TITLE: SUDs and human perceptions

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Abstract

This chapter considers the centrality of human perceptions, and so behaviour, to the *sustainability* of SuDS. Research shows a lack of engagement with flood preparedness and flood risk mitigation (FRM) in the public as a whole, and many people are averse to installing defences because of the clear acknowledgement of risk they represent. It is posited that sustainable approaches to FRM may represent a way around this seeming impasse, green spaces less self-evidently symbolising flood risk management techniques and further being generally favoured within neighbourhoods.

Portland, Oregon is considered as a case study, demonstrating the positive potentialities of sustainable FRM techniques, but also the importance of working with communities to ensure good understanding of the devices' nature, purpose and appropriate behaviour regarding them. A dialogic co-construction approach between experts and publics is advocated as the best way to ensure appropriate behaviour that will encourage the sustainability of SuDS devices.

Keywords

SuDS, sustainability, human perceptions, human behaviour, co-construction, lay knowledge, bioswales, Portland, Oregon.

Introduction

This chapter will argue that people's perceptions and understandings of the purpose, function and wider potential benefits of Sustainable Drainage Systems (SuDS) will be central to their *performed* sustainability. These perceptions and understandings will affect people's understanding of, and desire to perform, good and bad behaviours that will encourage or discourage function, and thereby impact upon performance, expected product life cycle and the accrual of associated benefits. These will in turn cycle back to influence perceptions and so the development and mainstreaming of individual inclinations and social norms to perform good behaviours and contribute to maintenance.

The chapter will firstly consider how people are engaging with flood risk as an issue. Secondly, it will present a brief literature review of works studying public preferences and behaviours regarding approaches to sustainable flood risk management (FRM). It will then turn to focus on Portland, Oregon (United States) as a case study of sustainable FRM, considering the published literature on public perceptions and behaviour, particularly around 'bioswales'. This section will consider public awareness and understanding of bioswale functions and how these may affect perceptions of amenity, costs and benefits, and so impact upon behaviour.

The conclusion will argue that maximising opportunities for involving citizens in the development and tailoring of SuDS could help encourage the take-up of more appropriate – sustainable – behaviours. Without such efforts, comprehension of the purpose and nature of installations might rest at such a level that inappropriate

behaviours remain commonplace, reducing the efficacy, cost-effectiveness and *sustainability* of nominally more 'sustainable' approaches.

Public Preferences and Understanding of Flood Risk Management

Around 5.5 million properties currently stand in areas at risk of flooding from rivers, the sea and surface water in England and Wales alone (Environment Agency 2009a, 2009b), yet action to install flood protection measures remains surprisingly low. Only around 1 in 4 of those who have been flooded have since taken action, whilst for those that have not experienced anything this drops to 6% (Thurston 2008, Harries 2010, 2012). Some forecasts predict that with climate change, UK flooding may increase dramatically over the next 75 years. If so, this could cost tens of billions of pounds every year in repairs and protection work (King 2004). This will be mirrored across the world as climate change impacts upon built environments.

However, as Lamond and Proverbs (2009) have argued, people must go through a number of stages of thinking before they can accept the realities of possible flooding and begin to engage with this. That is, developing the *desire* to act through awareness, perception and ownership of the problem, as well as the *ability* to act in developing the knowledge, the available capital and a belief that acting will alter the situation. Public ownership of flood risk is apparently low; respondents sometimes demonstrate aversion to acknowledging the scale of risks faced (Defra 2011, Speller 2005). This may stem from what Tim Harries (2010) has referred to as preferences for *feeling* secure over and above *being* more secure, and being constantly reminded of potential risk by measures put in place (seeing flood-doors and so forth).

