element of the system.

Within the multi-agency operational element, resilience is achieved through the sharing and exchange of information. This is facilitated through the development of relationships between responder organisations that enable a greater understanding of organisational structure and roles and responsibilities to ensure effective multi-agency collaboration in the delivery of emergency response. This is supported through multi-agency training and exercising to reinforce how each organisation operates during an emergency situation and contributes to a greater understanding regarding the inter-dependencies between each operating organisation.

This is connected to the institutional element at the level of government through the 'top down' delivery of legislation in the form of the CCA, 2004. However, it was demonstrated that the legislation is being applied within a framework that is inconsistent with the way in which the system operates. WSP's may not be able to engage effectively with multiple LRF's that have different ways of working. In order to be able to fulfil their obligations with respect to the CCA, 2004, many of the WSP's have developed a regional approach to multi-agency collaboration.

The results of the individual homeowner questionnaire (Chapter 5) demonstrated a great deal of confidence in the ability of the WSP to provide a safe, reliable and continuous supply of water in all circumstances and this may influence the perception of water supply failure and whether an individual will perceive it necessary to take action to prepare. While the majority of respondents did not actively prepare for water supply failure they did perceive they would obtain a supply of water from the local supermarket if there was a failure of the water

supply. The results of the Facebook analysis from the 'Beast from the East' event (Chapter 6), demonstrated the ability to achieve individual resilience to water supply failure was dependent on the ability of the WSP to provide accurate, timely information regarding the location of water supply failure, estimated timescales when the water supply would be restored and the distribution and location of an alternative supply of water.

The connection between the government, individuals and communities is through the 'top down' delivery of information and guidance on the government website to encourage resilience. It is recognised that information regarding hazards and how to achieve resilience is required by individuals and communities. However, this also requires a great deal of understanding regarding individual attitudes and perceptions to hazards, responder organisations and the provision of essential services. A greater understanding of these relationships will enable a more accurate determination of the information required by individuals to encourage preparedness and effective action during an emergency. This can be achieved though collaborative working partnerships connecting the multi-agency operational element with individuals and communities. This combination of a 'top down', 'bottom up' approach requires the support of legislation to encourage the sharing and exchange of information within the multi-agency operational level and funding to develop collaborative working partnerships at the community level.

It has been demonstrated throughout the development of this research that the application of a systems based approach allows for the identification of the main elements of a system and a greater understanding of how they are connected.

Systems thinking and systems dynamic models are effective methods to understand how the physical and social systems are connected. However, the emergency management system is complex and relies heavily on the social interactions between organisations, individuals and communities. This research demonstrates how taking a systems based approach to understand the structural elements of the emergency management system, combined with social research methods can be used to explore these relationships to develop a greater understanding of how resilience operates as a dynamic process within a complex socio-ecological-technical system. A summary of the findings is provided within the following Chapter 9 – Conclusions and Recommendations

9 CHAPTER 9 – CONCLUSIONS AND RECOMMENDATIONS

9.1 Thesis summary

A review of lessons learned reports following widespread flood events in the UK, demonstrated how the failure of critical infrastructure and the resultant loss of essential services seriously challenged the ability of infrastructure operators, emergency responders and the affected population to achieve resilience to extreme events (Pitt, 2008; Watermark, 2011; Environment Agency, 2016; HM Government 2016; Ofwat 2018).

The aim of this PhD was to explore how improved resilience to water supply failure can be achieved through effective emergency management. This was achieved by exploring how WSP's manage risk and resilience as part of a multi-agency approach within the context of the UK emergency management system. Each structural element of the UK emergency management system was defined and explored through a series of objectives (Chapter 1, Section 1.5) to explore and understand the characteristics of resilience operating within each structural element of the system, how each element is connected and the influence of these connections on the ability to achieve resilience to water supply failure.

This Chapter presents a summary of the research conducted to explore how resilience operates within and across the emergency management system and will proceed with a summary of the findings in relation to each objective. This will

be followed by a review of the contributions of this research, recommendations and future proposals.

9.1.1 Objective 1: Critically analyse the traditional risk based approach to emergency management and its application towards achieving resilience.

This objective was achieved throughout the development of the literature review, analysis of lessons learned reports, government guidance, reports, legislation and through attendance at conferences to understand the wider context and application of resilience within the UK emergency management system. All of this information provided the foundation for the development of objectives to understand how resilience is applied within the UK emergency management system. A summary of the findings is presented below.

Traditionally, the process of emergency management is defined by the stages within the emergency management cycle and include prevention, preparedness, response and recovery (NGA, 1979; Dynes, 1982; Quarentelli, 1986; Neal, 1997; Alexander, 2002a). This cycle is largely driven by the application of a risk management approach. The process usually starts with preparedness and includes the anticipation of threats and hazards and the assessment of risk. For instance, within the UK emergency management system this represents the development of the NRR and the CRR's at a local level (Cabinet Office, 2011). The assessment of risk enables emergency responders to determine the

resources and capabilities required for effective emergency response and recovery for known threats and hazards. This also enables the determination of mitigation methods depending on the assigned level of risk.

A review of the literature and lessons learned reports demonstrated the consequences of extreme events are very difficult to determine (Chapter 1, Section 1.1, Section 1.3. This is because these events are characterised by a rapidly changing dynamic environment where many of threats and hazards are unknown (Park *et al,* 2013; Linkov *et al,* 2014; Butler *et al,* 2014). Therefore it is exceedingly difficult to make an accurate assessment of potential risk. Not only that, the complex inter-dependencies within the socio-ecological-technical environment may result in known threats and hazards escalating into a series of cascading events increasing the potential for unknown threats and hazards (Boin and McConnell, 2007; Crichton *et al,* 2009; Vespignani, 2010). This makes the anticipation of threats and hazards and the assessment of risk an impossible task for low probability, high consequence events.

The risk management approach to emergency management is extremely successful when applied to known threats and hazards that may occur on a daily basis and is successfully applied within the determination of the resources and capabilities required for routine emergency response and recovery procedures. However, in order to be able to respond effectively to extreme events requires a resilience-based approach that supports the risk management approach applied for day to day emergencies and enables resilience to unknown threats and hazards.

Within the UK emergency management system, the concept of resilience is integrated within the legislative framework of the CCA, 2004 and operationalised through the development of a multi-agency approach to emergency management at the local level with LRF's (Cabinet Office, 2011). However, the flooding of Mythe water treatment works demonstrated difficulties with the ability to manage risk and resilience as part of a multi-agency approach (Pitt, 2008). This was explored in greater detail within Objective 2.

9.1.2 Objective 2: Investigate the multi-agency approach to emergency management.

This objective was achieved through a comparative content analysis to understand the multi-agency assessment of risk and through semi-structured interviews with emergency managers from the LRF, WSP's and the Fire Rescue Service (Chapter 4). These were conducted to explore the inconsistencies identified within the content analysis and to develop a deeper understanding of how resilience can be achieved through the multi-agency approach to emergency management.

It was demonstrated within Chapter 8, (Section 8.2.2) how the multi-agency approach to emergency management is fundamentally driven by a complex system of processes in order to achieve effective emergency preparedness and response. These include sharing information through the building of relationships to develop a greater understanding of organisational structure, roles and responsibilities and the active process of multi-agency training and exercising to encourage multi-agency collaboration. This contributes to the delivery of

effective emergency response because all of the responder organisations have a shared perception of risk and understand the roles and responsibilities of each responder organisation (Perry and Lindell, 2004; Boin and McConnell, 2007). This also contributes to the sharing of good practice, lessons learned, the anticipation and assessment of threats and hazards and the development of a multi-agency emergency plan. All of these activities enhance the process of achieving resilience through the accurate assessment of available resources and capabilities for effective emergency response and the opportunity to develop a greater understanding of the inter-dependencies that exist between different organisations. The development of trust between organisations also strengthens the ability to develop innovative solutions to complex problems under pressurised conditions during an emergency.

However, within the UK emergency management system, there are a number of factors influencing the ability to develop these processes. The CCA, 2004 was introduced to enhance resilience within the emergency management system through the development of LRF's and the multi-agency approach to emergency management (Cabinet Office, 2011). The results of the semi-structured interviews suggest the legislation is applied within a framework that is inconsistent with the way in which the system operates. WSP's operate over a wide geographical area and are expected to engage with multiple LRF's that each operate slightly differently. This has created difficulties in the sharing and exchange of information regarding the assessment of threats and hazards and the ability to regularly attend LRF meetings to build and establish relationships. These were perceived to be important facilitating the process of achieving resilience. The building of relationships has also been difficult to maintain due to

a reduction of funding available for developing multi-agency training exercises and to establish effective working practices within emergency management teams. A decrease in the number of personnel available to deliver emergency management at the local level also contributes a negative influence.

9.1.3 Objective 3: Understand individual attitudes and perceptions of water supply failure

This objective was achieved through the results of the individual homeowner questionnaire and the analysis of Facebook comments throughout a water supply failure incident known as the '*Beast from the East'* event.

Attributed responsibility (Shrubsole, 2000; Paton, 2003; Levac *et al,* 2012; Donahue *et al,* 2014), societal perceptions (Dobbie *et al*, 2016; Paton *et al*, 2008; Paton *et al*, 2013) and expectations (Dobbie *et al*, 2016; Paton, 2003) of utility providers and responder organisations may influence whether an individual perceives it necessary to prepare for a hazard such as water supply failure. The results of the individual questionnaire demonstrated that the majority of respondents have not had experience of water supply failure and perceive it to be *'low risk'* compared to other hazards. It was perceived as *'slightly important'* to prepare for with the majority of respondents indicating that they do not *'actively prepare'* for water supply failure. Respondents expressed a great deal of confidence in the WSP's ability to provide a reliable, continuous and safe supply of water and However, they also perceived in the event of water supply failure, it would be *'extremely likely'* that they would purchase water from the local supermarket.

Analysis of the Facebook comments during the '*Beast from the East'* demonstrate customer attitudes and perceptions toward water supply failure and the response of WSP's to be negative. Customers required accurate and timely information from the WSP regarding the location of water supply failure, estimated timescales when the water supply would be restored, whether an alternative supply of water was being provided and how it was being distributed. This information was necessary to enable customers to assess their individual requirements and determine how to actively respond either through the purchase of an alternative supply of water or to stay with relatives. However, a failure of the WSP's to provide consistent and timely information to their customers prevented customers from being able to achieve resilience to water supply failure. Customers were also not able to contact the WSP direct which created further difficulties for vulnerable customers who were not able to inform the WSP of the need for assistance if they could not attend one of the water distribution stations.

9.1.4 Objective 4: Investigate how the bottom up approach to emergency management can help to achieve resilience to extreme events through collaborative working relationships.

It was demonstrated within Chapter 2 (Section 2.3) how improved engagement between responder organisations and the local community can strengthen the emergency management process through sharing local knowledge, expertise and information during the formation of social networks (Gilchrist, 2009; Norris *et al,* 2008; O'Sullivan *et al,* 2015).

This objective was achieved through the process of participatory action research to understand how resilience to extreme events can be achieved through the development of collaborative working partnerships between a local authority and a group of Town and Parish Councils.

The successful integration of community groups within the emergency management system is a complex process requiring a high level of engagement from both the local community and the responder organisations to develop and establish a collaborative working partnership. It was recognised within the semi-structured interviews that the partnership approach strengthens the emergency management process through the sharing and exchange of local information, the development of trust, a shared perception of risk and the opportunity for collective decision making. It also contributed to the development of a shared understanding of the roles, responsibilities, and capabilities available for effective emergency response. This enables both local communities and responder organisations to manage realistic and achievable expectations with regard to emergency response.

It was also identified that these relationships are fragile and difficult to sustain with regard to organisational restructures and the loss of representatives either within the local community or from the responder organisations.

9.1.5 Objective 5: Taking a systems based approach, investigate the impact of the failure state to assess where vulnerabilities exist within the socio-technical system and how resilience can be achieved through effective emergency planning.

This objective was achieved through the triangulation of quantitative and qualitative results achieved within Objectives 1, 2, 3 and 4 and the application of the Safe and SuRe intervention framework. The results obtained from achieving each objective were used to explore and understand how resilience operates within and across each structural element of the UK emergency management system.

The main elements of the emergency management system were considered to comprise an institutional element identified at the national level of government, an operational multi-agency level identified at the local level and the individuals and communities affected by an emergency. The connections between each element were defined as follows:

- The institutional element and the operational multi-agency element are connected through the top down delivery of legislation, government policies and guidance documents.
- The operational multi-agency element and the individual and community element are connected through the provision and

availability of government funding to support collaborative working partnership schemes and local resilience strategies.

- The institutional element and the individual and community element are connected through the provision of information relating to effective emergency preparedness and response.

The resilience of the UK emergency management system was explored using the Safe and SuRe intervention framework to identify the main threats to the system and how the impact and consequences of these threats may affect the ability to achieve resilience to water supply failure.

The main threats regarding the ability to achieve resilience within the emergency management system are legislation, the availability of adequate funding and the difference in organisational culture between the Category 1 and the Category 2 responders. The legislation constrains the ability to achieve effective multi-agency cooperation and collaboration in the anticipation and assessment of threats and hazards and the ability to determine resources and capabilities required for effective emergency response. A lack of government funding has contributed to a loss of emergency management personnel, the ability to develop multi-agency training and exercising and the ability to develop collaborative working partnerships with local communities. The difference in organisational culture between the Category 1 and the Category 2 responders created tension regarding the different approach taken in response to emergency management. The command and control approach taken by the Category 1 responders provides an effective and structured emergency response to known threats and

hazards. However, a more flexible approach is required in order to achieve resilience to unknown threats and hazards during extreme events and facilitate the development of innovative solutions to complex technical problems.

The Safe and SuRe middle-based analysis was applied to the emergency management system to identify the failure modes contributing to water supply failure. These include a failure to participate in the multi-agency anticipation of hazards and assessment of risk, a failure of the WSP's to provide accurate and timely information to the public, a failure to accurately assess and identify the resources and capabilities to provide an alternative supply of water, a failure to understand the behavioural intention of the customers. The application of intervention measures to reduce the impact of failure may include:

- A greater understanding the multi-agency approach to emergency management within the framework of the CCA, 2004,
- Understanding the consequences of water supply failure and the resources and capabilities required for effective emergency response,
- Developing a greater understanding of customer attitudes and perceptions to water supply failure and the information they require to respond to water supply failure.

9.2   Summary of contributions

9.2.1 Elucidation of a systems based approach to resilience-led emergency management

Systems thinking and systems dynamic models are effective methods to understand how the physical and social systems are connected (Bruneau *et al,* 2003; Pagano *et al,* 2017: Franchin, 2018).   However, these models do not explore the complex social interactions between organisations, individuals and communities. This research demonstrates how taking a systems based approach to understand the structural elements of the emergency management system, combined with a pragmatic approach incorporating action research, participant observation methods and social research methods can be used to explore these relationships and understand resilience as a dynamic process operating within a complex socio-ecological-technical system

This research has also demonstrated the importance of taking a systems based approach to assess where vulnerabilities exist within the socio-ecological-technical system and how resilience can be achieved through effective emergency management.   This requires a shift away from conceptualising emergency management within the framework of the emergency management cycle and acknowledging resilience as a process that operates within a complex dynamic system of interconnecting elements that may include legislation, operational practices and individuals affected by an emergency.

Throughout the literature the concept of resilience has been explored and defined within the context of the specific discipline under investigation. This has contributed to the development of many different applications of resilience, for instance individual resilience, community resilience, infrastructure resilience, multi-agency resilience and institutional resilience. However, the complex inter-relationships between the different applications of resilience are rarely explored and has contributed to confusion regarding the practical application of resilience. In order to be able to achieve resilience to extreme events, the concept must be explored within the context of the wider system within which it operates.

This research demonstrates there is a requirement to understand the inter-dependencies between the different applications of resilience rather than a continuation of understanding the concept within the context of a specific discipline. It is hoped this research will stimulate debate and initiate a change towards an interdisciplinary approach to studying resilience combining a systems based approach with the application of social research.

9.2.2 Development of a contribution for the Resilience in the Round initiative.

It was demonstrated within Chapter 1, (Section 1.4) that a lack of understanding with regard to the influence of customer behaviour during water supply failure may result in a negative reinforcing feedback loop. The ability to achieve individual resilience to critical infrastructure failure requires a greater understanding of the relationship between an individual's perception of risk and the factors that influence preparedness (Paton 2003; Dobbie *et al*, 2016). The

results of the individual homeowner questionnaire (Chapter 5) and the analysis of Facebook comments during a water supply failure incident (Chapter 6), demonstrate the importance of understanding customer attitudes and perceptions with regard to water supply failure and how the provision or lack of information may influence customer behaviour. The approach developed within this research may support WSP's in the delivery of 'Resilience in the Round' (Chapter 2, Section 2.7) and contribute to the development of effective communication and knowledge provision strategies to encourage preparedness before an emergency and effective action during an emergency situation (Levac *et al,* 2012; Paton, 2003; Shrubsole, 2000). If customers are to be considered as active participants in the emergency management process than it is necessary to understand how their behaviour may influence the ability of the WSP to achieve resilience in an extreme event.

9.2.3 Demonstrating the complexity of collaborative working partnerships

O'Sullivan *et al, (*2015) applied the structured interview matrix approach to explore community resilience through the process of building collaborative working partnerships. This approach demonstrated how improved engagement between responder organisations and the local community can strengthen the emergency management process through sharing local knowledge, expertise and information. This process also contributes to the development of resilience during the formation of social networks (Gilchrist, 2009; Norris *et al,* 2008). However, there is limited research relating to the process of achieving resilience through the development of collaborative working partnerships and how the

development of these contribute to achieving resilience within the emergency management system.

The social network graphs developed in partnership with the local community representative were presented at the Environment Agency Flood and Coast Conference, 2018 and at local Environment Agency community workshops. These were used to stimulate debate, inspire change and demonstrate the importance of collaborative working partnerships to improve future flood risk management. This research demonstrates how these relationships can also be developed to increase understanding between responder organisations and the local community to achieve resilience to extreme events.

9.2.4 Inter-organisational application of the Safe and SuRe Framework

As discussed within Chapter 1, (Section 1.2) this research was developed to support the Safe and SuRe integrated socio-ecological-technical approach to resilience within the urban water management sector. The Safe and SuRe approach has traditionally been applied to explore the resilience of physical systems (Mugame *et al,* 2015; Butler *et al,* 2016). Whereas this research explores the use of the Safe and SuRe Intervention Framework within the context of a social system, the UK emergency management system. This research demonstrates how the Safe and SuRe intervention framework can be applied within the context of the UK emergency management system demonstrating the diversity of this approach.

9.3   Recommendations

The colour coding applied within Figure 8.1 has been used to identify recommendations that relate to a particular structural element of the emergency management system. Recommendations that apply to the whole system are represented within a black box.

1:   The emergency management system

To effectively integrate the concept of resilience within emergency management, requires a shift away from defining the process of emergency management within the context of the emergency management cycle. The cycle reinforces the application of a risk management approach to emergency management and may prevent the identification of complex inter-dependencies within the socio-ecological-technical system.

Recommendation:

To promote the development of resilience based strategies to extreme events, academics and practitioners should encourage a shift away from defining emergency management within the context of the emergency management cycle and seek to develop research to understand how resilience operates within a socio-ecological-technical system.

2: A systems based approach

In order to develop effective resilience based strategies requires a greater understanding of the relationships between applications of resilience within the wider context of the system within which it operates and include legislation, operational practices and those considered to be at risk. This will encourage and promote the development of innovative strategies to achieve resilience.

> **Recommendation:**
>
> **The process of emergency management should be understood within the context of the wider system within which it operates and include legislation, operational practices and individuals and communities considered at risk.**

> **Recommendation:**
>
> **Ofwat should encourage the development of innovative resilience based strategies to include effective emergency preparedness and response to water supply failure.**

> **Recommendation:**
>
> **To develop effective resilience based strategies it is necessary to understand the complex inter-dependencies that exist between different elements of the emergency management system. This will prevent situations where building resilience in one part of the system will reduce resilience in another.**

3: A review of the CCA, 2004

Within Chapter 6 and 8, it was demonstrated that the CCA, 2004 requires review to ensure it is aligned with current working practices and incorporate the application of new technologies.

> **The UK Government needs to conduct a thorough review of current operational practices between Category 1 and Category 2 responders within the framework of the LRF.**

> **Recommendation:**
>
> **The CCA, 2004 requires review to ensure the legislation is aligned with current operational practices to promote the development of resilience and incorporate the application of new technologies.**

4: A review of interoperability between Category 1 and Category 2 responders

While many of the WSP's have incorporated the principles of JESIP within their emergency operational procedures, a greater understanding is required by the Category 1 responders regarding the organisational structure adopted by the Category 2 responders. This will facilitate a greater understanding of organisational roles and responsibilities to enable an accurate determination of available resources and capabilities for effective emergency response and to achieve resilience.

> **Recommendation:**
>
> **The Government needs to conduct a review to establish how to improve inter-operability between the Category 1 and the Category 2 responders to enhance multi-agency resilience to extreme events.**

5: Increase investment in emergency management

A lack of funding available at the local level has led to a reduction of emergency management personnel available for effective emergency response. This has also contributed to a lack of resources and capabilities required to develop multi-agency emergency training exercises which contribute to achieving resilience through the development of strong working relationships.

> **Recommendation:**
>
> **The Government needs to increase investment in emergency management at the local level to ensure the provision of resources and capabilities for effective emergency management to extreme events.**

6: A greater understanding of individual householder attitudes and perceptions to water supply failure

Within the context of this research, individual homeowners perceived water supply failure to be *'low risk'*. While there was an understanding of the many different ways in which water supply failure could occur, the majority of individual

homeowners that responded within this research did not perceive water supply failure as a hazard to prepare for now but a hazard to prepare for in the future. The majority of respondents did not have experience of water supply failure and did not actively prepare.

Recommendations:

WSP's should conduct an independent householder questionnaire to understand individual attitudes and perceptions to water supply failure.

7: Investigating the communication of emergency information

Customers required consistent, accurate and timely information from the WSP regarding the location of water supply failure, estimated timescales when the water supply would be restored, whether an alternative supply of water was being provided and how it was being distributed.

Recommendation:

WSP's should conduct an investigation into the appropriate methods of communicating information to customers during a water supply failure incident to ensure the information provided is accurate, consistent and timely.

Recommendation:

WSP's should conduct an independent investigation regarding the information required by customers during an incident to encourage effective action by customers and enhance individual resilience.

8:   Promote collaborative working partnerships

It was identified from the semi-structured interviews and the results of the participatory action research conducted within Chapter 7, that collaborative working partnerships strengthen the process of emergency management. This is through the sharing and exchange of local knowledge and information to develop a shared perception of risk and encourage collective decision making. However, these relationships are difficult to sustain and require formal integration within the emergency management system. This requires financial support from the Government to enable the recruitment of specialised community engagement officers within local emergency management departments to encourage resilience to extreme events within local communities.

Recommendation:

The Government needs to support the development of collaborative working partnerships at the local level through financial investment and the provision of community engagement officers within local emergency management departments.

Recommendation:

There needs to be a greater awareness and identification of opportunities to engage both Category 1 and Category 2 responders within collaborative working partnerships with local communities through the LRF.

Recommendation:

Formalise collaborative working partnerships within the framework of Resilience Direct so they are accessible by other responders during an emergency.

Recommendation:

Community groups should be encouraged to incorporate the failure of essential services within their community emergency response plans.

9.4   Future work

This research has provided the foundation for further study to explore the application of resilience within the emergency management system. It has been demonstrated that the concept of resilience is complex, dynamic and operates on many different levels within society. It is a continuous process that requires constant evaluation as new challenges emerge as a result of the complex inter-dependencies within socio-ecological-technical environment.

9.4.1 Resilience in the Round

The approach taken within this PhD demonstrates the importance of exploring how resilience operates within the system of emergency management. Ofwat's 'Resilience in the Round' proposes the application of a systems based approach to understand the interdependencies and relationships between financial, corporate and operational resilience. However, it is also necessary to understand how to build resilience within the operational delivery of emergency management to ensure there are resources and capabilities in place for effective emergency response and recovery. This requires greater investment in the development of emergency management teams throughout the water industry to increase the ability to develop collaborative working partnerships within the structure of the LRF and identify opportunities for improvement.

