

## Response to Ofwat resilience consultation from Centre for Water Systems, University of Exeter

This response has been compiled by the *Safe and SuRe* (sustainable, resilient) project research team from the **Centre for Water Systems, University of Exeter led by Professor David Butler**. The Safe and SuRe (S&S) project has reliability, resilience and sustainability as core concepts in its conceptual and analytical frameworks and therefore the confidence with which we are commenting is high. We have provided direct research-informed comment where relevant in our response, but for further information please refer to the project website ([safeandsure.info](http://safeandsure.info)) and/or contact Professor Butler ([d.butler@exeter.ac.uk](mailto:d.butler@exeter.ac.uk)). Further details on the S & S project are given in the paper below, which can be directly accessed at the link provided.

- Butler D, Farmani R, Fu G, Ward S, Diao K, Astaraie-Imani M. (2014) [A new approach to urban water management: Safe and SuRe](#), *Procedia Engineering*, volume 89, no. C, pages 347-354, DOI:10.1016/j.proeng.2014.11.198.

Please ensure to reference this paper where any information from this response is used within any documentation produced as a result of the consultation.

The underpinning aim of the consultation seems to be to articulate Ofwat's definition of resilience, so that service providers can interpret it and apply it to assess their resilience and report back to Ofwat. This will allow Ofwat to provide support where needed and determine whether the resilience duty is being met and furthered. Key focuses are also trust and confidence. Trust and confidence are built through clarity and transparency. At present there is a lack of both in Ofwat's articulation of how they understand resilience and will undertake their resilience duty. Through our responses to the questions posed in the consultation, we aim to help improve this clarity and transparency to build trust and confidence between Ofwat, the service providers and customers. Before responding in detail to the questions posed in the consultation, our main comments are:

- Reliability, resilience and sustainability are conflated in the consultation document. Additionally, when a definition is posed, its concepts are usually elaborated upon directly afterwards. The concepts within the proposed working definition are currently not clearly explained. We provide guidance on the differences between the concepts and how to elucidate them in response to Q1;
- A number of different types of resilience are referred to throughout the document (we list them in response to Q1), but without clearly articulating to service providers whether each type could or should be addressed in their actions to build overall resilience. A summary of these types and how they could be addressed is warranted (we help with this in response to Q3);
- Responsibilities for delivery are implicit rather than explicit, with a certain amount of reading between the lines required. We encourage greater clarity on this and make suggestions in this regard in response to Q2;
- A much clearer distinction needs to be drawn between building resilience and achieving resilience. Service providers will be responsible for delivering, assessing and reporting on resilience (potentially via independent audit). Monitoring the achievement of resilience is, in our opinion, the role of Ofwat based on a set of resilience indicators or standards. It is presumed that Ofwat's indicators will be clearly and transparently made available to service providers. This will enable them or their independent assessors to consistently apply a common set of indicators and also allow Ofwat to undertake cross-comparisons. We provide guidance on potential indicators and methods of assessment in response to Q3.

## Q1 Is our basic understanding of resilience aligned with your own – are we addressing the right things in the right way?

Despite best efforts, concepts and terms are conflated and used incorrectly throughout the document. It is important to get these right the first time in order to address the right things in the right way. Reliability is not equal to resilience and thus the very title of the document is misleading: ‘reliable services’ are equated to ‘resilience’, which is incorrect. To clarify, we contend reliability pertains to minimising level of service failure **frequency** under **normal** conditions (i.e. maximising compliance), but resilience pertains to minimising level of service failure **magnitude and duration** under **extreme** conditions. This is reinforced by the ‘Keeping the Country Running’ report (2011), which is quoted (but seemingly misunderstood), which highlights that **reliability is one of the foundations of resilience** (along with redundancy, resistance and response/recovery) and therefore *the two are not the same thing*. The S&S way of illustrating the relationship between reliability, resilience and sustainability is shown in Figure 1, emphasising that reliability is the foundation for resilience and resilience the foundation for sustainability. The current proposed Ofwat definition of resilience includes an element of sustainability (“*now and in the future*”), which is understandable due to the way the Duty is described in the Water Act. However, the temporal element should be acknowledged as a feature of sustainability that converges with, rather than is part of, resilience. This will help service providers better consider how sustainability and resilience relate to each other. Park et al (2013) provide more guidance on this.



