3[rd] SWITCH Scientific Meeting
: Belo Horizonte, Brazil
30 Nov – 4 Dec 2008

Developing a framework for sustainable stormwater management

Bryan Ellis, Lian Scholes, Brian Shutes and Mike Revitt

Urban Pollution Research Centre, Middlesex University, The Burroughs, Hendon, London, NW4 4BT, UK

Abstract

Learning Alliances in three SWITCH demonstration cities (Belo Horizonte, Brazil; Birmingham, UK and Hamburg, Germany) are continuing to actively inform and refine the development of a framework of concepts for sustainable stormwater management. To-date this has involved the documentation and evaluation of current institutiona arrangements for managing stormwater in the three SWITCH cities (establishing a baseline on which to base further discussions) and the development and discussion of a stormwater re-use catalogue (generating awareness of alternative uses of stormwater), with both these aspects feeding into the revision of draft sustainable stormwater objectives and indicators. This paper presents the key findings of this work together with an overview of the proposed application of the identified stormwater objectives and indicators within further SWITCH tasks.

Keywords: stormwater management strategies; stormwater reuse; stormwater sustainability objectives and visions

1 Introduction

Developing a sustainable urban water management strategy is a complex challenge for many reasons, not least of which is the need to encompass a broad range of technical, environmental and institutional issues which may operate over a variety of spatial and time scales. Learning Alliances often need support in tackling these aspects as well as more clearly identifying city-specific needs and local solutions which address their surface water drainage needs. For these reasons, research undertaken within WP 2.2 of the SWITCH project has focused on documenting and analysing the current approaches to stormwater management in the SWITCH demonstration cities of Birmingham (UK), Belo Horizonte (Brazil) and Hamburg (Germany) with a view to establishing a base-line context against which to set further discussions (Ellis *et al*., 2007). A subsequent task has contributed to the development of concepts of sustainable stormwater use, and in particular the ‘paradigm shift’ towards utilising stormwater as a reusable resource. A catalogue of stormwater re-uses has been compiled which is intended to act as a source of ‘ideas’ to stimulate further discussions (Scholes and Shutes, 2007). Together with work being undertaken in WP 2.1, both of these documents have fed into the revision of the draft SWITCH objectives and indicators relating to stormwater management being developed within Theme 1. This paper highlights key aspects of these tasks, by further developing

* Corresponding Author: M.Revitt@mdx.ac.uk

relevant stormwater objectives and their proposed application in building-on the Learning Alliance visioning exercises undertaken within Theme 6.

2 The need for regulation of stormwater runoff and strategic approaches

Regulatory practice throughout the world now recognises the need for legislative and administrative frameworks to address the environmental problems caused by diffuse runoff from impermeable urban surfaces (e.g. EU WFD, 2000; US Federal Water Pollution Control Act, 2002). However, the push for increased urban densities has also received central government endorsement in many countries (PPS 3, 2006) without sufficient attention being paid to the impacts of the resulting elevated runoff discharges on receiving water bodies. The problem of wet weather flows from combined sewer outfalls (CSOs) has long been recognised by the introduction of relevant and frequently strict standards and regulations. Such point sources have attracted considerable rehabilitation and maintenance investment in recent years (US EPA, 2004). The problems associated with separately sewered surface stormwater runoff however, have only been more recently recognised and the regulatory frameworks for such diffuse, non-point sources are variable and less well developed. Far too often the management of water supply, wastewater and stormwater are regarded as separate entities by national water industry structures and decision-making processes. Clearly strategic catchment planning requires that the infrastructures for these water–based components be considered and regulated in a holistic, integrated manner.

Regulatory and administrative frameworks operate at national, regional and local levels and it is important that strategic objectives have similar operational interpretations of how the outcome targets will be delivered at each of these organisational levels. Table 1 provides a brief outline of generic regulatory targets and priorities for the urban aquatic environment and the need for differing actions at varying levels.