9.4.2 Exploring resilience within other sectors

This research focussed on building resilience to system failure within the UK water sector. However, this could also be applied to develop a greater understanding of how resilience is applied within other sectors in the context of the UK emergency management system. This information could be used to compare and contrast the ability to achieve resilience within different sectors and facilitate the sharing and exchange of cross-organisational lessons learned.

9.4.3 Understanding relationships between different applications of resilience

This research demonstrated how there is a tendency to explore the concept of resilience within the context of a specific discipline. However, in order to be able to effectively apply the concept with real world situations, it is necessary to develop a deeper understanding regarding how resilience operates within the system under investigation. This information could be incorporated within systems dynamic modelling to develop a greater understanding of causative effects of building resilience in one part of the system and whether this influences the ability to achieve resilience in another part of the system. The results could be incorporated within resilience based strategies.

9.4.4 Integrating communities within the emergency management system

The social network analysis demonstrated the potential benefits of integrating local community's collaborative partnership schemes within the local emergency management system. These networks are not currently formalised using this approach. However, this could be developed to understand the flow of information and communication within the network to identify and establish effective links between local communities and the local responders. If these networks were formalised and possibly integrated within Resilience Direct, they would be available for other sectors to access during an emergency.

9.5   Concluding statement

This research demonstrated that in order to be able to achieve resilience within the water sector to extreme events, the concept must be explored within the context of the wider system within which it operates. A lack of understanding regarding how the emergency management system operates may result in resilience strategies being applied within one part of the system that increase the chance of failure within another part of the system and contribute to an overall loss of resilience. Systems are dynamic and constantly changing in response to the complex inter-dependencies that exist between critical infrastructure, society, economics, politics and the natural environment and therefore resilience must not be considered as an outcome but a dynamic process operating within a complex socio-ecological-technical system.

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APPENDIX 1 – APPLICATION TO ETHICS COMMITTEE

COLLEGE OF ENGINEERING, MATHEMATICS, AND PHYSICAL SCIENCES

Ethical Guidelines Approval Form

Title of Project: Emergency Planning in the Water Sector	
Names of Researchers: Sarah Bunney	
Applicants E-mail: sb734@exeter.ac.uk	**Estimated Start Date:** (DD/MM/YY) 13/02/2017
Research Group: Safe and SuRe	**Supervisors:** Professor David Butler and Dr Sarah Ward

Lay Summary (max 400 words):

This PhD forms part of the Centre for Water Systems, Safe and SuRe research project looking at the impact of system failure in the water sector and how improved resilience to extreme events can be achieved through effective emergency planning. Within the framework of the Civil Contingencies Act, 2004 the UK takes a multi-agency approach to the anticipation and assessment of threats and hazards at a local level. Local Authorities, the Emergency Services and the Utility Companies are expected to work in partnership to identify risks to critical infrastructure. This information is then used to inform future planning and contingency capabilities. However, recent events have demonstrated a weakness in this approach and the ability to achieve resilience of critical infrastructure to flooding.

This PhD will investigate how emergency management is conducted within the UK from a number of different perspectives including:

- Top down approach – understanding how legislation, government policies and lessons learned reports influence current working practices and whether they help to achieve resilience.
- Organisational approach – analysing how the different responder organisations work together before, during and after an emergency. Research has identified that effective emergency response occurs where strong relationships have been formed during the emergency planning process. This PhD will investigate how these organisations communicate, transfer knowledge and share situational awareness before, during and after an emergency and whether this has improved following the 2007 flood event.

- Bottom up approach – assessing whether local communities and individuals understand the threats and hazards that may lead to a failure of the water supply, where to obtain information, assessing how reliant people are on receiving a fresh supply of water direct from the tap, whether people know what to do in the event of a serious failure of the water supply and if they prepare for such an emergency.

The methodology to explore each approach and gain an in depth knowledge of how emergency management is conducted within the UK will involve semi-structured interviews, postal questionnaires and focus groups. Semi-structured interviews will be conducted with Local Authority Emergency Planners, the Police, Fire Brigade and Water Company representatives to investigate the effectiveness of the 'top down' and the organisational approach. Questionnaires will be sent to individual householders and Parish Councils to investigate the 'bottom up' approach. Depending on the information provided and the interest of participants, further investigation may be conducted through community focus groups.

Please mark (x) as appropriate	Yes	No	n/a
Does your study involve work with animals?		X	
Does this study involve human tissue?		X	

Track A: No significant ethical implications *Please mark (x)as appropriate*	Yes	No	n/a
I consider that this project has no significant ethical implications to be brought before the Departmental Ethics Committee.	X		

| Briefly, what are the details of the experiment including the number and type of participants, methods and tests to be used (i.e. the procedure). | To understand and investigate attitudes and perceptions to preparing for a civil emergency involving the possible loss of a centralised water supply, the sample will be taken from 3 Water Service Provider areas.

The participants consist of approximately 300 individual home owners, 250 Parish Councils/Community Action Groups and 50 Category 1 and 2 responders. These include Local Authority emergency planners, the Police, Fire Brigade, Lead Government Departments and Water Company representatives.

Individual home owners and the Parish Councils/Community Action Groups will be sent questionnaires by post. This will include a covering letter explaining the purpose of the research, how to complete the questionnaire, where to obtain further information and a statement informing participants that their participation is voluntary, the information they provide is confidential and they will not be identified from any of the answers they provide.

Category 1 and Category 2 responders will be invited to participate in semi-structured interviews to understand how organisations work together during an emergency that may involve a loss of the water supply. They will also be invited to participate in a Delphi analysis to understand how effectively organisations to work together before, during and after an emergency and where improvements can be made. |

Track B: Possibility of ethical implications   *Please mark (x)as appropriate*

I consider that this project may have ethical implications that should be brought before the Departmental Ethics Committee, and/or it will be carried out with children or other vulnerable populations.

Yes	No	n/a
	X	

Purpose of project and its academic rationale.

Brief description of methods and measurements.

A clear but concise statement of the ethical considerations raised by the project and how you intend to deal with them.

Participants

Human research

- Recruitment methods
- Number
- Age
- Gender
- Exclusion/inclusion criteria

Animal research

- Location of study site
- Method of obtaining/ marking/identifying subjects
- Handling procedures for field experiments

Consent and participant information arrangements. (Not relevant for animal research) Please attach intended information and consent forms.

Consent and participant debriefing. (Not relevant for animal research) Please attach intended debriefing information.

Consent
as appropriate

	Please mark (x)	*Yes*	*No*	*n/a*
Will you describe the main experimental procedures to the participants in advance, so that they are informed in advance what to expect?		X		

	Yes	No	n/a
Will you tell the participants that their participation is voluntary?	X		
Will you obtain a written consent for participation?	X		
Will you tell the participants that they may withdraw from the research at any time and for any reason?	X		
Will you tell participants that their data will be treated with full confidentiality, and that, if the results are published, it will not be identifiable as theirs?	X		
Will you debrief participants at the end of their participation (i.e. give them a brief explanation of the study)?	X		

If you have ticked No to any of the questions in the section above and you consider that your project has no significant ethical implications, please give an explanation here	

Vulnerable Groups *as appropriate*	*Please mark(x)*	*Yes*	*No*	*n/a*
Do participants fall into the following categories?	School children (under 18 years of age)		X	
	People with learning or communication difficulties		X	
	Those at risk of psychological distress or otherwise vulnerable		X	
	People in custody		X	
	People engaged in illegal activities (e.g. drug taking)		X	

Projects involving human samples   *Please mark (x)*

as appropriate

The project will use DNA from:

Stock (anonymous)

Newly recruited participants

Please mark (x) as appropriate	Yes	No	n/a
Subjects will be informed of the aims and implications of the study procedure/information attached).			
Subjects will be notified of the results on request or automatically			
Participants will be advised on the legal and medical implications following from knowledge of their own results			
Tissue samples from the study will be destroyed upon completion			
If not, for how many years will tissue samples from the study kept?		**Years**	

Risk Assessments

The study has been assessed for risk and the following risk assessments are relevant (please attach any new Risk Assessment and COSHH forms on this page or enter the title of any existing relevant forms below).

Risk Assessment is attached below

Signed: *Sarah Bunney* **Date:** *13th January 2017*

Risk	Who might be harmed	Likelihood	Impact	Existing Control Measures
Data Protection	Participant	Low	High	• Information provided to the participant will outline the purpose of the research, what the data will be used for and confirm that only the researcher will have access to the original data • Personal data will be processed in accordance with data protection legislation and will be treated with confidentiality and anonymity will be protected • Personal data will only be used for the purpose of the research as presented to the participant • Personal data will be processed accurately • Personal data will not be kept for longer than that required for the purposes of the research and will be destroyed appropriately following completion of the research • Personal data/original questionnaires will be stored securely in a locked cabinet at all times and data used for analysis will be saved securely on password protected and encrypted computer.
Confidentiality	Participant and Researcher	Low	High	• The participant will be made aware that any information provided will be confidential and they will not be identified from the answers given • The participant will be made aware that any personal information provided will only be viewed by the researcher for the purposes of the research • The researcher will not disclose personal details regarding personal mobile number or home address. All contact is to be conducted in a professional manner through the University of Exeter
Integrity of Researcher		Low	Medium	The researcher has a responsibility to be honest and abide by the professional standards of social research. This includes:

	Control Measures			Responsibility
	- Being open, honest and clear regarding the research objectives - Ensure that participants of the semi-structured interviews and focus groups give informed consent, sign and complete a consent form - Ensure confidentiality is maintained at all times throughout the interview process - Ensure participants views are represented as accurately as possible			Participant and Researcher
Travel	- To minimise road travel, many of the semi-structured interviews could be conducted via skype, facetime or over the telephone - When travelling by road, the researcher must ensure the route has been determined in advance and the Supervisor and/or family members are aware of this. Regular breaks are to be taken if travelling long distances - Researcher to ensure that travel details are shared with the Supervisor and/or family members. Particularly leaving and arrival times	High	Low	Researcher
Lone Working	- Researcher to ensure that the Supervisor and/or family members know the details of any planned meetings and travel arrangements - Researcher to inform Supervisors or family members of departure and arrival times at all destinations and agree to inform Supervisors and/or family members of exact location at regular intervals - Focus group meetings will not be held in the home of a participant but will be conducted in a central location such as a village hall.	Medium	Low	Researcher
Difficult/Contentious or abusive members of the public	If a participant displays any characteristics of negative/abusive behaviour that is not constructive to the interview process then the interview will be politely concluded. If the interviewer feels threatened in any way or instinctively feels in a potentially dangerous situation the interview process will be politely concluded.	High	Low	Researcher

UNIVERSITY OF **EXETER** | Centre for Water Systems

Preparing for an Emergency

Thank you for taking the time to complete this questionnaire. The information that you provide will be used as part of a research project by the University of Exeter to understand attitudes and opinions to preparing for an emergency. This is defined as *'an event or situation which threatens serious damage to human welfare, the environment or the security of the United Kingdom.'* This may also include an event or situation where there is widespread and severe disruption to essential services such as transport, water, electricity and gas.

Data Protection Notice

The information that you provide will be used for the purpose of this research study and any personal data you provide will be processed in the strictest confidence in accordance with the Data Protection Act. It will not be disclosed to any third parties. Personal data and the original questionnaires will be stored securely in a locked cabinet at all times and data used for analysis will be saved securely on a password protected and encrypted computer. All of the data used for analysis and the results of the research will be published in anonymised form.

Instructions

Please answer all the questions and return the questionnaire in the pre-paid envelope provided. For each question, please place a tick in the box that matches your answer. For example, if your answer is yes:

Yes [✔]

No [ ]

Please don't worry if you make a mistake. Just cross it out and tick the box that matches your answer.

Completing the survey online

You are more than welcome to complete the questionnaire online at:

http://www.smartsurvey.co.uk/s/bishops/
To do this, you will need to enter the Password: **water01**

Section 1: Thinking about your local area.

The next few questions are about the local village, town or city where this questionnaire was delivered.

Q1	When thinking about your local area, do you think any of the following hazards are a risk to you? *Please tick **ONE** box on each line*				
	High Risk	Medium Risk	Don't know	Low Risk	No Risk
River flooding					
Coastal flooding					
Surface water flooding					
Sewer flooding					
Drought					
Heatwaves					
Low temperatures					
Heavy snow					
Storms and gales					
Pandemic influenza					
Widespread electricity failure					
Failure of the water supply					
Failure of the gas supply					
Other (please specify):					

Q2	What do you understand by a 1 in a 100 year event? *Please tick **ONE** option*	
An event that statistically can only happen once in every 100 years		
An event that statistically has a 1% chance of occurring in any given year		
An event that statistically has a 1% chance of occurring once in every 100 years		
An event that statistically happens every 100 years		

Q3	Do you think it is important for you to prepare for civil emergency events that have a low chance of occurring? *Please tick **ONE** option*		
Yes		Other (please specify):	
No			
Don't know			

Q4	Do you think it is important for you to prepare for the following hazards? *Please circle ONE number on each line*				
	Extremely Important	Very Important	Moderately Important	Slightly Important	Not at all Important
River flooding	1	2	3	4	5
Coastal flooding	1	2	3	4	5
Surface water flooding	1	2	3	4	5
Sewer flooding	1	2	3	4	5
Drought	1	2	3	4	5
Heatwaves	1	2	3	4	5
Low temperatures	1	2	3	4	5
Heavy snow	1	2	3	4	5
Storms and gales	1	2	3	4	5
Pandemic influenza	1	2	3	4	5
Widespread electricity failure	1	2	3	4	5
Failure of the water supply	1	2	3	4	5
Failure of the gas supply	1	2	3	4	5

Q5	When thinking about your local area, do you actively prepare for any of the following? *Please tick ONE box on each line.*		
	Yes	No	Don't think about it
River flooding			
Coastal flooding			
Surface water flooding			
Sewer Flooding			
Drought			
Heatwaves			
Low temperatures			
Heavy snow			
Storms and gales			
Pandemic influenza			
Widespread electricity failure			
Failure of the water supply			
Failure of the gas supply			

Q6	When thinking about your local area, have you experienced any of the following? *Please tick* **ONE** *box on each line.*			
		Yes	No	Don't Know
River flooding				
Coastal flooding				
Surface water flooding				
Sewer flooding				
Drought				
Heatwaves				
Low temperatures				
Heavy snow				
Storms and gales				
Pandemic influenza				
Widespread electricity failure				
Failure of the water supply				
Failure of the gas supply				

Q7	If you have experienced any of the hazards stated in question 6, we would be interested to know more. For instance, briefly describe what happened, who was involved and how was the emergency situation resolved?

Q8	Do you use any of the following sources of information to find out what hazards exist in your local area? *Please tick **ONE** box on each line*		
	Yes	No	Don't think about it
Local Authority			
Local Resilience Forum			
National Risk Register			
Community Risk Register			
Radio			
Television			
Government Website			
Parish Council			
Water Company Website			
Electricity Company Website			
Family and Friends			
Facebook			
Twitter			
Google or other search engines			
The Environment Agency			
Met Office			
Other (please specify):			

Q9	Do you use any of the following sources of information to find out how to prepare for a hazard in your local area? *Please tick **ONE** box on each line*		
	Yes	No	Don't think about it
Local Authority			
Local Resilience Forum			
National Risk Register			
Community Risk Register			
Radio			
Television			
Government Website			
Parish Council			
Water Company Website			
Electricity Company Website			
Family and Friends			
Facebook			
Twitter			
Google or other search engines			
The Environment Agency			
Met Office			
Other (please specify):			

Section 2: Thinking about your local water supply.

These questions are about understanding your attitudes and perceptions to your water supply and what would happen if there was a failure to provide you with a supply of water direct to your tap.

Q1	Who is your local water company?
Please specify:	

Q2	Do you know the source of your water supply?	
Yes		If your answer was **Yes,** please specify:
No		
Don't think about it		

Q3	When thinking about your local water supply, how important are the following issues to you? *Please circle ONE number on each line*				
	Extremely Important	Very Important	Moderately Important	Slightly Important	Not at all Important
Colour of the water	1	2	3	4	5
Taste of the water	1	2	3	4	5
Smell of the water	1	2	3	4	5
Clear drinking water	1	2	3	4	5
Reliable supply of water	1	2	3	4	5
Continuous supply of water	1	2	3	4	5
Sufficient water pressure	1	2	3	4	5
Safe drinking water	1	2	3	4	5
Effect on the environment	1	2	3	4	5
Cost of the water supply	1	2	3	4	5

Q4	Are you on a water meter?		
Yes		Other (please specify):	
No			
Don't know			

Q5	Do you take any of the following steps to save water in your home or garden? *Please tick ONE box on each line*					
		Always	Sometimes	Don't think about it	Rarely	Never
Turn off the tap when cleaning teeth						
Only boil the kettle with the amount needed						
Use a device in the toilet cistern						
Use water butts to collect rainwater						
Wash dishes in a bowl						
Install a water meter						
Only use the dishwasher on a full load						
Only use the washing machine on a full load						
Choose water efficient appliances when replacing old ones						
Other (please specify):						

Q6	How confident are you in receiving the following services from your local water company? *Please circle ONE number on each line*					
		Extremely Confident	Very Confident	Moderately Confident	Slightly Confident	Not at all Confident
A reliable supply of water		1	2	3	4	5
A continuous supply of water		1	2	3	4	5
A safe supply of water		1	2	3	4	5

Q7	In your opinion, what is the likelihood that any of the following could cause a failure of the water supply to your home? *Please tick **ONE** box on each line*					
	Extremely Likely	Very Likely	Moderately Likely	Unlikely	Never
River flooding					
Surface water flooding					
Coastal flooding					
Storms and gales					
Extreme cold and ice					
Prolonged hot and dry weather					
Power failure					
Fire					
Equipment failure					
Water contamination incident					
Accidental damage					
Malicious attack					

Q8	Do you consider a failure of the water supply: *Please tick **ONE** box on each line*		
	Yes	No	Don't think about it
A hazard you should prepare for now?			
A hazard you may have to prepare for in the future?			

Q9	In your opinion, what is the likelihood that your future water supply will be affected by: *Please tick **ONE** box on each line*				
	Extremely Likely	Very Likely	Moderately Likely	Unlikely	Never
Climate change					
Increasing population					

Q10	In the event of a serious failure of your water supply, how likely are you to obtain information from any of the following sources? *Please tick **ONE** box on each line*				
	Extremely Likely	Very Likely	Moderately Likely	Unlikely	Never
Local Radio					
Television					
Local Authority					
Water Company					
Government Website					
Parish Council					
Local Community					
Family and friends					
Facebook					
Twitter					
Electricity company					
Gas Company					
Environment Agency					
Other (please specify):					

Q11	In the event of a serious failure of the water supply. How confident are you that the water company will provide you with a supply of water from an alternative source?				
	Extremely Confident	Very Confident	Moderately Confident	Slightly Confident	Not at all confident
Please circle **ONE** number	1	2	3	4	5

Q12	In the event of a serious failure of the water supply. How likely are you to purchase water from your local supermarket?				
	Extremely Likely	Very Likely	Moderately Likely	Unlikely	Never
Please tick **ONE** box					

Q13	If there was a serious failure of the water supply. How long could you cope without a fresh supply of water direct from the tap? *Please tick **ONE** box*		
1 to 2 hours		Other (please specify):	
3 to 6 hours			
7 to 12 hours			
12 to 14 hours			
24 hours			
48 hours			
72 hours			
1 week			
2 weeks			
3 weeks			

Q14	If there was a serious failure of the water supply. What is an acceptable amount of time to be left without a fresh supply of water direct from the tap? *Please tick **ONE** box*		
1 to 2 hours		Other (please specify):	
3 to 6 hours			
7 to 12 hours			
12 to 14 hours			
24 hours			
48 hours			
72 hours			
1 week			
2 weeks			
3 weeks			

Section 3: Preparing for an emergency

The questions in this section are about understanding attitudes and opinions to preparing for an emergency and whether you prepare individually, as part of a community or both. Community preparation includes flood warden schemes.

Q1	Do you take the following steps to prepare for an emergency? *Please tick **ONE** box on each line*		
	Yes	No	Don't think about it
Make a household emergency plan			
Prepare an emergency contacts list			
Prepare an emergency kit			
Store an emergency supply of water			
Keep an emergency food supply			
Ensure you have adequate insurance			
Signed up to receive flood warnings from the Environment Agency			
Use flood protection products to protect your home from flooding			
Other (please specify):			

Q2	Do you participate in any community schemes to prepare for an emergency? *Please tick **ONE** box*	
Yes		*If yes, please specify the type of scheme and whether you have a role:*
No		
Don't think about it		

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Q3	Please indicate whether you agree or disagree with the following statements? *Please tick* **ONE** *box on each line*				
	Strongly Agree	Agree	Don't know	Disagree	Strongly Disagree
I have a responsibility to prepare for an emergency					
I have been provided with information about how I can prepare for an emergency					
I think about how to prepare for the risks in my local area					
I know where to obtain information about how I can prepare for an emergency					
I take actions to prepare for an emergency					
The local authority has a responsibility to prepare for an emergency					
I am aware of my local authority emergency plans					
The local authority provides information about how to prepare for an emergency					
I rely on the local authority to provide me with information during an emergency					
I rely on the emergency services to provide me with assistance during an emergency					
The emergency services will arrive quickly during an emergency					
The water company will provide water if there is a failure of the water supply					
I rely on the local water company to provide water in all circumstances					
The water company will provide me with information if there is a failure of the water supply					
I trust the information provided by the water company during an emergency					
The Government provides information about how to prepare for an emergency					
I trust the information provided by the Government during an emergency					

I trust the information provided by the media during an emergency					
I trust the information provided by the local authority during an emergency					

Section 4: About you

The questions in this section are optional but they will help us to categorise your answers. The answers you provide are confidential and you will not be identified from the answers you give. If you prefer not to answer a particular question, please feel free to leave it blank.

Q1	*Please tick **ONE** box*		
Male		Female	

| | | Prefer not to say | |

Q2	Which age bracket applies to you? *Please tick **ONE** box*				
18-24	25-34	35-44	45-54	55-64	65+

Q3	How many people, including children live in your household?	
Q4	How many children live in your household?	
Q5	How long have you lived at this address (Please state in years and months)	

Q6	Is your property: *Please tick **ONE** box*	
Owned outright		Other (please specify):
Owned with a mortgage or loan		
Rented from the Local Authority/Housing Association		
Privately rented		

Q7	Approximately how far do you have to travel to work each day?	

Q8		What type of property do you live in? *Please tick **ONE** box*	
Semi-detached		Other (please specify):	
Terraced			
Detached			
Bungalow			
Flat/Maisonette			

Q9		What is your current working status? *Please tick the relevant box*	
Employed full-time		Other (please specify):	
Employed part-time			
Unemployed looking for work			
Unemployed not looking for work			
House-wife/House-husband			
Student			
Retired			

Q10		Which of the following qualifications do you have? *Please tick **ALL** that apply*	
O levels, CSE's, GCSE's		Other (please specify):	
NVQ, GNVQ, ONC, OND, HNC, HND			
Other qualifications City and Guilds, RSA, BTEC			
Apprenticeship, vocational or work related			
A levels, VCE's, AS levels, Higher School Certificate, Welsh Baccalaureate Advanced Diploma			
Degree (BA, BSc) or Higher Degree (MA, PhD, PGCE)			
Professional Qualifications (for example, teaching, nursing, accountancy)			

Q11	Please choose one option that best describes your ethnicity.	
White		**Other Ethnic Groups (please specify):**
British, English, Northern Irish, Scottish or Welsh		
Irish		
Other		
Mixed or multiple ethnic group		
White and Black Caribbean		
White and Black African		
White and Asian		
Other		
Asian or Asian British		
Indian		
Pakistani		
Bangladeshi		
Chinese		
Other		
Black, African, Caribbean or Black British		
Caribbean		
African		
Other		
Other Ethnic Group		
Arab		
Other		
Prefer not to say		

Thank you for taking the time to complete this questionnaire. Please return the survey in the pre-paid envelope provided.