This may be no less true regarding the perceived utility of municipal defences as household adaptations; communities might not accept labelling and actions that acknowledge and work to reduce the risk, for fear they could negatively affect property prices (Burningham et al. 2008). Nonetheless, trends have been observed for people to perceive the responsibility for installing flood protections as a government-level one rather than that of households (Correia et al. 1998, Werritty et al. 2007), with people remaining passive and expecting government or insurance to cover the costs (Ludy and Kondolf 2012, Brilly and Polič 2005). Whilst other studies have found that publics recognise at least joint responsibility for managing flood risk with designated authorities (Laska 1986), findings have in turn shown that people's willingness to pay for mitigations can be as low as one-off payments of less than £100 (Kazmierczak and Bichard 2010), which would not cover the cost of effective measures, strongly implying that the problem still remains.

It could be however that there are some in-built preferences within society towards more sustainable approaches to managing flood risk. A number of studies have shown that increasing green space and biodiversity, or wildlife corridors, within the built environment is generally perceived positively (Dunnet & Qasim 2000, Fuller et al. 2007, Chiesura 2004, Coley et al. 1997, Seymour et al. 2010) whilst others indicate positive impacts upon mental and physical health (Dean et al. 2011, Tzoulas et al. 2007, Ulrich 1979). Thus it *could* be that sustainable approaches to FRM will be perceived more positively due to their increasing available green-space and contributing to biodiversity, whilst not presenting in the first instance as flood-risk defences; this is something we shall consider in the next section.

The *Sustainability* of SuDS

US and UK policy now favour employing more sustainable approaches to Flood Risk Management (FRM) (Defra 2005, EPA 2013, Scottish Government 2003). Implementing this shift away from hard 'grey' infrastructure will require the involvement of all stakeholders, including local publics who will be affected, in developing new practices and behaviours to ensure functionality and sustainability. This raises questions around where public preferences lie, and whether and if so how they might develop, positively or negatively, with the wider adoption of SuDS.

In contrast to generally more hidden grey infrastructure, SuDS will frequently alter the visible urban environment: 'green' SuDS such as green roofs, swales and rain gardens will involve locating green spaces within or atop the built environment, whilst rain-barrels will alter aspects of home aesthetics and permeable paving may change aesthetics and the 'feel' of the ground. All will therefore involve developments in thinking with regard to what flood risk management should involve and look like (Shandas et al. 2010), and will necessitate shifts in behaviour to enable them to carry out their function over the medium- to long-term. Furthermore, perceptions of SuDS could influence homebuyer preferences, house values and so developer practices (Netusil et al. 2014, Bolitzer & Netusil 2000, HR Wallingford 2003).

For this reason, understanding public perceptions and behaviours is vitally important. Crucially, Sustainable Drainage Systems will only ever be as *sustainable* as the behaviour surrounding them. Mistreated permeable paving or swales might last only a few years if people allowed their cars to leak oil onto paving or used swales as

convenient places to dispose of refuse, thereby blocking water flows.

Looking back to the SuDS Triangle [Chapter ??], Water Quality and Quantity make up a substantial part of the research that has been conducted around SuDS. Yet as Singleton (2012) acknowledges, the third arm of the triangle, Amenity (and Biodiversity or Wildlife), is frequently less considered. Indeed, 'sometimes it is sidelined, or even forgotten completely' (Singleton, 2012, 2). This is possibly because, as Singleton (2012) acknowledges, targets for 'amenity' can be hard to set and outcomes in turn vague. Biodiversity is furthermore a quite separate consideration without overall agreed measurement metrics, scales of assessment (Franklin, 2008; Purvis & Hector, 2000) or formulae for connecting this back to how it would benefit 'amenity' (Hanley, Spash, & Walker, 1995).

Yet the amenity arm of the SuDS triangle is arguably the most important from both social and sustainability perspectives. People need to understand SuDS' direct functions (reducing flooding and improving water quality), as well as their more indirect benefits, such as adding to the urban environment's green infrastructure, in order to be cognizant of how they contribute to amenity (such as reducing water consumption and enabling more access in times of drought, improving aesthetics and air quality, providing wildlife corridors to encourage biodiversity, and leisure and recreation spaces that frequently benefit mental and physical health, etc.). If they do not feel the devices contribute to their lives, people may be more unwilling to alter behaviour to encourage longer-term functioning, and to pay for the wider rollout as well as maintenance of such approaches.