The majority of current regulations, standards and guidelines pertaining to stormwater management have been developed for conventional hard engineered urban drainage systems and are therefore not always appropriate for alternative and often innovative design approaches, associated with BMPs, which are becoming more frequently adopted in integrated urban water management (Ellis *et al.,* 2007). Conventional approaches and, in particular drainage regulations can therefore be seen to lag behind leading-edge best practice in this area.

A further major barrier to the adoption of alternative technologies and approaches is that of risk aversion and legal liability. Non-conventional systems tend to create new risk profiles that normally are not consistent or even compatible with existing organisational and planning structures. The issues of unclear regulations and guidelines as well as a possible lengthening of the development approval process, act as conservative forces which can be difficult to address and overcome. Site development is also essentially a 'piecemeal' process with construction blocks coming on-stream at different times. This development streaming makes it difficult to ensure consistent drainage infrastructure practice between individual land parcels as they are released for development. In addition, the interpretation of codes of practice and guidelines can vary between regional offices of the same national regulatory agency, and this can act as a disincentive to developers. The relationship between urban drainage and land use planning has traditionally not been considered from a strategic, integrated policy perspective with the result that non-point discharge control has developed in a piece-meal and unsustainable manner.

Table 1. Regulatory Actions and Organisational Levels

Concern	National/Federal Action	Regional/Local Action	Comment
Urban surface water drainage and land use planning	Strategic policy and planning requirements; Financial incentives (and penalties) e.g. stormwater tax	Enforcement; Codes of practice; Mandatory guidelines; General Binding Rules (GBRs)	Need active community and other stakeholder involvement at local level. Target to Minimise Directly Connected Impermeable Area.
Illegal connections	Regulation for controlled activities.	Enforcement; Ordinances; GBRs	Liaison between municipal and wastewater utility; involvement of Environmental Health Departments
Pollution from site construction	Regulations for development sites e.g. licences, permits	Enforcement; Codes of practice; Licences/Permits	Use of on-site BMPs
Environmental damage from surface water drainage (including flooding)	Strategic policy and guiding legislation for flood and water quality e.g. permits, consents, licences etc); Regulation for controlled activities.	Setting receiving water objectives/targets; Enforcement; Codes of practice; guidelines/byelaws; GBRs; local liaison groups e.g. FLAGs (Flood Liaison Action Groups)	Also needs planning inputs and holistic, integrated approach to water resource management at both spatial and temporal scales; Community awareness
Chronic in-stream pollution	Legislation for persistent, low level discharges; Restrict usage rates and product substitution e.g. Pb, Cd etc	Inspection and policing of likely pollution sources; Company registration; BMP retrofitting	Identification of priorities and polluting substances; Capital and O&M programmes for severe problems
Oil & Chemicals	Oil & Chemical storage and disposal regulations	Company registration; SME support and guidance; BMP retrofitting; Awareness campaigns	Need to continually engage relevant sectors e.g. car washing/steam cleaning; Leaflets and signage campaigns.
Toxic traffic emissions and vehicle loss/wear	Legislation for traffic management; air emissions; GBRs; Mandatory guidelines; codes of practice	Traffic management; Driver awareness campaigns; BMP retrofitting.	Need for driver behavioural campaigns.

3 Catchment Scale Approaches to Regulatory Planning in Selected SWITCH Demonstration Cities

As part of the on-going work in WP 2.2, the legislative structures and decision-making frameworks for urban drainage infrastructure currently operating within Birmingham (UK), Hamburg (Germany) and Belo Horizonte (Brazil) have been documented (see full details in Ellis *et al.,* (2007)). The aim of this work was to identify the principal drivers and organisational structures that currently deliver surface water drainage under differing national and federal managing agencies. The following sections highlight key aspects and conclusions.