If you would like to participate in any further research or would like to be provided with the findings of the research, please provide your details below.

Would you be interested in participating in further research?	Yes	
	No	
Would you be interested in receiving a copy of the research findings?	Yes	
	No	
Name:		
Address:		

UNIVERSITY OF **EXETER** | Centre for Water Systems

ENGINEERING

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19th April 2017

Dear Resident,

I would like to invite you to participate in a research study conducted by the University of Exeter to understand attitudes and opinions to preparing for an emergency. This is defined by the UK Cabinet Office as *'an event or situation which threatens serious damage to human welfare, the environment or the security of the United Kingdom'*. An emergency may cause illness, loss of life, homelessness, damage to property or serious interruption of essential services such as water, energy or fuel and examples include flooding, water contamination and drought. It is hoped that the study will provide useful information to help inform the future delivery of emergency management in the UK.

While your contribution to the research study would be very valuable, it is entirely voluntary and I completely understand if you do not wish to participate. Before you make that decision, please take a few moments to read the following information. If you have any questions, please do not hesitate to contact me using the contact details at the top of this letter.

What will I have to do if I agree to participate?

Please either complete the enclosed questionnaire and return it to me in the pre-paid envelope provided or alternatively you can complete the questionnaire online at http://www.smartsurvey.co.uk/s/bishops/ using the password: **water01**

The questionnaire should take no longer than 20 minutes to complete.

Anonymity and Confidentiality

All of the information you provide in the questionnaire will be anonymised and will be strictly confidential. The questionnaire does not require you to provide any details of your name or address unless you wish to participate in further research or you want to request a copy of the research findings. If you provide your details to request further information they will be removed from the original questionnaire so that you cannot be identified from the answers you have given.

The information you provide in response to the questionnaire will only be used for the purpose of this research study and no-one other than the lead researcher will have access to the original questionnaires and the data. Your data will be held in accordance with the Data Protection Act.

Data Protection Notice

The information you provide will be used for the purpose of this research study and any personal data you provide will be processed in accordance with the Data Protection Act. Your data will be treated in the strictest confidence and will not be disclosed to any third parties. Personal data and the original questionnaires will be stored securely in a locked cabinet at all times and data used for analysis will be saved securely on a password protected and encrypted computer. All of the data used for analysis and the results of the research will be published in anonymised form.

I would like to thank you in advance for taking the time to participate in this research study.

Yours sincerely

Sarah Bunney
PhD Researcher

INFORMATION SHEET AND CONSENT FORM FOR RESEARCH STUDY
EMERGENCY PLANNING IN THE WATER SECTOR

Details of Project

I would like to invite you to participate in a research project conducted by the University of Exeter to determine how we can achieve resilience to extreme events through effective emergency planning in the water sector. It is hoped that the study will provide useful information to help inform the future delivery of emergency management in the UK.

While your contribution to the research study would be very valuable, it is entirely voluntary and I completely understand if you do not wish to participate. Before you make that decision, please take a few moments to read the following information. If you have any questions, please do not hesitate to contact me using the contact details below.

Primary Researcher	Supervisors
Sarah Bunney College of Engineering, Mathematics and Physical Sciences University of Exeter Harrison Building North Park Road Exeter EX4 4QF **Email**: sb734@exeter.ac.uk **Telephone**: 01392 723600	Professor David Butler and Dr Sarah Ward College of Engineering, Mathematics and Physical Sciences University of Exeter Harrison Building North Park Road Exeter EX4 4QF

How will the study be conducted?

If you agree to participate, the researcher will conduct an interview with you over the telephone. This should take approximately 40 minutes to complete. The researcher will record your responses in writing unless you have agreed for the interview to be recorded. Upon completion of the interview, the researcher will ask if you would like to participate in further research in the form of a Delphi survey. This is where the responses to all of the interviews between different organisations will be collated and a series of questions will be developed to explore attitudes and opinions to the multi-agency approach to emergency management in greater detail.

Anonymity and Confidentiality

All of the information that you provide in the telephone interview and the Delphi survey will be strictly confidential and anonymised. Interview transcripts will be held in confidence and will not be used other than for the purposes of this research study. Third parties will not be allowed access to them (except as may be required by law). However, if you request it, you will be supplied with a copy of your interview transcript so that you can comment on and edit it as you see fit. Your data will be held in accordance with the Data Protection Act.

Data Protection Notice

The information you provide will be used for the purpose of this research study and any personal data you provide will be processed in accordance with the Data Protection Act. Your data will be treated in the strictest confidence and will not be disclosed to any third parties. Personal data and the original transcripts will be stored securely in a locked cabinet at all times and data used for analysis will be saved securely on a password protected and encrypted computer. All of the data used for analysis and the results of the research will be published in anonymised form.

Consent

I have been fully informed about the aims and purpose of the project and I understand that:

- there is no compulsion for me to participate in this research study and, if I choose to participate, I may withdraw at any stage;
- all the information I provide will be treated as confidential;
- the researcher will ensure the information I provide is anonymous and I will not be identified from any of the answers I give;
- any information I provide will be used solely for the purposes of this research project, which may include publications or academic conference or seminar presentations;
- if applicable, the information I provide, may be shared between any of the other researchers participating in this project in anonymised form.

Signature of Participant	Date
Printed name of Participant	Email address for transcript
Signature of Researcher	Printed name of Researcher

One copy of this form will be kept by the participant; a second copy will be kept by the researcher. Your contact details will be kept separate from your interview data.

APPENDIX 4: CONFERENCES ATTENDED

A number of conferences were attended at the start of the PhD to gain a clear understanding of the main issues that were relevant to emergency management within the UK and the protection of critical infrastructure. The information obtained from attending the conferences was used to support the information obtained as part of the literature review and through the process of networking a number of issues were identified that helped to structure the initial aim and objectives of this PhD. The following section highlights the information obtained from each conference and how it was used within the research aims and objectives.

1 Water, Water, Everywhere ….

The first conference attended was the Water, Water, everywhere conference on the 20th November 2015. This involved a series of talks to demonstrate how Bristol City Council is attempting to prepare for the challenges they face in terms of climate change and how they are preparing for the threat of tidal and surface water flooding. They introduced a scheme to create and maintain a Local Flood Risk Management Strategy with Wessex Water and the Environment Agency highlighting the need to encourage resilience because flood levels within the City of Bristol are expected to exceed 1.5m depth with the projected figures for climate change.

It was evident that there was a very strong relationship between Bristol City Council and Wessex Water. Both organisations giving a joint presentation with

jokes and banter between the two representatives. However, there was no involvement from Bristol Water or even a representative presenting at the conference. This was interesting because many of the pilot schemes proposed as examples of reducing flood risk and achieving resilience at the community level were developed within the City Centre and should have involved Bristol Water. The information presented by the Wessex Water representative was very general and concerned the area surrounding Bristol.

A conversation with an Environment Agency representative regarding a recent multi-agency emergency exercise relating to a tidal flood event along the Bristol Channel also revealed some interesting questions. The event was conducted in Carlisle and involved all of the organisations that would be involved in the multi-agency response to an extreme tidal event along the Bristol Channel. However, it wasn't until the last minute that the organisers realised that they had only included representatives from the Welsh side of the Bristol Channel when in reality the flood event would place an extreme strain on emergency services on both sides of the channel. An interview with the Emergency Planning Manager of North Somerset Council revealed that they had not been involved in the exercise and did not have any knowledge that it had been conducted. It was also revealed that despite discovering a number of inadequacies as a result of the emergency exercise the Environment Agency representative had not received any further notification of lessons learned or recommendations following the exercise.

2   Flood Resilient Communities: Evaluating the Defra Flood Resilience Community Pathfinder Project

This conference was attended on the 3rd of December 2015. It was organised by the National Flood Forum as an opportunity to introduce and evaluate the Defra Community Pathfinder Project.   The conference consisted of a number of presentations from local community groups and Local Authorities that had been involved in the scheme and was an opportunity for them to present the results of their experience.   The presentations were varied, each was followed by a question and answer session and there was an opportunity to talk in depth with the presenters during break-out sessions.

This conference was invaluable in demonstrating how very little had changed over the last 15 years in developing resilience to flood risk at a local level. As part of my career I worked for the Environment Agency as a Flood Risk Management Officer and was actively involved in establishing and developing Flood Warden Schemes. These were promoted as a partnership approach to encourage the communities at risk of flooding to take action to prepare. The scheme was abandoned after a couple of years due to worries regarding liability should an individual become harmed whilst protecting their property from flooding. Yet, 14 years later I am being introduced to a new but incredibly similar scheme under the new branding of 'resilient communities.'

From watching the presentations it was perceived that schemes developed and run by community groups were far more effective than those run by the Local Authority.   Yet, from talking avidly with Paul Cobbing, Chief Executive of the

National Flood Forum it was discovered that this was not necessarily the case. Community groups that have been formed through the Local Authority via the 'top down' approach were much more 'engaged' than those that have been formed through the 'bottom up' approach.

A number of issues were identified as a result of attending this conference. Even after 14 years there were still difficulties encouraging those at risk of flooding to prepare. While the Defra Pathfinder project was involved in the implementation of a diverse number of different schemes to achieve and demonstrate resilience, it is not entirely evident that they understood why many communities at risk of flooding were not engaged with the process of preparing for a flood. This information would help to overcome many of the challenges faced with encouraging communities to become more resilient. Although, it wasn't clearly defined as to what they meant by community resilience and what will happen in the future to the schemes that were established? Will they still be provided with support or will they become abandoned?

Finally, there was also an example of a brilliant website that had been designed by a Local Authority with the help of a Consultant as a portal of information for community groups detailing what to do before, during and after a flood event, relevant contact details and the area at risk of flooding. However, all of this information is available on the Government website. Prior to the introduction of the Water Management Act, 2010, there used to be a 'one stop shop' for information regarding all aspects of flooding on the Environment Agency website. This had been promoted extensively through national and local public awareness

campaigns, largely as a result of the Bye Report (1999) that identified there was a great deal of confusion over who was responsible for flood related issues. Following the introduction of the Water Management Act, 2010 the responsibility for flood related issues was handed over to the Local Authority. All of the public awareness campaigns designed to promote the Environment Agency as the lead organisation for flood related issues were abandoned. However, with Local Authorities being designated this role it is unclear if they have adequate funding to be able to promote themselves as the lead organisation for flood related issues. Are the public being left in confusion once again over who is responsible for what? This takes us straight back to the problems identified within the Bye Report (1998) following the Easter Floods 1998. Is this an example of going round in circles rather than addressing the real issue of why communities are not preparing for flooding?

3   Making our Nation More Resilient to Flooding

This was a relatively small event and included a number of presentation from both academics and practitioners regarding the challenges being faced with the threat of climate change and the actions that should be taken to encourage a greater resilience to the threat of flooding. It was concluded that with all the academic research, Government and Environment Agency reports, everyone knew what needed to be done to achieve greater resilience but no-one was actually operationalising it.

4   Major Incident and Emergency Planning

In September 2016, I attended the Major Incident and Emergency Planning conference in London. This was a useful conference to attend because it was attended by emergency management professionals giving me the opportunity to network and it gave me an insight into the challenges experienced by the emergency response sector.

There is a new situational awareness tool that is being rolled out throughout the country called Resilience Direct. One of the keynote sessions was presented by Luana Avigliano the Head of Resilience Direct and this was the perfect opportunity to understand how this system works and how it will contribute to a greater working relationship between different organisations during emergency response.   Luana presented an overview of the system during one of the networking breaks and I was able to see how the system worked directly and ask her a few questions. She was very positive about the multi-agency approach to emergency management and gave me the contact details for the Local Resilience Forum Manager in the South West. Luana also accepted me as a friend on LinkedIn so I would be able to access her contacts.

I also spoke about my research to Tony Thompson, Chair of the Emergency Planning College. He was very positive and thought my research was valuable because he didn't think there was anyone doing this type of research. We spoke at length about how effective emergency management is in the UK and he has given me his card so I can contact him as part of my research project.

8.2   CIWEM: Beyond the National Resilience Review

During December 2016 I attended CIWEM's Beyond the National Resilience Review: Building resilient infrastructure and community's event. This conference was particularly relevant to my research with the majority of the presentations conducted by owners and operators of the UK's critical infrastructure. It was very interesting to understand the different interpretations of the review and the different approach taken by similar organisations. The information obtained from attending this conference was presented at the Safe and SuRe reading group in the National Flood Resilience Review presentation.

5   Cabinet Office Emergency Ambition Conference – Feb 2018

This was a really useful conference and very relevant to my PhD. There has been a review of the collaborative working relationships between CAT 1 responders (first responders) in the UK. Although I haven't gone through my interview transcripts in great detail, answers to a couple of my interview questions led me to believe there are still difficulties between organisations sharing information. This is something that was highlighted from the review. Also, this review is only looking at CAT 1 responders. There isn't currently a review looking at inter-operability between CAT 1 and CAT 2 (Utility providers).

I also spoke with the Emergency Planning College who are very interested for me to keep in touch and let them know how my research is progressing. They were also very keen to help put me in touch with Emergency Managers as part of my semi-structured interviews.

6   Environment Agency Flood and Coast 2018 – Resilience

I have been working in partnership with a community representative to develop a series of social network graphs to understand the development of a community flood group and a local authority flood board. The local community representative presented the social network graphs at the conference to demonstrate the complex relationships involved in building collaborative working partnership schemes at a local level. The conference was dedicated to understanding how to achieve greaer resilience to flood events and it was a good opportunity to understand community resilience from the perspective of people at risk. There was a great deal of discussion about resilience and what resilience means not just for an organisation but also for the people who are being affected.

I made a lot of contacts at this event and it would be brilliant to follow them all up and develop further social networks however, I am at a stage in my PhD where I recognise that I have enough data. I need to focus on developing and analysing my data sets.

7   Delivering Resilience in PR19 and Beyond

This was a very interesting conference examining resilience from the perspective of the WSP. There was a presentation by a representative from Ofwat regarding 'Resilience in the Round' and how the water sector should aim to include resilience within PR19 with customers at the heart of each resilience based strategy. However, this guidance document does not contain any reference to how this can be achieved through effective emergency management. Extreme

events require an effective emergency response involving the utility companies, emergency responders and the individuals affected so it is interesting why emergency management is not considered to be important as part of the process to achieving resilience.

The afternoon session included presentations from other sectors and this was also interesting because Highways have identified the need to collaborate more with responder organisations and other sectors during their normal daily to day operations. This is because road closures can significantly affect the response times of emergency response vehicles.

UNIVERSITY OF EXETER | Centre for Water Systems

Preparing for an Emergency – A multi-agency Approach

Thank you for taking the time to participate in this semi-structured interview. The information that you provide will be used as part of a research project by the University of Exeter to determine how we can achieve resilience to extreme events through effective emergency planning in the water sector.

Emergency is defined as *'an event or situation which threatens serious damage to human welfare, the environment or the security of the United Kingdom.'* This may also include an event or situation where there is widespread and severe disruption to essential services such as transport, water, electricity and gas.

My PhD is looking at how organisations can achieve resilience as part of a multi-agency approach. I am looking at the emergency management system in the UK to identify areas of best practice and how this can be shared effectively but also exploring where there are limitations in the system and how these can be improved. My focus is on the water sector and the flooding of critical infrastructure, water contamination, drought and the potential Dam failure as these are defined within the National Risk Register as specific risks to the water sector.

I would like to assure you the answers you provide are confidential and you will not be identified from the answers you give.

Before we start, please take a few moments to read and sign the information and consent form for research study. If you have any questions, please do not hesitate to ask.

Thank you for taking the time to participate in this research project.

Section 1: About You

Q1	Name

Q2	Organisation

Q3	What is your role within the organisation?

Q4	How long have you worked here?

Q5	Would you mind if I were to record the interview? *Reinforce that the process is entirely confidential and anonymous. All of the information that you provide will be strictly confidential and anonymised. Interview transcripts will be held in confidence and will not be used other than for the purposes of this research study. Third parties will not be allowed access to them (except as may be required by law). If you request it, you will be supplied with a copy of your interview transcript so that you can comment on and edit it as you see fit. Your data will be held in accordance with the Data Protection Act.*

Section 2: Organisational Systems

The next few questions are designed to understand your organisation and how it prepares for an emergency. I am interviewing people from different organisations and this helps me to put your answers into the correct context. For instance a government organisation may have a different perspective on resilience compared to a profit making organisation.

Q1	How would you describe the organisational structure within your organisation? • Hierarchical top down/rigid/command and control • Flat structure • Bottom up approach • People centred v process oriented ……… and how does this influence the culture within your organisation?

Q2	What do you perceive to be the main threats and hazards that would affect your organisations ability to respond to an emergency? • How does this align with your company's business plan/mission statement? • How are these incorporated within your organisations business plan?

Q3	How is information transferred within your organisation? • Top down or bottom up • If there is a mixture of the two, what is the dominant approach • Is information fed down through government/regulator policies and plans and how is information fed back up through the system

Q4	How would you define resilience and what does it mean for your organisation? • Is this something that you are constantly working towards? • Is it driving the organisation business plan and delivery? • Is this something that is integral to the organisation? • Do people understand how performance within their role may contribute to the overall resilience of the organisation? • Is there integration between different departments working towards achieving resilience or do departments have defined roles and work independently?

Q5	Do you think that current legislation, policies and guidance produced by the government and the regulators contribute effectively toward building and achieving resilience to emergencies for your organisation? Why? • Does it help to facilitate decision making within your organisation • Does it help to encourage ideas and innovation • Have you encountered any problems Does this approach allow for discussion, the incorporation of lessons learned and the sharing of best practice? • Do you consider yourself to be part of a two way process of sharing information?

Q6	How do you assess or determine the resilience of your organisation to a low probability/high consequence event? • Capabilities and resources to respond to an extreme event • Duty rotas/staff availability etc • How do you prepare for unknown threats and hazards • Are they incorporated within your business plan
Q7	What would you consider to be an effective measure of organisational resilience in response to a low probability/high consequence event? • For instance – recovery time/trained staff/multi-agency collaboration

Q8	Do you monitor the effectiveness of response to small scale events to assess the likelihood of a bigger failure occurring?

Section 3: Planning for Emergencies

This section of the questionnaire is to understand how your organisation prepares for an emergency and works together as part of a multi-agency approach.

Q9	How do you assess risk to your organisation? *For Instance do you analyse all the accidents and incidents that occurred or you responded to last year and develop a risk assessment on the most probable events …. Or it is based entirely on information provided in the LRAG and the NRR?* • Do you take an all hazards approach? • Do you consider unknown threats and hazards as well as unknown • Do you involve other organisations in the development of the plan. • Who are those organisations … rank them in terms of importance
Q10	What do you consider to be the purpose of an emergency plan? • For instance structure and coordinated approach • How do you plan for low probability/high consequence events?

Q11	How often is the plan updated and reviewed? • Is it reviewed in line with the business plan? • How do you allocate funds and resources to low probability/high consequence events?

Q12	Do you develop your emergency plan together with other organisations that may be involved in emergency preparedness and response? If not why not?

Q13	If the answer is yes …. Explore …. How do you share information with other organisations? • What information do you share • What do you perceive to be the barriers/constraints that make the sharing of information between organisation more difficult • Do you think there is adequate sharing of information between organisations • How could this be improved for effective emergency management

	• When is information shared is it before, during or after an event … how could this be improved

Q14	Do you share the details of your plan with other organisations that may be affected or involved in the emergency response • If not why not • What kind of organisations do you share your plan with • How would you rank them in them of their importance within the emergency response

Q15	How do you plan and prepare for low probability/high consequence events? Do you consider the emergency plan to be an effective approach for low probability/high consequence events? • Explore flexibility and adaptability

Q16	Do you develop any training exercises related to the emergency plan? What is the purpose of these? • Are these to develop and test the emergency plan • To ensure everyone involved in the emergency response understands what they have to do • Are they used to assess the resilience of the organisation to an emergency? Or the resilience of the multi-organisational approach?

Q17	Do you provide training within your organisation of how emergency management is conducted in the UK? • Does this include how this operates within the framework of a multi-agency approach? • Or is this provided as part of an external training exercise with other organisations?

Q18	Is the information obtained from any training exercises developed into a lessons learned report or document?

Q19	How do you apply lessons learned within your organisation? • Are they incorporated within the business plan? • Do they result in changes to operational procedures? • Is this met with a positive or negative attitude to change? • How are lessons learned incorporated within the organisational culture?

Q20	What would you consider to be the barriers to organisational learning within your organisation?

	What would you consider to be examples of best practice?

	As an organisation do you participate in multi-agency exercises?
Q21	• Who develops and designs the exercises • Are you involved in the initial planning stage • Is there a good response in terms of attendance • Do you consider the exercises to be a realistic interpretation of what could occur • How do you measure the effectiveness of the exercise • How is information regarding the effectiveness of the exercise disseminated to other organisations • Is there a good response • Is this information then used to develop the plan further

	Do you share best practice with other organisations?
Q22	• Why • What do you perceive to be the barriers with sharing best practice with other organisations • Could organisations use the LRF as a place to share best practice in terms of effective emergency management and response

Section 5: The role of your organisation in the Local Resilience Forum

The next few questions are to explore the role of your organisation in the Local Resilience Forum.

	Are you a member of the LRF? • What is your role and how long have you been a member?
Q23	• How often do you attend the meetings? • What do you consider to be the role or aim of the LRF • What do you consider to be the advantages of the LRF • What do you consider to be the constraints

	Please describe the structure of your Local Resilience Forum?
Q24	• Who is the Chair of the Local Resilience Forum? • Who attends the Local Resilience Forum Meetings? • How often do you meet? • Are there any sub committees? • Are you a member of any sub-committees? • Rank members in terms of influence?

	In your opinion, what is the level of collaboration between the Category 1 and the Category 2 responders in the multi-agency assessment of risk?
Q25	• Is the current approach effective?

	• How could it be improved? • Are there strong working relationships between organisations
Q26	In your opinion, what is the level of collaboration between the Category 1 and the Category 2 responders before, during and after an emergency?

Q27	In your opinion, what is the level of information sharing between the Category 1 and Category 2 responders before, during and after an emergency? • Where does this work well? • How can this be improved? • What are the current issues?

Q28	Are there any tools/technology that you use during an incident to improve multi-agency situational awareness? Do you use Resilience Direct? • Do all of the organisations use RD • Has it been used by the LRF for any incidents • Is it used during emergency exercises

Q29	What measures do you see as contributing to effective collaboration before, during and after an emergency?

Q30	Have you been involved in the production of the Community Risk Register? • What was your role? • Are you a lead assessor for the hazards relevant to your organisation? • If you are not the lead assessor, do you agree with the information provided by the nominated person? • How much did you contribute? • Do you think this is a useful/good approach
Q31	How is the risk assessment conducted? • In your opinion, do you think this is the best approach? • What would you consider to be the advantages of this approach? • What would you consider to be the disadvantages of this approach? • Are the results published on Resilience Direct?

Q32	How often is the Community Risk Register updated?

Q33	How do the risk ratings within the community risk register correlate with those of similar hazards within your organisation?

Q34	Do you use the risk ratings as defined within the Community Risk Register to inform any local contingency decision making within your organisation? • Please explain why?

Q35	In your opinion, does the Local Resilience Forum gain enough support from Central Government? What could be done to improve this

Q36	Do you share information and collaborate with any other Local Resilience Forums? • Particularly in the development of the Community Risk Register • How closely do you work together • Are you familiar with the people in the LRF • Is there a good rapport • Are you familiar with the roles and responsibilities of each organisation • Do you think other organisations understand the roles and responsibilities of your organisation • Is there anything that make/constrains your relationship with other organisations • Is there a good working relationship • Is there mutual trust and respect

Q37	Have you held a joint exercise with another Local Resilience Forum? Or been involved in an event with another LRF? • What was the purpose of this? • Did it enable the allocation and distribution of resources?