'Amenity' is a frequently referenced benefit of using SuDS (see Defra 2011, Graham

et al. 2012, Anglian Water 2011), yet the preferences and perceptions of those who live around devices are under-researched. A few studies have produced findings indicating that publics prefer structural defences to SuDS. Werritty et al. (2007, 44) found over 90% of respondents preferred structural defences to proposed alternatives, these being viewed as 'the first line in flood defence'. In looking at the potential benefits of SuDS, Johnson & Priest (2008) also concluded that the public, media and insurance industry remained heavily focused upon structural defences.

In contrast, Kenyon (2007) found her participants preferred rural SuDS approaches such as regeneration of woodlands, with structural defences the least favoured option. Three other studies from the UK also noted public preferences lying with more sustainable approaches to FRM; HR Wallingford (2003), Apostolaki & Jefferies (2005) and Bastien et al. (2011) each found SuDS ponds were valued by local residents for their aesthetics, amenity and contributions to wildlife, with wildlife being rated as the most important factor, but aesthetics being a deciding factor.

Apostolaki & Jefferies (2005) found low levels of awareness of local schemes' functions, with many respondents unaware of either the term 'SuDS' or the ponds' contributions to flood-control. It was observed that people's views about SuDS ponds related at least in part to their awareness of functions and services. Bastien et al. (2011) found that public awareness of ponds' functions was much higher than in Apostolaki & Jefferies' (2005) research (almost 75% of those surveyed understanding). However safety was a major concern of residents, and large differences were observed between *perceived* and *actual* safety levels (see also McKissock et al. 1999). Tunstall et al. (2000), however, evaluated several flood risk

and amenity improvement river restoration projects, concluding that 'well-presented' schemes could be implemented, alongside consultation and awareness-raising, without raising safety concerns. The overriding conclusion of these studies is therefore that education and consultation are vital to the effective pursuit of sustainable strategies.

Studies from the US, often more around Green Infrastructure (GI) generally than SuDS specifically, but with findings of central relevance, indicate similarly that awareness and understanding can be quite low (Barnhill & Smardon 2012, Everett et al. 2015, 2016). Barnhill & Smardon (2012) provide a concise but extensive literature review of the situation in the US. They cite LaBadie's (2010) findings of poor knowledge regarding the design, construction, maintenance and funding of such techniques in Albuquerque, New Mexico as an example of how core understanding is generally lacking, and how this can negatively impact upon willingness to consider SuDS alternatives. Similarly, Shandas et al. (2010) stress the need improve knowledge of stormwater management techniques, having observed some significant variance amongst neighbourhoods in their studies in Portland. Others have observed misconceptions regarding SuDS harbouring increased populations of mosquitoes (Traver 2009, Everett 2016), which could in turn negatively affect perceptions.

Barnhill and Smardon (2012) point to related potential issues to acknowledge and deal with, such as how interventions might affect the socio-economic profile or felt safety and security of areas (Pincetl and Gearin 2013, Seymour et al. 2010). However they also point to studies that reflect upon the potentially positive social equity

impacts of increasing access to green spaces (Floyd et al. 2009, Pincetl and Gearin 2013) and how this could develop safer and healthier neighbourhoods (Abrahams 2010, Qureshi et al. 2010, Shandas et al. 2010). Similarly, Dill et al. (2010) observed in their Portland study that residents saw children playing outside more on green streets, felt they were better places to live and found walking in their neighbourhoods more pleasant. The overall outcome is a sense of the significant potential positive or negative impact of designing GI SuDS into urban environments. In the next section, we will look to a series of case studies that have been conducted around the use of sustainable approaches towards flood risk management in Portland, Oregon.

Attitudes and Behaviour: Portland, Oregon

In the US, 'Green Infrastructure' (Benedict and McMahon 2006) has been being promoted for around 20 years for environmental, economic and social reasons. Portland, Oregon has a history of flood events with an expected 10-year return period known as 'nuisance flooding' – relatively minor floods which nonetheless cause road blockages, basement and house flooding, and contribute to worsening water quality through run-off from roads and industry (BES, 2001). As a result, the Portland government's Bureau of Environmental Services (BES) has been developing more sustainable approaches to managing stormwater throughout this time (Reinhardt 2011).

