Reflections of a Water Professional: Essays in the Philosophy of Engineering

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Introduction

Philosophy of Engineering is a reasonably new field of thought when compared to philosophy of science or technology (Pauli, 2012; Vermaas *et al.*, 2014). Taking this further, philosophy of water management is an even newer, emerging even, venture. Such philosophical disciplines share common ancestry and interdependencies between academic, practitioner, science and humanities perspectives. Whilst this historical inheritance brings with it problems of interplay, it enables unrivaled freedom to explore the nuances of managing water in society in a more (dare I use the word) holistic way. Philosophy of engineering allows conceptual, ontological, epistemic, ethical and social issues to be considered based on detailed philosophical, sociological and reflective studies on engineering (or in this case, water management) practices. By compiling and making public these essays I hope to contribute to the ongoing thought in this area, as well as perhaps encouraging more engineers and water professionals to think reflexively in their everyday work. I wrote these essays whilst undertaking an MRes programme 3 years after completing my PhD, because I felt the need to explore the 'whys' of the empirical water engineering I was doing. It was a rewarding journey and I hope more water professionals are able to take such a path. Please forgive any naivety herein – these ramblings represent initial steps on my philosophical voyage.

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Renegotiating the social and institutional realities of urban water management

Abstract

Searle's theory of social and institutional reality orientates around function assignments, collective intentions and constitutive rules, with a distinct emphasis on language. Within this essay the theory is presented and explained systematically and in detail by illustration with examples from the field of urban water management. It is further explored by examining the need for a renegotiation between urban water management social and institutional realities. The essay concludes by examining the role of an approach called 'water sensitive urban design' in making such renegotiations a reality (both social and institutional).

Introduction

The question set to explore within this essay was:

"Expound Searle's theory of social and institutional reality, and illustrate it with reference to examples of social and institutional phenomena such as going for a walk, a game of football, a university, an orchestral performance, property ownership, marriage, the law, etc.. [You could focus primarily on one example, or refer to a number of different ones; try to incorporate a good range of concepts, categories and distinctions]."

In order to fully illustrate Searle's theory with relevant social and institutional phenomena, I have decided to use examples from the field of urban water management. Consequently, the essay brief was reconfigured into the title of the essay. The essay will attempt to illustrate the physical, social and institutional realities at the core of Searle's theory by demonstrating that within the field of urban water management there is the need for a renegotiation of social and institutional realities. The argument for a reconfiguration has been catalysed by the perceived and real needs for a new and more 'sustainable' approach to managing water in the urban environment, using approaches such as 'water sensitive urban design'.

The essay will begin by formally expounding Searle's theory using examples from the field of urban water management. A more in depth discussion of the relevance of the theory for urban water management will then take place to explore how social and institutional realities are represented and why they might require renegotiation within a new urban water management paradigm. The essay concludes by highlighting aspects of the two realities that urban water management professionals may need to renegotiate within alternative approaches such as water sensitive urban design.

Conception of an urban water management ontology

In considering how social facts exist (i.e. ontology), we must also consider how the existence of social facts relates to other things that exist. With regard to this, Searle's Ontological Distinction asserts that there are: (a) things that exist regardless of whether someone is there to perceive them (observer independent) and (b) things

that exist only when someone is there to perceive them (observer dependent). Searle also talks about '*how the world is in fact*'. In the context of the 'world' of urban water management the 'facts' are that water is:

(a) Observer-independent and objective, its material is physical - a water molecule is a system of charged particles bound by forces (Searle, 1996), which exists independently of people's consciousness.

But that systems of water provision, whether physical (pipes) or transactional (bills) and their functionalities are (in general):

(b) Observer-dependent and subjective, they exist only in relation to the social and institutional consciousness - the materials of which they are comprised are objective (pipes can be made of iron from rock ore, bills can be made of paper from trees), but their purposes are subjective (if we did not require water to be used in buildings, we would not need pipes to convey it or bills for its provision).

By combining these observer independent and dependent facts within our consciousness, we establish a collective intentionality representing objects (water, pipes, bills) and states of affairs (the need to wash, to flush toilets) and draw the conclusion that one of the purposes of the existence of water is for it to be utilised by 'us' (humans). Thus a pre-cursor to social and institutional realities, is Searle's concept of physical reality, which is based on explanations such as Anscombe's 'brute' reality (1958). An example of social and institutional phenomena involving a physical reality from the urban water management field would be: taking a drink of potable water from a glass that has been filled from a kitchen tap in a house. In this scenario the social reality is the system of provision that turns water (the physical reality) into a drink (the house, the kitchen the glass) and the institutional reality is comprised of the rules and regulations (abstraction licences, tariffs, bills, money) that have resulted in water being supplied to the house to permit the tap to spill forth the water into the glass.

In a different culture it might be: taking a drink of fresh water from a wooden ladle filled from a water trough at the communal well water pump in a village. Here the physical and social realities are similar, but the institutional reality is very different – it is likely the well belongs to the community and therefore abstraction licences, tariffs, bills and money will be dealt with in an entirely different manner than in the previous example. From these examples we can see systems of water provision represented in two very distinct contexts, which demonstrate aspects of institutional and social realities; the former, more Western, example will be more fully explored within this essay in order to maintain its focus within the word count.

Furthermore, rather than focusing on the question '*what is water?*', over which other researchers have deliberated (Linton, 2010) and come to the (socially and institutionally constructed) conclusion that '*water is what we make of it*', this essay focuses on the construction of urban water management realities, rather than those

of water itself and as such regards water as a thing (Linton considers water a process not a thing).

To begin exploring the social and institutional realities of urban water management, it is first worth exploring the epistemic and ontologic objectivities and subjectivities of water itself. The relation between the representation of water and water as the object can be summarised as follows:

- Ontologically objective – this water (in its liquid state) flows
- Ontologically subjective – this water *feels* cold
- Epistemically objective – this water *is* cold
- Epistemically subjective – this water is expensive; Welsh water tastes better than Thames water

Within Searle's Ontological Levels of Reality, the brute reality of urban water management (the physical, intentionality-independent) is the substance of water itself and from where it originates. The social (intentionality-relative) reality of water is in its delivery, where people collectively participate in systems of water provision. Finally, the institutional reality emerges in the form of institutional facts (a special subset of social fact), such as abstraction licences, water bills and charging structures, which constitute the rules through which people may temporarily purchase, use and then dispose of water within institutional and social realities. Through the preceding discussion we have established how the urban water management world is in fact and we can now further explore the structure of its social and institutional realities.

Social and Institutional Realities of Urban Water Management

To further develop our conception of social and institutional realities of urban water management, we must explore Searle's three elements, which he defines as: (i) assignment (imposition) of function; (ii) collective intentionality; and (iii) constitutive rules. We have alluded to some of these already, but here we expound each one in a little more depth.

Imposition of Function. I do not experience water as the substance itself (other than it is wet), I actually experience it as the purpose intended for it within a certain practice. For example, in the act of washing clothes (or dishes, or humans), I experience water as a mode of cleaning human artefacts. I have imposed on the water the function of cleaning human artefacts. However, if I am sat by a river and admiring the way the water flows, I have assigned the function of water as being 'able to flow', but it would flow on regardless of whether I was there to admire it doing so or not.

The former example to which I referred is the *agentive* function of water, in that it is a function imposed by me as an agent using the water in a particular way (to wash human artefacts) that is not inherent to the purpose of water itself (although arguably it is – water would still, and does, clean things whether I am there or not – but the human artefacts would not be there to clean in my absence, so in this

example my argument holds true). The latter is an example of a *non-agentive* function – although I have discovered the water can flow, the river would still flow even if I were not there to perceive its conveyance of water.

It is perhaps at this point that water becomes a complex phenomenon, as it can support a vast range of observer-relative functions and perhaps more than its intrinsic state can support. Do we ask too much of water as an object? By adding functions to our discoveries of water's ability as a resource to provide us with a service, we add to it a set of values based on whether it performs the functions we require of it well or not so well. This is equally true for [what I have defined here] as non-agentive functions such as flowing: if a river's flow is low, we assign a value of poor function rather than as a natural state through which the river's flow cycle passes. Perhaps it is due to such complexities that urban water management has become a less than straight forward activity.

For example, using the terms of Wright (the function of X is Y means X is there because it does Z and Z is a consequence of X being there), we could see the function of water is to clean as meaning water is there because it cleans and cleaning is a consequence of water being there. However, in this case water would exist other than for cleaning; hence that function remains observer-relative. Water as an entity has the function of cleaning human artefacts, but does not carry out that function in the absence of those artefacts. In summation, water has inherently agentive and non-agentive functions.

Collective Intentionality. This can be defined as cooperative behaviour or sharing intentional states such as beliefs, desires or intentions. Searle argues that it is hard (nay impossible) to reduce the 'we' (collective) intentionality to the 'I' (individual) intentionality, primarily as within society the intentionality that exists in individual heads is 'we intend'. In his 2010 update to *The Construction of Social Reality*, '*Making of the Social World*', Searle revises his requirements around collective intentionality and extends it to include those who partake in a collective intention as having beliefs about each other's derived intentions (knowledge of what they are actually doing is not necessarily required). His development is criticised as not being comprehensive (Hindriks, 2011), but references to others who expand the explanation are provided by Hindriks (discussion of which is beyond the scope of this essay).

An example from urban water management would be that in order to participate in water saving behaviours, such as turning the tap off when brushing one's teeth, a person would have to believe that other people are also participating in the same behaviour (turning the tap off whilst brushing their teeth) also with the intention of saving water – without necessarily having information to support that belief. However, research into water saving behaviours (NCC and SDC, 2006) tends to suggest that people do need to see evidence that other people are saving water if they themselves are to save water as part of a collective action (Macrorie and Sharp, 2011).

Evans (2009) supports this argument philosophically, commenting that participants must reiterate the scene under consideration (turning the tap off whilst brushing, in our example) in order to maintain the scene's intelligibility (that the intention is to save water). Thus Searle's original proposition, that the 'we intentionality' is hard to disentangle from the 'I intentionality', is upheld, as without evidence of the 'we' turning the tap off whilst brushing, the 'I' is suspicious that the 'we' (which consists of a number of other 'Is') is not upholding their side of the collective action. Thus Hindrik's assertion that "*a conception of collective intentionality that involves collective commitment is needed in order to do justice to the normative dimension of institutions*", also resonates in an urban water context.

Constitutive Rules. A special case of function imposition is that of *status (symbolic)* functions or rules and it is against a backdrop of the capacities of humans coping with their environment that these functions produce institutional structures and realities within social realities. Additional requirements for these functions are language and rules (both regulative and constitutive) – though Hindriks (2011) argues that Searle overstates the importance of language. Hindriks also asserts that the difference between the two sets of rules is merely linguistic, based on the presence of deontic (authoritative) powers featuring explicitly in regulative, but implicitly in constitutive rules. To summarise, status rules concern the enabling and constraining roles of institutions and constitutive rules specify the preconditions that have to be met in order for them to play these roles.

When to flush a toilet, when clothes are dirty, how long a shower should be and so on are socially derived and very much imposed by social conventions related historically to public health, but more recently to concepts of personal hygiene. In the context of urban water management, regulative rules exist in forms such as water abstraction licences, water company tariffs, building regulations, water management legislation and so on. Constitutive rules are more difficult to exemplify, but include the actual act of paying a water bill (which some water customers do not do, either due to affordability or protestation issues). Water's agentive status function can be represented through its constitutive rules. These then lead to the creation of the institutional reality of water itself as symbolic of the practices with which it is associated in daily life – or to represent it in the form of constitutive rules often given in the literature: X counts as Y in C, where X = entity with imposed function (water), Y = what X is substituted for (removal of human waste), C = context in which X counts as Y (a transaction following the rules e.g. provision of a sewer or paying a bill for sanitation services).

By using Searle's definition, water is rendered an institutional fact where it is referred to as a resource – using water as a resource requires the collective assignment and intentionality of an agentive/status function beyond the virtue of water's intrinsic physical features. For example, in a performative statement created to determine a state of affairs such as 'The Environment Agency grants Water Company X this abstraction licence', the institutional fact (the licence to abstract) is also created and therefore Water Company X can abstract water for supply to its customers. The institution (licence) is imposed on the brute fact (water) by use of

the word ‘abstraction’. This institution of licences is connected to the institution of charging for water, which is in turn bound up in the system of water provision, which is itself bound up in the system of building use and so on, which is illustrative of Searle’s complex of interlocking institutional realities.

Due to the construction of these social and institutional realities, the physical reality of water and the brute fact that it exists independently of humans, becomes overlooked and replaced by the functions it performs within these social and institutional realities – it becomes normative. Water ceases to simply be water (a thing), even though it does not change itself in any way (even cleansing dirty water does not change its physical composition, it merely alters what is held in the spaces between the water molecules). The complexities around the institutional provision of water and its social utilisation have become weightless and invisible (Searle, 1996) due to the number of human generations that have been exposed to the traditional Western form of urban water management. Consequently, making visible and renegotiating these realities is an incredibly difficult task.

Wading Deeper into the Social and Institutional Realities of Urban Water Management

Although no new material objects (brute facts) are added, water provision adds epistemically objective features (functions of water: drinking, washing, conveyance of bodily waste) to reality, which exist only relative to observers and users (all humans). Consequently, the collective intentionality of water utilisation has become increasingly subconscious, as urban water management organisations, through the creation of various institutions, have assumed the role of water custodians, displacing public intentionality and resulting in a disconnect between people and water.

Using the terms of Anscombe (1958), we would say that for urban water management a set of events would be informing the water company we would like a supply of potable water to our houses and their conveying of it to our house via the reservoirs, treatment works, pipes, valves and pump stations that comprise our local water distribution system. The bill for this water provision is only a bill (institution) in the context of us being a customer and the water company being the provider. The payment of the bill is the regulative rule by which the transaction becomes part of our institutional reality. If we simply used a bucket to take water from a river to drink, none of the aforementioned set of events, institutions or regulative rules would necessarily exist, but (assuming social circumstances did not change) the constitutive rules around water-using practices might.

There is thus a dissonance between the institutional reality, which is formed by monetary transactions directly pertaining to the volume of water supplied and the social reality, which is formed by water-using practices, not the water (physical reality) itself. The monetary transactions forming the institutional reality refer directly to the physical reality i.e. water as itself a thing; whereas the social reality hinges on the practices in which the physical reality of water as a thing is merely a

method of obtaining a particular result (i.e. removal of sanitary waste, cleaning humans or human artefacts).

Recent research into systems of provision and social practices in the field of urban water management (Shove, 2003; Sharp, 2006; Pullinger *et al.*, 2013) has identified that within each water practice there are many different sub-types. For example, there are seven different types of shower, depending on the purpose of the use of water, such as getting clean, waking up, warming up or freshening up. This demonstrates even further that social and institutional realities are distanced from each other. To renegotiate the social and institutional realities of water-using practices, we must first reconfigure the functions, intentionalities and rules of how the physical reality is represented within those social and institutional realities. That is to say, we must reconcile the inconsistency between the two, by aligning the monetary transactions associated with water provision with the practices within which water is utilised rather than the volume of water supplied. This can only be done through using the 'correct' language and language features prominently in Searle's theory of social and institutional realities.

Realisation of the need for this linguistic renegotiation between social and institutional realities is occurring within certain urban water management networks, where new charging models for *services of water provision* (the new institutional reality) are being advocated to replace outdated charging models orientated around *units of water supplied* (the old institutional reality). However, transitioning from the 'old' to the 'new' institutional reality requires changing the language used and re-writing the [regulative and constitutive] rules of the game: it is on the writing of a new rule book that most contemporary urban water management research focuses.

Institutionally, water demand management measures (regulations, metering, efficiency measures) and messages [language] have traditionally oriented around reducing the number of units of water a building or a person utilises. Such measures do not follow the constitutive rules by which water is utilised within the social reality. In flushing my toilet, I am not necessarily concerned with the amount or quality (as long as it is 'safe') of water utilised, I am concerned that it performs the function of the removal of my urine and faeces. However, what I actually require in the social reality is just a method of cleanly disposing of my urine and faeces. Whether or not that method should involve utilisation of water is not of concern to me, it just happens to be the most well established method of performing such a service.