Section 6: Community Involvement

Q38	Do you work together with the local community in the development of emergency plans? • How and to what benefit does it bring • What are the advantages of working together with the local community • Does it strengthen or weaken the emergency response • Should they be integrated within the LRF's • Who provides the link between the LRF and the community, is this effective • Is there an opportunity for organisations to share information and utilise each other's connections into the community for effective emergency management

Thank you for taking the time to participate in this research project.

Local Community Questionnaire

1   Name:

_____

2   Address:

_____

3   How many people live in your property?   _____

Age Ranges: 1-16   17-35 36-50 51-70 71+
                       ☐   ☐   ☐   ☐   ☐

4   Are you on a water meter?   Yes: ☐

                                      No: ☐

5   Do you have a washing machine?   Yes: ☐

                                      No: ☐

How often do you use it?
_____

6   Do you have a dishwasher?   Yes: ☐

                                      No: ☐

How often do you use it?   _____

If not, how often do you wash the dishes?   _____

Do you wash the dishes in a bowl or under a running tap?

_____

7   On average, how often do you and the members of your family use the shower?

        _____

8   On average, how often do you and the members of your family use the bath?

        _____

9   Do you regularly wash your car?   Yes: ☐

                                                        No: ☐

        If you have more than one car, please provide details as to how often you wash

these?

        _____

        _____

        _____

10   Do you water your garden?   Yes: ☐

                                                        No: ☐

        If yes, approximately how often and for how long?

        _____

        Do you use a hose or a watering can?
        _____

11   Do you use water for any other purposes not previously mentioned?

                                                        Yes: ☐

                                                        No: ☐

Please provide details:

_____

_____

_____

_____

12   Do you take any measures to save water in your home or garden?

Yes: ☐

No: ☐

Please provide details of measures taken:

_____

_____

_____

_____

13   Who is your local water service provider?

_____

14   Has there ever been a problem with the water supply to your property?

Yes: ☐

No: ☐

If yes, please provide details:

_____

_____

_____

_____

_____

15   Have you ever had to contact your water service provider regarding any issues with your water supply?

How soon did they respond?
_____

Was the issue resolved?
_____

Any further comments:
_____

_____

_____

_____

16   On a scale of 1 to 5, how confident are you in receiving a fresh and safe supply of water from your water service provider?

    1   2   3   4   5

Least Confident   Very Confident

17   On a scale of 1 to 5, how confident are you in receiving a reliable and uninterrupted supply of water from your water service provider?

    1   2   3   4   5

Least Confident   Very Confident

18   Have you ever been issued with a 'boil water' notice at this address?

Yes: ☐
No: ☐

How did you find out about the 'boil water' notice?
_____

How long did it last for?

_____

19   What would you do if there was no cold water or very low pressure when you turn on the tap?

_____

_____

_____

20   Do you know how your local water service provider would contact you regarding a failure of the water supply?

_____

_____

21   In the event of an emergency, if there was a serious failure to provide a water supply to your property, whose responsibility is it to provide you with a safe supply of water?

_____

_____

_____

22   Do you consider that you have a responsibility to prepare for an emergency by storing   a supply of water in your property?

Yes: ☐

No: ☐

If yes, why?

_____

_____

_____

If no, why?

_____

_____

_____

23   On a scale of 1 to 5, how confident are you that your local water service provider will provide you with water if there was a serious problem with the water supply to your village/town?

| 1 | 2 | 3 | 4 | 5 |

Least Confident   Very Confident

24   In the event of an emergency and a failure to supply water to your town/village, do you know how much water should be provided per person per day?

Yes: ☐   Approximately how much? _____

No: ☐

In your opinion, how much water should be provided per person, per day?

_____

25   How long could you cope without a fresh, clean supply of water to your property?

_____

_____

_____

26   In your opinion what would be an acceptable amount of time to be left without a supply of fresh water direct from the tap?

_____

_____

_____

27   Would you rely on the water service provider to provide you with a supply of water in the event of a serious failure?

Yes: ☐
No: ☐

Why?

_____

_____

_____

28   Would you consider providing your own supply of water?

Yes: ☐
No: ☐

If yes, where would you obtain your own supply of water?

_____

_____

_____

29   Do you have any concerns regarding the future safety or reliability of your water supply?

Yes: ☐
No: ☐

If yes, why?

_____

_____

_____

If no, why?

_____

_____

_____

30   Do you keep a supply of water in your premises for emergency?

Yes: ☐

No: ☐

If yes, why?

_____

_____

_____

If no, why?

_____

_____

_____

31   Are you aware of any local or national risks that you, as a householder should prepare for in the case of an emergency?

Yes: ☐

No: ☐

If yes, please provide details:

_____

_____

_____

32   Are you aware of any resources that can help you to understand risks within your local area?

Yes: ☐
No: ☐

If yes, please provide details:

_____

_____

_____

33   Are you aware of the Community Risk Register for your local area?

Yes: ☐
No: ☐

If yes, have you read the Community Risk Register for your local area?

_____

_____

_____

34   Are you aware of your Local Resilience Forum?

Yes: ☐
No: ☐

If yes, please provide details of how you know about the Local Resilience Forum:

_____

_____

_____

_____

35   Are you aware of your local council's emergency plans and services?

Yes: ☐
No: ☐

If yes, please provide details:

_____

_____

_____

36   What do you understand by the meaning of the word resilient?

_____

_____

_____

APPENDIX 7: EXAMPLE OF A FOLLOW UP LETTER

UNIVERSITY OF EXETER | Centre for Water Systems

ENGINEERING

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Mathematics and
Physical Sciences

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19th June 2017

Dear Resident,

I contacted you on the 19th April, inviting you to participate in a research study conducted by the University of Exeter to understand attitudes and opinions to preparing for an emergency. Thank you very much if you have already completed the questionnaire and sent it back to me in the pre-paid envelope. Your contribution to my research project is very valuable and I appreciate you taking the time to assist me with this. If you have offered to participate in further research, thank you very much and I will be in contact with you within the next few months.

Don't worry if you haven't had time to return a completed questionnaire. There is still time and I would really appreciate if you could spare a few moments to complete the questionnaire and return it to me. It is hoped that the research project will provide useful information to help inform the future delivery of emergency management in the UK. The questionnaire can also be completed online at http://www.smartsurvey.co.uk/s/bishops/ using the password: **water01**

The questionnaire should take no longer than 20 minutes to complete.

While your contribution to the research study would be very valuable, it is entirely voluntary and I completely understand if you do not wish to participate. Before you make that decision, please take a few moments to read the following information. If you have any questions or require a paper copy of the questionnaire, please do not hesitate to contact me using the contact details at the top of this letter.

Anonymity and Confidentiality

All of the information you provide in the questionnaire will be anonymised and will be strictly confidential. The questionnaire does not require you to provide any details of your name or address unless you wish to participate in further research or you want to request a copy of the research findings. If you provide your details to request further information they will be removed from the original questionnaire so that you cannot be identified from the answers you have given.

The information you provide in response to the questionnaire will only be used for the purpose of this research study and no-one other than the lead researcher will have access to the original questionnaires and the data. Your data will be held in accordance with the Data Protection Act.

Data Protection Notice

The information you provide will be used for the purpose of this research study and any personal data you provide will be processed in accordance with the Data Protection Act. Your data will be treated in the strictest confidence and will not be disclosed to any third parties. Personal data and the original questionnaires will be stored securely in a locked cabinet at all times and data used for analysis will be saved securely on a password protected and encrypted computer. All of the data used for analysis and the results of the research will be published in anonymised form.

I would like to thank you in advance for taking the time to participate in this research study.

Yours sincerely

Sarah Bunney

PhD Researcher

APPENDIX 8: RADIO GLOUCESTERSHIRE CONTENT ANALYSIS RESULTS

Results of the content analysis performed on BBC Radio Gloucestershire throughout the duration of the Mythe Water Treatments Works flooding incident 2007.

Accessed via online article created on the 23/07/2007

http://www.bbc.co.uk/gloucestershire/content/articles/2007/07/23/flood_news_latest_feature.shtml

Categories		Number of Responses
Request for information	About people	2
	Travel	1
	Timescales	10
	Bowser deployment	34
	Locations flooded	8
	Loss of water supply	18
	Still have water	0
	Bowser refilling	1
	Local businesses	1
	General	2
Advice regarding	Flushing toilet	8
	Boiling water	2
	Water use	27
	Severn Trent website	3
	Gain water	20
	Water back on	28
Praise	Severn Trent website	0
	Radio Station	6
	Severn Trent	4
	Emergency services	10
	Others inc friends	26

Categories		Number of Responses
Raising Questions	Emergency services/operational	2
	Extreme situations	1
	Defences	3
	Normal business operations	4
	Providing help	23
	Suggestions for hygiene	6
	Bowser deployment and levels	8
	Severn Trent operations	24
	Compensation	26
	Other	11
Volunteers		3
Climate Change		1
Other/random		89
Providing Information	Still have water	11
	Supply reinstated	0
	Boiling water	5
	Loss of water supply	0
	Bowser deployment	4
	Flooded locations	1
	Empty bowser	1
	General information	5
Support	For Severn Trent	2
	For those affected	19
Complaints	Political	12
	Floodplain development	7
	Panic buying/taking bowser water	16
	Flood protection of Mythe WTW	3
	Dredging the Severn	1

	Inadequate communication	15
	Bowsers empty	3
	Bowsers location	1
	Vandalism	8
	Lack of emergency plan	8
	Severn Trent	29
	Improper use of water	7
	Authorities	3

APPENDIX 9: INDEPENDENT SAMPLES T TEST

Null Hypothesis: The means of both samples taken from the individual householder questionnaire are equal

Alternative Hypothesis: The means of both samples taken from the individual householder questionnaire are different.

Independent samples T Test

$$t = \frac{(\overline{x_1} - \overline{x_2})}{\sqrt{\frac{s_p^2}{n_1} + \frac{s_p^2}{n_2}}} \qquad s_p^2 = \frac{SS_1 + SS_2}{df_1 + df_2}$$

Sample 1 is a sample taken from the original individual householder questionnaire.

Sample 2 is a sample taken from the questionnaire following multiple imputation

$\overline{X_1}$ The mean of sample 1 taken from the original individual householder questionnaire

X_2 The mean of sample 2 following the multiple imputation

Sp^2 Standard deviation

SS_1 Sum of squares for sample 1

SS_2 Sum of squares for sample 2

df_1 Degrees of freedom for sample 1

df_2 Degrees of freedom for sample 2

n_1 Number of questions sampled from sample 1

n_2 Number of questions sampled from sample 2

Sample 1

	Surface Water Flooding	Sewer Flooding	Drought	Heatwaves	Low Temperatures	Heavy Snow	Storms and Gales	Pandemic Influenza	Widespread Electricity Failure	Water Supply Failure	Total	Mean
High Risk	11	6	2	1	5	5	14	1	6	3	54	5.4
Medium Risk	46	29	21	31	37	27	71	22	34	24	342	34.2
Don't Know	5	21	19	13	4	4	6	32	8	14	126	12.6
Low Risk	51	51	62	65	68	85	32	57	74	80	625	62.5
No Risk	15	17	20	16	11	7	4	12	6	7	115	11.5
Total	128	124	124	126	125	128	127	124	128	128		
Mean												

Sample 2

	Surface Water Flooding	Sewer Flooding	Drought	Heatwaves	Low Temperatures	Heavy Snow	Storms and Gales	Pandemic Influenza	Widespread Electricity Failure	Water Supply Failure	Total	Mean
High Risk	11	6	2	1	5	5	14	1	6	3	54	5.4
Medium Risk	46	29	21	32	38	27	72	24	35	24	348	34.8
Don't Know	6	21	22	15	6	4	7	33	8	14	136	13.6
Low Risk	51	55	64	65	69	86	32	58	74	81	635	63.5
No Risk	15	18	20	16	11	7	4	13	6	7	117	11.7
Total	129	129	129	129	129	129	129	129	129	129		
Mean												

Mean

		Surface Water Flooding	Sewer Flooding	Drought	Heatwaves	Low Temperatures	Heavy Snow	Storms and Gales	Pandemic Influenza	Widespread Electricity Failure	Water Supply Failure	Total	Mean
Sample 1	5.4	31.36	0.36	11.56	19.36	0.16	0.16	73.96	19.36	0.36	5.76	162.4	16.24
	34.2	139.24	27.04	174.24	10.24	7.84	51.84	1354.24	148.84	0.04	104.04	2017.6	201.76
	12.6	57.76	70.56	40.96	0.16	73.96	73.96	43.56	376.36	21.16	1.96	760.4	76.04
	62.5	132.25	132.25	0.25	6.25	30.25	506.25	930.25	30.25	132.25	306.25	2206.5	220.65
	11.5	12.25	30.25	72.25	20.25	0.25	20.25	56.25	0.25	30.25	20.25	262.5	26.25
Sample 2	5.4	31.36	0.36	11.56	19.36	0.16	0.16	73.96	19.36	0.36	5.76	162.4	16.24
	34.8	125.44	33.64	190.44	7.84	10.24	60.84	1383.84	116.64	0.04	116.64	2045.6	204.56
	13.6	57.76	54.76	710.56	1.96	57.76	92.16	43.56	376.36	31.36	0.16	786.4	78.64
	63.5	156.25	72.25	0.25	2.25	30.25	506.25	990.25	30.25	110.25	306.25	2206.5	220.65
	11.7	10.89	39.69	68.89	18.49	0.49	22.09	59.29	1.69	32.49	22.09	276.1	27.61

SD	SS1	SP2	Tmeans	T
4.029888336	64.96	16.24	0	0
14.20422472	807.04	203.16	0.6	0.084190317
8.720091743	304.16	77.34	1	0.227419611
14.85429231	882.6	220.65	1	0.134641217
5.123475383	105	26.93	0.2	0.077080019
4.029888336	64.96			
14.30244734	818.24			
8.867919711	314.56			
14.85429231	882.6			
5.254521862	110.44			

All documents accessed 14th March 2016

Hazard	Outcome Description	Ref	National (2015) Likelihood	National (2015) Impact	Cheshire Likelihood	Cheshire Impact	Cheshire Risk Rating	Cumbria Likelihood	Cumbria Impact	Cumbria Risk Rating	Manchester Likelihood	Manchester Impact	Manchester Risk Rating	Lancashire Likelihood	Lancashire Impact	Lancashire Risk Rating	Merseyside Likelihood	Merseyside Impact	Merseyside Risk Rating
Pandemic Influenza		H23	4	5	4	4	Very High Risk	4	5	Very High Risk	4	5	Very High Risk	4	5	Very High Risk	4	5	Very High Risk
Flooding - Major Coastal		H19	3	4	3	4	Very High Risk	3	N/A			N/A			N/A		3	4	Very High Risk
Widespread Electricity Failure		H41	3	4	3	3	High Risk	3	3	High Risk	3	5	Very High Risk	4	4	Very High Risk	3	4	Very High Risk
Emerging Infectious Diseases		H24	3	3	3	2	Medium Risk	3	3	High Risk	3	3	High Risk	3	3	High Risk	3	3	High Risk
Severe Effusive (gas rich) Volcanic Eruption		H55	3	3	4	4	Very High Risk	3	4	Very High Risk		-		3	1	Low Risk	3	2	Medium Risk
Severe Space Weather		H56	4	3	4	3	High Risk	4	3	High Risk	2	3	Medium Risk	4	2	Medium Risk	4	3	High Risk
Flooding - Severe Fluvial Flooding		H21	3	3	3	4	Very High Risk	3	5	Very High Risk	3	5	Very High Risk		N/A		3	3	High Risk
Low Temperatures and Heavy Snow		H18	4	3	3	2	Medium Risk	4	2	Medium Risk	3	2	Medium Risk	3	3	High Risk	4	3	High Risk
Heatwave	Daily maximum temperatures in excess of 28°C and minimum temperatures in excess of 15°C over most of the region for around 2 weeks at least 5 consecutive days where maximum temperatures exceed 32°C. Could cause fatalities and casualties, mainly amongst the elderly. There could be disruption to power supply and transport infrastructure.	H48	4	3	3	2	Medium Risk	3	2	Medium Risk	3	2	Medium Risk	3	3	High Risk	4	2	Medium Risk
Storms and Gales		H17	4	2	3	2	High Risk	3	2	Medium Risk	3	2	Medium Risk	3	2	Medium Risk	4	4	Very High Risk
Explosive Volcanic Eruptions		H54	4	2	1	1	Low Risk	4	1	Low Risk	2	2	Medium Risk	4	1	Low Risk	4	2	Medium Risk
Drought	Periodic water supply interruptions affecting businesses in London. Emergency drought orders in place which may impact supply in other areas of the country.	H50	3	2	3	3	High Risk	1	2	Low Risk	3	3	High Risk	1	3	Medium Risk	2	2	Medium Risk
Major pollution of surface waters or groundwater		HL4			5	3	High Risk	4	2	Medium Risk	5	3	High Risk	5	3	High Risk	3	3	High Risk
Coastal Flooding (affecting more than one region)		HL16			3	4	Very High Risk		N/A			-		3	4	Very High Risk	3	4	Very High Risk
Coastal Flooding (in one region)		HL17			4	3	High Risk		N/A			-		4	4	Very High Risk	3	3	High Risk
Local/urban (fluvial or surface run-off)		HL18			3	4	Very High Risk	3	4	Very High Risk	3	4	Very High Risk	3	4	Very High Risk	3	3	High Risk
Local Fluvial Flooding		HL19			4	3	High Risk	4	4	Very High Risk	4	4	Very High Risk	4	3	High Risk	3	3	High Risk
Localised, extremely hazardous flash flooding		HL20			3	3	High Risk	3	3	High Risk	3	5	Very High Risk	3	3	High Risk		-	
Failure of water infrastructure or accidental contamination with a non-toxic contaminant.	Loss of or non-availability for drinking of the piped water supply for a population up to 350,000 for more than 24 hrs and up to two weeks due to an accident. Impact on domestic, industrial, commercial and agricultural premises.	H39			2	2	Medium Risk	4	1	Low Risk	3	2	Medium Risk	4	4	Very High Risk	2	4	High Risk
No notice loss of significant telecommunications infrastructure	Loss of telecommunications for up to 100,000 people for up to 72 hrs.	H40			3	1	Low Risk	5	2	Medium Risk	2	3	Medium Risk	2	3	High Risk	2	1	Low Risk
Loss of drinking water supplies due to major accident affecting infrastructure	Loss of or non-availability for drinking, of the piped water supply, for a population of up to 350,000 for more than 24 rs and up to two weeks. Fatalities unlikely, but the possibility of a minimal number of casualties.	H49			1	4	Medium Risk	1	2	Low Risk	1	4	Medium Risk	1	4	Medium Risk		-	
Major Reservoir dam failure/collapse	Collapse without warning resulting in almost instantaneous flooding. Significant movement of debris (including vehicles) nd sediment. Complete destruction of some residential and commercial properties and serious damage to properties. Several thousand other properties could be flooded. Could cause fatalities and casualties. Missing persons and people stranded. Hazardous recovery amongst collapsed infrastructure and debris. Water supply to homes and businesses islost. People need temporary accommodation.	H44			1	4	Medium Risk	1	5	Medium Risk	1	5	High Risk	1	5	Medium Risk	1	4	Medium Risk
Tunstall Impounding Reservoir Failure		HLR4																	
Version of CRR							2014			2014						2013			2016
Available from LRF Website							Yes			Yes			Yes, GENERIC			Yes			No
Available from GOV Website							Yes			Yes			No			Yes			Yes
Available from EPA Website							Yes			Yes			No			Yes			No
Risk Matrix Style							-			1			-			1			2
Category 2 Utility Responders							United Utilities; Scottish Power Power Systems; Npower; National Grid Transco			United Utilities; Electricity North West; National Grid			United Utilities; Electricity North West			United Utilities; Scottish Power; National Grid Transco			United Utilities; Scottish Power

	Cleveland			Durham and Darlington			Northumbria			Humber			North Yorkshire			South Yorkshire			West Yorkshire			Staffordshire		
	Likelihood	Impact	Risk Rating	Likelihood	Impact	Risk Rating	Likelihood	Impact	Risk Rating	Likelihood	Impact	Risk Rating	Likelihood	Impact	Risk Rating	Likelihood	Impact	Risk Rating	Likelihood	Impact	Risk Rating	Likelihood	Impact	Risk Rating
General Info				4	4	Very High Risk		4	Very High Risk		4	Very High Risk		4	Very High Risk		4	Very High Risk		4	Very High Risk	5	5	Very High Risk
					-			-			5	Very High Risk		4	Very High Risk		4	Very High Risk		4	Very High Risk		N/A	High Risk
				3	3	High Risk	3	3	High Risk	3	3	High Risk	3	3	High Risk	2	2	Medium Risk	3	5	Very High Risk	3	3	High Risk
				3	3	High Risk	4	4	Medium Risk	3	3	High Risk	3	3	High Risk	4	2	Medium Risk	3	2	Medium Risk	2	3	Medium Risk
				3	3	High Risk	3	4	Very High Risk	3	4	Very High Risk	3	-	-	2	2	Low Risk	3	4	Very High Risk	2	3	Medium Risk
				4	3	High Risk	4	3	High Risk	4	3	High Risk	4	-	-	4	2	Medium Risk	4	3	High Risk	3	4	High Risk
				4	3	High Risk		-			5	Very High Risk	4	4	Very High Risk	3	4	Very High Risk	3	3	High Risk		-	
				4	3	High Risk	3	3	High Risk	4	3	High Risk	4	3	High Risk	4	2	Medium Risk	4	3	High Risk	2	4	Medium Risk
				3	3	High Risk	3	3	High Risk	3	3	High Risk	3	3	High Risk	3	3	High Risk	4	3	High Risk	3	4	High Risk
				4	3	High Risk	3	3	High Risk	4	3	High Risk	3	3	High Risk	4	2	Medium Risk	4	3	High Risk	2	4	Medium Risk
					-		4	3	Medium Risk	4	2	Medium Risk	3	2	Medium Risk	4	2	Medium Risk	4	2	Medium Risk	1	4	Low Risk
					-		1	3	Medium Risk		-		2	4	High Risk	1	2	Medium Risk	3	2	Medium Risk	2	2	Medium Risk
											-													
				5	3	High Risk	4	3	High Risk	5	3	High Risk	4	3	High Risk	4	3	High Risk	5	3	High Risk	1	5	Low Risk
					-		3	4	Very High Risk	3	4	Very High Risk	3	4	Very High Risk		N/A			N/A			N/A	
					-		4	4	Very High Risk	4	4	Very High Risk	4	3	High Risk		N/A			N/A			N/A	
				1	4	Medium Risk	3	4	Very High Risk	3	4	Very High Risk	3	4	Very High Risk	4	4	Very High Risk	3	3	High Risk	4	3	Very High Risk
				4	3	High Risk	4	3	High Risk	4	4	Very High Risk	4	4	Very High Risk	5	3	High Risk	4	2	Medium Risk	3	4	High Risk
				3	3	High Risk	4	3	High Risk	3	4	Very High Risk	4	3	High Risk	3	3	High Risk	4	3	High Risk	3	4	High Risk
				2	2	Medium Risk	1	3	Medium Risk	2	2	Medium Risk	2	3	High Risk	4	3	High Risk	2	2	Medium Risk	2	3	Medium Risk
				3	1	Low Risk	5	3	High Risk	3	2	Medium Risk	1	3	Medium Risk	5	3	High Risk	3	3	High Risk	2	2	Medium Risk
					-		1	3	Medium Risk		-		1	4	Medium Risk	1	3	Medium		-			-	
				1	3	Medium Risk	1	3	Medium Risk		-		1	5	Medium Risk	1	5	Medium	1	4	Medium Risk	3	1	Medium Risk
				1	3	Low Risk																		
No Date				2015			2014			2015-2018			2013			2013			2015			2015		
				Yes			Yes			Yes			Yes			Due to be updated			Yes			Yes		
No				No			No			No			Yes			No			No			Yes		
				Yes			Yes			No			Yes			Yes			Yes			Yes		
-				2			1			2			1			3			2			-		
Northumbria Water				Northumbria Water			Northumbria Water			Yorkshire Water			Yorkshire Water			Yorkshire Water			Yorkshire Water			South Staffordshire Water		
Cleveland and Redcar										Anglian Water														
										Severn Water														