The BES's *Grey to Green* initiative (2008-2013) focussed on expanding the use of stormwater management techniques that mimic natural systems, to restore and protect existing natural areas, improve water quality and reduce problems with

street and basement flooding (BES 2010). This has included, firstly, a Willing Seller Land Acquisition Program, targeting three specific areas that experienced regular nuisance flooding, to buy up houses and return the land to a more natural state; restoring wetlands, improving flood storage for surrounding areas and benefitting wildlife and leisure activity opportunities (BES 2015a). Secondly, the Clean River Rewards program has offered households up to a 100% reduction in their stormwater utility fees when stormwater is managed at property-level rather than feeding into the drainage system, as well as the City offering free workshops on how to register and how to manage stormwater at a household level (BES 2015b).

This has previously included offering reductions if households disconnected their 'downspout', or roof drainpipe, so that rainwater fed directly into their garden or rain-bucket rather than entering the drainage system (BES 2014, Wise 2010), as well as reductions for using green roofs (BCIT 2006). Portland has a mandatory policy of installing green roofs on city-owned buildings, unless this would be impractical (BPS 2009). Further, planning policy allows for increases in building density where green roofs are used (BCIT 2006). Whilst the City no longer offers free work or such incentives, they do still proudly assert that these programmes have led to 56,000 downspouts being disconnected, which has removed 1.3bn gallons of stormwater from the Combined Sewer Overflow systems each year within the City (BES 2014).

As a result, Portland is now considered one of the leading cities in the United States in its pursuit of using green infrastructure to improve many aspects of city life (improving liveability, promoting sustainable development practices and helping to prepare for climate change; see Slavin and Snyder 2011). Portland, for example,

receives a high score for sustainability endeavours in Portney's (2013) review of US cities (see also Mayer and Provo 2004).

The City adopted its first Stormwater Management Manual in 1999 (SWMM, BES 2014) and then officially assumed a Green Streets Policy in 2007 (BES 2007). As a result of this one further key element within their approaches to dealing with stormwater runoff, 'bioswales', have been being installed on city streets for over ten years. Bioswales, or bioretention gardens, are highly engineered SuDS stormwater management facilities similar to rain gardens, but with drainage installed underneath to transport the filtered water, using native plants to extract pollutants before it returns to the main watercourse (see Image 1). These have been being used extensively in Portland for reducing street and basement flooding and improving water quality, both as City retrofits to developed areas and through changes to legislation that require developers to undertake GI SuDS work wherever more than 500 sq. ft. of hard-standing is to be laid down (BES 2014).

Image 1. Bioswales in Portland, Oregon and pre-planting information

(Credit: Faith Ka Shun Chan, 2013)

In Portland, Shandas (2015) and Shandas et al. (2010) researched the Tabor to the River Program (T2R, BES 2015), a series of works involving extensive tree-planting, bioswale installation, habitat improvements and sewer pipe restoration, to improve the area's ability to cope with the limits of a historic Combined Sewer Overflow pipe system in the face of increases in urbanization, hard-standing, and climate change. Shandas (2015) and Shandas et al.'s (2010) work looked at resident understandings and attitudes in areas within the T2R programme where bioswales had been

installed and compared this with areas where no closer engagement work had yet been undertaken.

The surveys they conducted found respondents in general to be well informed about the nature of the programme. They found people in areas with bioswales rated their surroundings more highly on every variable considered (walkability, safety, aesthetics and green-space), pointing to a positive relationship between resident satisfaction and green infrastructure SuDS, as posited in the previous section. In terms of willingness to engage with maintenance of devices, Shandas et al. (2010) found that as a rule, higher income households were more likely to engage, and more likely still if they were already involved with the other environmental projects, if they had developed social interactions with others in their neighbourhood or if they rated the neighbourhood lower regarding the presence of parks and open space. Lower income households were more likely to engage when younger or with a graduate education.