Consequently, for water demand management measures to be effective, the urban water management institutional reality requires changing to: (a) develop a more detailed understanding of the constitutive (not just regulative) rules of the social reality of social practices currently utilising water; (b) understand that social practices are as equally important as units of water (and develop institutions (licences, tariffs, bills) that recognise that), and (c) accept that practices that currently involve utilisation of water need not necessarily do so (e.g. composting toilets may be the way forward).

Such reconstruction of the institutional reality of urban water management could only be achieved through extending organisational (collective) and professional (individual) concepts and categories of water demand management measures. These would need to encompass greater consideration of the variability of social realities by learning more about the social [constitutive] rules of the game, rather than by just trying to impose the [regulative] rules of the game from the institutional reality.

Changing the way by which I interact with water in the built environment means changing both my individual and collective intentionalities, not necessarily just the type of toilet that is available for me to buy. In order for me to feel comfortable in changing my intentionality, the collective intentionality of the social reality must also change, which is dependent on a simultaneous change in the institutional reality. It is here where difficulties in renegotiating realities in the urban water management field emerge – how do both my neighbour and I switch to composting toilets at the same time, when we are both waiting for the other to do so?

Dissolving the Boundary between Social and Institutional Realities of Urban Water Management

One approach which tries to align social and institutional realities is that of 'water sensitive urban design' ('WSUD'). WSUD sees the integration of urban water management into planning and urban design domains as vital to securing the water services and indeed, water cities, of the future. This integration is required at all levels of society from individual water-users, to water-using practices (whether domestic, commercial or agricultural), through to organisations responsible for managing or governing water management and construction of the built environment. Hence there is a drive toward a new mode of urban water *co-governance* through WSUD.

However, if institutional realities are constructed on function impositions, intentionalities and rules, in order for WSUD to be accepted its intentionalities and rules must be consistent enough with the existing urban water management reality. For if a reality is not internally consistent within its own sphere of influence then usually it lacks the rationality to be a true reality and will therefore collapse. Arguably, social reality is the hardest to change, as it involves developing a new form of language and a new interpretation of the rules: consistency in terminology and symbols, strong guidance and a coherent articulation of new rules and concepts is required, which requires institutions (acts) to be in place before new status objects. Where consensus is not reached within the institutional reality (as evidenced by the currently inconsistent selection and administration of surface water charging schemes), the social reality cannot easily accept change or change its rules. We need to better understand how to support the changing of social realities when new institutional realities are dynamic (i.e. not temporally or spatially fixed).

Furthermore, the social content of knowledge is generated by a society, therefore the knowledge may not be directly transferable to another society/culture without some level/form of translation. This is illustrated by current efforts to translate WSUD from Australia to the UK context (CIRIA, 2013). Social construction of a fact is

more evidenced by discussion of the object under study in publications within and between scientific fields or by evidence of discussion of the object under study in non-scientific literature such as newspapers and magazines. Until approaches such as WSUD start appearing in general circulation, their impact on changing the social reality of urban water management may be minimal. Additionally, we cannot see the rules of a particular institutional or social reality from inside; we have to get outside to see them. Perhaps there is merit in water professionals spending time within other professional domains such as town planning or landscape architecture, with a view to developing an external knowledge of the rules of the urban water management game. This might then enable them to reflect better on how they might need to influence institutional and social change.

Water companies have a government-bestowed deontic power conveyed upon them by the status function of being in control of the institutional realities of urban water management (tariffs, bills, regulations). In providing a service that abstracts fresh water, cleans water, pumps potable water, distributes potable water, collects dirty water, cleans dirty water, discharges cleaned water back into the environment and that administers the institutional facts, water companies have unwittingly become the entity responsible for collective action – rather than society at large.

At no point does the water company own the water it abstractions, it merely owns the infrastructure and institutions to perform all of the functions around the delivery, collection and charging for of clean and dirty waters for the benefit of society without detriment to the environment. Perhaps in order to bring about a shift in individual and collective action in relation to urban water management the government, or the water companies, need to bestow more deontic power onto other organisations. WSUD, which aims to do just that, may therefore be just the part of the response to renegotiating social and institutional realities of urban water management that is needed in the UK.

Conclusion

Within this essay Searle's theory of social and institutional realities has been expounded thoroughly using detailed examples from the field of urban water management. The discussion has shown that in that context both realities are complex and take the physical reality of water as a thing, used as an unconscious resource subject to many impositions of function (drinking, cleaning, waste conveyance) and exposed to many demands from observer-dependent viewpoints. Constitutive rules around the utilisation of water in social realities, conflict with regulative rules in institutional realities, which has important implications for its management. Furthermore, collective intentionalities in the social reality of urban water management are confused, which illustrates limitations in Searle's theory, as asserted by other authors. Water sensitive urban design (WSUD) offers a potential way out of the confusion and a prospective approach by which to renegotiate and realign social and institutional realities. However, WSUD faces its own challenges, related to proving itself as a viable alternative to the existing, well-established rules of the urban water management game in the UK.

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From domination to mimicry: what next for water engineering, a new kind of domination?

Abstract

By providing an account of civil (water) engineering practice, which includes using autoethnography as a mode of exploration, the author, a water professional, business engagement practitioner and researcher, will attempt to provide a reflexive account of how the traditional approach to water engineering (domination of nature) has shifted towards a contemporary approach (mimicry of nature) as a means of avoiding the 'deengineeringisation' of water infrastructure/water management. The essay will argue that the contemporary approach may have further developed towards a 'reengineeringisation' of water within society, which brings with it implications for social control (i.e. a new kind of domination). The essay concludes by highlighting the potential implications this reengineeringisation may have for the future of water engineering, as well as some cautionary comments.

A Brief History of the Philosophy of Engineering

To begin this essay, it is important to locate the engineering profession within the boundaries of science and technology studies (STS). The history of philosophy of engineering is itself brief; hence this introduction can take no other form but briefness. McCarthy (2006, pg 48) describes it as an area that is catching up with philosophy of science:

"Given that many scientific theories that seek knowledge about the world involve engineering in that endeavour, engineering should surely be of interest to philosophers."

Engineering has been the subject of philosophy of science and science and technology studies, but usually in an indirect form as a way to study science and technology that involves pieces of engineered 'kit' (bubble chambers (Pickering, 1995), iron/steel smelters (Misa, 1994), cars/roads (Urry, 2004)). As Fox (2010) asserts, it is no longer a new idea, yet it is still in its infancy due to a lack of published literature on the topic. In the UK, the Royal Academy of Engineering and the Institution of Civil Engineers are encouraging use of the philosophy of engineering in engineering practice (*ibid*; McCarthy, 2006).

Through an account of civil (water) engineering practice, which includes the performance of an autoethnography, this essay hopes to contribute to the (albeit unpublished) reflexive literature on philosophy of engineering within STS.

A Methodological Note

The methodology employed for this essay is the combination of a referenced account with an autoethnography. This section will elaborate on the autoethnographical methodology used, the following section will provide a literature-based referenced account in order to set the context for the autoethnography, the next section will perform the autoethnography and the final section will bring the parts together in a concluding discussion.

The subject of this essay is not to debate the validity of autoethnography as a tool for doing research, to comment on its origins in sociology or it being championed predominantly by interdisciplinary symbolic interactionists with postmodern or poststructuralist sensitivities (Anderson, 2006); therefore I will leave those debates well alone. However, I do think it appropriate to mention a few points about autoethnography, which are relevant to my use of it within this essay.

Muncey (2005) argues that individual identity is sufficiently worthy of research and more than just a deviant case, thus advocating autoethnography. She uses snapshots (photos), artifacts, metaphor and the journey to enhance the robustness of structured narratives, in order to protect against criticisms of autoethnography and the transient and disjunctive nature of memory.

Within the autoethnography I perform later in this essay, to give as thorough an account as possible, I combine elements of evocative[1] and analytical[2] autoethnography (Anderson, 2006; Wall, 2008). I focus on the use of my thoughts in relation to academic and grey literature, artifacts (notes scribbled on conference and event proceedings, a list of which is provided in Appendix 1) and how these have combined to form my personal journey, from which my thoughts about reengineeringisation have emerged i.e. how I have linked the personal to the social via the technological by conversing with the literature rather than just interjecting personal perspectives into gaps.

Korte (2010), using a narrative perspective to understand new engineers and engineering in organizations, asserts that such reflexivity might help deepen our understanding of the way engineering exists and unfolds in the workplace. Consequently, it might help us understand and renew institutional characterisations and perceptions of engineering.

Who's Autoethnography Is It Anyway?

As Hill (2008) notes, the route to the outcome of autoethnography requires awareness, reflexivity and care and I hope I have applied these things here. As someone working in the water sector and who uses water through the practices in which I participate (showering, cooking and so on), I ponder how reengineeringisation (I define this in the following section) could affect me and my life and that of future generations of my family. Will, as with medicalisation (Conrad, 1992; Clarke *et al.*, 2003) water-related science and technology and water engineers/managers/professionals (hereafter referred to as water professionals for ease of description) come to dominate more of our lives? I don't know. Neither do I know whether that would be good or bad. Would it be different? It depends on who you ask about engineeringisation in the present day. To echo Muncey, I started to take an interest in personal meanings of events and behaviours that were not

[1] A descriptive literary approach…invoking an epistemology of emotion, moving the reader to feel the feelings of the other (Anderson, 2006)

[2] Where the researcher is (1) a full member in the research group or setting, (2) visible as such a member in published texts, and (3) committed to developing theoretical understandings of broader social phenomena. (Anderson, 2006)

generated by the mainstream research which I found myself creating. Thus I am not arguing here that engineeringisation or reengineeringisation *is the case* (i.e. fact), but that it is possible and perhaps *approaching the case* and I provide some evidence in support of *that* argument.

Star (1991) flies the flag for more studies of underrepresented actors in STS, such as lab technicians, to examine the balance of power and agency across scientific networks and to represent multi-marginalities. Therefore in order to write this autoethnography I first have to ask of myself 'who am I?', which is one of those questions that is notoriously difficult to answer. Professionally, at this moment in time, I am a:

- Business engagement manager for the water and marine sectors in a climate change impacts Centre;
- Interdisciplinary research fellow in a Centre specialising in water systems;
- Chartered water and environmental manager and environmentalist;
- MRes Science and Technology Studies student.

All of these involve different 'hats' and interaction with different audiences/publics (or whatever you would prefer to call them). But actually, *who I am* is not merely this current array of roles, it is the sum total of my past experiences. I have been/am still a:

- Geographer;
- Earth scientist;
- Water resources analyst;
- Water engineering PhD student;
- Interdisciplinary associate research fellow;
- Environmental volunteer.

Conversely, *I have never been* a practicing water engineer in the sense that I could neither compile a Bill of Materials for nor design or install a water supply or drainage system if someone asked me to. I could explain their purpose and their pros and cons, assess the feasibility of such systems and understand their design and installation, but I have never actually done the latter two. Consequently, although I have worked with engineers for over a decade, I do not see myself as a 'full' engineer. Others do, as I performed my PhD in the College containing engineering at the University of Exeter. Therefore who I am is someone at a complex intersection of disciplinary and social locations and networks who meets the criteria for performing analytical autoethnography[2]. Does the sum total of these roles and the experiences that come with them, furnish me with the 'right' type of qualifications and enough reflexivity to write an autoethnography on water engineering? Hopefully so, but please wait until the end of this essay to decide. The essay tries to provide an account that is not value-laden, but by the nature of being an autoethnography, admittedly this may not be fully achieved.

How should someone like me position their research and writing? Critically? Sympathetically? Doing reflexive research/writing within the discipline/profession of water engineering and management using the traditional tools of those trades would be bounded, nigh constrained, by many scientific paradigmatic requirements. Those might include the need for objectivity, fact-stating and ultimate truths, rather than views, thoughts, opinions or reflections. I therefore realised that I had no option but to stray further across the disciplinary bridges and into the more methodologically-open world of STS to explore the concept of [re]engineeringisation.

The Journey Toward Reengineeringisation of Water Services

Before discussing the potential evidence for *reengineeringisation*, the concept of *engineeringisation* needs to be outlined. In reflecting on what I have learnt and observed throughout my 12 year relationship with the engineering profession, I have come up with the following explanation to expound the definition. The explanation then broadens out into a description of reengineeringisation using a thumbnail of the 'water sensitive urban design' (WSUD) approach in the contexts of the UK and Australia.

Engineered Domination of Water in Nature

Well-documented historic accounts of water engineering describe it as trying to dominate water environments to provide 'safe' water supply/drainage systems to improve public health, which took the form of systems of centralised infrastructure (Howe and Mitchell, 2012). Consequently, domination of water environments is often described as civil engineering trying to dominate nature for human ends, even though water is only one aspect [though vital] of the wider natural environment. For the purposes of this essay, therefore, I will use the term 'water in nature' to refer to this conceptualised domination of nature *for* society through water systems engineering.

Arguably this dominance could be termed 'engineeringisation', to steal and adapt the medicalisation and biomedicalisation terminology used by Conrad (1992) and Clarke *et al.* (2003). Although societally-endorsed to attain public health goals, the development of many water systems and engineered solutions around this time led to the expansion of engineering's jurisdiction, authority and practices into new personal and social spaces (e.g. the communal flushing toilet as opposed to personal chamber pot), albeit for noteworthy reasons.

Following Conrad's articulation of secularisation with medicine placed as a trend in the chain of dominant moral ideologies, following religion and law, one wonders what could be the next? Perhaps environmentalism, which seems to be gradually pervading and trying to influence all aspects of people's lives. But for the purposes of this essay I will only consider water engineering, which arguably seeks to define as engineering problems, problems linked to environmentalism that could be considered as outside the 'normal' remit of engineering (how and where people use water, how spatial planners prioritise water issues such as flooding and drought). Could this be seen as 'engineeringisation' rather than just increasing interdiscipliniarity?

The historical criticism of trying to dominate nature through its techniques (usually involving lots of concrete to 'hold nature back' or 'keep nature out'), has resulted in contemporary engineering moving to 'deengineer' itself by incorporating the art of mimicry of water management in nature, as this is perceived to be a more sustainable and socially acceptable way of working with/in natural and social environments.

Engineered Mimicry of Water in Nature

The title of a recent campaign I observed exemplifies the 'engineeringisation' concept I introduced at the end of the previous section. '*Engineering Nature's Way*' is supposed to encourage the mimicking or recreation of natural hydrological systems in new or refurbished urban developments using engineered 'natural' systems. Examples of such systems include '*green infrastructure*', (GI) '*sustainable drainage systems*' (SuDS) and '*blue-green gyms*', all of which incorporate additional benefits beyond water services, such as amenity and health and well being benefits. These engineered natural 'technologies' aim to minimise risk from water scarcity or flooding impacts, by better managing rainwater across catchments for human benefit. The engineered features are given engineered names: a vegetated ditch becomes a 'bioswale', a pond becomes a 'retention pond' and so on. Nature is redesigned, repurposed, revalued and given an identity based on the function it performs[3]. Other water supply and drainage systems are also part of this shift, such as rainwater harvesting, greywater reuse and reedbed/wetland treatment systems. The main tenet of this mode of engineeringisation is on *bringing water in nature back into society*, thus rather than being a form of dengineeringisation it could be argued that it is more toward a *reengineeringisation* of water systems.

Engineered Domination of Water in Society?

Taking mimicry as a starting point, the water sensitive urban design (WSUD) approach aims to go further, by establishing water as the main focus for water management, landscape architecture and urban design practices (Ward *et al.*, 2012; Ashley *et al.*, 2013). Equivalent practices exist, such as Low Impact Urban Design and Development (LIUDD) in New Zealand, but WSUD will form the basis of the account presented here, as I am more familiar with its philosophy and implementation.

WSUD sees the integration of water engineering into planning and urban design domains as vital to securing the water services and indeed, water cities, of the future. This integration is required at all levels of society from individual water-users, to water-using practices (whether domestic, commercial or agricultural), through to institutions responsible for managing or governing water management and construction of the built environment. Hence there is a drive toward a new mode of urban water *co-governance* through WSUD. The aim of this integration is to achieve 'multi-purpose cities of the future', as illustrated in Figure 1.