	Warwickshire			West Mercia			West Midlands			Derbyshire LRF			Leicestershire LRF			Lincolnshire LRF			Northamptonshire			Nottinghamshire			Bedfordshire			Cambridgeshire		
	Likelihood	Impact	Risk Rating	Likelihood	Impact	Risk Rating	Likelihood	Impact	Risk Rating	Likelihood	Impact	Risk Rating	Likelihood	Impact	Risk Rating	Likelihood	Impact	Risk Rating	Likelihood	Impact	Risk Rating	Likelihood	Impact	Risk Rating	Likelihood	Impact	Risk Rating	Likelihood	Impact	Risk Rating
	4	4	Very High Risk	3	4	Very High Risk			General Version	4	5	Very High Risk	4	5	Very High Risk			General Version			Very High Risk	4	4	Very High Risk			General (contains sensitive information)	3	4	Very High Risk
		N/A			N/A					3	4	High Risk	3	4	Very High Risk					N/A	N/A		N/A	N/A					3	4	Very High Risk
	2	3	High Risk	2	2	High Risk				2	4	High Risk	2	3	High Risk						Medium Risk	3	3	High Risk				2	3	High Risk
	2	3	High Risk	2	3	Medium Risk				3	3	High Risk	3	3	High Risk						Low Risk	3	2	Medium Risk				2	3	High Risk
		-			-					3	3	High Risk	4	1	Low Risk						Very High Risk	3	4	Very High Risk				3	4	Very High Risk
		-			-					4	2	Medium Risk	3	4	Very High Risk						High Risk	4	2	Medium Risk				4	3	High Risk
		-		2	4	High Risk				1	3	Medium Risk		-							Very High Risk		-					1	4	Medium Risk
	2	3	High Risk	4	3	High Risk				4	3	High Risk	4	3	High Risk						Medium Risk	3	3	High Risk				4	3	High Risk
	2	2	Medium Risk			High Risk				2	2	Medium Risk	4	3	High Risk						Medium Risk	3	3	High Risk				4	3	High Risk
	2	3	High Risk	4	3	High Risk				3	2	Medium Risk	3	3	High Risk						Low Risk	3	2	Medium Risk				3	3	High Risk
	1	3	Medium Risk		-					4	2	Medium Risk	4	1	Low Risk						Low Risk	4	1	Low Risk				4	3	High Risk
	2	2	Medium Risk	3	2	Medium Risk				2	2	Medium Risk		-							Low Risk		-					3	3	High Risk
	3	3	High Risk	5	3	High Risk				5	2	Medium Risk	5	2	Medium						Medium Risk	5	2	Medium Risk				4	3	High Risk
		N/A			N/A						N/A			N/A									N/A					2	4	High Risk
		N/A			N/A						N/A			N/A									N/A					4	4	Very High Risk
	3	3	High Risk	3	3	High Risk					-		2	3	High Risk						High Risk	2	4	High Risk				2	4	High Risk
	3	3	High Risk	4	3	High Risk				3	4	Very High Risk	2	3	High Risk							4	3	High Risk				3	4	Very High Risk
	3	3	High Risk	3	3	High Risk				3	3	High Risk		-							High Risk	2	3	Medium Risk					-	
	2	2	Medium Risk	2	2	Medium Risk				2	3	Medium Risk	2	1	Low Risk							3	3	High Risk				2	2	Medium Risk
	3	3	High Risk	3	1	Low Risk				2	1	Low Risk	2	2	Medium Risk							2	2	Medium Risk				5	2	Medium Risk
	1	2	Low Risk	2	4	High Risk					-			-							Low Risk		-					1	4	Medium Risk
	1	3	Medium Risk	1	4	High Risk				1	5	High Risk	1	3	Medium Risk						Medium Risk	1	4	Medium Risk				1	5	Medium Risk
	2013-2016			2015			2014			2015			2015						2015			2014			2006			2013		
	Yes			Yes			Yes			Yes			Yes						Yes			Yes			Yes			Link doesn't work		
	Yes			Yes			No			Yes			Not to CRR			Yes			Yes			No			Yes but limited			No		
	Yes			Yes			No			Yes			Yes						Yes			Yes			Yes			Yes		
	1			2			-			-			2?			-			4			2			-			1		
	Severn Trent			Severn Trent			Severn Trent			Severn Trent			Severn Trent			Anglian Water			Anglian Water			Anglian Water			Anglian Water			Anglian Water		
																												Affinity Water			Cambridge Water		

Risk assessment matrix — regional water company risk ratings

	Essex			Hertfordshire			Norfolk			Suffolk			Avon and Somerset			Dorset			Devon and Cornwall			Gloucestershire			Wiltshire		
	Likelihood	Impact	Risk Rating	Likelihood	Impact	Risk Rating	Likelihood	Impact	Risk Rating	Likelihood	Impact	Risk Rating	Likelihood	Impact	Risk Rating	Likelihood	Impact	Risk Rating	Likelihood	Impact	Risk Rating	Likelihood	Impact	Risk Rating	Likelihood	Impact	Risk Rating
	email for copy			not available			4	5	Very High Risk	3	5	Very High Risk	4	4	Very High Risk				4	4	Very High Risk	4	5	Very High Risk	4	5	Very High Risk
							5	4	Very High Risk		4	Very High Risk	3	4	Very High Risk								4	Very High Risk		N/A	N/A
							3			3	4	Very High Risk	3	3	High Risk				2	3	High Risk	3	4	Very High Risk	2	4	High Risk
							3	2	Medium Risk	3	2	Medium Risk			Very High Risk				2	2	Medium Risk	2	2	Medium Risk	2	4	High Risk
									High Risk			High Risk			Very High Risk							3	4	Very High Risk	3	4	Very High Risk
									High Risk			High Risk	3	4	Very High Risk				4	3	High Risk	3	2	Medium Risk	4	3	High Risk
							2	2	Medium Risk			High Risk	4	4	Very High Risk				2	3	High Risk	2	4	High Risk	4	5	Very High Risk
							4			4	2	Medium Risk	4	3	Medium Risk				4	3	High Risk	3	3	High Risk	5	3	High Risk
							4			4	2	Medium Risk	4	4	Very High Risk				2	3	High Risk	4	3	High Risk	4	4	Very High Risk
							1	2	Medium Risk	1	3	Medium Risk	2	3	Medium Risk				4	2	Medium Risk	2	2	Medium Risk	2	4	Medium Risk
													3	4	Very High Risk							4	3	Medium Risk			
							5	4	Very High Risk	5	2	Medium Risk	5	2	Medium Risk				4	3	High Risk	5	3	High Risk	2	4	High Risk
												Medium Risk	3	4	Very High Risk				3	4	Very High Risk	3	4	High Risk	4	4	Very High Risk
										4	2	Medium Risk	4	4	Very High Risk				3	4	Very High Risk	2	3	High Risk		N/A	N/A
										3	1	Low Risk	3	4	Very High Risk				4	4	Very High Risk	2	3	Medium Risk	3	3	High Risk
										3	1	Low Risk	2	4	High Risk				4	4	Very High Risk	3	3	High Risk	4	4	Very High Risk
													2	2	Medium Risk				2	2	Medium Risk	5	3	High Risk	2	3	Medium Risk
										2	2	Medium Risk	5	3	High Risk				3	2	Medium Risk	3	3	High Risk	3	3	High Risk
										3	1	Low Risk	2	3	High Risk							2	2	Medium Risk			Very High Risk
												Medium Risk	3	5	Very High Risk				1	5	Medium Risk	1	5	High Risk	3	4	Medium Risk
																									2	3	High Risk

Bottom summary rows:

	Essex	Hertfordshire	Norfolk	Suffolk	Avon and Somerset	Dorset	Devon and Cornwall	Gloucestershire	Wiltshire
		BASIC	2014?	2016	2014		2013	2014-2015	2015
	No	No	Yes	Yes	No - SCC	No	Yes	Yes	Yes
	No	Yes but limited	Yes but limited	Yes	No	No	Yes	Yes	Yes
	No	No	No	Yes	No	No	Yes	Yes	Yes
	-	-	2	2	2		1	2	2
	Essex and Suffolk Water	Affinity Water	Anglian Water	Anglian Water	Bristol Water	Wessex Water	South West Water	Wessex Water	Wessex Water
	Affinity Water	Essex and Suffolk Water	Essex and Suffolk Water	Essex and Suffolk Water	Wessex Water	Bournemouth Water		Severn Trent	Cholderton and District Water
								Thames Water	
								Bristol Water	
								Dwr Cymru	

Hampshire and Isle of Wight			Kent			Surrey			Sussex			Thames Valley			London		
Likelihood	Impact	Risk Rating	Likelihood	Impact	Risk Rating	Likelihood	Impact	Risk Rating	Likelihood	Impact	Risk Rating	Likelihood	Impact	Risk Rating	Likelihood	Impact	Risk Rating
4	4	Very High Risk		Need to email		4	5	Very High Risk	4	4	Very High Risk	4	4	Very High Risk	4	4	Very High Risk
3	5	Very High Risk					N/A		4	2	High Risk		N/A		2	5	Very High Risk
3	3	High Risk				1	4	Medium Risk	3	3	High Risk	3	3	High Risk	2	5	Very High Risk
3	2	Medium Risk				3	3	High Risk	3	2	Medium Risk		-		3	3	High Risk
	-					3	3	High Risk					-			-	
	-					4	3	High Risk	4	3	High Risk	4	3	High Risk	3	3	High Risk
3	4	Very High Risk				3	4	Very High Risk	3	4	Very High Risk	4	5	Very High Risk	3	4	Very High Risk
4	4	Very High Risk				4	3	High Risk	4	3	High Risk	4	4	Very High Risk	4	3	High Risk
4	3	High Risk				4	3	High Risk	4	2	Medium Risk	4	2	Medium Risk	3	3	High Risk
4	3	High Risk				4	1	Low Risk	4	3	High Risk	4	4	Very High Risk	4	2	Medium Risk
4	2	Medium Risk				3	2	Medium Risk	4	2	Medium Risk	They have a local version L50, 3,3, High Risk			2	4	High Risk
3	3	High Risk				5	3	High Risk	3	2	Medium Risk	5	3	High Risk	4	3	Medium
5	3	High Risk					N/A		5	3	High Risk		N/A		2	5	Very High Risk
3	4	Very High Risk					N/A		3	2	Medium Risk		N/A		3	3	High Risk
4	4	Very High Risk				3	4	Very High Risk	4	3	High Risk	3	4	Very High Risk	4	4	Very High Risk
3	3	High Risk				4	3	High Risk	3	4	Very High Risk	4	4	Very High Risk	3	3	High Risk
4	3	High Risk				4	3	High Risk	4	3	High Risk	1	2	Low Risk		-	
3	2	Medium Risk								N/A					Consequences amalgamated into H49		
4	2	Medium Risk				2	3	Medium Risk	4	2	Medium Risk	4	3	High Risk	2	2	Medium Risk
5	3	High Risk				3	1	Low Risk	3	2	Medium Risk	5	3	High Risk	1	4	Medium Risk
1	3	Medium Risk					-			-		1	3	Medium Risk			
1	3	Medium Risk				1	5	High Risk	1	1	Low Risk	1	4	Medium Risk	2	5	Very High Risk
2012						2015			2014-2015			2014			2015		
Yes			Yes but limited			Yes			Yes			Yes			Yes		
Yes						Yes			Yes			Yes			Yes		
Yes						Yes						Yes			Yes		
1			-			2			-			1			2		
Southern Water			Southern Water			South East Water			Southern Water			Thames Water			Thames Water		
Bournemouth Water			Affinity Water			Sutton and East Surrey Water			Essex and Suffolk Water						Affinity Water		
			South East Water			Thames Water			Sussex Water								
						Affinity Water											

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4.2 Legislation and Governance

4.2.1 Practitioner interpretations of applying the principles of the Civil Contingencies Act, 2004

*"So yes it's effective bringing everyone together and you know that in itself is a benefit certainly". – **10 Participant***

"I think they are, they require us to engage with the LRFs and yes so I think and the SEMD legislation requires us to have security and emergency measures in place, we're audited every year so we've got an external view on what we do which I think obviously always encourages you to do stuff. So at the moment to me it feels adequate but I'm not sure if that's a view, I just don't know if that's a view shared across all of our team if you like." **– 11 Participant**

"The advantages in particular are as I see it is that we do a lot of work together in what I would call peace time i.e. when there are no emergencies and we plan in peace time and that enables us to stand up together when there is an emergency because we've already met each other, we know what our roles are, we develop plans together and we're better connected than we would be if we weren't doing those things in peace time." **– 15 Participant**

"I think that's the reason why LRFs have done it differently because everyone interprets things differently when you see it on a piece of paper." **– 01 Participant**

"It's been an add-on to there used to be a role emergency planning officer and it's stood alone, then when the Civil Contingencies Act came in there were so many discussions about right, how do we put this in place and it was decided that within (Location) it would go to a particular emergency planning officer who'd provide a management function. A number of areas have an LRF co-ordinator function and I think that's maybe one of the

issues for the water industry is every single LRF does things entirely differently." – 02 Participant

"The Civil Contingencies Act was written in 2001/2 and came into being in 2004. In thirteen years the resilience world has changed immeasurably so I think the core is there you know people need to get together but what it needs to do is to have an overview and someone needs to look at it and like I'm saying about responding to an emergency or responding to something that's going to impact they need to redefine, clarify, steer. It wouldn't be completely new legislation or a new act but the CCA needs to be updated because at the moment you're struggling dealing with incidents." – 07 Participant

"So kind of the legislation really to some degree perhaps needs a bit of reviewing in light of the way agencies now operate you know I mean they're talking about bringing in professional standards within emergency planning. Well that's fine but who's going to enforce them when you can't even enforce agencies to turn up to an LRF meeting twice a year." – 14 Participant

"Well I guess we've just, just recently Ofwat who's our Ofwat's water services is our regulator so they have just been recently I supposed tasked with the new Water Act have responsibility for resilience for the water industry so I guess I suppose things like the Civil Contingencies Act and other sort of legislation is probably getting a bit old now and probably isn't certainly in the cyber world particularly relative and current." – 09 Participant

"All we have to do is we have to share information and we have to work with partners. Well we're doing that in other areas of the business so we can evidence that, you don't have to do it, stop doing it." – 13 Participant

4.2.2 Government support and guidance

" …… because we don't get a tremendous lot from central government we realise that actually we've got to find the solutions locally" – 08 Participant

"We don't have an audit, we don't have people unless you do it you know, you do like a peer one so we do one you know blah-blah with for example [place], there's no way of measuring yourself how good or bad you are based on what's happening now." – 06 Participant

"We're practitioners we know what the problems are and it's getting that mix between you don't want the government to say you can only do something one way but you do want them to have embraced best practice and almost signposted it and say oh this is working in this area how about you consider that and they've started to do that in this last year whereas previously they probably didn't and I'm a bit sceptical about where the expertise sit you know I think it's at the practitioner level….." – 07 Participant

" ….and also there's no performance measures on it, there's no accountability on it and you know I think the government now are thinking oh yes I've done it now and that's great and let's move on." – 06 Participant

"I think the challenge is that Department for Communities and Local Government locally again they're struggling with funding and personnel and in many ways yes I get the support I need but I think a lot of the times we're setting the agenda and they're not." – 07 Participant

"And they have done a very good job over the last several years but unfortunately in these times of austerity they've been badly hit with cuts and because of that they've become less efficient so our reach back to central government through them has been somewhat diluted." – 15 Participant

4.3.2 Building relationships

"…… so I think you know it's just getting to know people getting to know where your help is getting to know where your additional resources is and how that can be put together you know in you know the response and

recovery phases and think about the pre-planning and how each organisation can dovetail into that planning" – 04 Participant

4.3.3 Regional collaboration

"…….and that brings all the sort of Cat 2 responders together who cover that sort of area so that covers I think about seven or eight LRFs and the LRF co-ordinators are present as well at that meeting." **– 09 *Participant***

"….so there's a little bit of me that says you know have they got the structure of the LRFs working or correct because one of the things that we're doing within the [name] at the moment is we're looking at working and developing regional packages …… *"– 13 Participant*

"And so whether the next step moving forward would be for a regionalised local resilience or regional resilience forum rather than the local resilience forum but it has its advantages and its disadvantages because you'd lose that local ownership of your own hazards and your planning and your own communities within the areas in which you work but actually it gives you a bigger pool of resources to work together …." *– 13 Participant*

4.4   Sharing information – sensitivities and timing

"….it's just basically a call that is about sharing information, sharing it so that everyone has the same common picture of what's going on …" – 01 Participant

"We share when there's a need to share but you need a framework so that data protection is in place and we need to work to that framework but that framework shouldn't be used as an excuse for not sharing data where it's required and I've not seen anything that counters that." – 07 Participant

"So if there's an incident they would get we send out a standardised email it's about that shared situational awareness that's what we're trying to achieve so you would share information for, across all agencies, all of our partners if we think it's going to have an impact on a community." – 07 Participant

"I think it's good, I think we don't have any problem with getting information and sharing information when we require it and as I say before knowing people within the organisation certainly breaks down barriers so we don't have the same issues." – 06 Participant

4.4.1 Resilience Direct

"And Resilience Direct is probably one of the best tools for sharing information, I think it's so much easier so it's a great tool. One of the best tools that I've seen ever, I think to create, just to share information, to share plans, but also to share knowledge and just using the tool to interact." – 01 Participant

" … we have all our documents and our files on it and people can share information and when we're doing planning it's better just to put it on Resilience Direct and they can make changes and suggest things. We also are starting to use it in response now which we haven't done in the past so in other words we send out alerts when people have got stuff that's going on that may have a multiagency approach and they did, so we give people the heads-up." – 06 Participant

"And we don't want to take people away from the incident just to sit and upload information but we're going to need to so it's an area where need to improve our capability if you like." – 12 Participant

"Yes exactly you're not going to pick up and use something that you're not familiar with for the benefit of others when actually all the benefit that you need as a company is in the systems that you're using on a day to day basis." – 13 Participant

4.4.2 Good practice and lessons learned using Resilience Direct

"Yes I mean we have a, we have a forum for the water industry and we share information so we have a specific [name] group that we share information and best practice with, we meet regularly on that so probably three times a year and then we have a [Name] as well for emergency planners and again we meet twice a year and again sort of shared learnings, practice, knowledge and we tend to get individual requests as well so the thing I mentioned earlier about cyber for example so we ran a

[name] exercise towards the end of 2016 that's quite well known in the industry now so everybody's coming asking about how we performed, what learnings we had and looking at running similar exercises in their businesses." – 09 Participant

"It's not always a hundred percent but at least it gets somewhere and if there's any joint organisational learning that's identified then that goes up through JESIP, Joint Emergency Services Interoperability Principles blah for them to publicise across the UK." – 03 Participant

"We talk quite a lot with [Name], obviously we are aware of when other [Name] have big issues we do find out, so we often chat to them and find out what they do and we will go an visit other [Name] incident rooms." – 01 Participant

"Yes I mean it opened our eyes a lot, I know the discussions we had with sort of [name] after the event they had a plan to respond to a sort of a certain number that we're all obliged to respond to, population loss and the intention was that you would just then replicate that and multiple that a number of times depending on how severe the scenario was and they said it just that didn't work you couldn't just multiple your response up ten times sort of thing it just became a completely different sort of response requirement. So I think that was one of the big learnings for a lot of the [Name] that came out of that." – 09 Participant

4.5.1 The purpose of the emergency plan

"And I think a lot of plans can be very information plans and for me they're great, it gives you background information, but they don't help you when you come into incidents …… It needs us to say what we'd do, how we are going to do it, how we are going to manage the situation." – 01 Participant

"...that's all I need to worry about now, the rest of the plan I've used in advance or I've used as the structure for training and it's there as a reference document so there's a few there but it's that process of planning I think is, it gives you that framework on which you can start to pin other things." – 02 Participant

*"Well one is to provide a frame, a general framework to allow response so identify the key resources, how to contact the organisation, how to initiate a response, where that response can be managed." – **03 Participant***

*"The plan's important, don't get me wrong, a planned approach is very necessary having command and control sort of thing but people are more important than a plan." – **06 Participant***

*"So again we train people so that their competencies mean that they should be doing all the right things in the early stages, we're saying give them time later on to check through the plan and say OK have I done what I need to do and if I was running an incident I would give somebody the job of reading the plan and coming back to me later on and saying have I done everything I need to do or is there anything I've missed. So I think it's a good checklist in an incident to make sure that you've done the right things." – **12 Participant***

4.5.2 The Multi-Agency Assessment of Risk

*"Now it's one thing to do the risk assessment you know that they're responsible for each LRF but it's another thing to then have to do it in a different format for every LRF. So what we've managed to do is to persuade them to sort of go to a single format that then makes it much easier for us when we're replicating if you like risk assessment as an example." – **09 Participant***

*"So if you take something like the risk register at one point we've got three LRFs within the north east, one was using Access, one was using Word and one was using Excel, completely different formats in terms of the way the risk register was undertaken." – **02 Participant***

"I think there'll always be some where some of the more unusual ones where you think oh I'm not quite sure if anyone locally sort of is an expert on solar flares or volcanic ash but I suppose that's why the national stuff's there to sort of provide guidance but yes it forces us to look collectively at pretty much all of the major risks, all the things that could go wrong and even if some of them if we don't think they're relevant then at least we've sort of gone through that process and sort of at least sort of considered

them and documented them why they're not very relevant so yes I think it's useful." – 10 Participant

4.5.3 Working collaboratively in the development of a multi-agency emergency plan

"…we're an [Name] with three [Name] whereas they're a {name] with you know [Name] so what I was saying is we don't really want discrepancy between how you're going to deal with it and how [Name] are going to deal with it otherwise it'll confuse the hell out of us so it was quite an interesting you know I'm happy with what they've got and it's broadly the same so we can respond to that." – 08 Participant

"So I think where we know we're going to have to work with an external agency collaboratively in an incident we would work, we would try and put the plans together, together. For the big water ones I know that we've looked at what we would need and how we would want to respond and then we've shared those with the LRFs where we can and we've shared the principles with them. Having said that the development of the principles document was with two LRFs together, well one main one, [Name] so we worked very closely with them so that we understood what all their questions were, what their concerns were, how the document worked for them so although it's our document it's for them to be able to read and interpret and to then go away and make a plan from." – 11 Participant

"Yes, yes so our general approach is to get a working group together of key members that are going to be there and it's a collective, a collective input over a number of meetings and different people pitching in what they think needs to be in there as a discussion and then I do the writing initially and then put it back out again for consultation and it gets tweaked again…" - 05 Participant

4.6.2 Multi-agency exercising and training

"It means the ability to recognise and assess the risks that we face and to make preparations to deal with examples where we face emergencies based around those risks so it's environmentally scanning, it's looking

forwards, it's anticipating, it's making preparations, it's practising and rehearsing and being prepared for the real event when they come along as they do every so often." **- 15 Participant**

"….but what we need to do is invest in people and make sure they understand what's in the plan because it's pointless picking a plan up when you're on your way to a flood and you haven't got a clue but what you need to do is make sure people are aware of what their responsibility is, what the expectations of a chair, of a tactical or a strategic co-ordinating group is of that organisation when they attend that meeting and that's the sort of thing we've been doing the last twelve months now investing in people." **– 06 Participant**

"…..if there's an opportunity to get involved during an exercise we will because that's when we're going , incidents is where we're going to need them most so the more familiar we are with them and they are with us in those situations the better we think. So we've invited them onto our exercising programme internally as well so when we've had major exercises we've had two or three representatives from the LRFs involved." **– 11 Participant**

"Yes I mean all our LRF exercises are multiagency I mean it's not but what we have found again and part of this sort of trying to work smarter is and I talked about finance because if you set up a big live exercise you know that can be quite costly so what we're finding we're doing much more of now is piggybacking an LRF exercise on the back of other exercises." **– 16 Participant**