3.1 Catchment-scale planning in Europe

Within a European context, the EU Water Framework Directive (WFD) sets major and strategic policy goals for the future direction and implementation of urban drainage in all European member states (EU WFD, 2000). Through its emphasis on the need to manage diffuse pollution, the EU WFD can provide substantial opportunities for the consideration and inclusion of alternative source control BMP approaches within future urban land use planning programmes. Key administrative requirements within the EU WFD (under Article 13), will be the production of River Basin Management Plans

(RBMPs), and under Article 11 an associated Programme of Measures (PoM) which will be the main delivery mechanisms to achieve the Directive's ecological objectives. Most EU member states (including Germany and the UK) are already familiar with water management strategies developed within the context of river basin planning. Following initial risk assessment and River Basin District (RBD) characterisation based on land use activities, waterbody classification based on ecological and chemical status will be identified, and the competent regulatory authorities must then use this information to develop an integrated PoM. Figure 1 illustrates the structural requirements for such a programme and in many member states, urban surface water discharges might be principally dealt with under Supplementary Measures utilising General Binding Rules (GBRs) with accompanying codes of practice and guidelines.

As reported in both the Birmingham, UK and Hamburg, Germany descriptions of strategic regulatory frameworks and administrative structures (see Ellis *et al.,* 2007), the German and UK agencies and organisations already have a basis for regional and catchment scale planning which incorporates elements of both Basic and Supplementary Measures for the management of urban drainage. Nevertheless, there are clearly tensions between the federal/national levels of regulation and the operational delivery of infrastructure programmes at the local municipal level. One particular source of tension will be the compatibility between RBMPs, which will be the responsibility of state/national regulatory agencies and local based stormwater management plans (SWMPs) which will be the responsibility of individual municipalities (or local authorities). The organisational distribution of responsibilities in respect of urban surface water drainage will undoubtedly become clearer as the RBMP process proceeds with a deadline for implementation of 2012.

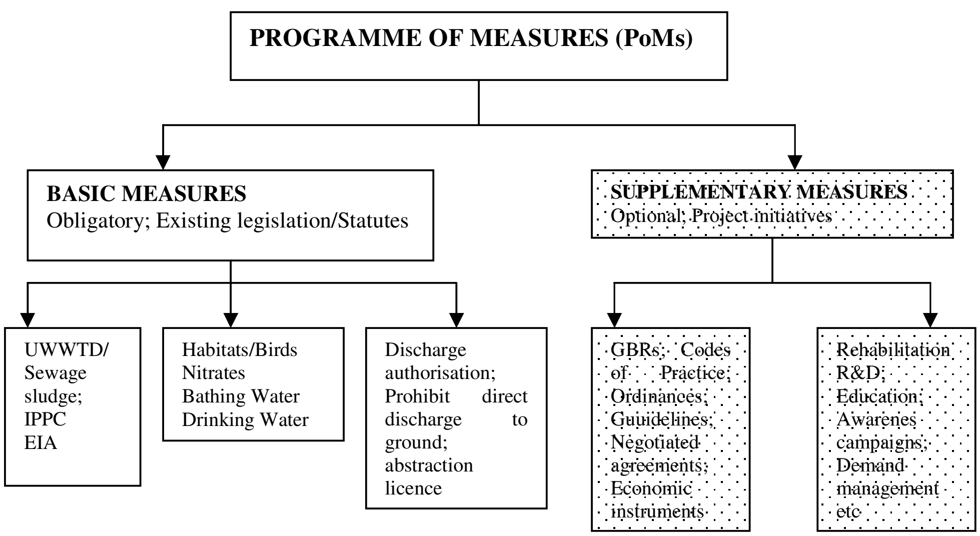

Figure 1. EU WFD RBMP Programme of Measures

The expectation is that much of the operational implementation of the PoMs in respect of urban drainage improvements for flood and water quality control will be primarily within the remit of local municipalities, with federal/national levels setting strategic directions and objectives for the master planning and decision-making process. This devolution of urban planning guidance and control to the regional/local level is a feature of all the demonstration cities (Ellis *et al.,* 2007). However, the capacity and performance of the urban sewer network (for both stormwater and wastewater), has been so far unable to achieve a priority position in the regulatory planning process.