Church (2015) also studied T2R, finding strong awareness of and support for the use of bioswales, crediting this to outreach work undertaken by the Bureau of Environmental Services (BES). Church (2015) found support for the statement that bioswales were ‘a good idea’ (82%), but weaker support for the notion that bioswales improve aesthetics and act as an amenity (32%). A large proportion of the sample (63%) understood the function of bioswales. Church’s (2015) work did however discover mixed views of bioswales as ‘nature’; around two-fifths felt they were and the same number felt they were not, the rest considering them a

purposive ‘manufactured’ nature – highly-engineered City interventions rather than natural, or providing green-space or wildlife corridors.

Dill et al. (2010) looked across several sites in Portland to assess whether green streets impacted upon ‘active ageing’. They found green streets residents walked more than other areas, even controlling for demographics, attitudes and nearby destinations, and were more likely to concur that walking in their neighbourhood was more pleasant since facilities were installed. It was further found that green streets residents stopped and talked with their neighbours more often than on other streets. Concurring to some extent with Shandas et al. (2010) work, Dill et al. (2010) found older residents tended to hold more negative opinions about facilities.

Everett et al. (2015, 2016) also researched public perceptions and behaviour regarding Portland bioswales. This research looked outside of the T2R programme area, and possibly due to demographic differences and a different methodological approach, findings differed somewhat from those of the authors detailed above. Everett et al. (2015, 2016) adopted a Point of Opportunity Interaction (POI) approach, talking without prior notification with people on the street or in their gardens, to avoid ‘self-selection bias’ whereby residents might respond only if they were already aware of the installations and had strong opinions about them (see Whitehead 1991, Hudson et al. 2004). The interactions produced valuable insights from people who may not otherwise have volunteered for more formal engagements.

Everett et al. (2016) found a lot of low awareness of the purpose and function of devices. Those with some awareness spoke much more about reducing flood risk

and cleaning the water than they did about possible wider benefits of the devices, such as providing wildlife corridors or helping with adaptation to climate change. Importantly, a significant minority of residents in areas not at direct flood risk did not connect with how devices local to them might help mitigate risks elsewhere, or the City-wide economic benefits of avoiding flooding. Others were rather cynical about City claims for flood reduction and water cleaning, indicating lower awareness. With regard to maintenance, some respondents took part in basic litter clearing, but very few were aware of the existence of the Green Street Steward programme. The City publishes materials advising on how to clear facilities (BES 2012, 2013), and encourages members of the public to sign up as Stewards, where they gain training and then 'adopt' bioswales. These points again reemphasise the importance of engagement and awareness-raising taking place prior to, during and following the installation of devices.

Everett et al.'s (2016) study also demonstrated some pronounced dissatisfaction with plant choice and maintenance on certain streets, with some residents thinking plants looked like weeds, others that they looked overgrown and unkempt and a final group asking why they could not plant edible produce in the bioswales. Dialogue in such cases might allow for local aesthetic adaptations and negotiation as well as awareness raising. Finally, as a result of poor bioswale understandings and perceptions, Everett et al. (2016) heard stories of people emptying their trash into the devices, cutting back or removing plants that had been placed there for a reason, and diverting water *away* from bioswales so that it remained on the street. Whilst such stories were in a minority, they were frequent enough to cause some concern

regarding levels of awareness and 'buy-in' to City strategy, and how this might affect longer-term performance and sustainability of devices.

Co-Development and Co-Ownership

An increasing number of authors therefore advocate for adopting what we might term a knowledge *co-construction* approach where all interested parties can discuss and learn from each other in developing together solutions that all might be more satisfied with, over a 'deficit model', expert-public knowledge-transfer approach (Fielding et al. 2007, White and Richards 2008, Evers et al. 2012, O'Sullivan et al. 2012).