The location of water professionals as [arguably] the primary advocates of WSUD potentially reconfigures the historic dominance to maintain their power/control over public health and now, other domains. The use of all-encompassing approaches

[3] The hotly debated 'Paid Ecosystem Services' approach

brings back into purview the engineers' historic driver – improving public health (historic systems through reducing exposure to pathogens, contemporary systems as enhancing exposure to environments that improve health/well being).

FIGURE REMOVED DUE TO COPYRIGHT – REFER TO PAGE 5 OF CIRIA (2013)
http://www.ciria.org/documents/wsudreport/index.html#/2/

Figure 1 Water sensitive urban design as a method for moving toward multi-purpose cities (CIRIA, 2013)

WSUD statements have yet to become facts, though modifiers such as "*Water Sensitive Urban Design is the process of integrating water cycle management with the built environment through planning and urban design*" and "*Water Sensitive Urban Design is the process. Water sensitive places are the outcome*" are on their way to becoming dictums (Latour, 1999). Their fate is in the hands of representatives of water companies, government quangos and housing developers, as well as scientists and water professionals. Translations are required, however, which are being produced through public engagement activities (CIRIA, 2013). Latour (pg 95) asserts that:

"…there is no way to skip any of the steps toward conviction…"

Using public engagement techniques water professionals, landscape architects and spatial planners are trying to speed up the process, though still asking the question, is it rhetoric or proof that finally convinces? Political and scientific interests and goals are embedded in WSUD and progression towards WSUD goals is at different stages in different countries, as illustrated in Figure 2 using Latour's translation diagram (Figure 3.1, pg 89) as an inspiration.

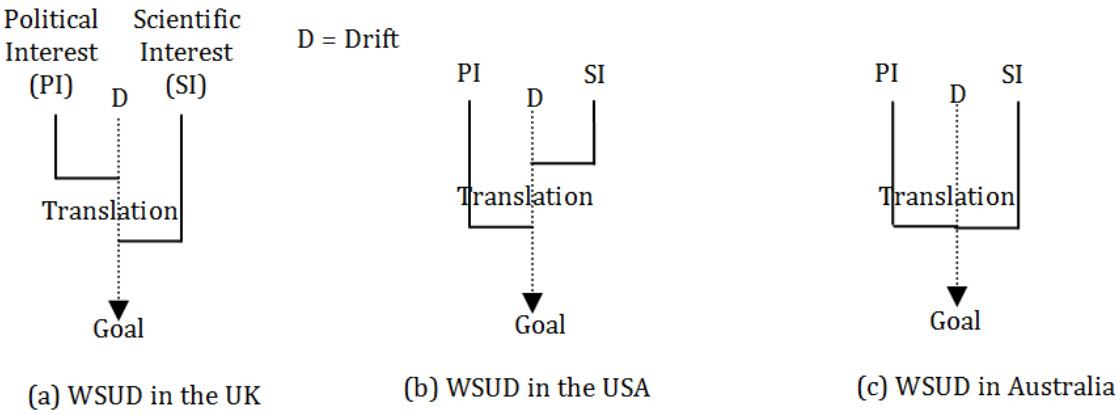

Figure 2 Progression towards translation of political and scientific interests for the goal of water sensitive urban design in the UK, USA and Australia

WSUD statements have become more embedded as dictums in the Australian context, where some places, such as Melbourne, are already well on the way to becoming 'water sensitive cities'. This is in response to, in some places, a decade of

drought and recent, unprecedented flooding, that has engendered a complete rethink of water systems and services. It would be easy to say that these environmental causes have driven the political will to change the approach to water engineering in Australia, but would that be too easy? WSUD has been driven by academics (scientists, social scientists, engineers, planners), politicians/civil servants and practitioners, though arguably the latter two have been heavily influenced by the former. Particularly strong are engineering-political alliances, which have been vital in developing 'links and knots' across all of the target WSUD disciplines (Wong *et al.*, 2011). It is unclear as to whether the collaboration is a step towards [socio] technological determinism, an advanced step toward reengineeringisation or perhaps even a 'Parliament of Things' on water (Latour in Pickering, 2009) that should be regarded with caution. Whichever of these it *may* be, it is clear that it *is* an ultimate demonstration of Mode 2 science: interdisciplinary, institutionally dispersed, problem-driven and dependent on legitimacy beyond its scientific community being created through translation via public engagement activities (Jasanoff, 2010).

In the UK, WSUD is at a different stage. Unlike in Australia where water and drainage services are managed by regulated public-private partnerships, such services in England and Wales are provided by regulated regional private monopoly owner-companies, with separate environmental, financial and health regulators (the Environment Agency (EA), Water Services Regulatory Authority (OFWAT) and Drinking Water Inspectorate (DWI), respectively) (things are done differently in Scotland and Northern Ireland). The privatised structure was implemented in 1989 by the government of Margaret Thatcher and following the formation of private water companies, Local Authorities (LAs) devolved the majority of their remaining water engineering [public health] functions. Thus the majority of engineers were thrust into the private sector, where they no longer had coordinated control over the measures implemented within their sector. Consequently, in the present day this means that WSUD may be more difficult to implement, due to the collaboration of all parties responsible for water or drainage services not being compulsory. Furthermore, despite engineering being one of the disciplines we are disposed to take seriously (Pickering, 2009); WSUD has yet to be ratified in the UK, as evidence is still required of the affectivity of the approach – this is not the case in Australia, where a 'lets do it and see' attitude prevails i.e. the civic epistemologies of the two contexts are divergent (Jasanoff, 2010).

Using this background as a lens, we could ask the question, is the current shift towards integrating water professionals, spatial planners and urban designers really about what is best for urban spaces? Or, particularly for the UK, is the WSUD approach just a way to get water engineering back into the position of power it enjoyed pre-privatisation? Hearing some engineers who were shifted out of the public sector during that period talk at conferences would seem to indicate so. Or are the approaches really the 'right' way of doing things and the way things need to go? Experience from Australia indicates the latter, but for the UK the background political context may suggest a combination of the former and latter. Privatisation led to the creation of numerous private water engineering consultancies, which now

work with and are paid by, but have no formal control over LAs (though arguably they have plenty of influence). 'Stakeholder engagement' (meaning consultancies collaborate with LAs, water companies and environmental agencies) is seen as both vital and time-consuming in contemporary water engineering and management. Getting recommended measures implemented is perceived to be more difficult and if these entities were still under one banner, it is argued by some that it would be easier to do things or respond to change more quickly. Is this just an argument to try to regain control over the WSUD process, rather than merely facilitating or coordinating it?

In either context, contemporary water engineering aims to bring water in nature back into society. But why stop there? Water professionals discovered they could not control nature, so have they turned instead to using water in nature to control society?[4] Are GI and SuDS not enough? Fox (2010, pg 84) observes that:

"It [engineering] utilises resources that may be inert, semi automated or even living and it is driven by an instinct for survival, a need for protection and desire to develop."

Through uncovering and embedding the water environment within the physical *and* emotional heart of urban spaces, could it be that water professionals are trying to regain some of the societal control they feel was lost/displaced? Surely full reengineeringisation depends on water engineering more substantially permeating our personal, social, cultural and physical spaces than it did before?

Sites of Surveillance for Reengineeringisation

Sites of reengineeringisation can be identified wherever water is used by and within human practices. These include appliances, buildings, cities, supply chains, industrial or agricultural activity and many others. These are perhaps best exemplified in Figure 3 (CIRIA, 2013), which illustrates placing water at the heart of everything. The site with the most potential for reengineeringisation is the building, as it is seen as the place in which water is used, but is beyond the control of the water companies, LAs or environmental agencies (i.e. most water professionals). Methods of persuading people to use less water in buildings form a significant part of the effort of the contemporary water professional (the nature of these methods and their value-ladenness is beyond the scope of this essay).

If water professionals are trying to control water users (and ergo society) through water use in buildings, they will need some form of surveillance. Since the Walker Review (2009) recommended transitioning to a fully metered water charging system (to ensure fairness and to encourage water efficiency), there has been wide-ranging debate on the topic. Politicians are appearing resistant to implementing the recommendation, with the Draft Water Bill released in 2012 (due to become the Water Act in 2013) not endorsing the transition. Without this endorsement, water companies will not be incentivised (i.e. allowed to charge customers more by Ofwat,

[4] i.e. nature is still not *allowed* to be in control

the financial regulator of the water sector in England and Wales) to transition their customers to meters.

FIGURE REMOVED DUE TO COPYRIGHT – REFER TO PAGES 7 & 12 OF CIRIA (2013)
http://www.ciria.org/documents/wsudreport/index.html#/2/

Figure 3 Sites of reengineeringisation: water sensitive urban design at the house and city scales (CIRIA, 2013)

Despite this, some water companies have taken it upon themselves to roll-out metering programmes, as they view it as the best way of monitoring demand and encouraging water efficiency in water scarce areas. The majority, however, are not rushing to meter customers. Talk of 'smart' meters (meters that do more than just mechanical measurement of water consumption, such as electronically transmitting it back to water companies), however, is a more emotive topic, with such devices viewed as surveillance devices with health risks that breach human rights where installed without permission[5].

New sensors that can be embedded within appliances are also being developed that can be read by a watch or similar device, worn or held by the water user. This could be seen as the ultimate demonstration of reengineeringisation of water services, as a watch would previously have had no connection to water use or water saving. The water-user is yet again being deconstructed and reconstructed as a vehicle through which to observe the water supply-demand balance. Balsamo (1999) presents a critique of Foucault's and Suleiman's representation of gender as an 'effect' at body level, from which institutional issues arise, which echoes that of the way the 'water-user' (a person) is traditionally represented within the field of water engineering. This is as a marginal entity with limited agency, to be dominated and controlled (via encouraging behaviour change to reduce water use).

A potential dualism here emerges, as the contemporary alternative to quantitative monitoring of water use is to qualitatively assess water use by asking people about their interaction with technology through water using *practices*, whether through diaries, surveys or interviews. This is still a surveillance technique that is arguably as invasive, if not more, than water metering, but in a way it has the potential to reconnect people with water through dialogue and discussion, which an automatic meter reading may not. Recent discussions have highlighted the value of using both qualitative and quantitative approaches to complement each other. Both approaches are illustrative of reengineeringisation, particularly where they encourage water companies to move away from traditional 'water as the product' model to a 'water service as the product' model (for example by providing centralised maintenance services to encourage more creative combinations of water-using technologies in buildings, such as rainwater harvesting or greywater reuse systems). The 'water service as the product' model has the potential to take

[5] http://www.moggies.co.uk/articles/fight.html

responsibility for and the inconvenience of maintenance away from the water user/building owner for a fee.

Although this is no different to the existing model (we already pay water companies to supply us with water/remove effluent and maintain the associated infrastructure), it puts the water-user more fully in the domain of the water professional thereby securing the building as a site of reengineeringisation. However, if water-users maintained building-scale systems themselves, reengineeringisation would not be as complete. In a water future where decentralised technologies are perhaps more mainstream, the water-user could be seen as a hybrid, indeed cyborg, of person and technology, where the two are more consciously interrelated and where water is more responsively managed. In the way that Balsamo encourages more feminists to use ethnography to document representations of women's lives, to move away from reengineeringisation perhaps we require more ethnographies from water-users. Would this enable a greater understanding of how they could become more effective cyborgs whom use water differently?

The 'water service as product' model approaches reengineeringisation where householder agency is removed and replaced with institutional structure in order to prevent [rainwater, greywater] systems falling into disrepair and potentially putting health at risk. Is this reduction/removal of agency acceptable in a context where agency in relation to water-use is already almost non-existent or should water professionals try to re-establish greater agency and accept the potential risks?

Revisiting Who I Am: a Cyborg with a Hand on the Handle of the Reengineeringisation Mangle?[6]

At the beginning of this essay I promised an authoethnographical account of my personal journey alongside the reengineeringisation journey and in this section I will deliver on that promise, having now set the scene. I refer to Pickering's Mangle here, as reengineeringisation implies a dynamic relationship between resistances (such as social rejection of historic engineering approaches) and accommodations (such as transitioning from the use of concrete to vegetated structures), ultimately embroiled in a process of mangling (such as institutional debate over the acceptability and affectivity of different or alternative approaches).

With regards to cyborgs, Harraway (2004) describes them as any system or entity that requires hybridisation to fully understand it, with the nature of the constituent components being changed by the interaction. Pickering (2013) finally asserts what everyone was already thinking: that we are all cyborgs. In the context of reengineeringisation, I am a cyborg in many, posthuman and other, ways. I have hybridised myself by working as a practitioner and researcher alongside hydrologists, water professionals, planners and within industry, as well as by studying alongside engineers, social scientists, geographers and philosophers. Thus my critical thinking (aka one of my 'constituent components') has certainly been irrevocably changed by such interaction. In terms of my posthuman cyborgisation within the field of water management, this emerges in the type of research I perform, which focuses on new types of decentralised water systems, such as rainwater harvesting, greywater reuse

[6] Easier done than said

and sustainable drainage, as well as new approaches to collaborative working (Ashley *et al.*, 2013; Potter *et al*., 2011 and Ward *et al.*, 2012). Consequently, it could be asserted that I occasionally get to turn the handle of the reengineeringisation mangle. I often ask myself the question: [how] does my research contribute to reengineeringisation?

Although my interest in water began during my first MRes studies, I only became a practitioner after joining one of the UK's largest water companies back in 2001. I worked there in two technical roles and observed traditional engineeringisation, with very limited reference to alternative techniques or approaches – water efficiency was only just starting to come into its own. After leaving the water company in 2006, my interaction with and observation of reengineeringisation began in 2007, when I (then a PhD candidate) attended a young scientist workshop in the Netherlands, which bought together engineers, social scientists, architects and other professionals, all with water management in various international contexts as their common focus. At this workshop I contributed to group activities about creating visions of the 'water sensitive' cities of the future, led by an Australian academic-practitioner.

The following year I attended the 10th International Conference on Urban Drainage in Edinburgh, as a presenting PhD candidate. My interest in socio-technical perspectives and interest in the way that engineers do what they do began in earnest at this conference, where a noticeable shift was taking place – towards the integration of water-users into the debates around how to more effectively manage water. These were again being driven by Australian academic-practitioners in collaboration with their UK-based counterparts. Until this point, my PhD research had been tasked with integrating decentralised water systems into an existing water management modelling tool. After the ICUD I decided to reframe my research to focus on these 'new' perspectives, but still in relation to decentralised systems (primarily rainwater harvesting).

In the same year I also presented at a British Hydrological Society Symposium in Exeter, where I met a planner interested in water (specifically floodplain restoration, rather than water provision). We discussed common issues of planners not being interested in water and water professionals not being hugely interested in planning. We embarked on a [to date unfinished] quest to try to get the two sides talking to and understanding each other better. This quest took the form of organising two UK-based 'Bridging Troubled Waters' events (2010, 2012) and holding a collaborative workshop at the Cities of the Future: Sustainable Urban Planning and Water Management conference in Stockholm (2011). At these events it became clear that in the UK, water science and engineering was driving the transition, whereas elsewhere spatial or town planners and landscape architects were at the helm of change (refer to Figure 2).

The tried and tested Australian concept of WSUD began to really take hold in 2011, as a potentially destabilising or disruptive approach to water management and urban planning. In 2012 I was invited to sit on the project steering group for the UK WSUD

scoping study and at the same time co-authored papers on WSUD with both UK and Australian authors. This raises questions about the individual and collective agency of the 'water professional' who may be exposed to a range of interacting or competing identities – due to being within the domain trying to be influenced. It certainly made me ask the question: am I [should I be] trying to push practice in a particular direction or facilitating institutional change?

At this point I began to experience a conflict of interest between the subjectivity of being a chartered water professional responsible for promoting current and future best practice, the personal desire to help protect the water environment (as a bodyboarder and dragonboater) and the objectivity of being a researcher expected to undertake public engagement activities. Requirements of these roles and their associated networks and institutions resulted in me attending, presenting at and organising academic conferences, business engagement events (for SMEs and large organisations), institutional network meetings, meetings with potential and actual collaborators, and national/international exchanges. This lead to a range of personal interactions with a range of individuals and groups and individuals who represent groups/organisations (consultants, quangos, civil servants, social entrepreneurs, representatives, corporates). Through these interactions I became aware of the difficulties of being perceived as one discipline or another or in trying to present myself as an interdisciplinary water professional – developing a thorough knowledge of the language of each discipline became crucial. Ironically, water knows no boundaries, yet its use and management must conform to societal and disciplinary boundaries. Consequently, I realised accommodations to overcome this included taking several qualifications in different disciplines.