3.2 Catchment-scale planning in Brazil

Within Brazil, water and sanitation facilities present a major concern with some 10 million households being affected by the absence of an adequate water system. In comparison the provision in Belo Horizonte is relatively good, with the city having a contracted concession to the private sector through a basic state sanitation company (CESB). This means that the institutional and technical organisation of water and sanitation systems do not directly respond to the directives of urban policy which fall under municipality authority. The service concession essentially pursues a sector-based strategy which does not necessarily heed municipality master-planning and determines their investment plans autonomously without a requirement for consultation with the municipality. With increasing numbers of urban poor, rising water and sanitation costs effectively exclude increasing numbers of users from the public system leading to increases in the use of alternative supply modes such as well drilling. In these poorer urban areas there has also been an increase in illegal water and stormwater connections and it is difficult for companies to identify and combat such illicit connections (Ellis *et al.,* 2007).

This has significance for both public and receiving water health and sustainability as well as increasing flood potential resulting from reflux of contaminated water into local channels. This raises the issue of the appropriate technologies and systems management with respect to pollution removal whereas the emphasis to-date has traditionally focussed on construction and enhancement of treatment plant capacity. However, better receiving water quality cannot be guaranteed because there is no real control of non-point source pollution which results from uncompleted, poorly maintained and antiquated systems of wastewater collection and from rainwater systems which are heavily contaminated by untreated household and industrial misconnections.

The new Ministry of Cities water bill will create a national sanitation system which will require the production of a strategic master plan involving local community input and which will define the relative roles and responsibilities of the public and private sectors in the management of water-based services. This will give much greater powers to the municipality which will govern the form of service delivery. This model of urban water resources management will be based on an integrated vision of water uses at the catchment level and will enable cross-subsidisation among different uses and users. Thus integrated, holistic measures for source control can be combined to manage downstream flooding and water quality. However, there is an absence of institutional integration for services management and water resources management at present and a critical lack of integration at the operational level. The strategic policies and programmes for "*saneamento ambiental*" (or integrated water resource and solid waste management) will need to have common objectives, plans and priority targets set within the context of the catchment scale. This is currently missing from the structural organisational and legislative framework. The 20th article of the 2001 Law which established a Municipality Sanitation Law (FMS) and Plan (PMS) for Belo Horizonte, identifies the "*water basin as the planning unit for actions related to sanitation services*" and has set up a cross-sector municipality working group to elaborate a Drainage Master Plan (PDD). The integrated urban water management grouping (DRENURBS; an LA member) is associated with both the PMS and PDD and is strongly catchment based in terms of its operational remit as well as being structured as a wide participatory stakeholder executive unit.

It is apparent from the Belo Horizonte situation (see Ellis *et al.,* 2007) that the catchment scale unit therefore also provides the fundamental basis for the Brazilian regulatory framework with the various river basin agencies serving executive administrative functions. In comparison to the European situation however, it is clear that the municipality level will have greater responsibility and power for decision making for both local and regional drainage infrastructure. The new law represents a first step towards the construction of integrated management and the "*saneamento ambiental*" plans will need to be compatible with river basin plans and with the municipality master-plan development planning. The city council will have decision-making oversight of water and sanitation services and will be responsible for strategic prioritisation within the municipal water and sanitation policy. However, they will be required to collaborate closely with the private sector companies and the public in developing, delivering and evaluating service provision. A major challenge will be to articulate sanitation with low income housing policies within sub-catchments of the city territorial boundaries.

3.3 Comparison and evaluation of catchment scale approaches in SWITCH case study cities

The same issues of lack of clarity in terms of institutional responsibilities and the translation of legislative and administrative instruments to the local municipality level are identified in Brazil, Germany and the UK (Ellis *et al.,* 2007). One source of tension between central government and local authority is likely to be that of financing integrated urban drainage infrastructure schemes. Economic analysis is frequently undertaken under national economic efficiency terms and not necessarily in terms of the magnitude or severity of the local impacts of flooding and pollution or their downstream effects.