"It's two sides, one it gives you a chance to assess the plan that you have available so you run through your plan and it gives you a chance to assess whether that plan's effective or does it need modifying but then it also gives the individuals and the people some, as close as you can, experience of a real event and prepares them ready for the real thing rather than the first time they are doing it is a real event rather than an exercise." **– 09 Participant**

"we will sort of run an exercise and see whether that, see whether all the aspects of that plan you know are valid and appropriate for an appropriate response to that sort of event." **– 09 Participant**

4.7 Achieving effective emergency response

"Lack of staff or inability of staff to communicate. The key aspect is always whether to communicate it doesn't matter how many plans you have if you can't actually contact people nothing's going to happen so communications are the key and we take a lot of it for granted." – 03 Participant

4.7.1 Resources and availability of personnel

"…it's around that ability to get staff out and doing the job they need to do in an emergency response, that's probably the biggest risk to our ability to respond." – 02 Participant

"I suppose it's getting a little bit political now but it's resources and it's the ability of people to be able to contribute staff to the centre." – 05 Participant

"I know that certain parts of the local authority have gone from X number of planning down to about half in five years so the number of people in planning now is less, the number of people responding is less and I think that's right across the piece so in other words there'll be an issue regarding anything that goes on more than twenty-four hours may be an issue regarding capability." – 06 Participant

"That's a good question. In terms of response I mean size and scale-wise if there's a really big, a really big incident it's resources and numbers of sort of people within the business so we would be reliant on mutual aid both from a multiagency point of view and other water company point of view. So it's when you get to that Mythe type size and scale we certainly wouldn't be able to respond to something like that on our own." – 09 Participant

"So I'd say if we were short of staff that would probably be a big impact on our ability and the second one would probably be the loss of IT so if we had centrally we rely on a lot of monitoring and what have you in order to view the network and to get information to help us with decision making, some of the plans and things like that are also on our systems …" – 11 Participant

4.8.1 Social Media

*"…social media is such a powerful tool now for and against you that you have to make, manage it somehow and I think most people are trying to but you know [Name] definitely set a standard there, a benchmark that you should be achieving that you know because they really did manage the media and social media very, very well." – **06 Participant***

*"The problem with social media they want instantaneous results don't they they're not, you can't get there fast enough to be able to do that and people are going look at this, it's going worse, it's going worse and you know it's been thirty seconds since and you know unfortunately that's life isn't it today the modern world's full of these expectations that you can't live up to I'm afraid." – **06 Participant***

*"Social media has changed absolutely everything about how we respond because you need to be proactive and if like [Location] you don't say anything the gap will be filled by whatever and you lose control of the agenda." – **07 Participant***

*"We had responses in place but it's I guess the new environment is the social media and we put a lot of social media injections into that exercise and it showed a few holes in our response plan so again we're now amending our response plan to, we already had social media response in there but I guess it's just moved on again since we sort of updated the plan previously in terms of the numbers and scale of social media and how it operates these days." – **09 Participant***

APPENDIX 12:   SUPPORTING QUOTES FROM CHAPTER 6

6.2   The communication of information

"And what about [Location]? No water for about 15 hours and no word about progress to rectify the situation. [Name], what is going on???" **– Reference 4, WSP 1 2018 03 04 11**

"Can you PLEASE PLEASE. Give us in [Location] some specific information. Do you have anyone, yet, looking into this local problem? If not why not, after ten hours. If so, what progress? Of course you are under lots of pressure (unlike your water!) But you must surely be able to inform us now in something more than generalities. You have several hundred village customers, and a had-to-be closed primary school needing to know so they can plan at least how to deal with matters in the short term. Last night you told me in a tweet 'you were on it'. Please prove it." **– Reference 6, WSP 2 2018 03 05 05**

"[Name] I think a lot of us would prefer a bit more than this standard reply! Like if the problem is identified? If yes is it likely to be long or short term? Surely your inspectors are feeding something back? Else we will run out of what bottles we have and Sunday so shops are shut. Planning is needed if long term issue. P.s please don't bother to reply to this with a standard response! Better to not reply at all!" **– Reference 3, WSP 3 2018 03 03 01**

General information posts:

"Beastfromthe East - please see below for up to date information. For updates about any disruption to service please visit 'In Your Area' on our website [Website] For frozen pipes please follow these steps on our website [Website}" **WSP 3**

"After the freezing temperatures and sudden thaw caused supply issues for many, we will be paying compensation to any customers who were without water for more than 12 continuous hours, or for more than 15 hours of intermittent supply. The payment of £30, will be deducted automatically so domestic customers don't need to do anything. You can read more about the compensation here: [Website]" **WSP 2**

Notification post:

"We're sorry to customers in [Location] who may be experiencing no water/low pressure. Bottled water is on its way and we'll update you on when it's available as soon as we can." **WSP 1**

"[Location]: We're increasing the amount of water being fed into the system,but we are still not seeing pressure build up as much we'd like - but pressure is increasing. We believe that there is air trapped in the system and we're currently working to bleed the air out. We're also working to fix a number of leaks in the local area, which will help improve our position. We know this is frustrating, but we're working as quickly as we can to resolve this and return your water supply." **WSP 1**

"We have temporarily closed our Billing and Accounts helpline so that as many staff as possible are able to answer emergency calls to the Services helpline. [Website]" **WSP 3**

"People in [Location] will see our tankers out and about today as the thaw's causing problems with our sewage treatment works that we're trying to work through together with [Name]. Apologies if this causes any issues." **WSP 2**

Advice post:

"It's starting to thaw out across our region – which is good news! However we'd like to ask our customers to please check their outside taps and taps in vacant properties. If you attempted to turn these taps on during the cold spell, but couldn't as they were frozen, they could now be thawed out but still in the on position and risk flooding your property." **WSP 1**

"Be prepared for the thaw - as temperatures rise, we are likely to see a rise in the number of burst pipes both on our customers' own pipework and across the mains network. Check out what to do if you discover a problem: [Website]
Be prepared for the thaw What to do if you discover a problem" **WSP 3**

Request for information:

"We're asking for any vulnerable customer's or their family members to contact us with their names, address and a contact number." **WSP 1**

"we're asking for any customer's who are vulnerable or their family members to contact us. We need full names, address's and contact number's and we'll be in contact with these customer's" **WSP 1**

Request for action:

"Alongside [Name] we're all asking customers who have water, to use as little as possible this morning Following the recent freeze and rapid thaw, water companies across [Location] are experiencing exceptionally high levels of demand for water due to multiple bursts on networks and an increase in leaks in and on customer properties." **WSP 1**

"We are asking customers to check that their garden taps are turned off and not using water following the freezing pipes and taps over the past two days. [Location] [Website]" **WSP 3**

"Customers in the [Location] areas may experience interruptions to their water supply. We encourage customers to use water wisely and suggest water is stored for use overnight and into tomorrow. For updates, visit [Website]" **WSP 3**

The communication of information

"4th day with no water! No communication either which is the most frustrating part! Nothing even recorded on your website!" **– Reference 13, WSP 1 2018 03 06 01**

"Communication fail. These updates are far too infrequent and far too inaccurate. You need to be far more transparent - people need to make plans" **– Reference 7, WSP 1 EP 2018 03 05 17**

"Shall I go take my washing to the laundrette? Shall I go to my mums for a shower? Shall I buy 0ltr of water or 600? Surely they know how broken it is!" **– Reference 13, WSP 2, 2018 03 05 07**

"I just want to know whether it's going to be days or hours! Simple really!" **– Reference 21, WSP 2 2018 03 05 07**

"[Location] Now back on but stubborn refusal to keep us informed. Keep saying see website for updates but our area had no updates all 2nd until

sometime late evening when it just disappeared from the fault map. Water came back on some time after 1:00 this morning but yesterday the switchboard just kept telling us the inspector was still looking for the fault and check the website for updates. Evidentially at some time he found the fault and it was subsequently repaired but why not tell us! 30 seconds for an update that would save a lot of grief and let us know work is in hand even if you were still looking for the fault. Time after time we see this companies just do not understand the importance of keeping their customers informed. Most of us are perfectly reasonable, we understand the problems but want to be kept in the loop ignoring us until we complain or you send out the next bill does the image of [Name] no favours when the magnificent effort your teams in the field do should be getting high praise" **– Reference 7, WSP 3 2018 03 02 14**

Examples of WSP notification posts

"Update: Customers in [Locations] who are without water. Our team are working on repairs to restore supply as quickly as possible. We are really sorry we don't have a timescale at this point. As soon as we do we will post it here. Thank you for your patience." **– Reference WSP 1, 2018 03 04 10**

"Our repairs on many burst pipes in [Locations] will continue into next week. Customers in [Location] are starting to see water return to their taps after work on a 18" burst main but we know there are other burst pipes in the area which we're working hard to fix. Customers in [Location] may experience low pressure whilst we rezone the system to return water to [Location]." **– Reference WSP 1, 2018 03 04 23**

Lack of Information regarding the provision of timescales

"Well you got that wrong its 10:50 and still nothing" **– WSP 1, 2018 03 05 16**

"It's 22:50 and there is still no water in [Location]" **– WSP 1, 2018 03 05 16**

"So your 10pm line was a complete lie! SHOCK!!!! We are now on day 3!!!!!! Still no water!!!! STILL no information! Can you let me know when I can have a shower and go to work!" **– WSP 1, 2018 03 05 16**

Example of a supporting quote for the WSP providing customers of the difficulties they were experiencing

"The rapid thaw has seen our teams called out to an unprecedented number of burst pipes. To put that into perspective, we've had an increase in burst pipe alarms of nearly 4000%. When water freezes within a pipe it expands, putting more pressure on it and causing it to split or the joints to pull apart. When the temperature starts to increase again, the water will start to leak out.

This has put pressure on our network and meant small pockets of it experienced low pressure or periodic interruptions to supply during Sunday evening. Our teams have worked tirelessly throughout the night to fix many of the bursts, and as a result we have managed to restore supplies to everyone who was impacted.

Overnight there have been a further series of bursts though, and so as we enter peak demand this morning, there may still be poor pressure or intermittent supplies in pockets again as we fix these. We have teams deployed to deal with these and can reassure customers that we are doing everything we can to restore supplies as soon as possible. We would like to offer a huge apology to these customers for any disruption to their Monday mornings. We know just how hard it is to be without water and we hugely appreciate everyone's patience as our teams work around the clock to mend the bursts and reduce any impact to our customers.

Customers can get all the latest updates via our website here [Website]" **– Reference WSP 2, 2018 03 05 05**

Difficulties accessing information from the WSP

"Thank you! We have been on hold for 1 hour trying to report this. To confirm NO Water on [Location]. And your website is not updated!" **– Reference 2, WSP 1 2018 03 03 10**

"We certainly can't get through on the phone!!!" **- Reference 1, WSP 1 2018 03 04 12**

"Well [Name] are a waste of time not answering any questions or messages then get through to them and I'm 269 in the que because we all have 6months to wait to talk to anyone." **– Reference 9, WSP 2 2018 03 05 02**

"I've checked your website and tried calling several time but getting no information..." **– Reference 15, WSP 2 2018 03 05 02**

"[Name] should by now be getting water bowsers to all affected areas their website hasn't been updated since yesterday I've tried phoning again this morning and all I got was an answering service!!" **– Reference 5, WSP 3 2018 03 02 07**

Supporting quotes regarding a lack of consistent information from

the WSP

"If you are sorry please provide proper updates that are accurate. 3 times today you have given the messgae out that [Location] is fixed and it will be a few hours before the water is back on. If people had followed your updates they would not have gone to get water but waited for it to come back on. They would be dehydrated by now. We havent had water in [Location] for 48 hours. Please give realistic information. How about the same information that you are giving to our local schools? They say you wont update them til 10pm. So why have you said something completely different on FB. Clearly they are being given different information than us.
– Reference 22, WSP 1 2018 03 05 15

"You need to change the post. Then people have the right information. It is not right to have a post up that says you have fixed it when it isnt fixed and the water is still not on. People dont know whether they need to go to the water stations again or not. Your post says a few hours but the reality is the post is now hours old. It needs updating. You are misleading people."
– Reference 8, WSP 1 2018 03 04 23

"Still No water at [Location]. No water since Saturday. How much longer so I can decide to make alternative plans!" **– Reference 8, WSP 1 2018 03 06 03**

"No supply in [Location], according to your website the leak is fixed but whole street is without water. I have an autistic child who doesn't understand why he can't have a shower. Any idea when it will be back on please?" **– Reference 3, WSP 2 2018 03 05 05**

"Make sure the updates are realistic though yesterday you promised we would get water back at three different times...woke up this morning with no water. Just be honest and realistic and tell us when we will get the water...still can't believe [Location] is without water for 3 days..." **– Reference 3, WSP 1 2018 03 03 13**

Your communications are not accurate at all and you are endangering peoples health." **– Reference 22, WSP 1 2018 03 05 15**

"[Name]- you're putting conflicting information on this thread- [Name] is saying that there is still work that needs to be done and there is no timescale. [Name] is saying that the problem is fixed but it may take a while for pressure to return. Which is it please??" **– Reference 9, WSP 1 2018 03 05 02**

"It does seem a bit confusing…. *The text in the post refers to [Location], which is wrong – your link on the [Name] website in the original post specifies [Location] which is correct and is the exact location.   My father rang your organisation earlier AGAIN explaining that they were almost out of water. The reply he got was "go to a supermarket". Given the recent snow, I don't think that's an acceptable response to give to [Name] customers who are in their late 70's and be forced to go out in low temperatures.   I hope that their supply can be restored ASAP."* **– Reference 01, WSP 3 2018 03 03 08**

"Why are you still investigating when you told us this morning it was all sorted? We are constantly getting conflicting information." **– Reference 11, WSP 3 2018 03 04 24**

Problems accessing the WSP website

"How is it possible that [Name] are unable to communcate to us effectively. The [Name] website is useless for trying to obtain info. No water in [Location] and no idea how long we can expect this to continue. RENATIONALISE THE WATER COMPANIES." **– Reference 5, WSP 1 2018 03 04 08**

"Any chance of updating website to highlight the areas you're working on?" **– Reference 4, WSP 2 2018 03 05 07**

"[Name] should by now be getting water bowsers to all affected areas their website hasn't been updated since yesterday I've tried phoning again this morning and all I got was an answering service!!" **– Reference 5, WSP 3 2018 03 02 07**

"For those if us in [Name] (and I guess [Name]) i have just been told they are still working in the area and have no indication of when supplies will be restored to us. They have promised to update website etc but I don't hold out much hope!" **– Reference 6, WSP 3 2018 03 03 24**

"Yeah their communication is appalling! They said they were updating their website but no new information has actually gone up! No idea when it's supposed to be restored." **– Reference 9, WSP 3 2018 03 03 02**

"How about an update for [Location]? Been without water since Monday afternoon, was told it would be back on yesterday afternoon. Spent hours in queue for on-line chat & operator cut me off once! Emergency phone lines useless, just giving a recorded message about [Location] - nowhere near us - then hanging up. Check My Area on website does not work under any browser I've tried. No response to messages left via Facebook as web site suggests as means of contact. Job reference numbers come up with error messages when you try to check them on web site. Social media / web site info hugely lacking. Other folks without water - I feel your pain - I've been told there's a second burst pipe in the [Location] this morning, but no info about that elsewhere - some of you may find that nugget of information useful." **– Reference 5, WSP 2 2018 03 07 02**

Quote providing suggestions for improvement

"And to the delivery driver who came up from [Location] with more bottled water for the village yesterdat afternoon and turned up on Dad's doorstep with some more for him. I think issue has been as [Name] said earlier, it has been insufficient and slow communications. I found the website particularly unhelpful. Suggest that when [Name] have their SEA (significant event audit) in response to this major incident they look at the speed of the comms responses by the likes of Police and NHS organisations and use their website home page to get key messages out as soon with clear links to detailed information. Not everyone has FB or twitter and many in rural areas do not have Internet or mobile signals. More information through traditional comms such as local radio for the elderly?" **– Reference 39, WSP 3 2018 03 04 23**

WSP 3 Communication of information regarding snow

"Please don't blame the NON EXISTANT SNOW!!!" **– Reference 4, WSP 3 2018 03 02 10**

"….Fobbing people off with faux excuses and fake facts is not acceptable. For example telling people that you can't find the leak because the ground is covered in snow - as your website announcement for this area said yesterday evening - an announcement made some 8 hours after the snow had cleared; or telling people that you can't supply them with bowsers because the roads aren't safe, some 5 hours after all weather warnings in the area have ceased; or telling them that it is their neighbor's burst pipe that is causing the problem etc etc. The people who you are reading your posts and talking to you on the phone live in these areas - so they kind of know that they are being lied to. It makes [Name] look very bad." **– Reference 3, WSP 3 2018 03 02 14**

"Disruptions!!! There has been no water supply over a very large area for nearly 24 hours!! Why are you leaving people in remote areas of [Location], who have already been cut off due to snow for 2 days, without water with no information on when they might expect their water supply to resume? There are some basic human rights and heath issues here. Supermarkets sold out of bottled water around lunch time. There are many poor, elderly and vulnerable people in the area without cars, without internet, who have been coping with exceptionally cold weather, and who

*now have no water to drink, flush toilets or to even wash their hands in? When residents have called [Name] to ask if they have any idea when the situation will be resolved the answer has been a resounding 'no'. When we ask them if there are plans to use water bowsers the answer has again been a resounding 'no'.... not today, not tomorrow, not Sunday, not at any point does there seem to be a plan to supply people with water during the outage. Some of us have been told that the reason for the lack of water delivery by truck is that the inspectors can't get out to assess if the roads are safe. The roads in the area concerned have largely been clear since this morning, and will certainly be clear tomorrow, Sunday and Monday - using this as an excuse is an an extremely distasteful exploitation of the weather situation." – **Reference 6, WSP 3 2018 03 02 14**

6.2.1 The provision of information

"No water in [Postcode] either." **– Reference 7, WSP 2, 2018 03 04 02**

"We have no water at all [Postcode]"- **Reference 9, WSP 2, 2018 03 05 04**

"*What about [Postcode] we've still no water?"* **– Reference 12, 2018 03 05 09**

"we're still without water is there any update? Thanks." **– Reference 2, WSP 3 2018 03 03 02**

"Ok I'm reporting an area outside of those you've got on your website and on here, we have NO WATER now on the [Location], please respond to one of the messages I've left for you and let us know what's going on?" **– Reference 2, WSP 1 2018 03 04 14**

Facebook as the primary method of communication

"No mention of [Location] on your updates, people have been reporting no water again all morning. After being off all yesterday came on for about 2 hours then off again.what do we do to get a response from you?" **– Reference 1, WSP 1 2018 03 04 12**

"[Name] what's happening with the water supply to [Location] according to your website there's no issues in this area but clearly there is as so many people are with low pressure water atacan we have update please." **– Reference 7, WSP 1 2018 03 04 02**

"No water in [Location] since 8:30. Map to check leaks no longer working" **– Reference 18, WSP 1 2018 03 04 27**

"Still no water [Location]. Your twitter account said the problem had been fixed at 5.45 this morning but clearly not. We understand the problems that you are having and the hard work you are putting in but all we ask is to be given the proper information to keep us updated so we can plan properly too. Many thanks" **– Reference 73, WSP 1 2018 03 04 18**

"FB is not one of your main social media page? As I don't know where to check more. At least could you let us know when in [Location] the problem will be fixed? Could be today? My baby has a nursery tomo in [Location] and without water it won't be impossible to attend and hence I won't be able to go to work" **– Reference 15, WSP 1 2018 03 04 11**

"On Twitter you say check our social media page and on Facebook the same. Could you please confirm where to check and let us know when the problem will be fixed? Thanks." **– Reference 3, WSP 1 2018 03 04 14**

"If neither FB nor Twitter is your main social media page then what is? Instagram? MySpace?!" **– Reference 4, WSP 1 2018 03 04 15**

"[Name] we haven't had any update all day. The website hasn't been updated since **6am." – Reference 1, WSP 3 2018 03 04 18**

"The website doesn't give any information at all. Can you at least give updates as to what time [Location] will get water? I was told it would be 1pm and now it's after 2pm. I'd really like to be able to have a hot drink today." **– Reference 5, WSP 2 2018 03 05 08**

"We went to use our water at 2am this morning to discover that we have no running water. Our postcode area is not mentioned on your website and I've tried to call for 30 minutes in the early hours without getting through. Our postcode is [Postcode]. Lots of other postcode areas nearby are listed. If the wider area is affected, then parts of [Location] may be affected too." **– Reference 45, WSP 1 2018 03 04 29**

"No mention of [Location]. We have had no clean water since Friday! Despite reporting it to [Name] and [Name]." **– Reference 24, 2018 WSP 1 03 04 12**

Using Facebook to report leaks and burst pipes

"I know you've been busy and working very hard for us. But I need to let you know that we don't have water in [Location]. Sorry for adding up to your problem." **– Reference 1, WSP 1 2018 03 03 01**

"…leaking pipe next door to me but no one is home.please can someone look into this as it has been a good 5 hours & no one knows their contact details. postcode is [Location]." **– Reference 8, WSP 1 2018 03 03 07**

"I'm in [Location] and my water is now finally back to normal" **– Reference 4, WSP 1 2018 03 04 29**.

"[Location] has water" **– Reference 1, WSP 1 2018 03 07 12**

"I tried to report a burst pipe this morning online but it would not submit. It's on [Location]." **– Reference 24, WSP 2 2018 03 05 02**

"Water is leaking from a place you've dug up the road, at corner where [Location]. Looks like the masking tape didn't hold!!" **– Reference 4, WSP 2 2018 03 05 04**

"We are without water again. Pressure was awful all day but has now gone again" **– Reference 4, WSP 3 2018 03 02 13**

"Are you guys aware there's a burst pipe on [Location], it's been running like the [Location] for days, the communal bin cupboards both [Location] there is water coming from them the water is flowing like a waterfall on the back walls. It may be the water containers on the roof or a major pipe has gone in the blocks." – **Reference 14, WSP 1 2018 03 05 10**

"Same [Location] has gone again, we had very low pressure what I got home from work. There is a leak on [Location] - that is not being looked at, it was pretty bad early when I walked in." – **Reference 6, WSP 1 2018 03 05 06**

"Finally have my water back in [Location] after a looooog wait please don't let it ever go again." – **Reference 2, WSP 1 2018 03 07 02**

Customers providing detailed information regarding water supply failure

"Any update for [Location] please, we have only had 10ltrs so far, two young children and no water for 34 hours is getting very tough and unhygienic ! Thank you." – **Reference 9, WP 3 2018 03 02 13**

"Still nothing, not a drop, I have children, my neighbour is 102 years old, I've been buying her water the past 2 days. Really unfair on the elderly." – **Reference 1, WSP 1 2018 03 04 09**

"We have twin babies, told that we were on a priority list today for supplies but nothing yet. Spent about 20 quid on water and most shops are out. How can there be just one" – **Reference 1, WSP 1 2018 03 05 04**

"..my 4 year old has been up allnight being sick. desperately need some water" – **Reference 3, WSP 1 2018 03 04 09**

"Still nothing in [Location]! I have a severely disabled elderly woman here." – **Reference 37, WSP 1 2018 03 04 29**

"No response from [Name] by phone or email - two 97 year olds with dementia at risk. No water [Location]." – **Reference 10, WSP 2 2018 03 04 02**

"We haven't had water now for over 30hrs!! live the in at a boarding kennels for cats and dogs. And we MUST have water supply at all times.