Consequently, this disciplinary marginality and my [perceived] lack of power or ability to really influence anything due to the status imbued by my professional roles (seen as one thing in one context and another in another and not necessarily the 'right one at the right time') has encouraged me to actively stimulate research into socio-technical water management. For example, I am leading work packages exploring how to embed water-users and planners within a project that aims to develop a new paradigm for water management. I also work with SMEs to try to innovate and implement environmental technologies, particularly developing new decentralised water systems and facilitating their implementation. Do I really undertake these activities because I believe they are the right thing to do or do I do them to try to convey credibility in particular contexts or networks? Do I really have a hand on the mangle's handle or am I merely helping someone else turn it?

This awareness means I am very reflexive about my actions within the water management field, as well as being aware of the power balances and where the power lies. I realise I have to be careful not to promote too heavily one approach without first thinking about its potential impact (both negative and positive) – but I wonder how many other water professionals think this way?

Reengineeringisation – is resistance futile?

Through the account of the potential for reengineeringisation performed in this essay, the following question arises: should we be suspicious of water professionals motives? Is it really all about power - are water professionals really looking to integrate with other disciplines and professions, such as spatial planning and urban design, for genuinely societal benefit or is it to re-establish water engineering dominance by extending its jurisdiction into these realms? Is a shift occurring from domination of nature *for* society to domination *of* society through nature via water systems engineering? Or is it a performative dance of agency versus structure (Pickering, 2009 & 2013) within the water professional's self, as both water citizen and water engineer? Does it matter? McCarthy (2006, pg 49) argues that:

"…the 'know-how' that engineering provides, is secure knowledge. Engineering knowledge is also genuinely cumulative – improved all the time by building on, and not re-writing,what went before."

I think it is arguable that engineering knowledge is cumulative and I would disagree that it is secure knowledge. This seems particularly evident for water engineering, where engineers seem reluctant to reflect on how the current approach to the domination of water in society *could be* just a re-writing of what went before (but with a different target this time).

To use the words of Fox (2010, pg 85):

"…to grasp the greater meaning of engineering requires the development of philosophical concepts such as a cognitive awareness of life, self, others and the external world. This needs to be blended with a higher understanding of science, the environment and society.…If engineers desire to truly understand themselves, their profession and their role in society, they need to include in their education the study of philosophy."

Engineering engagement is beginning to incorporate philosophy into engineering education at the undergraduate level (Bell *et al.*, 2010), but who is going to 'educate' the well-established engineers and water professionals in becoming more philosophical? (Assuming they haven't become philosophically-inclined during their careers). My position, role and identity is one of participant and observer in the reengineeringisation, therefore it only represents one view, but hopefully it will enable others to reflect on how they may have a handle on or indeed be already turning the mangle. As Shove and Walker (2007) and Pickering (2009) put it, doing something is better than nothing, but it must be done reflexively to avoid repeating the same mistakes. Is water engineering in danger of making the same mistake of trying to dominate something it perhaps shouldn't or indeed, trying again to dominate the undominateable?

Further Research

Further research would look to explore the concluding question further by using methods such as thematic analysis of vignettes from or open interviews with water

professionals. The framing of the research would be to explore whether water professionals view themselves as participating in a reengineeringisation and whether their belief is that they are doing what is needed by society, their profession or their own person agenda (or a combination of all three) and their anticipated vision of the resulting consequences.

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Appendix 1 - Major International Events Attended

(name of event_year_organiser/sponsor_location)

1. Waterwise/Watef Conference (2013) Waterwise. University of Oxford, Oxford, UK.
2. 85th Annual Water Environment Federation (WEF) Technology Exhibition and Conference (WEFTEC) (2012) WEF. New Orleans, USA.
3. Utility Management Conference (2012) American Water Works Association (AWWA) and WEF. Miami, USA.
4. International Exchange Scheme Visit (2012) British Council. University of South Florida, Tampa, USA.
5. 13th IWA UK Young Water Professionals Conference (2012) University of Exeter, Exeter, UK.
6. Water and Planning – what could the future look like? (2012) Chartered Institution of Water and Environmental Management and the RTPI. University of the West of England, Bristol.
7. Sustainability Live! (2008, 2010, 2012) Various. NEC, Birmingham, UK.
8. 11th International Conference on Urban Drainage (2011) Various. Porto Alegre, Brazil.
9. 11th International Conference on Computing and Control in the Water Industry (CCWI) (2011) Various. University of Exeter, Exeter, UK.
10. Future Water (2011) Royal Geographical Society. London, UK.
11. Technological Innovation Systems Summer School (2011) Chalmers University. Goteborg, Sweden.
12. Identity and Communication: Psychology of Sustainability Seminar (2011) University of Exeter. Exeter, UK.
13. Water and Tourism (2011) Network for the Pooling of Tourism, Equity and Water Knowledge. University of the West of England, Bristol, UK.
14. IWA Cities of the Future: Sustainable Urban Planning and Water Management (2011) Various. Stockholm, Sweden.
15. International Water Association (IWA) Water and Energy Conference (2010) IWA. Amsterdam, Netherlands.
16. Practicing Science and Technology, Performing the Social (2010) European Association for the Study of Science and Technology (EASST). Trento, Italy.
17. Bridging Troubled Waters – Hydrology and Spatial Planning (2010) British Hydrological Society and the Royal Town Planning Institute (RTPI). University of Liverpool.
18. 2nd International Conference on Rainwater Harvesting and Management (2009) University of Tokyo. Tokyo, Japan.
19. 10th British Hydrological Society National Hydrology Symposium (2008) BHS. University of Exeter, Exeter, UK.
20. 10th International Conference on Urban Drainage (2008) Various. Edinburgh, Scotland, UK.
21. Young Scientists Workshop (2007) Delft University of Technology. Amsterdam, Netherlands.

Resilience framings in English water service provider long-term strategies (2015-2040)

Abstract

Resilience has become a well-used term and concept in both academic and applied arenas. This essay examines the use of the term (via social, ecological and technical framings) within the complex adaptive system (CAS) that is urban water management (UWM) through the content analysis of water service provider (WSP) long-term strategies. Using anti-reflexivity as a further lens, it has been identified that WSPs favour the technical resilience framing, as they are historically driven by a focus on the technical UWM sub-system. Where social framings are considered, they are focused on primarily financial institutions and finding out 'what the customer wants' rather than the broader focus of social change in relation to water use or provision through 'true' community engagement. If significant strides are to be made in the future in relation to increasing *overall* resilience of all the UWM sub-systems (social, ecological and technical), WSPs will need to recognise that their capacities to drive and facilitate social change are severely limited and they will need to be proactive in increasing them across the time horizon of their long-term strategies (2015-2040).

Introduction

One academic discipline that has begun to adopt and apply a range of resilience frameworks and methods is that of civil engineering, in particular urban water management (UWM). Due to a range of drivers such as ageing infrastructure, population growth and climate change, UWM is experiencing a period of uncertainty in how to perform better under future scenarios. In this context, resilience methods are regarded as considering qualities of complex adaptive systems (CAS) such as flexibility, adaptability, engagement, learning and experimentation and thus able to resolve infrastructural or other sub-system weaknesses. However, questions arise as to whether such approaches are actually (or will be) used in UWM practices.

The essay begins with a section that examines why resilience concepts are potentially of interest to the UWM field, takes a critical look at how the concept is currently interpreted in relation to engineered systems and critical infrastructure and begins to build an understanding of why it is important to understand resilience narratives currently portrayed within UWM. A brief overview of previous investigations into resilience framings in a European UWM context is also given. The essay identifies the UWM CAS as being constructed of social, ecological and technical sub-systems (for example water-users (of different scales), the natural environment and water company assets, respectively), which are echoed in framings identified in resilience literature.

This section is followed by a detailed in-depth survey of the different framings of resilience discussed within academic and grey literature. Three framings are constructed and focused on within the essay, those being social (socio-ecological, organisational and community), technical (engineering and infrastructural) and

ecological to echo the UWM sub-systems. From these framings, qualitative indicators for the different framings of resilience were developed and took the form of thematic lists of key phrases such as:

- Social – renewal, reorganisation, learning, capability, livelihoods
- Ecological – Persistence, absorb, consistency, status quo, accommodate;
- Technical – conservative, robust, reliability, redundancy, Affordable.

Using these indicators as a lens, content analysis of the long-term strategy documents of Water Service Providers (WSPs) located in England is undertaken to identify how resilience is framed in the context of contemporary planning for the future of UWM. By using these indicators to identify how the three framings and narratives around them are present in the field of UWM in England, an understanding of implications for future resilience approaches is developed. The findings are further recontextualised using anti-reflexivity as a secondary lens, which helps to further expand on implications for the future direction of UWM, such as where resilience has been (or may be) used to beneficial effect or where opportunities have been (or may be) potentially missed.

Why are resilience framings potentially of interest to the urban water management (UWM) sector?

The word resilience comes from "r*esilio*", which is the Latin for 'spring back' (Wiktionary, 2013). The *term* resilience, however, has recently been used in myriad ways depending on disciplinary leanings and the situation in hand (McManus, 2008). Consequently, there is limited consensus on an 'ultimate' definition of resilience. It could be argued that the formulation of such a definition may anyhow be inappropriate and inherently constraining. Additionally, methods for achieving improved resilience at an operational level still challenge both the academic and the practitioner (McManus, 2008).

The recent move towards using "resilience thinking" stems from the historic pathway of resilience framings, from their foundation in ecological science, through to integrating social and technical dimensions in the last ten years: one cannot have social and economic development without a functioning life support system (the environment) or infrastructure (Leach, 2008). In relation to critical infrastructure, the UK government defines resilience as:

"*…the ability of a system or organisation to withstand and recover from adversity*…" (Blockley *et al.*, 2012, pg 13).

It further asserts that resilience of infrastructure can be achieved through (a) designing networks/systems to have necessary resistance, reliability and redundancy (spare capacity) and (b) designing organisations to have the necessary ability, capacity and capability to respond and recover from disruptive events (Montgomery *et al.*, 2012). This illustrates the recognition that resilience in an operational sense is more than just one isolated disciplinary definition: it is an outcome of the interaction of sub-processes/systems, *as well as* organisations and communities.

Despite this, the majority of literature on critical infrastructure published by engineers emphasises the importance of resilience within the engineered assets comprising the urban water management (UWM) system. This may be indicative of a preference for the engineering definition of resilience or an inability to fully problematise how the non-engineered (i.e. social, ecological, organisational) sub-systems interact with the engineered sub-systems, which constrains formulation of comprehensive multi-level responses. This is further compounded where resilience is seen as a disaster management issue; linking both resilient day-to-day operations and emergency recovery is typically not well understood by organisations (McManus, 2008). Leach (2008, pg 7) asserts, in the summary report of a symposium on resilience thinking, that:

"…*system boundaries, dynamics, functions and outcomes are open to multiple framings*…" and consequently "*A central analytical task is to uncover the range of narratives in a given situation, identifying which are dominant, what alternative narratives exist, and which might be hidden or suppressed – including those produced by marginalised people, or supporting their perspectives and priorities.*"

Hence, it becomes important to understand resilience framings and narratives to determine if and how any are neglected and any potential implications of such omissions. Surely an approach to resilience cannot be considered 'integrated' or 'game-changing' if it does not consider the framings and narratives of all of the sub-systems within a complex adaptive system (CAS) or regime?

Resilience framings and urban water management

One type of CAS or regime that requires an integrated approach to operationalizing resilience is urban water systems, whether for water supply (water distribution systems) or drainage (foul or surface water sewer networks) – collectively referred to in this essay as 'urban water management' (UWM). Several authors have identified UWM as a socio-technical system (Bos and Brown, 2012; Brown, 2012; Ward *et al.*, 2012), as it represents the interface of people (water-users, of many scales and types) with engineered components (pipes, pumps, tanks, treatment works and so on). Other authors have characterised UWM as a socio-ecological system, as it represents the interface of water-users with the natural environment and different ecosystems (natural resource use in the form of water abstraction from rivers, lakes and groundwater) (Walker *et al.*, 2004; Smith *et al.*, 2013b).

Consequently, within the context of this essay, UWM will be characterised as a socio-ecological-technical (SET) system, as it is clear it represents the interface of these three sub-systems. Subsequently, resilience framings (defined in full in the proceeding section) become central to the analysis undertaken in this essay, as socio-ecological, organisational and community framings relate to the societal UWM sub-system, the ecological resilience framing relates to the ecological sub-system and engineering and infrastructure framings relate to the technical sub-system. These three framings will be utilised throughout the analysis contained within the bulk of this essay. Scholars have called for cautiously integrated consideration of

socio-ecological and socio-technical systems (**Figure 4**; Smith and Stirling, 2008) and this essay aims to follow that sentiment.

Caution is recommended, as properties considered socio-technically attractive may result in negative outcomes for socio-ecological systems. Consequently, transitions to resilient socio-technical systems may not necessarily result in resilience across socio-ecological systems. Past, present and future threats to UWM, which might result in perturbations to the SET system, include population growth (projecting and meeting rises in demand), urbanisation (increase in impervious areas resulting in increased runoff), climate change (extreme weather events resulting in flooding or drought) and unsustainable abstraction of raw surface/ground water (requiring diversification of sources) (Ward *et al.*, 2012).

Water Service Providers (WSPs) are one of the organisations responsible for overall UWM; they are arguably the core organisation as they have wide-ranging legal obligations for compliance in a number of financial, environmental and customer-based arenas. It is therefore vital that WSPs have a comprehensive view to operationalizing resilience. Smith *et al.* (2013b) examined the resilience approaches utilised by contemporary European Water Service Providers (WSPs) through interviews with representatives of the WSPs and document analysis. Representations of resilience were more variable than for risk, suggesting the concept may be less familiar and definitions given paralleled engineering resilience. One participant defined resilience as the ability to deal with risk, underlining perceived connections and in general operational definitions were problematic ("*easy to talk about, not easy to do*"). Resilience was commonly associated with increasing redundancy in assets and infrastructure (reserves, emergency capacity). However, it was also asserted that resilience could relate to human aspects of organisations (though mainly by negative inference, such as being inflexible, fragmented and out of touch), demonstrating the socio-ecological and organisational definitions did feature in European WSPs consideration of resilient UWM.

If a deeper understanding of resilience framings in an UWM context could be useful for comprehending how to better integrate new approaches, particularly in the UK, the more commonly used framings must first be defined before any sort of analysis can be undertaken. These framings are discussed in the following section; as three UWM sub-systems have been identified, the framings follow the same convention, that being: Ecological, Social (representing socio-ecological, organisational and community) and Technical (representing engineering and infrastructural).