There is also the problem of delivering multi-functional schemes through functional budgets. Similar issues exist regarding the integration of the local and regional planning process with the development of sustainable drainage infrastructure. The new Brazilian 2005 public consortium law will be severely tested in terms of the need for several municipalities to agree and approve regional common planning and regulatory approaches within a catchment scale. The organisational consortia should provide however, a more open and public collaborative structure similar to the Flood Liaison Advice Groups (FLAGs) constituted within Scottish regulation (PAN 69, 2004) to facilitate community action planning for urban drainage management. However, these Brazilian consortia are still in very formative stages and their initial priority concerns may legitimately focus on sanitation and water supply problems rather than on urban stormwater runoff. Unfortunately, the increasing public and wider stakeholder engagement in urban service provision is ahead of best practice on the ground as well as in terms of the development of robust analytical tools and theory to support the practice. This could destabilise the collaborative relationships and make them politically charged. It is also the case that the stormwater strategic plans of the local municipality have legislation and regulatory guidelines which emphasise the importance of intra-urban flood control over receiving water quality.

One clear priority that emerges from a review of the legislative, administrative and strategic frameworks of the various demonstration cities is that of focussing stakeholder engagement on the interface between urban land use and water management needs in order to achieve sustainable and integrated water resource opportunities. This can be encouraged through engagement opportunities arising from:

- development of policy documents, guidelines and codes of practice etc
- the preparation of strategic local development plans and infrastructure provision
- public involvement in planning consents
- negotiations of agreements between authorities, agencies, organisations and developers.

The concept of "*managed retreat*" as sacrificial flood (or water quality) protection along shorelines is now an accepted land management approach in coastal areas. However, its strategic application for stormwater management in urban areas is much more problematic even where the sacrificial area might constitute only temporary flood "meadows" on existing parks, playing field or urban open space. It is undoubtedly politically contentious and could lead to planning blight, with compulsory "purchase" powers by local or regulatory authorities being fraught with difficulties. The same would be true if using residential cul-de-sacs and other low-trafficked suburban streets as temporary storage "ponds" during rainfall events. Such land management approaches may comprise best practice for stormwater runoff control when integrated with vegetated and infiltrative BMP retrofit for the more densely populated inner urban areas of major metropolitan cities.

In delivering integrated urban catchment management, it will be necessary to deliver integration through a geographically overlapping, functional mosaic of legislation, institutions and organisations and how this will be done is not at all clear in any of the demonstration cities. Equally, integration and multi-functional urban drainage schemes will need to be delivered through functional budgets, and reaching agreements on cost apportionment will not be straightforward. This also becomes more critical in terms of establishing lines of accountability. It is nevertheless apparent that restoration and enhancement targets for urban receiving waters are embedded in Brazilian, German and UK regulation and that wider collaborative stakeholder consultation will form an essential component of future planning decision-making processes. It is also apparent that future infrastructure planning frameworks within Europe and Brazil are being developed with a view towards sensitising more integrative and holistic approaches to urban water resource management. Stormwater is now becoming viewed as an interdependent component of the larger urban water cycle which must also consider water supply, wastewater and solid waste disposal as well as air pollution and traffic management as further vectors of the same life cycle regulatory framework.

4 Development and use of the SWITCH stormwater re-use catalogue

The documentation and evaluation of the current stormwater management strategies in selected demonstration cities (as described above) has enabled a base-line to be established as a first step towards considering the development and implementation of an alternative approach to stormwater management. With a view to disseminating information on alternative uses for stormwater with urban areas, a catalogue describing the state-of-the art practices in stormwater re-use has been developed (Scholes and Shutes, 2007). As well as presenting the concept of stormwater re-use, the catalogue describes the application of stormwater as an alternative urban water resource to meet water demands at the household, municipal and industrial scales and is illustrated through the use of case studies from around the world (see Table 2).