Engaging and involving locally affected communities should be a fundamental first step in looking to encourage the community buy-in needed for device longevity. 'Deliberative participation strategies' need to be employed alongside efforts at community education in order to effectively empower and involve publics (Ryan and Brown 2000). As Tunstall et al. (2000) have noted, publics expect to be consulted about changes to their local environment, especially ones that will negatively alter aesthetics in the short term and that some may regard as negatively affecting their flood risk.

Dialogue and consultation around engagement work could help to bring in local knowledge, concerns and preferences, with the aim of constructing devices that local people feel greater ownership of and investment in, improving awareness to improve acceptability (Hostetler et al. 2011, HR Wallingford 2003). Consultation could also allow people to input to modifications that could improve preferences

and give them a sense that these were 'their' spaces, thereby hopefully encouraging interest in adopting stewardship roles (Dill et al. 2010, Larson and Lach 2008, Shandas et al. 2010, Everett 2016).

Conducting engagement could be challenging, and costly; it would be important to try to get beyond the 'usual suspects', as Larson and Lach (2008) and Shandas et al. (2010) found with their studies that higher income and more highly-educated respondents were more likely to engage with consultation exercises and other city interaction efforts. Henning (2015) presents an interesting approach to thinking about engagement in looking to break down the catchall of 'homeowners' into a more textured analysis of motivations. Henning (2015) arrives at a 6-point typology relating to people's concerns, or lack of, with the adoption of green infrastructure and stormwater management techniques. This ranges from those more concerned with maintaining clean aesthetics, through 'the greens' concerned to do what they believe is good for 'the' environment, to 'early adopters' of stormwater management techniques such as rain barrels. This more textured and nuanced attempt at understanding 'the public' could, Henning argues, allow for more targeted communications pitched at top-level preferences (reducing flooding, increasing green-space, improving biodiversity or aesthetics, and so forth). This could in turn work to bring more people in to conversations around SuDS and GI.

Conclusion

This chapter has looked at what we know so far of public understanding, preferences and behaviour around SuDS systems. We have seen that understanding of the purpose, function and wider benefits of such systems do exist, but that they appear

to be far from mainstream. The published literature supports the feeling that a strong majority of the public are unaware, or insufficiently aware, of the reasons these systems are put in place, unless they are engaged with early and in an on-going manner. As a result, preferences will frequently be developed based upon the aesthetics and perceived amenity or disbenefits of systems. Yet if people are unaware of the wider potential benefits, whilst costs such as reduced parking space or perceived reductions in safety are more obvious, this will feed back to negative preferences regarding SuDS.

As a result of low awareness, further, people have been argued to be often poorly informed about behaviours required to ensure continued functioning and the development of the multiple potential benefits from established devices, as we saw with Portland. This will tend again to feed back to reduced functioning, worsened aesthetics, and further negative preferences.

We have acknowledged and agreed with arguments from the literature that to encourage more positive preferences it will be important to bring potentially affected or concerned publics in to conversations around SuDS as early as possible. Where people are involved, they can express their personal preferences, share their local expert knowledge, learn from professional stakeholders and negotiate towards maximally preferred solutions for all parties. In so doing, members of the public will hopefully become more disposed to assume 'ownership' over devices and therefore be more willing to engage with both good behaviour and maintenance practices.

The engagement efforts around the *Tabor to the River* programme in Portland stand as an example of best practice, where local voices have been listened to, awareness

is high and behaviour generally good. However the further Portland research cited demonstrated that where such engagement work was not undertaken, awareness remained low.

Engagement will cost in the short-term, but engagement of publics with the development and implementation of their local devices might save money over the longer-term. A greater desire to have devices that have been co-developed and people feel ownership over alongside improved awareness and appreciation of devices' multiple benefits could encourage more widespread appropriate behaviour (and community-level disapproval of inappropriate behaviours). Such desire could further help inculcate community-level endeavours at low- to medium- level maintenance work in the manner of Portland's Green Street Stewards.

Engaging communities as early on as possible, and in an on-going manner, in the co-development and implementation of SuDS solutions is perhaps the best approach for ensuring that Sustainable Drainage Systems truly are *sustainable*, as well as more cost-effective in the long-term.

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