What can we do? As [Name] have been far from helpful and haven't even offered us emergency water!!!" **– Reference 77, WSP 1 2018 03 04 12**

"[Location], from my personal experience today even the vulnerable customers are not getting water . I have a disabled son with incontinence and yet we still have no water. We have been told three times that we are a priority but still no water." **– Reference 26, WSP 3 2018 03 02 07**

"[Name] I understand that but I have 2 young children in my house I need to wash bottles for my youngest which I can not do so now when he wakes for his milk I can not give it to him. Also after 12 hours your meant to provide us with water in some form being bottled or in a tank outside on the road which hasn't happened! My water has been off for 28 and a half hours now and all local shops have now sold out of water! This is not just for me but for other people within the area." **- Reference 14, WSP 2 2018 03 05 02**

Perceived lack of information from the WSP

"no water in parts of [Location] - an hour on the phone, listening to weird music and being told that "one adviser will be with me soon" - yeah right - some information somewhere? - when is water back?" **– Reference 27, WSP 1 2018 03 04 12**

"[Location] without water for several hours now - I've been on hold for over an hour! Nothing on the website, nothing on social media. Please tell us what is going on!!!" **– Reference 81, WSP 1 2018 03 04 12**

"Tried to reach the via fb, twitter and phone - no information at all about water supply in [Location]" **– Reference 4, WSP 1 2018 03 05 08**

"You asked us to DM you the other day with our numbers so you could keep us updated with sms messages but you never did? My messages haven't even been read let alone responded to. I have have been without water since Saturday, it came back on last night for the first time but nothing again this morning. [Location]. You have my number so please call me!" **– Reference 10, WSP 1 2018 03 07 01**

"I have been waiting for your response on the phone for a long time and can't find any explanation for the problem for water supply in [Location] nor an offered solution for your customers. When the problem will be resolved and if not what alternative will be." **– Reference 9, WSP 1 ALT 2018 03 04 29**

Difficulties obtaining an alternative supply of water

"[Name] - customer service not great at present. Your SM updates need to be more regular and specific, to provide reassurance. Providing one location to collect water in a city the size of [Location] is not acceptable. This is not a situation you have created but a situation thatviscwithin your gift to improve." **– Reference 15, WSP 2 2018 03 05 08**

"Everyone appreciates the workload you have. But set up more places for people to pick up water. The situation in [Location] is appalling you cannot even get to the car park at Sainsbury's !!" **– Reference 16, WSP 2 2018 03 05 08**

"Not even water at the supermarkets !!!!" **– Reference 1, WSP 1 2018 03 04 14**

"No water still at [Location]! None since Saturday at 7pm. Shops are sold out of water." **– Reference 3, WSP 1 2018 03 05 17**

"Is there any water stations planned for [Location]? Over 26hrs with nothing now and local supermarkets have sold out of bottled water today..." **– Reference 1, WSP 2 2018 03 05 04**

"[Location] still have no water. Text said to be resolved by 1pm. NOomost 5 pm....any idea of whats happening? No water to buy in local supermarkets, all sold out whilst I've been at work !." **– Reference 3, WSP 2 2018 03 05 04**

"Shops in [Location] sold out of water!" **– Reference 10, WSP 2 2018 03 05 07**

"We have now been without water for nearly 30 hours!!! I know it's not your

fault and you are probably getting grief from every angle but this is now becoming ridiculous. We are now down to our last bottle of water. All shops have sold out!! Was promised some and apparently a request for some was put through bout 2.15. It is now 7 nearly 5 hours later!!!!!" **– Reference 2, WSP 3, 2018 03 02 07**

"Any updates [Name]? No water and shops all sold out of bottled water, rest of the shops are shut." **– Reference 18, WSP 3 2018 03 04 19**

"Any chance of some water as the shops have ran out. Please" **– Reference 1, WSP 3 2018 03 04 05**

Difficulties customers experienced without a supply of water

"[Name] - I am in [Location] and like everyone else here, still obviously without water. I saw your updated post that the works will be continuing into "next week", but do you have some kind of more detailed idea of when the issues will be resolved and for what areas? I have two children, one a newborn on formula, which can't be made without water. I've seen you're setting up areas to collect water, but we were unable to get any. We went to a few super markets, stores, petrol stations etc tonight to try and get some water and literally everywhere is sold out. I appreciate you're receiving god knows how many complaints and messages like this, but we just want some kind of estimated timeframe so we can get water into our homes. My main concern is my children" **– Reference 36, WSP 1 2018 03 04 23**

"[Name] I understand that but I have 2 young children in my house I need to wash bottles for my youngest which I can not do so now when he wakes for his milk I can not give it to him. Also after 12 hours your meant to provide us with water in some form being bottled or in a tank outside on the road which hasn't happened! My water has been off for 28 and a half hours now and all local shops have now sold out of water! This is not just for me but for other people within the area." **– Reference 14, WSP 2 2018 03 05 02**

"[Name], from my personal experience today even the vulnerable customers are not getting water. I have a disabled son with incontinence and yet we still have no water. We have been told three times that we are a priority but still no water." **– Reference 42, WSP 3 2018 03 02 07**

"[Name] are they still working on it as my partner leaves at 10 tonight he can't get his washing done when away as he works from 7 am to 7 pm and gets his food and then goes to sleep in his van at 9 pm also bungalow smelling bad now, dogs are out of water, i know i am not the only one that has no water." **– Reference 3, WSP 3 2018 03 03 01**

"[Name] with all due respect I have been with out water for 3 days [Name] are aware of that they are also aware that I have two children I am having to move out of my home today to live with my friend because we can not live !! I pay a fortune for water and I expect to get what I pay for !! The weather is no longer bad here so all u need to do is turn the pressure up?! When will it be sorted ?!" **– Reference 7, WSP 3 2018 03 05 06**

6.2.2   Requesting information

"[Location] without water for several hours now - I've been on hold for over an hour! Nothing on the website, nothing on social media. Please tell us what is going on!!!" **– Reference 104, WSP 1 2018 03 04 12**

"Do you know what the status is for [Location] area please? Not getting any joy via Twitter or FBDM." **– Reference 14, WSP 2 2018 03 05 02**

"We have not water in [Location]. Used Twitter no response, your website shows no problems. Your news section has nothing. Your telephone lines ring engaged and I am number 33 on live chat. How do i know what the problem is or when I can expect resolution or how don The vulnerable old people in my village get looked after??" **– Reference 2, WSP 2 2018 03 06 02**

Negative comments regarding the provision of service

"Is there any news for [Location]? Or at least when approximatly we will have the water back?? We have no water since this early morning and this is kinda of a problem now..." **– Reference 8, WSP 1 2018 03 04 08**

"[Location] i have no water. Do you know what the problem is/when it will be resolved?" **– Reference 14, WSP 1 2018 03 04 18**

"[Location] gone off again after coming back on all day? why?" **- Reference 6, WSP 1 2018 03 05 10**

"No water at [Location] either... can we please get an update on when this issue will be fixed?" **– Reference 8, WSP 1 2018 03 04 25**

"Hi [Name], so rather than post a generic reply why not answer the question? So my postcode is [Location], what is the update with our water supply as the link you keep directing me to tells my your coming out on the 13th March? I have had no water since approximately 19:30 last night." **– Reference 2, WSP 2 2018 03 05 02**

"No water in [Location] so this is not accurate information. Can you tell us when you intend to fix the problem by? The total lack of information is appalling. What a disgrace [Name]." **– Reference 23, WSP 1 2018 03 04 23**

"[Location]..2 days without having a shower at home, being able to use a toilet, washing up or drinking anything other than overpriced bottled water. Still no sign from [Name] regarding a timeline on these so called "investigations in to the matter /repairs" and when I can expect to get running water back. You need to be more informative [Name], you need to give people some kind of idea on how long this is going to take, even if it's bad news, we need to know!" **– Reference 5, WSP 1 2018 03 06 11**

Examples of customers needing information to determine how to prepare

"Any updates on [Location] [Name] your website is showing nothing! Even if you could give us a rough time of when it's due on as if it's off all day again we won't be able to stay indoors with no toilet and no way to wash anything up. Thank you." **– Reference 8, WSP 1 2018 03 04 02**

"I appreciate that this is because of the recent weather and cannot be helped, but can you give a rough idea on how long it will be before water is back on in [Location]? I have a 9 week old bottle fed baby and need to prepare if it's going to be a while before it's back on, the website isn't very helpful." **– Reference 4, WSP 2 2018 03 05 08**

"I'm so fed up - not so much being without water (although that's a pain - I do understand there's a countrywide problem after the big freeze) but the lack of information and clarity is staggering. I have a job raised - it says "investigation completed". What does that mean? I still have no water. And I also have no explanation as to what the next step will be, or when it might happen! The email I received says "There are full updates for each area in our news section of our website." But this isn't true - there are only 5 entries for 5th May 2018 and my area isn't one of them. I also checked out jobs in my area using the map tool. Guess what? Nothing there either. I rang [Name] and got told to call another number. I called. I held on for 45 minutes then gave up. I understand that it's busy, but I only want to know how long I need to prepare for having no water! I could bulk buy water if I knew it was going to be days. I'd go to the leisure centre and have a shower. But if the water is coming back on tomorrow I can wait. Please can I have some proper information??." **– Reference 45, WSP 2 2018 03 05 08**

"No we are in a temporary build, we have procedures in place to close if necessary just want a clear indication of timescales of when the water will be back on and drinkable. We need to give parents as much notice as possible to make childcare plans for their children." **– Reference 14, WSP 3 03 03 01**

Requesting information about timescales

"Do not make promises you can't keep. Give realistic timescales so that people can make plans. 22:00 been and gone and not a droplet from my tap. So. That's multiple days now." **– Reference 10, WSP 1 2018 03 05 17**

"Could you at least have the decency to let us know when are we gonna get water so at least we can plan ahead and bother friends and family to beg for a shower? As long as they don't leave in [Location] that is..." **– Reference 33, WSP 1 2018 03 05 17**

Requests for information regarding alternative supplies

"Where's [Location] bottled water?! Are we expected to travel to [Location] to get our bottled water - this has been 24hours now!!" **– Reference 1, WSP 1 2018 03 04 27**

"Where do we get drinking water from in [Location]?" **– Reference 17, WSP 1 2018 03 04 28**

"Is there any chance you'll be sending out an alternative water supply at all? (Bottled/Bowsers) I bought some bottled water last night when it started but nearly all gone! In [Location] - no water since around 7pm..." **– Reference 1, WSP 1 2018 03 04 05**

"So [Name] - where is the bottled water oh bowsers for [Location]? No water in the taps, no water in the shops and no water supplies from you [Name] .... compensation!!" **– Reference 16, WSP 1 2018 03 04 09**

"[Name] No point publishing an update which is factually incorrect. And why have thousands of bottles of water been sent to schools which haven't had their water cut off - when we are fast approaching 24 hours with not even a murmur from you about providing an alternative supply." **– Reference 21, WSP 2 2018 03 05 08**

"[Name] ... aren't you supposed to provide alternative water (eg Bowser / Bottled water) after 12 hours?????" **– Reference 10, WSP 3 2018 03 03 02**

"So 2 questions, how do we go about compensation, as we're almost at the 24 hour mark. And why has an alternative not been provided as its been over 12 hours? The shops locally are running out of bottled water." **– Reference 7, WSP 2 2018 03 05 02**

"I have no water all the shops in the area are sold out of water ... where can we get water??? been holding on your helpline for over 3hrs no one is answering." **– Reference 7, WSP 1 2018 03 04 29**

"[Name] absolutely disgusting, still no water at [Location], you've done absolutely nothing to source alternative water for us, all the shops are out, can you please sort us out some **water."** **– Reference 21, WSP 3 2018 03 03 02**

"Over 24hrs still no water. I understand burst pipes and engineering problems on site but for you not to be able or capable to provide us with

an alternative water supply is not acceptable in this day and age. So what are you going to do fix the pipe or alternate water supply..!!!" **– Reference 25, WSP 3 2018 03 03 02**

Requests regarding how to register as vulnerable

"How exactly are you prioritising people? Are you driving around the affected areas and dropping off water on our streets? Because that's what you should be doing. Do you really think 'vulnerable people can hop in a car and drive across [Location] to pick up water, not even knowing if there will be any left when they get there? Your attitude to your customers is disgraceful."- **Reference 4, WSP 1 2018 03 04 14**

"I spent over 3 hours trying to call you yesterday. I'm a vulnerable person, whose registered disabled and also has Ulcerative Colitis. Why are we not getting any proper updates?" **– Reference 24, WSP 1 2018 03 04 18**

"Just wondering why some customers have had text messages from [Name] & we (presumably others too) haven't? Also, heard they are supposed to be contacting the vulnerable themselves? How do they know who's vunerable & what qualifies you as this?" **– Reference 10, WSP 2 2018 03 05 06**

"The latest update for [Location] (8.20am) states [Name] will continue to deliver water to the vulnerable throughout today. How do we get in touch to arrange that? I have vulnerable clients in [Location] town centre and in [Location]." **– Reference 51, WSP 2 2018 03 05 07**

"How can I register someone as vulnerable and needs their water delivered please?" **– Reference 1, WSP 3 2018 03 05 02**

"Desparately trying to find out when water being restored to [Location], my elderly frail father living alone with mobility issues and chronic health conditions has had no water for over 24 hours.. What are [Name] doing about vulnerable and elderly customers who do not use the Internet? Found the website less than helpful as nothing about help for the vulnerable and spoke to Customer Services late last night with my

concerns, they took his details and mine and promised if extended beyond this morning they get back to me, we have heard nothing since." – **Reference 5, WSP 3 2018 03 03 05**

Requests for compensation

"Hi Now entering day 4 with zero running water in [Location]. Please advise your compensation procedures." – **Reference 37, WSP 1 2018 03 05 17**

"This is disgraceful. No water since Sam! Are you kidding me. Please advise on how we will be compensated. Your lines don't even work and your 'water stations' have no water your not only encouraging vulnerable people to leave there homes in the night for nothing but also not providing clear timelines as to when this f mess will be sorted. Pathetic." – **Reference 20, WSP 1 2018 03 04 10**

"Hope you have made compensation available for your customers??" **- Reference 29, WSP 2 2018 03 05 08**

"Does this mean customers who have been without water since Sunday night still only receive the same compensation as those who have only been without for 12 hours?" – **Reference 1, WSP 2 2018 03 03 06**

"*How and where do we apply for compensation plz" –* **Reference 21, WSP 3 2018 03 04 24**

6.2.3 Conversations between the WSP and the customer

Customer comment 3

"We've got no water in [Location] any idea of how long it will be off. Thank you."

WSP response 3

"Hi, I'm really sorry we haven't got a timescale yet. We're workingas quickly as we can to get this fixed. We have a bottled water location at [Location]" **– Reference 3, WSP 1 2018 03 05 07**

Customer comment 4

"There is still no supply to [Location] not even a dribble tho told is back on.

WSP response 4

"The damaged pipes in your area are now repaired but we have airlocks that are preventing the water from flowing freely. We are working hard to clear the airlocks and to get your water supply back to normal as soon as possible. For more information please go to [Website]." **– Reference 17, WSP 2 2018 03 05 02**

Customer comment 5

"What about the old, sick, disabled and mothers with small children? Not everyone can travel"

WSP response 5

"..... we're asking for any customer's who are vulnerable or their family members to contact us. We need full names, address's and contact number's and we'll be in contact with these customer's" **– Reference 4, WSP 1 2018 03 05 07**

Negative response to WSP replies to customers

"*I'm still waiting for my DM to be answered their colleague told me to message about receiving bottled water without a car and no reply."* **– Reference 20, WSP 1 2018 03 05 17**

"It's great when certain people get a reply and some get ignored so not only do we have no water it seems some people aren't good enough for a response ...welldone excellent customer service." **– Reference 5, WSP 3 2018 03 04 24**

6.2.4 Customers sharing information

"I just spoke to the council. [Name] have confirmed there is an issue at [Location] and are onsite to check the problem." **– Reference 1, WSP 1 2018 03 03 11**

"This was posted to the [Name] twitter feed: "We've now completed our work to repair a large leaking water pipe, which has been causing low pressure or no water in [Locations] Pressure is now building and we expect water to return over the next few hours (1/2)". Is this correct information?" **– Reference 6, WSP 1 2018 03 04 18**

"Now the website says "We're aware that customers may currently be experiencing disruptions to their supplies. We have despatched a team to the area and will provide further updates as soon as they become available. We ask that our customers conserve water whilst we work to identify the cause of the disruption in the area." I love the way they say "may" be experiencing difficulties. So we are now supposed to conserve the water we don't have." **– Reference 13, WSP 3 2018 03 02 07**

"Contrary to what [Name] says (yet again) the contractor from [Name] providing water had 5l plastic water bags emblazoned with [Name] logo, at least he did first thing this morning. Best to take your own just in case though." **– Reference 13, WSP 3 2018 03 04 02**
"We were at the [Name] local near a [Location] an hour ago, there was water there and in the shop on the corner by [Location]" **– Reference 1, WSP 1 2018 03 04 05**

"Here is a link to [Name] complaints procedure. Just in case anyone else wishes to lodge a complaint about either or both the lack of water or [Name] shoddy customer service in dealing with this failure to supply water. [Website]" **– Reference 27, WSP 3 2018 03 03 02**

"It says on the citizens advice website that after 12 hours we should be providing with water somehow... Well, we haven't been! I remember last summer on one of the hottest days of the year the water was off for almost a full day... Got nothing then so I'm not hopeful now!" **– Reference 8, WSP 2 2018 03 05 02**

6.3　Alternative supplies of water

Difficulties with the location of water distribution stations

*"Can someone at [Name] start using their common sense and supply the water in the Streatham are closest to those affected around [Location], and not 2 miles away. Most [Location] don't have cars, and there are many people unable to get there (elderly, disabled, those who can't carry water etc)." – **Reference 10, WSP 1 2018 03 04 14***

*"Where's [Location] bottled water?! Are we expected to travel to [Location] to get our bottled water - this has been 24hours now!!" – **Reference 1, WSP 1 2018 03 04 27***

*"Told nearest water station is [Location]... That's a joke - how do we get there from [Location] .... [Location]." – **Reference 18, WSP 1 2018 03 04 29***

*"What about the ones that can't collect !!!!!" – **Reference 8, WSP 2 2018 03 06 05***

*"Where is our supply of bottled water - we are a small village [Location]. This is our 2nd without water." – **Reference 76, WSP 2 2018 03 06 05***

*"It's great that you are handing out free water, but when you don't have access to a car it's a bit difficult to reach, pick up and transport the water back to where it is needed. Can there not be multiple distribution points so everyone can reach one easily?" – **Reference 3, WSP 2 2018 03 05 08***

*"Cant we get a delivery of water in [Location]? some people who live here don't have cars so how are they surposed to bring water back." – **Reference 8, WSP 3 2018 03 04 03***

"I'm not driving and I got a small kids on a buggy we are on

[Location] how can I carry water for more then 30 min walking ? You should provide the upper part of [Location] as well with water!" **– Reference 3, WSP 1 2018 03 04 13**

"they could have atleast offered us water bottles as it says on the website there is a station in [Location] or something." **– Reference 4, WSP 1 2018 03 04 29**

"Amazing effort [Name]! The water station at [Location] was fab. Thank you." **– Reference 56, WSP 2 2018 03 06 05**

"Do they provide containers? Our closest pick up point is 5 miles away!" **- Reference 12, WSP 3 2018 03 04 02**

"Dear [Name] There is also issues in [Location] and there are residents that are unable to get to your locations you have set in [Location] only. I think a collection point in the village centre would be advisable to enable these residents to access bottled water. Many thanks." **– Reference 36, WSP 3 2018 03 05 02**

6.3.1 Availability of alternative supplies of water

"Having had problems trying to buy water in [Location] supermarkets I was surprised to find out [Name] was giving out drinking water,however it was all gone,and by the way it was nowhere near [Location]. Still without water, let's hope we can believe them, a statement at 5 am informed us we would have a supply in 2 hours." **– Reference 5, WSP 1 2018 03 05 14**

"52 hours without so much as a dribble of water!! And not so much as a text or email from my water supplier with information! Why should I have to check social media for updates, you should be updating your paying customers directly! Every time I arrive I arrive at a water distribution stop, they have run out of supplies! Also distribution points are nowhere near to where I live [Location] so have to drag my 3year old and 5month old out in the car. I can almost forgive the ageing infrastructure but your handling of

*the situation in the aftermath has definitely fallen short! Provide your customers with more information, and start delivering water to those who need it!" – **Reference 6, WSP 1 2018 03 05 16**

*"Every time you post there is water at one of your collection points by the time we can get there I see a post to say that it's all gone and only 1 litre each, come on [Name] this is not good." – **Reference 7, WSP 1 2018 03 05 04.**

*"At the Sainsbury's [Location] water station they are saying one litre per person. People are naturally arguing but equally not the fault of the person manning the station. They are just doing what they've been told to do. Whole thing is being managed so badly. Where are the senior stakeholders hiding right now?" – **Reference 6, WSP 1 2018 03 05 06**

*"I drove to the village square and you said I could only have a few litres which is no good with a family to look after, then the water ran out anyway. Why can't you tell us exactly what is wrong and be more realistic about when it will be fixed? at least then we will know the extent to which we need to prepare. Your efforts at supplying us with emergency water are completely inadequate. Your communication with your customers is laughable. You have one job ffs." – **Reference 1 WSP 3, 2018 03 04 08**

Chaos at the water distribution station

*"We were there this afternoon .... it was a horrible experience .... utter chaos & a complete 'bun fight. Nobody knows how to queue anymore!!!" – **Reference 21, WSP 1 2018 03 04 15**

"If you are referring to those at [Location], to be fair, the [Name] people I spoke to were drafted in at short notice, drainage workers, lorry drivers etc. They were not trained in crowd control and it wasn't them who chose to almost riot. There was plenty of water and people just had to be patient. The guys at [Location] were there to help. they didn't cause the problem.I heard several people say they were there for "free" water and didn't have a water issue. These contributed to the problem. I waited for over an hour to get water for the elderly residents of my road and will probably have to go back tomorrow for more. The biggest concern is the lack of comms and

sheer size of the problem. All of [Location] appears to have spung a leak. It's not new btw [Website]” **– Reference 24, 2018 03 04 15**

When I went it was like Armageddon. Traffic was truly crazy and then to make matters worse when [Name] closed for the day they locked their car park gate...... mean really [Name] REALLY these are desperate times, what is wrong with mankind sometimes. Yea so after that things got worse.” **– Reference 29, 2018 03 04 11**

Location of water distribution stations

“Is there any chance you'll be sending out an alternative water supply at all? (Bottled/Bowsers) I bought some bottled water last night when it started but nearly all gone! In [Location] - no water since around 7pm...” **– Reference 1, 2018 03 04 05**

So [Name] - where is the bottled water oh bowsers for [Location]? No water in the taps, no water in the shops and no water supplies from you [Name] .... compensation!!” **– Reference 25, 2018 03 04 09**

“When can we expect water bowsers on street corners? [Location]” **– Reference 13, 2018 03 05 12**

Serious health risk. We need standpipes or bowsers every half-mile so we can get enough water to wash. Not Facebook posts with no info or incorrect info.” **- Reference 1, 2018 03 06 03**

“[Name] Why will you not put water bowsers on street this is a joke what about people with no cars.” **– Reference 5, 2018 03 06 03**

You need to bring water tankers on the streets!!Bottled water is not good enough and not everyone can reach it.It's been 5 days without any water.