This catalogue is intended to act as both a vehicle for dissemination as well as providing inspiration to LAs involved in developing alternative strategies. In order to contribute to both these objectives, the SWITCH stormwater catalogue has been presented at LA meetings in Birmingham (January 2007) and Brazil (September 2007), with a further stormwater management workshop scheduled to take place in Lodz, Poland in December 2008.

5 Development of the SWITCH stormwater sustainability indicators

To support an assessment of whether alternative strategies developed and implemented through the work of the SWITCH Learning Alliances do contribute to sustainability, work within Theme 1 includes the development of a series of sustainability objectives and supporting indicators against which the performance of alternative strategies can be assessed. The tasks described in Sections 3 and 4 above (together with discussions with LA members; and work undertaken in WP2.1), have been used to revise the set of sustainable stormwater management objectives initially proposed in Theme 1 (see Table 3).

Table 2. Stormwater re-use in examples from different countries and continents

Stormwater reuse	Africa	Australia	Brazil	China	Germany	India	Singapore	Thailand	UK	USA
Groundwater recharge	x			x						
Drinking water			x			x	x	x		
Non-potable use in homes e.g.										
* garden watering	x	x	x	x	x				x	x
* toilet flushing	x	x	x	x	x	x	x	x	x	x
* hot water	x	x	x		x	x	x	x	x	
* car washing	x	x			x					
Industrial uses e.g.				x						
* cooling towers		x		x	x		x			
* cleaning processes					x		x			
* electricity generation		x		x	x					
* toilet flushing					x		x			
Irrigation e.g.										
* grazing lands	x	x								
* crops		x								
* golf course		x		x						
* parks									x	x
Creation of artificial water bodies e.g.				x						
* lakes		x		x					x	x
* wetlands		x		x					x	x
* ponds		x		x					x	x
Recharge of natural wetlands	x	x								
Commercial vehicle washing				x	x					

Each objective is supported by a consideration of the current situation and, looking forward, suggest appropriate responses to addressing identified concerns. In both cases, these considerations are divided into a ‘subject matter’ component (which describes the current situation or a desirable future scenario, in relation to state and response respectively) and an ‘indicator’ category where an approach for quantitatively or qualitatively benchmarking the relevant subject matter is proposed.

The identified sustainable stormwater objectives incorporate the technical (e.g. flooding), social (e.g. quality-of-life) and environmental (e.g. management of diffuse pollution) considerations which have been shown to be important (see Section 3) for implementing more holistic stormwater strategies. Further objectives relating to promoting the use of stormwater as an alternative water resource for non-potable uses as well as considering the management of stormwater resources within a wider planning context, reflect the synergies between work being undertaken within Themes 2 and 5 within the SWITCH Water Sensitive Urban Design task group.

6 Conclusions

This paper describes the work underpinning a continued development and refinement of a sustainable stormwater management framework which has involved documenting current stormwater management strategies in selected demonstration cities (Belo Horizonte, Brazil; Birmingham, UK and Hamburg,

Table 3. Draft SWITCH sustainable stormwater indicators

	State		Response	
Sustainability objectives	**Subject matter**	**Indicator**	**Subject matter**	**Indicators**
Reduce the risk of flooding in vulnerable areas to levels acceptable to all stakeholders, even under future climate change scenarios	Vulnerable areas within the city are flooded with an unacceptable frequency, causing unacceptable socio-economic damage.	Flooding frequency & depth Economic and health damage (euro/capita/year)	Flood risk mitigation measures; especially for extreme exceedence flows	Decrease in flood frequency (return period in years) & damage cost function (euro/land use area/year)
Protect & enhance the water quality & ecological status of urban receiving waters,for both surface & ground waters	Urban water quality & ecology suppressed by wet weather diffuse pollution.	Good chemical & ecological status (e.g. expressed by GQA & RE classifications for surface waters in UK)	Surface & ground waters typical of good chemical & ecological status.	Percentage of waters meeting the requirements of the EU WFD & the Groundwater Directive.
Apply source control techniques to enable stormwater to contribute to the quality of life in the urban environment.	Poor aesthetic & amenity values for urban water bodies.	Level of community awareness of local water bodies & scope for recreational use; consideration of BMP installation	Create new water control systems & improve aesthetic & amenity value of those which currently exist.	Percentage of local population valuing local water bodies for amenity purposes. Take up rate of BMPs
Harvest rainwater & stormwater for non-potable reuse purposes.	Rainwater & stormwater are rarely collected & mainly drained directly from urban areas.	Assessment of water re-use benefits	Rainwater & stormwater harvesting projects.	% of total urban water demand satisfied by rainwater & stormwater harvesting projects.
Utilise stormwater to re-establish a balanced water cycle (in conjunction with landscape development).	Increased overland flows & evaporation losses and reductions in groundwater recharge.	Imbalance between runoff, infiltration, evaporation, transpiration & storage.	Re-establish pre-development water balance.	Water movements match the Greenfield situation in terms of ratios of recharge/ evaporation/storage/runoff.