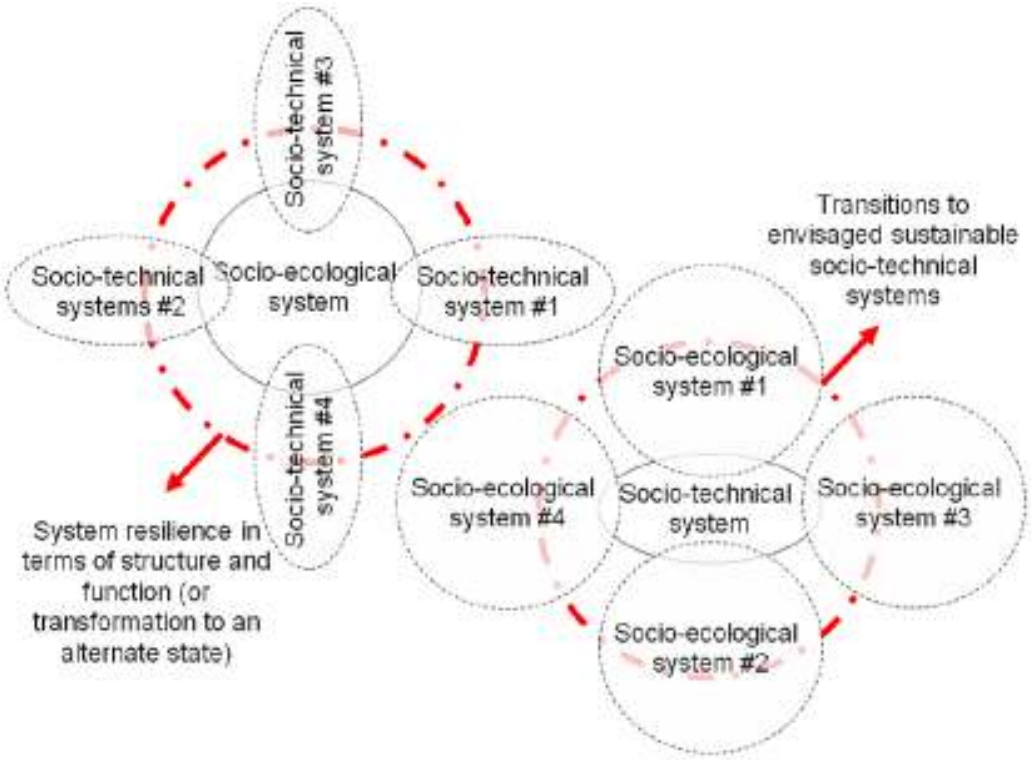

Figure 4 Schematic representation of differences and overlaps in the analysis and governance of social-ecological systems and socio-technical systems (Smith and Stirling, 2008) REPRODUCED WITH PERMISSION VIA CREATIVE COMMONS LICENCE FROM STEPS Centre website (www.steps-centre.org)[7]

Who's resilience is it anyway?

Blockley *et al.* (2012) assert that sustainability, resilience and robustness are intertwined; robustness is necessary but not sufficient for resilience, with resilience then being necessary but not sufficient for sustainability. Vulnerability also features in the discussion, as vulnerability implies a lack of robustness and therefore resilience and sustainability. Consequently, resilience is often used as a bridging term between robustness and sustainability. Examining the framings of all of these terms in depth is beyond the scope of this essay; resilience is the focus of the proceeding discussion, but the other terms may arise where appropriate.

There is on-going debate as to whether resilience is something an item (person, asset, system) has (an ability) or something an item does (a function), but there is consensus that the term must be applied in a normative way. That is, when resilience as a term is used it must be attached to a person, form, organisation or system *and* a scale (Leach, 2008). Different disciplinary views of resilience include (Blockley *et al.*, 2012; MacKinnon and Driscoll Derickson, 2012; Dieleman, 2013):

- Physicists: ability of an elastic material to absorb energy and deflect elasticity;
- Ecologists: ability of an ecosystem to persist and resume its initial status following disruption;

[7] http://steps-centre.org/anewmanifesto/manifesto_2010/clusters/cluster7/Transitions_Working_Paper.pdf

- Medics: ability to recuperate from illness or stress;
- Civil engineers: ability of an infrastructure system to endure or quickly recover from difficult conditions;
- Epidemiology (later introduced in psychology): capacity to respond to various effects;
- Psychology: capacity for successful adaptation and functioning, despite high risk, stress or trauma;
- Geography: ability of communities to withstand external shocks and the ways in which they adapt to changing circumstances;
- Urban planning: ability of a region to recover successfully from shocks to its economy.

Literature on these definitions is utilised in the sub-sections that follow, as a basis for developing the ecological, social and technical resilience framings that form the tool of analysis for the proceeding empirical sections of this essay.

Ecological resilience

Holling (1973), a Canadian ecologist, is credited with introducing the term resilience to the field of ecology (alongside stability – the ability to return to equilibrium after a temporary disturbance) using the following framing:

"*But there is another property, termed resilience, that is a measure of the persistence of systems and of their ability to absorb change and disturbance and still maintain the same relationships between populations or state variables.*" (Holling, 1973, pg 14).

Thus the traditional ecological framing of resilience became that of one of a measure of the magnitude of disturbances that a system could absorb and still persist. Resilience becomes a property imbued on the system and persistence (maintaining the status quo) the outcome – a system could therefore be highly resilient, but have low stability or low resilience if subject to low fluctuations (resulting in minimal opportunity for learning). Holling summarises his proposed resilience framework by asserting that it does not require the ability to make future predictions, just the understanding that systems should be able to absorb and accommodate unexpected future events.

Social resilience (socio-ecological, organisational, community)

Socio-ecological resilience. Holling's 1970's view of resilience served well for several decades, but started to increasingly receive criticism for being too narrow and inflexible. Such criticism began to appear as understandings of complex systems, complex adaptive systems and panarchy have grown over the last ten to fifteen years. A complex system is a system comprised of overlapping sub-systems (Smith *et al.*, 2013b) and a complex adaptive system (CAS), such as the biosphere or a political party, has diverse and interconnected elements that have the capacity to change and learn from experience (McManus, 2008; Montgomery *et al.*, 2012). The interaction of the biosphere and political/other social systems tends to be characterised as a *socio-ecological system* (SES) and a panarchy is described as a nested set of adaptive

cycles, which can initiate bottom-up or top down change within a CAS (hence a panarchy differs from a hierarchy) (Garmestani and Benson, 2013). Similarly, the interconnections between social and technical systems and the potential for learning between these interconnected sub-systems lends to the term *socio-technical system* (STS) (Smith *et al.*, 2013b).

Current thinking in socio-ecological resilience frames it as renewal, creative reorganisation and development, as well as encompassing adaptive capacities and adaptive management (Folke, 2006). The re-framing of socio-ecological resilience enables it to combine responses to both transient shocks and chronic stresses and a new emphasis is placed on flexibility, learning, adaption and self-organisation, which may require a shift in regime (the dominant way of operating) (Folke, 2010). This is an important evolution, as the ecological framing appeared to infer that resilience could prevent a dominant, but obsolete, regime from being ousted from its position as it could resist (beat) change.

The revised socio-ecological framing suggests that regime change (needed change) is possible where shocks or stresses present themselves. This means that building resilience within a complex adaptive system and transitioning the system to a different regime may not necessarily be mutual exclusive activities. This is in contradiction to some views, which see a system crossing predefined acceptability thresholds as being less resilient (Smith and Stirling, 2010). Thus a distinction may be warranted as to whether a system requires strategies to maintain performance (build resilience) under transient shocks, strategies to instigate transition (change regime) under chronic stresses or both – even where a regime change may ultimately lead to lower resilience (Adger, pg 5 in Leach, 2008). In the context of UWM, it may be that too many system components are being preserved, which actually require change in order for resilience to be built or for the transition to a new, more resilient regime to be achieved. Consensus has yet to be agreed on the characteristics of the latter.

Organisational resilience. McManus (2008), in a detailed study of organisational resilience in 10 organisations from a range of industry sectors, sizes, localities and types, utilised the following framing:

"…a function of an organisation's situation awareness, identification and management of keystone vulnerabilities and adaptive capacity in a complex, dynamic and interconnected system/environment."

This contrasts with the previous framings by considering the organisation as the system, though it still implicitly includes aspects of change absorption, coping, adaptation and recovery. Other additional features of resilience under this framing, such as preventing the occurrence of negative impacts, the prevention of temporal worsening of such impacts or engaging in recovery following negative consequences. Applying these framings operationally to the problems organisations face and how they may achieve or improve resilience in response to threats, remains a challenge (McManus, 2008).

In High Reliability Organisations (HROs), which could be argued as having high resilience, the prevention of failure is a preoccupation and recognition of errors is rewarded, there is a commitment to utilising different viewpoints to ensure a comprehensive representation of a situation ('seeing the big picture'), the conviction that there are gaps in knowledge, the belief the organisation can recover and decision making processes that incorporate perspectives from knowledgeable individuals across the organisation, irrespective of their position in the hierarchy (McManus, 2008). This parallels the assertion by Blockley *et al.* (2012) that a resilient organisation should expect complex systems to behave in unintended ways and design systems accordingly. Further to this, alongside ecological resilience, Holling (1973) also considered resilience at a management level, which could be considered similar to this framing of organisational resilience:

"*A management approach based on resilience, on the other hand, would emphasize the need to keep options open, the need to view events in a regional rather than a local context, and the need to emphasize heterogeneity.*" (Holling, 1973, pg 21).

One term that recurs in literature regarding organisational resilience is adaptive capacity, which can be framed as the capacity of actors in a system to manage resilience (Gersonius *et al.*, 2012); the ability of the organisation to cope in a complex and changing environment (ISO Guide 73 in Blockley *et al.*, 2012) or, in the case of Hudson *et al.*, 2012 in relation to large-scale infrastructure, the provision of measures to identify the affected population, to construct short-term protection, as well as to enable clean-up and return to normality. McManus (2008) adds to this, through empirical assessment of organisational reactions to shocks, essential capacities for organisational resilience such as:

- Situational awareness (perception of disturbances, comprehension of their meaning and identifying what they may result in in the future);
- Identification and management of keystone vulnerabilities (experimental scenarios, planning strategies, internal/external resources).

Further to this, Dieleman (2013) argues that, within cities (in the context of responses to climate change), resilience operates at three levels: physical form, infrastructure and technology; the interconnectedness and self-reliance of people and multi-level governance; and the inclusion of marginal groups within a culture of innovative capacity. These levels require significant organisational learning, including reflective action, active learning, experiential learning and mental mapping. Such approaches can be introduced at a range of social levels, which brings us to our final resilience framing.

Community resilience. As in previous resilience framings, social or community resilience is also framed across the diverse academic and grey literature as the response of societies, communities or groups to external stresses or disturbances in a range of contexts and is related to their social capital (such as trust norms and networks). The focus of the community framing centres very much on the knowledge, confidence, adaptive, learning and recovery capabilities of

neighbourhoods, groups and individuals, in both rural and urban settings, rather than the ecological or perhaps technological causes of the stresses or disturbances (Adger, 2000; Davis *et al.*, 2005; Gubbins, 2010; Hillman and Blume, 2011; IFRC, 2012).

Adger (2000) considers resilience in relation to social and ecological systems and highlights their interconnectedness; hence there are parallels with this framing and the *socio-ecological* framing. However, he cautions that use of the term does require tailoring for each system, especially where institutions (meaning both modes of socialised behaviour and formal structures of governance) connecting the two are concerned (he explores this through a detailed example of diversification within mangrove forests in Vietnam and the resilience of related institutions such as property rights). Further, Adger (2000) asserts social resilience can be examined via indicators such as institutional change, economic structure (growth, employment, income), demographic change (migration) and stability of livelihoods.

More recent and perhaps operational insights into community resilience in the context of disaster recovery (disturbance), energy management (stress) and community empowerment (Hillman and Blume, 2011) provide a deeper understand of how support projects contribute to resilience (Gubbins, 2010; IFRC, 2012). For example, in response to tsunami recovery IFRC (2012) emphasize that a [safe and] resilient community is knowledgeable and healthy, organised, connected, has infrastructure, services and economic opportunities and can manage its assets, particularly at the local level. This is complemented by Gubbins (2010) who asserts that community resilience is about meeting the needs of the community, looking at the long-term and strengthening and diversifying awareness and skills. Finally, Hillman and Blume (2011) reinforce this by outlining detailed steps to work towards building resilient communities by taking community action in relation to food, time, assets, trading, establishing cooperatives, planning, buildings, land, energy and finance and money (currencies, enterprise, credit unions, crowdfunding, bonds, multipliers and shares). Interestingly, building community resilience around water resources is not mentioned.

One final perspective on community resilience on which to finish this section, is that provided by Fabricius (in Leach, 2008), who argued that responsiveness, or ability to respond, is not necessarily inherently desirable. Responses must be appropriate – in terms of timing, intensity and resources; an inappropriate response may do more harm than good. Additionally, he questioned the tendency of some communities towards inertia and maintaining the status quo - if responsiveness is a positive attribute, why can there sometimes be so much resistance?

Technical resilience (engineering, infrastructural)

Bijker (pg 7 in Leach, 2008) asserts that in mainstream engineering and technology-focused framings, the term resilience implies a narrow perspective, an assumption of rational actors, a focus on technology (rather than incorporating social or other dimensions) and a conservative style. However, more recent research into resilience in the engineering discipline has begun to consider engineering's place within CASs

such as STSs and SESs and their interdependencies (Blockley *et al.*, 2012). Despite this recognition, most resilience framings utilised in the engineering discipline focus on infrastructure. For example, the following definition is used within the Resilient and Sustainable Infrastructure Networks (RESIN, 2013) project:

"The resilience of a system is defined as the ability to gracefully degrade and subsequently recover from a potentially catastrophic disturbance that is internal or external in origin."

Similarly, within a range of papers published by the Institution of Civil Engineers (Hudson et al., 2012; Gersonius *et al.*, 2012; Montgomery *et al.*, 2012; Blockley *et al.*, 2012), the following definitions and framings of infrastructure resilience or engineering resilience were utilized:

- Ability of an infrastructure system to withstand or recover quickly from difficult conditions;
- Ability at all levels of an organisation to be robust yet flexible, and to use resources to proactively manage processes to success;
- Resilience is an outcome of a process that emerges from the interactions between its sub-processes;
- How to ensure that 'surprises' are managed;
- Handling known knowns, known unknowns and unknown unknowns;
- Networks/systems have the necessary resistance, reliability and redundancy (spare capacity);
- Establishing relationships between issues and predicting emergent properties of interactions (e.g. between different stocks of capital, whether manufactured, financial, social, human or natural);
- Ability of the system [flood infrastructure] as a whole to function as expected in the face of change;
- Satisfactory recovery and reduction of damage/loss in response to disruptive, high impact shock events;
- The scale of the challenge that the system can endure beyond normal demand, taking into account what is proportional, affordable and tolerable;
- The ability to anticipate prior to an event; to resist, absorb and adapt during an event; then to recover rapidly and apply lessons learnt after the event;
- Ability to maintain functionality and return to normal following a harmful event, ensuring that damage or disruption is proportionate, tolerable and affordable;
- Ability to withstand, recover from and mitigate the impact of abnormal and extreme natural and man-made hazards.

From this range of descriptions and definitions, it can be seen that there are a wide range of terms in use in the engineering discipline in relation to resilience. Consideration of whether this range of terms is constraining or liberating is beyond the scope of this essay; they will be used in the following section to develop resilience indicators.

Resilience framings in English water service provider long-term strategies

The preceding discussion has identified multiple framings of resilience and briefly explored how such framings are present within the European UWM arena. As resilience features heavily in academic and grey literature on UWM, this essay aims to identify the framings that are utilised and operationalized by WSPs based in England in order to better understand how resilience approaches to UWM could be more integrated across the social, ecological and technical sub-systems. To achieve this aim, the following methodology has been developed.

A methodology to identify resilience framings in an UWM context

Resilience indicators. Using the disciplinary framings of resilience previously identified, the indicators of resilience summarised in Table 1 have been derived by pulling out key words, terms and phrases and formulating them into thematic lists for each UWM CAS sub-system framing (social, ecological, technical). These themes were then refined into the form of lists of phrases as summarised in Table 1; phrases overlapping between sub-systems are highlighted in **bold**. These indicators form the lens through which the content of the long-term strategies of two WSPs were analysed.

Table 1 Indicators of resilience derived for this essay from relevant resilience-orientated literature

Resilience Framing Indicators		
Social	**Ecological**	**Technical**
+ Renewal	+ Persistence	+ Conservative (risk averse)
+ Reorganisation	+ Absorb	+ Decline/Recover/Absorb
+ **Adaptive**	+ Consistency	+ Robust
+ **Flexibility**	+ **Tolerance**	+ **Flexible/Adaptable**
+ Learning	+ Status quo	+ Proactive
+ Shifting/switching	+ Accommodate	+ [Un] Predictability
+ Awareness/recognition (knowledge gaps)	+ Unexpected futures	+ Resistance
+ Reward		+ Reliability
+ Viewpoints		+ Redundancy
+ Panarchical decision-making		+ Recovery
+ Capability		+ Reduction
+ Livelihoods		+ Proportional
+ [Inter] Connected		+ Affordable
+ Strength		+ **Tolerable**
+ Diversity		

WSP selection and content analysis. WSPs are required to produce long-term strategies, which they use as a basis for the formulation of their business plans, which they must submit to the water sector's financial regulator, Ofwat. These long-term strategies aim to provide a background to the total expenditure (capital and operational) that the WSPs will require for long-term (25 year) operation and

investment in critical water infrastructure and UWM. Every 5 years, in response to the submission of the business plan (in the so-called 'periodic review') Ofwat awards a proportion of the requested expenditure, aiming to balance WSP requirements with keeping water bills for customers low (Butler and Memon, 2006).