**Figure 1 The relationship between reliability, resilience and sustainability (the Safe & SuRe pyramid (Butler et al., 2014))**

Whilst the proposed definition of resilience given on page 10 broadly aligns with well-established grey literature and academic definitions of resilience, it is not the only definition given in the document. There are other definitions peppered throughout the document. Aside from the proposed working definition (pg 10/14, given here first), the following alternative meanings are also offered:

- Pg 10/14 - “Resilience is the ability to cope with, and recover from, disruption, trends and variability in order to maintain services for people and protect the natural environment, now and in the future.”
- Pg 5 - “They [customers] may not call this resilience, but resilience is reliability in the broadest sense, and that is the way in which we are using ‘reliable’ in this consultation.”
- Pg 22 - “But resilience is not just about disruptions. It is about maintaining a quality service for the long term at a price that current and future generations can afford.” This definition of

resilience includes affordability and is phrased very similarly to existing definitions of *sustainability*.

- Pg 24 - *“And resilience – what customers want and rely on - will mean different things to different customers; and different things at different times; as well as in different places.”* This definition effectively implies resilience is *anything!*
- Pg 27 – *“Resilience is about deviations from standard service for any reason, not just loss of service for extreme reasons.”*
- Pg 28 – *“Resilience means the need to seek to avoid service disruptions as well as to bounce back from them if they do happen.”*
- Pg 28 – *“resilience as efficiency.”* Resilience is not efficiency. However, improving resilience may facilitate improved efficiency and vice versa.

**This is an issue of clarity and any documentation produced on resilience should be consistent in the words and phrases it uses to describe types of resilience, resiliency and resilient systems or services.** To facilitate this, the words (concepts) within the proposed definition need to be explained in turn and then used consistently throughout any associated guidance. Here we propose definitions using S&S terminology as a guide (Butler et al., 2014). Please note that in the descriptions below the term ‘system’ could apply to any type of system (e.g. infrastructural, financial, organisational):

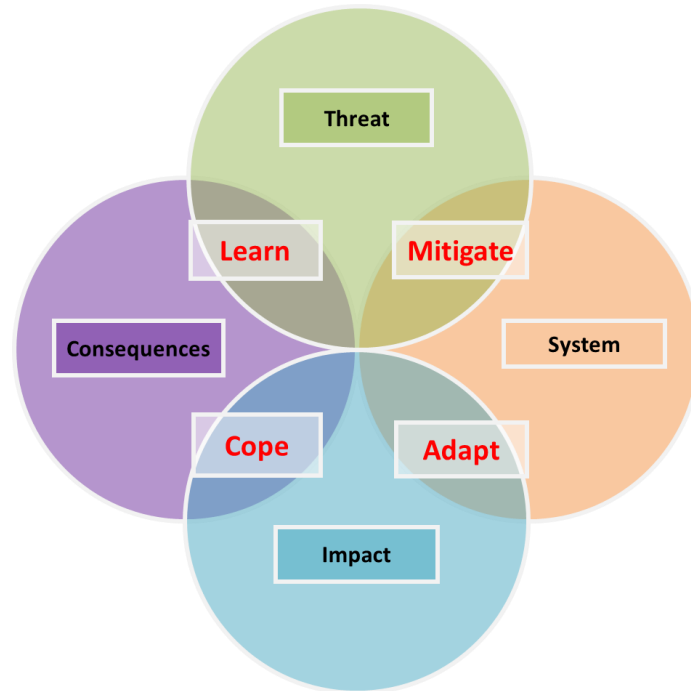
- Sustainable – the degree to which the system maintains levels of service in the long-term whilst maximising social, economic and environmental goals;
- Resilience – the degree to which the system minimises level of service failure magnitude and duration over its design life when subject to exceptional conditions [extremes];
- Reliability – the degree to which the system minimises level of service failure frequency over its design life when subject to standard loading [normal conditions];
- Threat (‘disruption, trend, variability’) – any actual and/or likely event with the potential to reduce the degree to which the system delivers a defined level of service. Can be internal or external to a system and includes knowns and unknowns;
- Impact – the degree of non-compliance with the defined level of service [results from a *threat*];
- Consequence – any outcomes and effects of the impacts (i.e. non-compliance with a level of service) on each pillar of sustainability;
- Cope – any preparation or action taken to reduce the frequency, magnitude or duration of an impact on a recipient (society, economy, environment);
- Mitigate - reduce the threat;
- Adapt – efforts to increase system reliability and resilience;
- Learn – embed experiences and new knowledge in best practice;
- Recover – regain the ability to deliver and comply with a defined level of service.

The relationship between these concepts is illustrated in Figure 2.

In addition to these concepts and definitions, the types of resilience hidden throughout the document need to be more clearly summarised and articulated. We found the following types of resilience mentioned:

- Water sector resilience (page 9) – this will be the culmination of all stakeholder efforts, not just service providers;
- Service resilience (throughout);
- System resilience (throughout);
- Asset resilience (page 12, 23);
- Ecosystem resilience (page 10);
- Customer resilience (page 11, implied throughout);
- Market resilience (page 16);

- Planning resilience (page 16);
- Corporate (organisational) resilience (page 7, 16, 19);
- Financial resilience (page 7, 19)
- Water resource resilience (page 27);
- Water environment resilience (page 27)
- Skills resilience (page 28).