Germany). Despite differing institutional, socio-economic and climatic settings, similar challenges were identified in all three cities, primarily in relation to a lack of clarity in terms of identifying organisational responsibilities and challenges in integrating regional and local policy developments. Within all three cities, the implementation of on-going legislation requires or supports the engagement of a range of stakeholders within the decision-making process paving the way towards a more integrated approach to both stormwater and urban water management. However, as noted in Section 3.3, the requirement to engage stakeholders appears to be in advance of the availability of proven, robust tools to support the meaningful integration of stakeholder views. This gap between policy and practice leaves urban water mangers in a highly challenging position and is highlighted as a key area for further research.

Through the preparation of a stormwater catalogue for re-use options and associated discussions with LA members, the range of sustainable stormwater objectives and indicators initially proposed have been refined. One use for these indicators is to support an assessment of the contribution to sustainability of alternative approaches to urban water management developed by LAs. However, this work is also being utilised in the development of sustainable stormwater management ‘visions’ which build on the results of the visioning exercises undertaken by Theme 6 by further developing aspects relating to stormwater management. On completion, these stormwater vision statements will form the basis for further discussions with LA members with regard to their achievement feasibility. In addition, it will be important to identify potential conflicts with goals being set within other parts of the urban water sector, enabling further input to the on-going and iterative process of developing a sustainable stormwater management framework.

Acknowledgements

The authors gratefully acknowledge the input from the Learning Alliances in Belo Horizonte, Birmingham and Hamburg, and in particular contributions from N Nascimento and J-R Champs in relation to Brazilian legislation, J Eckart, W Holste and H Lagenbach in relation to German legislation and P Sharp in relation to UK legislation.

References

Ellis, JB, Scholes, L and Revitt DM (2007). Deliverable 2.2.1a Evauation of Current Stormwater Management Strategies. www.switch.watsan.net/page/767 Accessed 11 November 2008.

EU WFD (2000) Directive of the European Parliament and of the Council of 23 October 2000. Establishing a Framework for Community Action in the Field of Water Policy. 2000/60/EC.

PAN 69 (2004). Planning Advice Note 69: Planning and Building Standards Advice on Flooding. The Scottish Government Publications, Edinburg, UK, pp 67 (ISBN: 0 7559 4254 X)

PPS 3 (2006). Planning Policy Statement 3: Housing. Communities and Local Government, London. HMSO, Norwich, UK , pp 30 (ISBN: 9780117539761)

Scholes, L and Shutes, RBE (2007) Deliverable 2.2.1b Catalogue of Options for the Reuse of Stormwater. www.switch.watsan.net/page/767 Accessed 11 November 2008

US EPA (2004). Report to Congress: Impact and Control of CSOs and SSOs. Report No. EPA 833-R-04-001. http://cfpub.epa.gov/npdes/cso/cpolicy_report2004.cfm Accessed 12 November 2008

US Federal Water Pollution Control Act (2002). United States Senate Committee. http://epw.senate.gov/water.pdf Accessed 12 November 2008.