The business plans themselves could have formed the basis of the analysis performed for this essay, but the latest ones had not been released at the time of writing. The Water Resources Management Plans (another statutory document WSPs are required to formulate) were another possible data source, but as these run into hundreds of pages they were considered too lengthy for use in this essay (such documents could form the focus of future analysis/research, however). Consequently, content analysis of the long-term strategies of two English WSPs, South West Water and Thames Water, was undertaken to determine how they interpret and apply (i.e. frame) the term 'resilience' within their proposed future planning and activities. This was done in two ways: (i) examining the documents for direct references to 'resilience' or 'resilient' and (ii) examining the documents for indirect references to resilience in terms of their responses to sub-system limitations that aligned with the identified resilience indicators. South West Water and Thames Water's documents were selected due to the following criteria:

- Their long-term strategy documents were easily locatable and downloadable from their websites, were written around the same time (2012/13) and for the same timescale (2015-2040);
- They represent contrasting:
    - Geographical regions (South West Water has a high coastline to land ratio, Thames Water's ratio is more even; weather and climate profiles are divergent, as are geologies, pedologies, hydrologies and other water management-related features);
    - Demographics (South West Water has a high proportion of low-income customers, Thames Water has a high proportion of high-income customers);
    - Water prices (South West Water being the most expensive in England, Thames Water being one of the cheapest);
    - Customer bases/company sizes (South West Water serves approximately 1.6M customers (5M in summer), Thames Water serves 14M customers).

It was felt that these characteristics might yield some difference in interpretation and framing of resilience and therefore potentially give contrasting results that would increase the validity of the analysis. Due to the length of the long-term strategies (South West Water, 68 pgs.; Thames Water, 31 pgs.), it was decided to focus on two WSP documents to ensure depth of analysis for two companies rather than breadth across more than two, in order to enhance the robustness of the results.

At the first document pass, each WSP long-term strategy was read page by page and each paragraph analysed as to whether it contained or indicated a 'System

Limitation'. The System Limitation was taken to be a reference to one of the sub-systems comprising the UWM CAS system that required some sort of action against it for the WSP to continue to operate under future scenarios. The text around these system limitations was then subjectively analysed by the author for associated 'Shocks'/'Events' (chronic versus transient) that might impact the sub-system and require actions ('Measures'), as detailed in the long-term strategy text. Corresponding Resilience Indicators from Table 1 were then associated to each Measure to yield a profile for each WSP. A second pass of the documents was then made to re-examine the long-term strategies for dominant and hidden narratives of importance to the resilience framings. Thought was also given to potentially omitted alternative narratives. A final pass was made to double-check for anything that was previously missed. The author was the only analyst who undertook the content analysis, thus inter-rater reliability was not assessed via duplicate interpretation. The analysis that follows is therefore the subjective interpretation of the author.

Which resilience framings do we find in English water service provider long-term strategies?

This section describes the results of the content analysis conducted on the long-term strategy documents of South West Water and Thames Water. The results for each WSP are first described individually and then a proceeding discussion section draws together the overall findings and repositions them in the context of the resilience literature previously discussed, as well as other literature relevant to the findings.

South West Water (SWW). Resilience was identified as one of SWW's four key strategic outcomes, the four being Reliability, Responsiveness, Resilience and Sustainability. Resilience was represented by the symbol (pg 8) shown in Figure 5, though its meaning is not explained. It could be inferred that as it depicts a linking chain, resilience is taken to mean connectivity or interconnectedness.

Figure 5 Symbol representing resilience in SWW's long-term strategy document (redrawn from SWW, 2012)

The following direct quotes relating to or containing the words resilience or resilient were identified:

"Resilience is the capability of our assets to be immune to changes in the physical environment, such as those caused by climate change and the resultant shift in weather patterns and conditions. Our resilience also includes the strength of our business to cope with economic changes. It relies on ensuring that our ways of working, the infrastructure and technologies we use, and the ways in which we fund those activities can all stand the test of time." (SWW, 2012, pg 8) (Quote 1)

"*SWW must continue to adapt and improve the resilience of its assets in order to deal with these extreme weather events as they are forecast to become more frequent.*" (SWW, 2012, pg 14) (Quote 2)

"*We will improve the resilience of our network, for example, by duplicating our strategic water mains.*" (SWW, 2012, pg 31) (Quote 3)

"*Improve the resilience of our network against extreme events such as flooding and coastal erosion so that the water supplies for homes and businesses are protected.*" (SWW, 2012, pg 34) (Quote 4)

"*South West Water continues to make the necessary investment in areas such as phosphate and nitrate removal and in the resilience of our assets to ensure that the quality of the waste water returned to the environment meets or exceeds the standards set by our regulators.*" (SWW, 2012, pg 48) (Quote 5)

"*Our vision is to continue supporting the regional economy through the provision of resilient services, ensuring our investment plans are balanced and are in the areas that deliver the most for our customers, whilst keeping our costs as low as possible.*" (SWW, 2012, pg 54) (Quote 6)

"*Financial resilience requires financial providers to be attracted by a rate of return that is fair compared to other sectors.*" (SWW, 2012, pg 57) (Quote 7)

Resilience framings represented within these quotes include technical (infrastructural: assets, network) and social (organisational: strength of business, ways of working, services, finance). From this high-level overview, it would seem that community and ecological resilience are low priorities. However, a more in depth analysis is required before such assertions can be substantiated and the full content analysis is summarised in Table 2.

In relation to narratives, the document starts off with regulatory compliance dominating, along with an emphasis on 'what the customer wants' (a reliable, safe, clean supply of water). A narrative of environmental protectionism is intertwined throughout and it is asserted that:

"*Our customers attach a high importance to the environment and they expect us to protect it at all times."* (SWW, 2012, pg 42) (Quote 8)

This is apparently ascertained through the extensive customer consultation (surveys, focus groups) and stakeholder engagement activities SWW undertakes. However, a potentially hidden narrative here is that SWW are required to meet the regulatory demands of the Water Framework Directive and would protect the environment whether or not customers rated it as of high importance. It is also possible that SWW have asked their customers about only the future UWM options that the company deems feasible – have all options (feasible or otherwise) been presented? If not, data will be highly biased and tell SWW what it wants to justify to the regulator.

Finally, although it would appear that SWW have listened to their customers and aim to accommodate their requests, there is limited evidence that they have empowered them or *will* empower them in relation to future UWM. In Quote 8, the emphasis seems to be that the customer "*expect **us***" i.e. SWW, to protect the environment. This seems to indicate that SWW have not asked their customers if they would be willing to protect the environment *in collaboration with* them. This is a topic of current debate in the urban water governance literature; an emphasis is placed on not only customer consultation, but community empowerment, where citizens (not customers or consumers) take back some ownership of UWM issues in their localities (Brown, 2012). SWW (and TW to an extent) does not seem to acknowledge that agents and actors such as their customers have resources and capacities and that they (SWW) may actually be dominating and even removing their (the customer's) ownership, governance and feeling of responsibility towards the environment, creating the norm that it is therefore SWW's responsibility rather than a collective responsibility (Shove, 2003) and reducing resilience by reducing the community's ability to respond (Tyler and Moench, 2012).

It should be noted that this urban water governance approach is viewed as less sinister than the 'Big Society' approach to broader community resilience, which is described as intending to promote greater community self-reliance and empowerment by decreasing the powers of the state and supporting volunteering and community activity. This latter approach has been heavily criticised as operating to satisfy a fundamental gap created by favouring market lucidities over social needs. This results in the legitimisation and maintenance of existing forms of social hierarchy and control related to long-standing Conservative and middle-class voluntarism and social responsibility, which overlook the ability of disadvantaged communities (who are perceived to have fewer material resources, professional skill sets and stocks of social capital) that may be less able to meet the void created by state retrenchment (MacKinnon and Driscoll Derickson, 2012). These themes will be revisited more fully in the proceeding discussion section.

Thames Water (TW). TW's long-term strategy document was significantly shorter (31 pgs.) than SWW's (68 pgs.) and resilience was far less explicitly mentioned, with only the following direct reference, which represents very much a technical framing:
"*We will continue to improve the resilience of electricity supplies to our treatment works….*" (TW, 2013, pg 20) (Quote 9)

However, as can be seen from the results of the full content analysis for TW (Table 3), a similar range of resilience indicators and framings was present as for SWW. Perhaps the one notable difference is that TW recognises and directly addresses a requirement for change in operational and management models, organisational structure and proposes large-scale reorganisation as a reaction to the separating out of wholesale and retail parts of the business. This appears to explicitly deal with organisational resilience under an uncertain UWM future. In terms of narratives, there is, as with SWW, an emphasis on what the customer wants, as derived from various consultation and engagement activities.

Table 2 Summary of the Results of the Content Analysis of South West Water's Long-term Strategy Document

[1]Social (S); Ecological (E); Technical (T); [2]Chronic (C) v. Transient (T); [3]See Table 1

Page Ref	System Limitation[1]	Shock/Event[2]	Measure	Resilience Indicator[3] (Frame[1])
3, 10, 11	Service provision (T)	Compliance (C)	• Maintain & upgrade systems	• Status quo (E) • Consistency (E) • Predictability (T) • Reliability (T)
4, 12, 16	Product provision & environmental protection (S; E)	Duty of care (C)	• Efficient, sustainable processes • Low cost	• Flexible (S; T) • Affordable (T)
5, 16	Ability to pay (S)	Incomes & expenditure (C)	• Schemes (e.g. WaterCare) & partnerships (CAB, AgeUK)	• Awareness (S) • Viewpoints (S) • Livelihoods (S)
12-16	Future provision (S; E)	Climate change, legislation & competition (C)	• Choice • Maintenance • Network/asset improvement	• Affordable (T) • Status quo (E) • Diversity (S) • Reliability (T) • Tolerable (E; T) • Absorb (E)
7, 12, 13, 16	Responsiveness (S)	Unexpected circumstances (T)	• Quick & effective problem solving • Foresight & flexibility • Research • Invest in people & skills • Metering & water efficiency	• Decline/Recover/Absorb (T) • Awareness (S) • Flexible (S; T) • Strength (S) • Affordable (T)
6, 40-41	Reliability (T)	Expectation &	• Maintenance, refurbishment, upgrade	• Reliability (T)

Page Ref	System Limitation[1]	Shock/Event[2]	Measure	Resilience Indicator[3] (Frame[1])
		compliance (domestic & business customers) (C)	• Duplication of strategic water mains & sewers • Improvements to regional network connections • New waste water treatment works (WWTW) • Widen range of business services • Retail tariffs • Market-sector specific services	• Status quo (E) • Redundancy (T) • Robust (T) • Reduction (T) • Accommodate (E) • Viewpoints (S) • Livelihoods (S) • Diversity (S)
8, 12-14	Resilience (S; T)	Environmental, economic & technological change (C; T)	• Asset improvement (WWTW, sewers) • Sewer separation • Partnerships (Environment Agency, Local Authorities, Drinking Water Inspectorate, Natural England) • Improvements in urban drainage	• Tolerable (E; T) • Resistance (T) • Reduction (T) • Redundancy (T) • Accommodation (E) • Viewpoints (S)
13, 16	Private sewer transfer (T)	Increased network length (T)	• Future investment (assets & operations)	• Accommodate (E) • Consistency (E) • Reliability (T)

16	Long-term & seasonal growth, wholesale/retail separation & increasing competition (S; E; T)	Demand changes (C; T)	• Sustainable water resources & solutions:
			  ○ Reservoirs from clay pits
			  ○ Water efficiency
			  ○ Catchment management
			  ○ Moving water around
			• Established subsidiary (Source for Business)
				• Diversity (S)
				• Accommodate (E)
				• Predictability (T)
				• Absorb (E)
				• Reliability (T)
				• Tolerable (E)
				• Affordable (T)

Page Ref	System Limitation[1]	Shock/Event[2]	Measure	Resilience Indicator[3] (Frame[1])
			• Tailor services to individual businesses	• Viewpoints (S)
9, 13	Sustainability (S; E; T)	Social, economic & environmental relationships of SWW with wider world (C; T)	• Responsible working practices • Reduce energy consumption & CO_2 emissions • Renewable/efficient technologies • Reduce landfill (sludge for energy) • Reliability, responsiveness & resilience • Low cost • Employer, contactor, supplier engagement • Upstream Thinking (reducing agricultural impact & rewetting the moors)	• Conservative (T) • Reduction (T) • Reliability (T) • Status quo (E) • Affordable (T) • Viewpoints (S) • Livelihoods (S) • Diversity (S) • Capability (S) • Proactive (T)
23-39	Avoiding water scarcity (S; E; T)	Population, extreme weather, natural disasters, malicious attacks, IT protection, emergency planning (C; T)	• Moving water around • Leakage prevention • Prevent unplanned interruptions • Maintaining/updating WWTWs, reservoirs, networks • Regional watergrid, duplicating pipework • SMART metering & social media	• Redundancy (T) • Resistance (T) • Robust (T) • Reduction (T) • Unexpected future (E) • Status quo (E) • Affordable (T)
44, 49-51	Maintaining the environment & reducing flooding (E)	Preventing environmental degradation & sewer flooding (equipment failure, excessive flows, misuse)	• Sewer separation & WWTW maintenance • Process & system improvements • Non-return valves & identify illegal connections • Sustainable drainage systems (SuDS) (once responsibilities are better defined) • Working with partner agencies,	• Decline/Recover/Absorb (T) • Resistance (T) • Reliability (T), Reduction (T) • Redundancy (T) • Recovery (T), Robust (T) • Accommodate (E)

Page Ref	System Limitation[1]	Shock/Event[2]	Measure	Resilience Indicator[3] (Frame[1])
			encouraging customers to collect rainwater, raising awareness about improper use	• Viewpoints (S) • Awareness (S) • [some] Panarchical D-M
52-59	Continuing to invest & manage cost pressures (S)	Potential of not attracting investors & ensuring returns for funders, as well as changes in costs (C; T)	• Prioritise investments in areas customers & stakeholders value most • Efficiency, ensuring return on investment • Keep financing costs as low as possible • Balanced investment plans • Ensuring customers who can pay, do; social tariffs • Affordability Strategy & Toolkit • Delivering campaigns (WaterCare, Restart, FreshStart Fund, Money Advice Sponsorship, Water Debt Gateway, WaterSure, metering, credit management system)	• Consistency (E) • Viewpoints (S) • Diversity (S) • Conservative (T) • Proportional (T) • Affordable (T) • Learning (S) • Flexible (S; T) • Livelihoods (S) • Awareness (S)
60	Economic & social development & environmental protection (S; E)	Lack of future employment, employees, research, recreation & conservation (C)	• Supporting staff development • Training/educating young people (e.g. apprenticeships) • Partnerships with universities • Staff volunteering & community work • Conservation activities & amenities for customers • Ecosystem services approach • Biodiversity action plan	• Unexpected futures (E) • Renewal (S) • Organised (S) • Shifting/switching (S) • Reward (S) • Viewpoints (S) • Capability (S) • Livelihoods (S) • Diversity (S)

Page Ref	System Limitation[1]	Shock/Event[2]	Measure	Resilience Indicator[3] (Frame[1])
				• Proactive (T)

[1]Social (S); Ecological (E); Technical (T); [2]Chronic (C) v. Transient (T); [3]See Table 1

Table 3 Summary of the Results of the Content Analysis of Thames Water's Long-term Strategy Document

[1]Social (S); Ecological (E); Technical (T); [2]Chronic (C) v. Transient (T); [3]See Table 1