*People need to flush their toilets,wash or shower." – **Reference 19, 2018 03 06 03***

6.3.2 Contingency planning

*"Not good enough [Name], only two sites for the whole of [Location]? Why are you not distributing water bottles to schools, set up water station's near each [Location]. Not everyone has transport to get to your two designated water station's and not everyone physically able or even financially able to travel to these areas. What are you doing to help the elderly, disabled and single parent families with babies & small children who probably cannot afford to get there? Not acceptable, no helpline available & no real estimated timeframe given of when this will be resolved. No real plan has been actioned and no real reassurance has been given." – **Reference 13, 2018 03 05 03***

*"Still no water, it's been over 24 hours now. No emergency water delivered, no regular updates. [Name] you need to sort this !!!" – **Reference 7, WSP 3 2018 03 03 02***

*"There are several people who cannot get out of the village needing water in [Location]. When are you planning on helping all those residents. Small bowsers in neighbouring villages completely insufficient." – **Reference 21, WSP 3 2018 03 04 08***

6.3.3 Altruistic behaviour

*"My local leisure centre let me use their showers if you have one near by that's easy enough to get to it's worth giving them a call to see if they can help." – **Reference 3, WSP 1 2018 03 06 03***

*"if you still don't have water tomorrow and need a shower you're welcome to come and use mine, just drop me a message." – **Reference 1, WSP 2 2018 03 05 12***

*"Thank you for keeping us informed. [Location].my kind neighbour collected some water for me." – **Reference 1, WSP 2 2018 03 05 14***

*"Not a problem sweet I'll drop u some down I was on the phone crying to them it's been quite stress full xx" – **Reference 1, WSP 3 2018 03 05 01***

*"..you're all more than welcome to come over to ours if you need to shower xx" – **Reference 1, WSP 3 2018 03 05 02***

Quotes supporting the WSP

*"you pay for the amount of water you use whithin your property. Be flexible and understanding. They're doing as much as they can to get this sorted by also providing bottles of water in [Location]." – **Reference 1, WSP 1 2018 03 04 16***

*"Well done [Name] for all your hard work trying to get the matter resolved and I agree that it's not your fault but unfortunately your just picking up the pieces after the whole mess! Well done and thank you for providing water in local store car parks!" – **Reference 2, WSP 2 2018 03 05 02***

*"[Name] have just delivered an emergency supply of water. Which we are very grateful for during this difficult time. Our thanks also to [Name] on the emergency desk who rang us through out the day to assess our position. Thank you.., also to [Name] for all your help today., you are all our heroes this evening." – **Reference 2, WSP 3 2018 03 02 11***

*"Awesome, thanks to all your staff. Some of which i am sure have been out in some very cold and challenging conditions to try and find the cause. Now off to search for some vessels to fill!" – **Reference 6, WSP 3 PC 2018 03 04 02***

*"A BIG THANK YOU**!!!** TO [NAME]!!! Ive just had 3 Bottles of water delivered to [Location]. A lovely man who couldn't apologise enough! He has no idea when we will have WATER but told me it was because we lived high up and the reservoir at [Location] is causing problems. So will sit down and have a nice cuppa now! Thank you to the team on*

FACEBOOK you acted with it in a matter of 25 mins where calling 10 times got us nowhere. I really do appreciate it! Thanks to all!!" **– Reference 2, WSP 3 2018 03 04 03**

6.4   Living without a water supply

"I could cry! Last thing you want with a toddler – can't shower, nothing to drink, can't wash hands or flush the loo!! Going to have to take over Mum's for the day." **– Reference 3, WSP 2 2018 03 05 03**

"Still no water in [Location] I must have missed the 2 hours it came back on. Am distressed cannot go to work this smelly" **– Reference 3, WSP 1 2018 03 04 20**

Difficulties living without a water supply

"I understand it is not your fault, but it is not ours either. No water to cook, no water to even use the toilet or take a simple shower. Yeah shops do sell water, but it is not the same thing." **– Reference 63, WSP 1 AP 2018 03 04 12**

"Compensation?? Pretty annoying now [Location], I've got a kitchen full of dirty washing up, haven't been able to shower or flush the toilet for three days. [Location]." **– Reference 5, WSP 1 2018 03 05 16**

"Ahh the toilet issue is annoying but trying to recycle water and using the bottle water supplies from [Location] I have to wash the dishes in a basin then throw the dirty water down the loo after. Worst part for me is I keep going to the tap to wash my hands then remember there's no water. After 72hrs you would have thought I would catch on lol but hopefully one day I'll be surprised and see water is back." **– Reference 25 WSP 1 AP 2018 03 05 16**

"I'm more bothered about no being able to have a wash really it's just crazy" **– Reference 3, WSP 2 2018 03 05 02**

"Iv had to take my kids to live at my friends I'm so stressed it's unreal I cnt when wash my cloths." **– Reference 2, WSP 3 2018 03 04 24**

Difficulties living without water to flush the toilet

"No water in [Location] yet, how can a family share a toilet like this for over 24hours." **– Reference 17, WSP 1 2018 03 04 23**

"You know, having a load of wee in the toilet is actually bothering me more than anything" **– Reference 2, WSP 2 2018 03 05 02**

"..thanks very much, ok at the mo. Biggest problem kids and the loo!" **– Reference 1, WSP 3 2018 03 03 02**

"not a single drip since Saturday at 6pm 2 under 5s and water pick up point a 30min walk. water is not light its not possible to carry it.. ive bought 40bottles since Sunday afternoon, it takes 3 bottles for 1 flush, 2bottles for the smallest bit of washing up, my son was throwing up early hours sunday and i still can't wash hes bedding which is covered in vomit, i appreciate your doing all you can but we need more than that." **– Reference 9, WSP 1 2018 03 06 11**

"We all need water, not just vulnerable people. Obviously drinking water is vital, but we still need to wash and flush our toilets. This is getting on for 30 hours and is ridiculous." **– Reference 3, WSP 3 2018 03 03 02**

"[Name] Not good enough. I don't have a car and I have two kids. How can I get enough water to flush the loo and keep us all clean? (Getting enough to drink has been hard enough!)." **– Reference 2, WSP 1 2018 03 05 12**

"My husband went and bought loads of bottles of water last night, so we were OK... My 2 are a bit older so they are OK.... But yknow... Can't flush the toilet!! Flipping grim!! it's getting to the point where I'm going to have to use a couple of bottles of water to flush the loo! We're at the point now where they should be providing an alternative water supply." **– Reference 2, WSP 2 2018 03 05 02**

"[Name] any news in [Location]. We've had no water or toilet use since 8pm yesterday and no news/updates from [Name]. Can you please let us have an update this is now becoming a nightmare. Gone thru 8 large

halons type waters for washing etc. No update for water collection in [Location] either" **– Reference 13, WSP 1 2018 03 04 25**

Still no water in [Location]. Our toilets are blocked by now. Can you please work harder to resolve this chaotic situation. This is unacceptable." **– Reference 4, WSP 1 2018 03 04 28**

"[Name] [Location] no water since Saturday afternoon almost 48 hours, toilet block, [Location] water supply only one bottle per person it's not enough even to drink or flush toilet, can you please let me when water will be back since ham you posted in few hours been 7 hours since then. Thank you" **– Reference 13, WSP 1 2018 03 04 18**

"You have to buy water and fill the toilet tank. We had to do it on Sunday and it uses like 6ltrs + of water for one flush." **– Reference 2, WSP 1 2018 03 05 17**

6.5 The provision of a service

Negative comments regarding the provision of service

"There zero water being supplied so none available for washing cars or for essential uses like toilets, showers, washing, drinking etc. You blame a 'sudden demand for water however its the same demand as every weekend. Zero customer service or response" **– Reference 5, WSP 1 2018 03 04 12**

"Come on [Name]! No water for 4 days now! This surely should be illegal to leave tenants without water! If it's not back by tomorrow you can put me and my family up in a hotel until it's fixed, and my water bill for this month I am not paying for a service I'm not using! Bloody joke! Where are your engineers at!!????" **- Reference 14, WSP 1 2018 03 04 12**

"Now 20-00hrs Sunday night, still no water and only water station is 4 miles away, which is difficult to get to for those without transport, reported in no water early this morning, told would receive phone call later that day, still nothing...... We pay our water bills but [Name] don't deliver the service required..... " they are no longer fit for purpose needs to be renationalised and take back into public hands and all profits recovered from shareholders...." **– Reference 3, WSP 1 2018 03 04 23**

"STILL NO WATER [Location].. NO UPDATES.. NOTHING!! DISGUSTED WITH THE LEVEL OF SERVICE. I REPORTED IT FOR 3RD TIME TODAY YO BE TOLD ITS THE FIRST [NAME] HAVE HEARD NO NEWS OF MY POSTCODE I TOLD YOU ON SUNDAY!!! UNACCEPTABLE!!!" **– Reference 14, WSP 1 2018 03 06 11**

"Your service is absolutely awful! We still have no water [Location] & still no contact from you! I don't drive, I have a baby & this is all the water I have left... thanks for all your help, NOT!! Absolutely disgusting!" **– Reference 2, WSP 2 2018 03 06 01**

"It's a disgusting service" **– Reference 25, WSP 2 2018 03 05 08**

Will you be refunding customers in those areas as you are currently unable to provide adequate service?" **– Reference 6, WSP 1 2018 03 03 10**

"Still no water in [Location]. No update from [Name]. Your website does not provide any details on my area. Terrible communication. Terrible service." **- Reference 17, WSP 1 2018 03 04 12**

"This is getting ridiculous! I commented yesterday on your post about our area. Still not good enough! As a pregnant woman I NEED WATER! Just like everyone in this effected area. This is absolutely Appalling service" **– Reference 3, WSP 1 2018 03 04 02**

"It's the lack of information provided by [Name]. If you could give any indication of how long this would go on for this would help. Any indication would help people to make provisions. Just to ignore your customers is an example of a poor service. I'm sure if you sent out an FAQ to customers that would slightly appease people rather than being disregarded." **– Reference 8, WSP 1 2018 03 04 28**

"I am sorry is not being spoiled but is paying for a service in one of the most evolved city on the planet, a service that should deal with this in a different way. There must be a back up plan for any emergency" **– Reference 4, WSP 1 2018 03 04 11**

"Disgusting service! [Name] treating their customers YES CUSTOMERS so poorly!!!!" **– Reference 9, WSP 1 2018 03 04 12**

Still no water [Location]!!!!!! Any update??? Your service is shocking!" **– Reference 7, WSP 1 2018 03 04 23**

"How very disappointing from [Name] to leave us without water for such a long time It is more than disappointing not to be able to wash and flush the toilet" **– Reference 9, WSP 1 2018 03 04 10**

"Again another [Location] resident here with 2 young children no water since 8pm last night can't get through to anyone absolute disgraceful service so far" **– Reference 8, WSP 2 2018 03 05 08**

Quotes relating to the WSP suggestion to conserve water

"Now the website says "We're aware that customers may currently be experiencing disruptions to their supplies. We have despatched a team to the area and will provide further updates as soon as they become available. We ask that our customers conserve water whilst we work to identify the cause of the disruption in the area." I love the way they say "may" be experiencing difficulties. So we are now supposed to conserve

*the water we don't have.“ – **Reference 14, WSP 3 2018 03 02 07***

"[Location] Same comment how are we meant to store water when there is none. Could [Name] please let consumers know the exact postcodes affected, what is causing it in each post code and rectification times now the roads are open and we are above." **– Reference 9, WSP 3 2018 03 02 14**

"Very difficult to conserve water when you haven't had a supply all day. Trying to run a pub and can't wash glasses or flush toilets. Food service had to be cancelled. Also personally I have a medical condition requiring water. Any chance of getting us some bottled water or a bowser.?" **– Reference 1, WSP 3 2018 03 02 17**

"Washing the car. I haven't been able to flash the toilet since last night. In [Location]." **– Reference 4, WSP 1 WC 2018 03 04 12**

Customer criticism regarding infrastructure

"Why the hell should we be patient and understanding of a company who chooses profit over reinvestment into infrastructure.“ **– Reference 7, WSP 1 2018 03 04 28**

"That would make sense. I wish [Name] had referred to it as 'leakage due to bad infrastructure' instead of 'demand', which makes it seem like it's down to the customers." **– Reference 3, WSP 1 2018 03 05 01**

"Your hollow apologies aren't worth anything... We ALL knew the snow was coming - so it seems every industry prepared for the consequences except [Name] - simple not acceptable." **– Reference 1, WSP 1 2018 03 03 10**

"From my professional experience [Name] don't want to put too much strain on the pipe work because it's so old and fragile. It's time more money was put back into upgrading the antiquated system. I've every respect for the guys out there repairing the pipes but none for the fat cat cat shareholders creaming the profits! Still no water on [Location]." **–**

Reference 3, WSP 2 2018 03 06 03

"Dnt get me wrong the workers do a brilliant job its not their fault I too thank them and applaud them. Its the shareholders and fat cats at the top creaming off the money which should be ploughed back into the infrastructure so that these workmen and their families arent put under such stress under these condition. I whole heartedly apologise if I have upset anyone." **– Reference 20, WSP 3 2018 03 04**

"Stop blaming the cold weather - if your infrastructure was fit for purpose these incidents wouldn't exist." **– Reference 2, WSP 1 2018 03 04 25**

Ridiculous situation. It's about time the water companies started a methodical upgrade of the old and deteriorating systems rather than trying to patch them up all the time. They are a service provider so it's high time they put service before profits!" **– Reference 5, WSP 1 2018 03 05 01**

"Every year we have a cold snap, yet the water companies are never prepared. Taking customers money to feed shareholders and pay dividends. No investment, no planning. First World problems, I know, but water is a basic right." **– Reference 33, WSP 2 2018 03 05 08**

"[Name] make enough out of us so this should never happen in the first place the consumer is paying highly for a service they are not getting. Shareholders getting priority over updating and replacing old pipelines etc. I know the weather has been a contributory factor but in the summer you dnt see thm working on replacing or checking potential supply problems they wait until something happens." **– Reference 6, WSP 3 2018 03 04 24**

Comments thanking the WSP

"Well done [Name] ... [Location] up and running ok now. What a relief. Feels so good to have water back on. Ty to all you hardworking [Name] employees working throughout the night to get it fixed. Yippee" **– Reference 1, WSP 1 2018 03 04 07**

"I have flushed the loo for the first time since Saturday - thank you very much to all your staff for working so hard on our behalf. And it's ok to say

"We don't know" and keep customers up to date. False hope is what is so damaging!!" **– Reference 81, WSP 1 AP 2018 03 06 11**

"Thank you for all your hard work because i know for certain you will be working around the clock inside the call centre and out in the field." **– Reference 3, WSP 2 2018 03 05 04**

"Personally I think [Name] do an amazing job. They always try to fix problems as soon as possible and I regularly hear of stories where they hand out FREE bottled water in some instances. Can you imagine if our gas or electric supplies went off for long periods...... Not sure we'd get free candles or gas bottles." **– Reference 1, WSP 2 2018 03 05 08**

"I'm gunna thank [Name] engineers on the ground who've clearly worked all hours to get things moving again. It's not perfect and there are major issues here - but instead of complaining incessantly, let's actually thank those workers who worked all wknd to help." **– Reference 14, WSP 1 AP 2018 03 05 02**

"Thanks guys for getting my water back to what passes for normal. Many thanks, still need an infrastructure upgrade in the area to cater for the increased demand since the original infrastructure was put in. [Location] back as it was." **– Reference 6, WSP 1 AP 2018 03 07 06**

Customers reporting leaks and burst pipes

"Water coming out of the 'water' drain covering on bottom of [Location] just now. Our water has been normal for hours but just seen this walking the dog." **– Reference 1, WSP 3 2018 03 05 01**

"There's a substantial leak at the top of [Location], just off the [Location] between [Location] Think it's been attended to before." **– Reference 2, WSP 2 2018 03 06 07**

"I'm amazed at [Name] actually trying to fix a leak, there's been one on [Location] for at least a year now reported several times they came 2 weeks ago dug a hole filled it in and it's still pouring water onto the road and into the gutter......." **– Reference 29, WSP 1 AP 2018 03 04 23**

"perhaps someone could fix the leak I reported in December that has now fractured to pathway and is losing gallons every day" **– Reference 11, WSP 1 2018 03 04 28**

"You have a burst main running all down [Location] for the last week. Visible to everybody passing by. It's not a good advert when you have the problems you have in the rest of the county. Stuff the the Council and get it repaired Sunday esrly when there is no traffic about." **– Reference 1, WSP 2 2018 03 07 03**

Customer providing evidence of engineers on site

Looks like all the carnage is happening down [Location]. Road closed and lots guy's in orange overalls scratching their heads." **– Reference 53, WSP 1 2018 03 03 02**

"[Name] are round on [Location] now I've just drive past but they are just stood looking around" **– Reference 1, WSP 2 2018 03 05 02**

Customers comments regarding the timescale of repairs

"[Name] but that's not true. We just went out to the engineers on our road who said they can't find the leak to our area and so can't fix anything until they can find the leak!!!!!!!??? Who's telling the truth exactly!???" **– Reference 1, WSP 2 2018 03 05 07**

"Nearly 24hrs now in [Location] and still nothing, you've dug a hole up near us, barriered it off and left it, right on a cross roads with traffic lights causing bedlam for traffic and the website says someone will get to sort it on the 25/3, that's 3 weeks away ......" **– Reference 1, WSP 2 2018 03 05 08**

"Can assure you was a huge team out all night. " **– Reference 3, WSP 3 2018 03 03 01**

6.5.1 WSP customer service

"no water in parts of [Location] - an hour on the phone, listening to weird music and being told that "one adviser will be with me soon" - yeah right -

some information somewhere? - when is water back?" **– Reference 73, WSP 1 AP 2018 03 04 12**

"No water [Location] been on phone for 2 hours tweeted them loads and guess what...nothing" **– Reference 125, WSP 1 AP 2018 03 04 12**

"I have contacted you today as I am registered disabled and have Ulcerative Colitis. But heard nothing yet. I tried calling yesterday but hung on for over 3 hours until the battery on my phone died. Quite shocked no one answered." **– Reference 134 WSP 1 AP 2018 03 04 18**

"No water in [Location] can't even get anyone on the phone!" **– Reference 13, WSP 1 AP 2018 03 04 27**

"Over 2 hours spent on hold trying to talk to someone! Emailed, tweeted, facebooked-now your bloody website is down. What is going on? When will the water be back on!? [Location]." **– Reference 35, WSP 1 AP 2018 03 04 29**

"[Name] I've tried and so have others we get cut off! Or get an automated message and live chat cuts you off!!!" **– Reference 1, WSP 2 2018 03 05 01**

"But you are keeping people waiting for 3 hours+ for a response on live chat." **– Reference 6, WSP 2 2018 03 05 07**

"You didn't miss anything. I stayed on for 22 minutes then lost the will to live. The website info hasn't been updated since 6:21 p.m. yesterday. I am thinking about taking two buckets and walking a mile to a stream and filling up. It's a bit Mediaeval but needs must." **– Reference 3, WSP 3 2018 03 02 07**

Customers comments regarding direct messaging the WSP

"I DM'd you this morning. No response so far" **– Reference 24, WSP 1 AP 2018 03 07 01.**

"I've sent 3 private messages since Sunday morning because I can't get through on the phones and they haven't even been looked at let alone responded to." **– Reference 24, WSP 1 AP 2018 03 06 04**

"I've had low pressure for 6 and a half days. I've sent a DM as advised - do you know how long it will take to get a response?" **– Reference 01, WSP 1 2018 03 07 09**

"has anyone received their compensation yet for loss of service? I was without water from 3rd March to 7th March and apparently am due compensation which [Name] said they would pay, but oddly the link to that page on their website no longer works. Have they changed their minds? Wonder what Ofwat will have to say about this?" **– Reference 19, WSP 1 AP 2018 03 04 10**

"https://www.ofwat.gov.uk/.../supply.../standards-of-service/ " **- Reference 08, WSP 1 AP 2018 03 04 10**

"Sent a private message a couple of hours ago as requested, to get help to vulnerable clients in [Location], and [Name] have not even read it yet!" **– Reference 14, WSP 2 2018 03 05 07**

6.5.2 Vulnerable customers

"DISTRIBUTE ThEm on the roads affected please.....imagine the elderly ?single mums at home with kids? the sick?....can they really travel to collect the water?.....Actually even better distribute them door to door Imagine if ur 80 years old stuck in a flat?Please ppl check if your elderly neighbours are ok and need water." **– Reference 1 WSP 1 2018 03 05 03**

"Not good enough [name], only two sites for the whole of [Location]? Why are you not distributing water bottles to schools, set up water station's near each [Location]. Not everyone has transport to get to your two designated water station's and not everyone physically able or even financially able to travel to these areas. What are you doing to help the elderly, disabled and single parent families with babies & small children who probably cannot afford to get there? Not acceptable, no helpline available & no real estimated timeframe given of when this will be resolved. No real plan has been actioned and no real reassurance has been given" – **Reference 2 WSP 1, 2018 03 05 03**

"An appalling response [Name]. Why aren't you delivering water to the streets effected? Some homes have been 48hrs without water now. How is an elderly or disabled person supposed to get to [Location] [Name] (miles away from the worst effected areas) to carry litres of water?" – **Reference 1, WSP 1 2018 03 05 01**

"What about the ones that can't collect !!!!!" – **Reference 2, WSP 2 2018 03 06 05**

"Are you delivering to those who are elderly & housebound? My Grandad is 90 and lives in [Location}!!" – **Reference 1, WSP 3 2018 03 04 02**

"[Location] what about [Location]. Elderly frail lady no water no heating 5 days ?????" – **Reference 1, WSP 1 2018 03 03 06**

"Still nothing in [Location]! I have a severely disabled elderly woman here." **- Reference 4, WSP 1 2018 03 04 29**

"My neighbour is 84 and house bound living on state pension even if he could get out he could not afford bottled water. This country is going to hell in a hand." – **Reference 3, WSP 1 2018 03 05 03**

"Desparately trying to find out when water being restored to [Location], my elderly frail father living alone with mobility issues and chronic health conditions has had no water for over 24 hours.. What are [Name] doing about vulnerable and elderly customers who do not use the Internet?

Found the website less than helpful as nothing about help for the vulnerable and spoke to Customer Services late last night with my concerns, they took his details and mine and promised if extended beyond this morning they get back to me, we have heard nothing since." **– Reference 5, WSP 3 03 03 01**

Vulnerable customers request for information and assistance

"how do we get water if we are disabled? as can find no info on this, i live [Location] area." **– Reference 1, WSP 2 2018 03 05 09**

"[Location] baby and disabled person. Any news would be great." **– Reference 3, WSP 2 2018 03 05 07**

"Well you are supplying free water in [Name] in [Location] but i live [Location] why are u not supplying water to those of us affected here. Our water is filthy i also have kids with disabilities and am a type 1 diabetic with low immune system" **– Reference 2, WSP 2, 2018 03 05 06**

"We are 2 OAPs living in a very small hamlet in [Location] area we have thanks to you some cold water supply but at much reduced pressure this means that there is not enough pressure to run our unvented hot water cylinder system so we have no hot water and must boil kettles all the time. Can you please tell us if and when the pressure we had before the outage will be restored, we are concerned about doing damage to the expensive unvented hot water cylinder system since we cannot re-pressurise it. Thanks for all your help." **– Reference 1, WSP 3 2018 03 04 24**

6.6 Compensation and bills

"Come on [Name]! No water for 4 days now! This surely should be illegal to leave tenants without water! If it's not back by tomorrow you can put me and my family up in a hotel until it's fixed, and my water bill for this month I am not paying for a service I'm not using! Bloody joke! Where are your engineers at!!????" **– Reference 30, WSP 1 2018 03 04 12**

"Understandable that these things happened, but I have to say your customer service is shocking! You left me without running water for 30+ and I never got any email, text money back for all the money I spend on

bottled water and ready made milk for my son. Instead you still take £40 off me even though your website stated that you would reimburse me £30.” **– Reference 1, WSP 02 2018 03 05 07**

“Hi Now entering day 4 with zero running water in [Location]. Please advise your compensation procedures.” **– Reference 158, WSP 1 AP 2018 03 05 17**

“Come on [Name] bosses show some compassion & give all those affected a rebate for all the inconvenience & stress these people have suffered & still are suffering!” **– Reference 1, WSP 3 2018 03 04 02**

“We should all have a refund on our bills you can't have a bath or shower with bottled and how about disabled or people that couldn't get out one place to get water disgusting.” **– Reference 2, WSP 2 2018 03 05 02**

6.6.1   Complaints to the regulator

“[Name], report this to Ofwat - one badlyplaced distribution point is not good enough. [Name], you could work with the [Location] and the voluntary sector to help get water out there, if resources is the issue.” **– Reference 1, WSP 1 2018 03 05 09**

“has anyone received their compensation yet for loss of service? I was without water from 3rd March to 7th March and apparently am due compensation which [Name] said they would pay, but oddly the link to that page on their website no longer works. Have they changed their minds? Wonder what Ofwat will have to say about this?” **- Reference 1, WSP 1, 2018 03 03 10**

“Doesn't seem that posts here get meaningful answer from [Name]. Time to remind you of your obligations under the OfWat regime? EG about keeping public properly and specifically informed, within certain time limit.... “ **– Reference 1, WSP 2 2018 03 05 02**