**Figure 2 Building reliability, resilience and sustainability - the Safe & SuRe conceptual framework**

Approaching resilience assessment by focusing on an impact to a service, system or other type, rather than the actual threat, means that unknowns can be included. We agree that it is impossible and inappropriate to identify all threats (or 'risks'), therefore identifying the ways in which a component or system or service may react to a threat (e.g. a pipe fails; the impact of which affects water pressures throughout the network) negates the need to identify the actual threat causing the failure (Mugume et al., 2015a, b). Assessment should focus on the ability of the existing system or component to cope and recover from failures, impacts and consequences (through quantification of stress via measuring magnitude and duration). If they are deemed not resilient enough, mitigation, adaptation, coping and learning interventions will need to be modelled to determine their effect on resilience (how magnitude and duration of stress vary), before interventions are then implemented. This will help Ofwat, service providers and customers better understand how each aspect of the sector is dealing with resilience.

Use of the concepts, their definitions and the types of resilience listed, will help make more transparent how each of the case studies included in the consultation document is actually 'resilience in action'; currently this is not at all clear. As an example, we have taken the first case study (page 6) and shown how the types, concepts and definitions map to it:

***Affinity Water's Resilience in Action***

*Type of resilience:* ecosystem, customer

*Threat:* relieving pressure on the environment

*Failure mode:* reduced abstraction based on environmental need and customer motivation

*Impact:* deficit of 42million litres a day by 2020

*Consequence:* social - reduce customer demand and leakage; economic – keep bills below rate of inflation; environment – ecosystem pressure relieved

*Cope:* work with customers to enable them to use 10l less per day

*Adapt:* improve infrastructure reliability to reduce leakage by 14%

*Learn:* embed and share cope and adapt actions in general practice

*Recover:* demand can be met with a reduced volume of supply

Finally, “resilience risks” is a confusing term given the variety of existing approaches to risk (‘uncertainty’) management. Based on the S&S terminology perhaps “threats to resilience” would be a better phrase to use in relation to ‘what-if’ scenarios, as risk assessment and management is usually based on probability estimations. Resilience can focus on whether systems can overcome failure (or not), whether that failure is predicted or not (i.e. not probability-based).

**Q2 Do you agree with our view of what Ofwat should deliver, including where we might step in, and what is for others to deliver?**

There is a hidden emphasis on the assessment, delivery and reporting of resilience by service providers in collaboration with its customers, including community groups, local authorities, business partners and linked sectors. However, it is unclear as to exactly what these non-service provider partners are to deliver. We agree that, due to the individual nature of each service provider and their ‘knowing their patch best’, service providers should be responsible for delivering and assessing their own resilience. However, to avoid a mere re-branding of everything they do as ‘resilience’ due to a lack of clear definition with poorly elucidated concepts and loosely defined assessment methods, we encourage Ofwat to provide substantially more detail when they are compiling their final document and the proposed framework for assessment that they will use (page 20). We provide information that may be useful in this respect in response to Q3. At present it is implicit rather than explicit that service providers should assess, deliver and report on resilience building and that Ofwat will provide guidance where needed and report on achieving resilience across the water sector. This needs to be clearly stated in a single paragraph, rather than hidden in different sentences throughout.

There is an emphasis on meeting the levels of service customers expect, but also recognition that the cost of meeting higher expectations may not be realistic. It is not clear whether *acceptable* levels of service under *normal and extreme conditions* have been elucidated by service providers through engagement with customers. As acknowledged by the proposed resilience definition, coping with and recovering from threats, impacts and consequences is key to resilience. Resilience is not about eradicating all threats, therefore levels of service will be affected under certain conditions/failure modes. The consultation says “*Customers themselves are part of this system*” and as such they need to be resilient too. That is they need to be able to cope with and respond to impacts and consequences of varying frequencies, magnitudes and durations.

Ofwat should emphasise the need to work with CCWater, service providers and customers to increase awareness of the role residential and business customers play in contributing to the types of resilience listed and the levels of service they find acceptable. If this is not undertaken in a comprehensive way, Ofwat and service providers may alienate customers from the decision-making process, which is counter-productive to building trust and confidence.