Page Ref	System Limitation[1]	Shock/Event[2]	Measure	Resilience Indicator[3] (Frame[1])
2-5, 9-10, 12-13	Future service provision (S; E; T)	Unknown future, including regulatory change, population growth & climate change (C)	• Compliance with standards • Meeting customer expectations/levels of service at low cost/using social tariffs, customer segmentation, consultation, WaterSure • Being trusted by customers • Limit impact on the environment • Socially responsible, sustainable business • Leakage reduction • Staff training, water efficiency advice & new technology (full smart metering, real-time control, monitoring) • Continue with tried & tested ways to help disadvantaged customers • Develop new supply sources (where demand management is not sufficient) • Inter-company transfers/water trading • Wastewater recycling/new future options • Improve capacity & reliability of assets • Replacing & rationalising trunk mains • Thames/Lee Tunnels ('super sewers') • Limit rainwater to sewers working with EA, local authorities & regulatory bodies (partnerships), including SuDS • Energy efficiency & renewable energy from sludge	• Status quo (E) • Unexpected future (E) • Absorb (E) • Accommodate (E) • Diversity (S) • [Inter] Connected (S) • Viewpoints (S) • Conservative (T) • Reliability (T) • Reduction (T) • Affordable (T)

Page Ref	System Limitation[1]	Shock/Event[2]	Measure	Resilience Indicator[3] (Frame[1])
7, 14	Wholesale/retail separation, increasing competition	Demand changes (C; T)	• Change in operational model, organisational structure & reorganise over time into 4 separate businesses (retail household; retail non-household; water services; wastewater services) each with managing director & senior leadership team, but a central support services unit (finance, HR, regulation) • Creation of Thames Water Commercial Services Ltd, adopt new attitude of change	• Reorganisation (S) • Adaptive (S; T) • Shifting/switching (S) • Proactive (T) • Awareness (S) • Diversity (S)
8-9	Customer satisfaction	Meeting expectations (C)	• Public consultation (customers, stakeholders, staff) • Customer Challenge Group (CCWater, Las, AgeUK, businesses, customers) – understanding preferences & priorities • Conservative view of what will be affordable • A range of value-added services for businesses	• Learning (S) • Awareness (S) • Viewpoints (S) • Reliability (T) • Conservative (T)
10	Future workforce (S)	Lack of future employees	• Supporting staff development • Training/educating young people (e.g. apprenticeships)	• Unexpected futures (E) • Renewal (S) • Organised (S) • Capability (S) • Livelihoods (S) • Proactive (T)
16-19	Water service provision with minimal environmental impact (E; T)	Compliance with statutory duties (C)	• Leakage control/reduction (mains replacement), smart metering (increase from 30 to 56%), water efficiency (tech & advice e.g. Save Water Swindon), new tariffs • New strategic water resource (reservoir,	• Status quo (E) • Accommodate (E) • Decline/Recover/Absorb (T) • Reliability (T)

Page Ref	System Limitation[1]	Shock/Event[2]	Measure	Resilience Indicator[3] (Frame[1])
			wastewater recycling, bulk transfers) - research	• Affordable (T)
20-23	Water treatment & distribution	Compliance with statutory duties (C)	• Improve capacity and reliability, replace mains • Catchment management to improve raw water quality • Monitor, model, predict & manage water loss/bursts	• Status quo (E) • Accommodate (E) • Decline/Recover/Absorb (T) • Reliability (T) • Predictability (T)
24-31	Wastewater collection, treatment & disposal (including private sewer & pumping station transfers)	Compliance with statutory duties & other voluntary agreements, such as the Safe Sludge Matrix (C)	• Preventing sewer flooding – reduce rainfall to sewers • Thames Tideway Tunnel • Awareness raising of improper use • Challenge manufacturers of 'flushable' items • Increase capacity via network extension or SuDS • Monitoring, real-time control, new survey methods, maintenance, research • Risk-based approach • Reducing chemical & energy use & carbon emissions • Renewable energy generation from sludge using new technology (e.g. gasification; new presses & driers) & generator replacement • Work with the energy sector • Stakeholder & partnership working	• Status quo (E) • Accommodate (E) • Decline/Recover/Absorb (T) • Reliability (T) • Affordable (T) • Reduction (T) • Diversity (S) • Viewpoints (S) • Awareness (S) • Flexible (S; T) •

[1]Social (S); Ecological (E); Technical (T); [2]Chronic (C) v. Transient (T); [3]See Table 1

What do resilience framings in English water company long-term strategies tell us about their current and future approaches to UWM?

The results gathered in the previous section and Tables 2 and 3 are not meant to be quantitative tallies of the resilience framings identified within the long-term strategies of English WSPs. Instead they are meant to indicate the tendencies of WSPs towards one framing or another and the implications this might represent. From the results it is apparent that WSPs interpret resilience in terms of avoidance rather than management of failure. To an extent they also avoid or confuse the distinction between robustness and resilience. For example, the duplication of pipework increases the redundancy (robustness) of the network, but not necessarily its resilience – both parts of the network could still fail simultaneously, therefore the failure is not managed, an attempt is made merely to avoid it. Although the terms robustness and resilience are related, the WSPs seem to conflate them, which means proposed future measures do not necessarily resolve the identified limitations on the UWM sub-systems or increase resilience (technical or otherwise), despite the WSPs' perception that they do.

For both South West Water (SWW) and Thames Water (TW), though perhaps more for SWW, technical ('T') framings seem to dominate indicating that both WSPs are comfortable with engineering and infrastructural approaches to resilience. The limited appearance of ecological ('E') framings, more so for TW than SWW, could be interpreted as both positive (the WSPs recognise the need for systems to be less persistent and more adaptable to change) as well as negative (they place less emphasis on the stability perhaps required in engineered systems (discharges to recipient water bodies, for example) to maintain some ecosystems/habitats). As asserted by Adger (pg 5 in Leach, 2008), the changing social and technical approaches of the WSPs may ultimately lead to lower ecological/environmental resilience.

Social ('S') framings are less dominant than technical, but more dominant than ecological. The apparent dominance of technical resilience framings, reduced emphasis on social framings and limited community empowerment narratives (as identified in the previous section), may also indicate that WSPs are perhaps tending towards anti-reflexive behaviours (whether consciously or unconsciously is unclear based on the limited analysis undertaken here), which has implications for [non]-decision-making.

To further examine the significance of the findings, the concept of reflexivity or as it is perhaps more relevant in this case, anti-reflexivity, was therefore considered. The concept of reflexivity arises from theories of reflexive modernisation, which originate themselves from risk society theory and ecological modernisation theory frameworks (McCright and Dunlap, 2010). Research on reflexivity sees social change as reflexive; that is, it involves continual reflection and action (including social movements), as well as dialectic renegotiation through the accumulation of contradictions, challenge and resolution (Kenny, 2007). Thus in contrast, anti-reflexivity focuses on a lack of reflection or action in a particular situation and

assumes the perspective that the forces of anti-reflexivity often aim to preserve industrial capitalist social order against transformations (McCright and Dunlap, 2010).

Consequently, anti-reflexivity is perhaps a possible explanation for wide-ranging resistance by WSPs to utilising new approaches in UWM and in significant indecision in relation to changing how things are done (for example, delaying the transition to the widespread implementation of sustainable drainage systems (SuDS) until such a time when the Government has set out clear pathways for ownership and maintenance responsibilities or using the 'yuk factor' to claim the public 'is not ready' for alternative approaches such as large scale rainwater harvesting or effluent reuse, despite recent research to the contrary (Smith *et al.*, 2013)). McCright and Dunlap (2010) demonstrated the relationship between such anti-reflexivity and non-decision-making, in the context of the American Conservatism Movement's undermining of climate science and policy. As in that case, the forces of anti-reflexivity in this case (the WSPs) may be trying to create their preferred reality (where significant change in the UWM status quo is not required), yet eventually the 'real reality' will undermine their socially constructed one (as it potentially becomes apparent that their predominantly technically-orientated measures are not enough to resolve the system limitations outlined).

McCright and Dunlap (2010) also call for more focused attention on understanding the forces and effectiveness of anti-reflexivity, as such understanding may be imperative for societal resilience and adaptation, especially in relation to climate change. This is echoed by Davidson (2012), also in the context of climate change, where consideration is given to and emphasis placed on the role of the individual, how they focus on certain problems, how they are influenced by social interactions and how they formulate responses or instigate change in social order. Such research would be of invaluable use in the field of UWM, as despite WSPs' best efforts to engage and consult with their customers, they do not appear to be equipped with suitable approaches to influencing their customers into understanding the requirement for wider social change in relation to UWM issues (for example by accepting different levels of service, which may not meet their espoused number one requirement of ultimate service reliability). The WSPs are also not incentivised by the current regulatory framework to encourage a dialogue around significant social rather than technical change, though perhaps this is a useful scapegoat that provides the WSPs with an excuse not to actively or independently pursue such avenues of UWM transition.

From the analysis undertaken it can be inferred that WSPs' formal organisational learning mechanisms promote instrumental learning, which can impede reflective and relational learning. These latter approaches could theoretically transform WSP organisational assumptions and routines around participation in UWM, as informal social networks have been shown to promote transformative social learning and reflexivity (Pallett and Chilvers, 2013). However, transitions of the required magnitude in public engagement, participation and social movements utilised by the WSPs, would require WSPs to significantly increase their capacities in non-traditional

areas, which is unlikely to occur unless the current or future regulatory regime changes in their favour or the WSPs reinterpret the current regulatory focus on customer satisfaction as being broader than it is (i.e. shifting from reliability and affordability to accepting that some social practices around water-use need to be modified/modernised (in the ecological modernisation sense)) (Shove, 2003).

If conscious, WSPs may be being deliberately anti-reflexive in an attempt to maintain the status quo and not have to make decisions on increasing UWM resilience beyond engineering or infrastructural approaches. If sub-conscious, WSPs are unaware that their potentially anti-reflexive stance is preventing them from fully exploring how UWM resilience could be increased, for example by encouraging more community and organisationally resilient (adaptive capacity-orientated) behaviours. These might include rewarding recognition of errors, using panarchical decision-making (this indicator was noted once, but only in minor way) or encouraging greater use of adaptive learning techniques, such as:

- Adapting and applying information to problem solving more creatively;
- Sharing roles between present and absent organisation members;
- Knowing the limits of information and seeking out complementary information;
- Respecting the reports and decisions of others and acting upon them;
- Tolerating uncertainty;
- Strengthening and diversifying awareness and skills.

Researchers in socio-environmental adaption consider that socio-environmental systems are investigated at the scale of a community (a 'definable aggregation of households, interconnected in some way and with a limited spatial extent') (McManus, 2008; Gubbins, 2010), which neither WSP recognises in any significant manner.

Returning to the work of Leach (2008), who asked the question: "*What are the political and institutional factors that continue to push us into such stability/risk framings, despite a language of resilience*?" (pg 6), we begin to see that the narratives, processes and pressures operating in UWM management (at least from a WSP perspective) that dominate the political and institutional factors pushing against broader resilience approaches is that of regulatory compliance within the UWM social and technical sub-systems. Compliance, not only in terms of environmental regulation, but also in compliance with the needs and wants of customers; the latter of which is being driven by financial regulator, Ofwat (by incentivising customer-centric approaches to service provision). Although Ofwat may have the best interests of the customer at its heart, it could be stifling community and organisational resilience at a time (or future time) when it may be needed most, by emphasising (individual) customer and not *community* needs and wants. Leach asserts that without tackling such pressures, shifting to new governance designs will be heavily constrained.

Institutionally (meaning in this instance modes of socialised behaviour rather than formal structures of governance), it is also apparent that the WSPs do not discuss or raise the need for a renegotiation of the less financially-orientated social transactions. For example, as in previous research on water-user representations, charging tariffs and billing are mentioned in detail, as are metering demand and water efficiency, whereas other practice related behaviours and social norms, such as daily routines and preferences for cleanliness and convenience, are somewhat overlooked (Shove, 2003; Sharp, 2006; Wong and Sharp, 2009). As with anti-reflexivity, this has implications for the future resilience of UWM in the same way as does not tackling community needs and wants; it undermines the social part of the social-ecological-technical UWM complex adaptive system and re-emphasises the technical.

Conclusion

Within this essay, a number of different academic and applied disciplinary framings of resilience have been examined, those being social (socio-ecological, organisational and community), technical (engineering and infrastructural) and ecological. Deconstruction of these framings into 'resilience indicators' facilitated the content analysis of English water service provider (WSP) long-term strategy documents to determine the indicators that were more dominant operationally in the domain of urban water management (UWM).

From the empirical analysis it was apparent that WSPs interpreted resilience in terms of avoidance rather than management of failure, as well as combining the concepts of robustness and resilience. Consequently, proposed future UWM measures might not necessarily resolve the limitations of the UWM sub-systems or increase resilience (technical or otherwise), despite WSP perceptions that they do.

The more detailed results of the analysis revealed that technical framings persist in WSP approaches to UWM and a reduced emphasis on social framings and limited community empowerment narratives may be indicative of a tendency of WSPs towards [conscious or unconscious] anti-reflexive behaviours. Introducing anti-reflexivity as an analytical lens, illustrated that there is resistance by WSPs to utilise new approaches in UWM and significant indecision in relation to changing how things are done (for example, using the financial excuses or the 'yuk factor' to claim the public 'is not ready' for alternative approaches such as large scale rainwater harvesting or effluent reuse, despite recent research to the contrary). Although the primary lens through which the WSP long-term strategies were analysed was that of the concept of resilience, it became apparently that anti-reflexivity was also a useful analytical concept. Consequently, future research should focus on the application of reflexive modernisation theory to the field of UWM with a particular focus on WSPs, policy and regulation.

Ultimately it would appear that WSPs favour the engineering framing of resilience as they have historically been incentivised (and, to a certain degree still are) to control the technical (engineering and infrastructural) sub-systems of the UWM complex adaptive system. They have not been previously significantly tasked with

reconfiguring the social sub-system, other than in a financial sense via institutions such as charging tariffs, water bills or metering programmes. If significant strides are to be made in the future in relation to increasing *overall* resilience of all the UWM sub-systems, WSPs will need to recognise that their capacities to drive and facilitate *social* change are severely limited and they will need to be proactive in increasing them across the time horizon of their long-term strategies (2015-2040).

This would mean not only being open to approaches involving dialectic renegotiation through examination of current societal water-use contradictions (high levels of cleanliness (potentially using lots of water, according to the current paradigm) being a social norm, but water efficiency being the preached ideal), but also consideration of how individuals and communities focus on certain problems, are influenced by social interactions and formulate responses or instigate change in social order. As well as building WSP capacities and abilities in relation to interpreting research from the social sciences, this will require WSPs to undertake reflective, relational and transformative learning, as well as transitions in approaches to public engagement and panarchical decision-making.

There will also need to be a shift in WSP perceptions and encouragement of social movements orientated around water in order to switch their UWM assumptions and routines from predominantly technical, as at present, to a more balanced social-ecological-technical view, as required for the more 'resilient' future.

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Absent Animals? Rights and representations of the water environment and its non-human inhabitants in contemporary water management legislation and thinking

Abstract

In 2014 the law relating to water management in England and Wales changed. The resilience of water systems in relation to, amongst other things, environmental pressures is emphasised. However, it is not clear how 'the environment' and its non-human inhabitants are represented or what are their rights. The research presented in this paper utilises a theoretical framework comprising the environmental entitlements approach, the theory of social representations and the wayfaring model. This framework is combined with a mixed methods approach that includes content and focus group analyses, to explore how the environment and its non-human inhabitants are represented in water management legislation and thinking. In the legislation analysed the rights and requirements of the environment were present, though to a limited extent. The water environment became a depersonalised background entity with narrow attribution of its socio-cultural value. In contrast to rights, representations were more elucidated within focus group participant's thinking. Some participants struggled to fully conceptualise and communicate their thoughts and meanings beyond scientific representations – though this did change after they were presented with pictorial representations of aquatic wildlife. The theoretical framework was demonstrated as a useful approach in reconceptualising how the water environment and its non-human inhabitants are represented in water management legislation and thinking. It is suggested that the framework could be used to complement existing dominant frameworks such as sustainability transition theory and the technological innovation system concept. This may in turn facilitate water management approaches that have the best interests of all actors at their core to better enable people to live with environmental change. Recommendations are suggested for improving consideration of the rights and representations of non-human animals in water management legislation and thinking.

Introduction

In 2014 the law relating to water management in England and Wales changed. A new Water Act (2014) amended the primary pieces of legislation for water management: the Water Industry Act (1991), the Water Resources Act (1991) and the Flood and Water Management Act (2010) (amongst others). The Water Industry Act now emphasises the resilience of water systems in relation to, amongst other things, environmental pressures. However, it is not clear how 'the environment' and non-human animals are represented or what are their rights within these Acts. Do the terms representing 'consumers' or 'water users' apply to the environment or its non-human inhabitants?

Though the World Wildlife Fund (2014a) campaigned hard to get the environment better represented within the Water Act ('the Act'), it admits to not having wholly achieved what it would have liked. The environmental wins it highlights include abstraction reform (to prevent too much water being taken from the environment),

a resilience duty for the financial regulator (Ofwat) and environmental safeguards in relation to water trading and less focus on business and competition – overall more measures to prevent over-use and damage (WWF, 2014b). However, the Act was far from the holistic vision for stewardship the WWF envisaged (WWF, 2014c). Could this be due to the way the rights of the environment and its non-human inhabitants are represented?

Further to this, water management and governance literature has recently been dominated by the use of sustainability transition and technological innovation systems approaches, which originate from evolutionary economics (Geels, 2005). Theories and models from these sub-disciplines have been utilised in research as an attempt to better include social systems within water management legislation and thinking. Consequently, a limitation of these approaches is that they focus primarily on markets, technologies, organisations and institutions – constructs relating primarily to *engineered* water infrastructure and systems (Brown and Farrelly, 2009). As a result they only consider to a limited extent how to situate and reconnect people within the governance of the *natural* water environment and its non-human inhabitants (Strang, 2009).

Through consideration of models and theories from anthrozoology and environmental psychology, it is argued that there may be alternative or complementary approaches to use alongside these dominant schools of thought. For example, in anthropology, 'waterworlds' are considered as the scales of watersheds, water regimes and waterscapes (Strang, 2009; Orlove and Caton, 2010), rather than the systems traditionally considered as starting points in the engineering profession (water supply, wastewater and stormwater). The terminologies presented by the former may be more conducive to thinking about non-human inhabitants in the water environment and could be considered more 'friendly' and accessible than the latter's.

Understanding the relationship between people (cultural systems), infrastructure (engineered systems) and the water environment (natural systems) may provide insight into how to better situate and enable people to live with environmental change. This may in turn facilitate water management approaches that have the best interests of all actors (humans, non-human inhabitants, landscapes) at their core. Consequently, the research presented in this paper was undertaken to contribute to the development of an understanding of how the water environment and its non-human inhabitants are represented within contemporary water management legislation and thinking. The paper proceeds as follows: the Method section outlines the theoretical framework and data collection and analysis techniques used. The Rights and Representations section provides an in depth analysis of the findings using an interpretive approach. Finally, the main notions determined by the research are reiterated in the Conclusion section along with suggested recommendations for action.

Method

The aim of the research was to develop an understanding of how the water environment and in particular, its non-human inhabitants (animals) are represented in contemporary water management legislation and thinking in England and Wales. Literature from a range of disciplines (such as anthropology, anthrozoology, ecological/environmental/social psychology) was reviewed in order to develop a theoretical framework to use as a lens through which to interpret findings from data analysis activities.

Theoretical Framework

From the consulted literature it was identified that three approaches/theories/models were beneficial to the research being pursued: the environmental entitlements approach (Sen, 1981; Leach *et al.*, 1999), the social representations theory (Bauer and Gaskell, 1999) and the wayfinding/wayfaring model (Ingold, 2000; Ingold, 2011).

Environmental Entitlements

The environmental entitlements approach was started by Sen (1981) to understand how people can starve amidst plenty. It was identified that focusing on the aggregate availability of food (or resources – environmental goods and services) detracts attention from how individuals and groups gain access to and control food – there are many parallels with how water is accessed and controlled. Conflicts over access often intensify when the resources in question become scarce in absolute terms. The term 'entitlements' therefore does not refer to people's rights in a normative sense — what people *should* have - but the range of possibilities that people *can* have. In Sen's words, entitlements are *'the set of alternative commodity bundles that a person can command in a society using the totality of rights and opportunities that he or she faces'* (Sen 1984: 497).

Entitlements arise through a process of 'mapping': endowments, defined as a person's initial ownership for instance of water, are transformed into a set of entitlements. The endowments themselves refer to the rights and resources that social actors have. Environmental entitlements was identified as being of relevance to the research, as it considers both the rights and representations of natural resources and their social allocation. However, within this research rather than considering social entitlements or humans as the entity commanding the entitlements, the environment and non-human animals are considered the commanding entity of water endowments and entitlements. In taking this approach, the research elucidates how water management legislation and thinking sees the rights and entitlements of these entities.

Social Representations

Bauer and Gaskell's essay (1999) explores the relevance of social representations in *'…research areas, such as the public understanding of science'* (pg 164) and therefore it seems pertinent to include it within the theoretical framework developed here to understand representations of non-human animals in the water management sector. The theory focuses on how so-called 'expert knowledge' is circulated and becomes public 'common sense' through the translation of abstract or conceptual entities into

images, metaphors, articles and practices and their communication. Representations are viewed as a medium linking shared objects, subjects and activities. The social element comprises how the representation is made sense of by a group through anchoring and objectification. Modes of representation (habitual behaviour, individual cognition and informal/formal communication) are distinct from mediums of representation (movement, words, images, and non-linguistic sounds) (Bauer and Gaskell, 1999).

Wayfaring

Ingold's wayfinding (2000) model, which was later revised to the wayfaring model (2011), describes the process of moving from one place to another in a region through trail-following and the consequent transmission of knowledge through time and space. As wayfarers, humans proceed along a path and lay a trail (their life). Consequently, trails (lives) become intertwined and knotted where inhabitants (humans and non-humans) meet. This provides a useful visual analogy of how knotted the complexity of water management is where natural, cultural and engineered systems meet. Adopting the wayfaring model and then proceeding to chart someone's trails and knots in relation to water and non-human animals could be a useful approach to understanding how they consider the rights and representations of such entities.

In order to determine whether this theoretical framework is useful for developing an understanding of the rights and representations of non-human animals within the world of water management, the following methods were used to collect and analyse data.

Data Collection and Analysis

Using the previously outlined theoretical framework as a lens, the research adopted a phenomenographical approach (Richardson, 1999), which entails the study of the relationship between actors and a phenomenon. In this case these are the relationship (beliefs, ideas, values, practices) between water professionals, water legislation and non-human animal rights and representations in water management (in England and Wales). Further to this, a mixed methods approach was used and the following data collection and analysis techniques were utilised:

i. Content analysis of key legislative documents, including:
    a. Water Act 2014;
    b. Amended Water Resources Act (1991)
    c. Amended Water Industry Act (1991);
    d. Amended Flood and Water Management Act (2010);

Other European legislation, such as the Water Framework Directive, was not considered as it is not specific to England and Wales and is more water environment health focused rather than directly water management focused (i.e. delivery of water and sanitation services). The Water Act (260 pages) was read once, scanned once and searched once (using terms such as environment, animal, creature, organism, fish, bird, flora, fauna and related phrases). The other three Acts were only scanned and searched due to having a significant document length (a total of over 500 pages). Consequently, the analysis presented in this paper represents a

high-level interpretation of rights and representations primarily within the overarching Water Act, rather than a detailed one of all the Acts to which it amends.

This analysis was complemented by undertaking:

ii. A focus group with 8 water management professionals. Two key questions were asked, separated by the facilitator presenting some visual representations of the non-human inhabitants that feature in water environments. The questions asked were: (1) what do you think the term 'environment' means in the phrase 'water environment'? And (2) in what ways do you consider animals [non-human inhabitants] when thinking about water environments? (refer to Appendix 2 for examples of resources used)

In relation to question (2), the only prompts given were words such as 'practices, hobbies, recreation, travel and activities' to help participants to think about their behaviours and how non-human animals might feature in relation to them. As well as verbal contributions, participants were encouraged to write down words or create sketches, diagrams or other exemplifications of their thoughts and feelings. These articles were then subject to thematic coding based on the theoretical framework to iterate for shared/divergent narratives, influence of experiences, change of outlook (after visual representations were presented) and consideration of non-human animals in the water environment, including identification of deviations from the general themes. Interpretive findings from all data analyses were then interwoven with reviewed literature by undertaking a triangulation exercise that is articulated in the following section on Rights and Representations.

Rights and Representations

In the legislation analysed the rights and requirements of the environment were present, though to a limited extent. Though rights were not alluded to in the Water Act (the Act), the Water Resources Act refers to minimum acceptable flows and levels. It also requires precautions to be taken against pollution with both 'flora' and 'fauna' in mind, albeit in the context of preventing damage to people's economic or social well-being. Whether social well-being extends to include the cultural value of the environment and non-human inhabitants is unclear.

In the formulation of the Act it was clear that the rights of the environment and non-human inhabitants were represented by the WWF (who tried to influence it as much as possible) and the Environment Agency, with similar but not fully aligned agendas. The WWF championed on behalf of all non-human inhabitants, but it seemed that the EA (in part due to its responsibilities) championed only on behalf of economically valuable fish species such as salmon, trout and eels. Despite use of the words 'flora' and 'fauna', there appeared to be a disconnect with the water environment and water-needing non-human inhabitants that also reside on land, such as birds (heron, king fisher), and mammals (otter, vole), as well as aquatic species such as amphibians (newt, frog). The environment as an entity appeared to be represented by the term 'Environment Agency', which conveyed a distancing of the 'real' water environment – it became a mere background or peripheral entity and

depersonalised with narrow consideration of its socio-cultural, as well as economic, value.

In their use of an entitlements approach to analyse access to environmental justice in urban areas, Jenkins *et al.* (1997 cited in Leach *et al.*, 1999) emphasised the nonmaterial dimension of institutional skills, which enable people to access official decision-making structures and other public goods. Unfortunately the environment and its non-human inhabitants have to rely on surrogates (such as WWF) to provide such skills, which have limited powers of influence on Governmental decision-making structures (discussion of resulting issues of power is beyond the scope of this paper).

From this it could be inferred that legislation has become too utilitarian and that cultural beliefs and values are neglected. Whilst water legislation has to be focused on operational issues (granting of licenses, regulation of water/sewerage undertakers, mains connections etc) this need not necessarily preclude better inclusion of cultural aspects of the water environment. Wayfaring would provide an approach that would better enable consideration of a culture's water histories, stories, narratives and connections, which could better situate them in the matrix of movement of a changing water governance environment. It has been conjectured that such performative initiatives could potentially enable reflexive consideration of the water environment and its non-human animal inhabitants and the consequent development of more 'water friendly' beliefs, values and practices (Strang, 2001; 2009); perhaps this too would be true in a more holistic legislative setting. Alternatively, perhaps the particular section of the Act claiming to 'regulate for the water environment', should be renamed to 'regulate for water infrastructure'.

Finally, arrangements for the taking of water from other parties (non-water service providers e.g. private individuals with abstraction boreholes on their land) do not seem to recognise the rights of the environment from which this water originates. Instead they focus on the landowner or permit holder. This parallels Australian and Bengalese findings (Strang, 2009; Lahiri-Dutt, 2014), which highlight that decoupling of water and land can result in water apportionments becoming 'owned' by people rather than the environment, with negative consequences.

In the focus group, despite a recognition by participants that humans are part of, not excepted from, the water environment, its rights and requirements were barely represented and much less so than in the legislation. Only one participant specifically mentioned requirements, by which they meant habitats and the quality of water required by non-human inhabitants. There was not enough exploration of this theme to make apparent whether participants saw their water entitlements as being shared with wildlife. Consequently, it was difficult to ascertain whether participants saw themselves at conflict with wildlife over access to water resources.

In contrast to rights, representations were more elucidated within participant's thinking, though some participants struggled to fully conceptualise and communicate their thoughts and meanings beyond scientific representations. The

water environment was generally considered a series of components comprising a system, though one participant did attribute colours to individual 'layers' of the environment in a more conceptual manner. The water environment was not described as something with which the participants interacted on a regular basis.

Perhaps this can be understood by recognising that the behaviour of social actors is not automatic or unconscious; actors monitor, interpret and shape the world around them (Long and Long, 1992). However, in the case of the participants in this research, there may be a disconnect between their personal representations of the water environment and its non-human inhabitants and their profession representation of the systems relating to those entities. This potentially arises where water management, engineering and environmental modelling techniques are used that distance and depersonalised the entities, representing them as 'black boxes', strings of programming or series of data.

After the presentation of the pictorial representations of non-human inhabitants of the water environment, however, the participants began to reflect more meaningfully about how such entities featured in their everyday lives, activities and personal interactions. These representations acted as anchoring points and they began to think in a more wayfaring-orientated manner, grappling with how their lives intertwined with non-human inhabitants of the water environment. Fish and birds were mentioned, gold and ornamental fish and heron specifically, as well as seals, but no other individual species. Balance and harmony between humans and non-human inhabitants was described by two participants and one described how environments should be kept as natural as possible with flora and fauna in mind. This participant went on to elaborate by expressing that where there are human and wildlife conflicts in water environments, approaches to protection should meet the needs of both rather than being at the expense of the environment or the wildlife.
A final theme that was common across several participants' responses was that of the resource (or ecosystem service) value of water environments and their non-human inhabitants. The latter were also described as critical indicators of the health of the water environment that should be regularly measured and monitored, as well as providing products. These utilitarian views parallel that identified in the legislation, suggesting that water legislation and thinking both systematise and functionalise water environments and their non-human inhabitants.

Conclusion

It can be summarised that there are not a wide range of options for endowments or entitlements that the water environment and its non-human inhabitants can access or control. They are set by Government bodies, which, as evidenced by the WWF's attempts, are incredibly hard to influence. Socio-cultural beliefs and values, as well as the rights of non-human inhabitants are generally underrepresented in law. They are also peripheral to water professional's consideration of the water environment, which is characterised as comprising systems of provision for water supply and sanitation services.

Wayfaring could be a useful model to incorporate into law-making and water management education, to enable decision-makers and professionals to better consider how the water environment and its non-human inhabitants intertwine with water-users' lives and infrastructures on which both human and non-human lives depend. As it must have a narrow focus in order to be operational, legislation may depersonalise cultural values and beliefs relating to water environments and their non-human inhabitants. Water management thinking can also systematise and functionalise these entities. Consequently, more widespread representations of non-human inhabitants of the water environment in legislation and thinking could help re-personalise connections between the two by providing specific anchoring points. Such points could facilitate a better understanding of how natural, engineered and cultural complex systems are intertwined, as well as their interdependencies.

A theoretical framework comprising environmental entitlements, social representations and wayfaring theories has been demonstrated as a useful approach in reconceptualising how the water environment and its non-human inhabitants are represented in water management legislation and thinking. This framework could be used to complement existing dominant frameworks such as sustainability transition theory and the technological innovation system concept. This may in turn facilitate water management approaches that have the best interests of all actors (humans, non-human inhabitants, landscapes) at their core and ultimately better enabling people to live with environmental change.

With this in mind, the following recommendations are suggested for improving consideration of the rights and representations of non-human animals in water management legislation and thinking:

- Enhanced representations of aquatic wildlife in water legislation and thinking could provide useful reference points to link human, engineered and natural systems;
- Interventions should focus on representing non-human inhabitants rather than the depersonalised 'water environment';
- Stronger collaboration between a wider group of organisations should be developed in order to better influence Government and policy-making;
- Future research should explore interdisciplinary approaches that seek to explore the complex links and interdependencies of the human-engineered-natural system of the water environment.

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Appendix 2 - Focus group participant sheets & pictorial representations

Questions for us to explore together:
(discussion will be followed by a debrief)

1. What does the term 'environment' mean to you in the phrase 'water environment'?

Words **Sketches**

Diagrams

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2. In what ways do you consider non-human animals when thinking about water environments?

Practices **Recreation**

Hobbies

Travel **Other activities**