**Q3 What views do you have on how the water and wastewater sector might measure its performance in delivering resilient services – and the best way for us to demonstrate that we are carrying out our role?**

To create a framework that encourages, incentivises and enables the sector to deliver resilience Ofwat needs to formulate guidance on indicators and assessment based on the responses to this

consultation. The current ‘resilience principles’ given in the consultation document are not strong enough to guide service providers to assess, deliver and report on resilience. These resilience principles relate to Ofwat duties wider than the resilience duty and should therefore not be called ‘resilience principles’, as this is confusing. Perhaps renaming them something along the lines of ‘Principles to Build Trust and Confidence’ would be more appropriate. The seemingly under-used 2012 document “Resilience – outcomes focused regulation: principles for resilience planning” (Ofwat and Mott MacDonald, 2012) provides a tighter set of 9 principles, to which Ofwat should refer back to and consider operationalising. To be outcome-focused, there needs to be a method of objectively assessing outcomes, which the methodology provided in that 2012 report could facilitate.

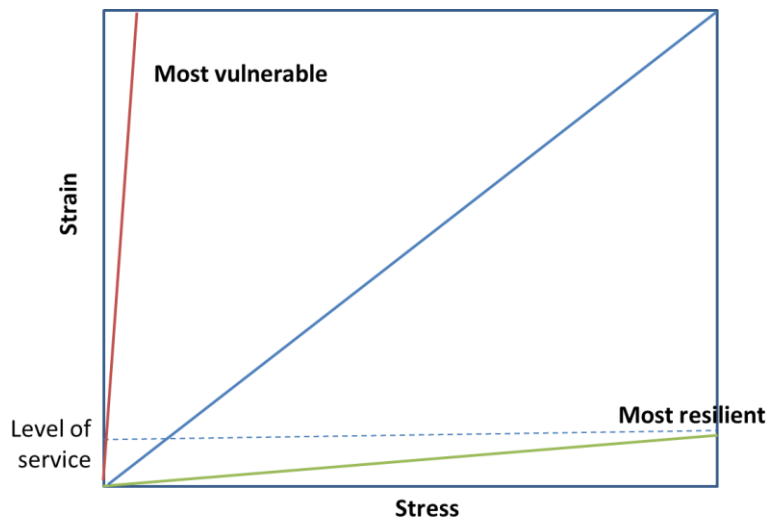
Whilst understanding the need for a flexible approach from Ofwat (to ensure service providers act creatively rather than just doing enough to comply), we believe there is currently inadequate guidance on indicators for assessing resilience. Unless provided with an assessment framework with which to work, independent assessment could lead to an inability to undertake cross-comparisons, which would hinder Ofwat’s furthering of its resilience duty. For Ofwat to carry out its role it should benchmark how service providers and others are assessing and operationalising the resilience definition. To enable this, Ofwat needs to provide a clear approach to assessment that need not include targets or a standard or be intervention specific, but should show that there is a common methodology to be used by partners across the sector. Otherwise a range of different methods could be developed across the sector by service providers and independents. If this happens, how will Ofwat ensure that the methods developed are comparable?

There are a number of starting points for resilience indicator and assessment development. For example, resilience could be assessed for each of the types of resilience outlined in response to Q1 across the three primary tasks of service providers, those being provision of:

- Water supply and distribution;
- Drainage and flood control;
- Wastewater treatment and disposal.

We suggest that both qualitative and quantitative indicators may be required. This type of framework is specific yet flexible enough for service providers to apply it to doing “.....*different things in different ways*” (page 19).

The consultation also asks for guidance “.....*including any useful stress tests they may perform.*” In response to Q1, we briefly touched on the idea that threats (disruptions) need not necessarily be identified. Instead the focus becomes how the system fails in order to assess how it can be made ‘safe to fail’ rather than totally ‘fail safe’ (as is expected under current levels of service). This is also known technically as ‘middle state’ focused and middle states refer to the failure modes of the system, which can be further explained as *degrees of stress* to a system that result in *performance strains* (leading to impacts and consequences). A stress could be the number of pipes that break and the corresponding strain could be the number of customers supplied who may be affected. This can be displayed graphically as a stress-strain curve, as exemplified in Figure 3, where the red, blue and green lines represent the stress-strain responses of different systems, with the green line representing the most resilient system. Service providers and other partners across the sector could use graph theory (Yazdani et al., 2011), synthetic water distribution and urban drainage networks (Mugume et al., 2015a) and/or physically based modelling approaches to examine resilience by testing different interventions and analysing results. The latter enables more realistic representation of system-specific interactions between structure (failed components) and function (performance). These types of analysis are being explored by the S&S research team for different systems (Mugume et al., 2015b; Diao et al., submitted).



**Figure 3 Middle state stress-strain curves (Butler et al., forthcoming)**

For example, a service provider may use the indicator of investment diversification for financial resilience, as they have examined the effect of a particular adaptation intervention on failure modes and identified that it will minimise the level of service failure magnitude and duration and the resulting impacts and consequences. In summary, outcomes resulting from any proposed interventions must be articulated as an increase in the ability to cope with and recover from failures and related impacts and consequences for each type of resilience. This will enable Ofwat to show how it has guided the companies to demonstrate their action on overall resilience.

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