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RESEARCH ARTICLE

SUDS, LID, BMPs, WSUD and more – The evolution and application of terminology surrounding urban drainage

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The management of urban stormwater has become increasingly complex over recent decades. Consequently, terminology describing the principles and practices of urban drainage has become increasingly diverse, increasing the potential for confusion and miscommunication. This paper documents the history, scope, application and underlying principles of terms used in urban drainage and provides recommendations for clear communication of these principles. Terminology evolves locally and thus has an important role in establishing awareness and credibility of new approaches and contains nuanced understandings of the principles that are applied locally to address specific problems. Despite the understandable desire to have a 'uniform set of terminology', such a concept is flawed, ignoring the fact that terms reflect locally shared understanding. The local development of terminology thus has an important role in advancing the profession, but authors should facilitate communication between disciplines and between regions of the world, by being explicit and accurate in their application.

Keywords: alternative techniques; best management practices (BMPs); green infrastructure (GI); integrated urban water management (IUWM); Joint Committee on Urban Drainage (JCUD); low impact development (LID); low impact urban design and development (LIUDD); source control; stormwater control measures (SCMs); sustainable urban drainage systems (SUDS); terminology; urban drainage; urban stormwater management; water sensitive urban design (WSUD)

1. Introduction

Given the increase in urbanisation worldwide, and the impact of urban stormwater on both humans and aquatic ecosystems, the management of urban drainage is a critically important challenge (Chocat et al., 2001; Fletcher et al., 2013). The management of urban drainage and the urban water cycle more broadly has thus seen significant change over the past few decades, shifting from largely narrowly-focussed approaches (typically with the sole aim of reducing flooding) to an approach where multiple objectives drive the design and decision-making process (see for example Chocat et al., 2001; Fratini et al., 2012; Marsalek & Chocat, 2002; Wong, 2007). The cultural change in the discipline has been substantial; while urban drainage was once seen only as a problem, the opportunities it presents (e.g. additional water supply, increased biodiversity, improved microclimate) are widely recognised (Ashley et al., 2013). Consequently, a whole new area of terminology has developed, with the aim of conveying the objectives, approaches and benefits of new, more integrated approaches.

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In any field, the development of professional terminology – often referred to as *jargon* – serves to improve the efficiency of communication between professionals in the particular field. Such terminology can be used to concisely convey ideas, concepts, methods and techniques. For example, in medicine, there are agreed approaches to the development of terminology, based initially around *Nomina Anatomica* (anatomical nomenclature) which aim to remove "confusion in medical terminology (which) is an obstacle to the communication of new findings" (International Group of Experts on Medical Terminology and Medical Dictionaries, 1967). Medical terminology and its foundation principles are explained to all medical students through a range of specific textbooks (e.g. Stanfield & Hui, 1996). Such an approach, which is a reflection of the medical profession's importance to all humans and its history of development, leads to a certain degree of uniformity and predictability in the development of medical terms internationally.

In the case of urban drainage management (also known as urban stormwater management)[1], however, the development and use of terminology has come about in a more informal manner, driven by local and regional perspectives, understandings and context. The result of such an approach is that different terms are used to define similar concepts in different parts of the world, potentially leading to overlaps, contradictions and confusion. For example, in 2004, Ellis *et al.* published the *Urban Drainage Multilingual Glossary* (UDMG), as a first attempt to provide urban drainage definitions in English, French, German and Japanese. While many terms had very similar definitions in the four languages, the glossary also demonstrated that some concepts, tools and techniques could not be precisely or adequately translated from their original language to another.

The aim of this paper is to document the recent history and evolution of the underpinning terminology around urban drainage[2]. By discussing the origins and the initial intent behind the terms, we seek to draw out the important principles, processes and objectives which drive this evolving practice. The paper has been motivated by the Joint Committee on Urban Drainage (JCUD) under the auspices of the International Water Association (IWA) and International Association of Hydro-Environment Engineering and Research (IAHR), in an attempt to facilitate communication:

1. within the discipline in different regions of the world, *and*
2. between the urban drainage discipline and other related fields, such as architecture, landscape architecture, urban design and planning, sociology, ecology and economics.

We do not attempt to stipulate preferred terms and their definitions, given the critical role of local cultural and political context in the development and adoption of language. Indeed, language has an inherently cultural basis, meaning that the cultural context will influence the development, meaning and understanding of terminology (Calude & Pagel, 2011). In New Zealand, for example, the terminology around urban drainage has been developed with recognition of Maori values and their links to water and the environment (Barlow, 1993). Despite the importance therefore of local context, we do conclude that all authors should attempt, as much as possible, to be explicit and unambiguous in their use and description of terms. Doing so will facilitate local as well as international translation, adaptation and adoption of ideas. This paper is focused on terminology: we do not attempt to develop a 'cook book' or a performance evaluation of urban drainage practices.

2. The history and evolution of urban drainage terms

Urban drainage is a very old field, dating back to at least 3000 BC (Burian & Edwards, 2002), with a primary focus on conveyance of water away from urban areas. In recent decades, however, the urban drainage and related literature has seen the development and adoption of a range of 'new' terms that attempt to describe the evolution towards a more holistic approach. There has been rapid growth in the use of terms such as low impact development (Department of Environmental Resources, 1999), sustainable urban drainage systems (SUDS) (CIRIA, 2000), water sensitive urban design (Whelans et al., 1994; Wong, 2007), best management practices (BMPs) (Schueler, 1987) and alternative techniques (Azzout et al., 1994). In this section, we examine the history and evolution of each of the common terms associated with urban drainage.

It is interesting to note that despite their emergence in the 1980s and 1990s, only four of the terms covered in this paper (BMPs, source control, integrated urban water management and techniques alternatives in the French part) were included in the original *Urban Drainage Multilingual Glossary* (Ellis et al., 2004), perhaps demonstrating the time necessary for terms to become recognised internationally.

2.1. Low impact development (LID) and low impact urban design and development (LIUDD)

The term low impact development (LID) has been most commonly used in North America and New Zealand. It appears to have been first used by Barlow et al. (1977) in a report on land use planning in Vermont, USA. The approach attempts to minimize the cost of stormwater management, by taking a "design with nature approach" (McHarg, 1971, cited in: Barlow *et al.*, 1977). The name resonated with those pioneering environmentally sensitive area (ESA) planning. For example, Eagles (1981) used the term to describe the central policy in ESA planning as being to allow only low impact development, protecting areas such as "aquifer recharge and headwaters". This helped to drive a new focus on urban stormwater runoff and water quality, contributing in part to development of the National Urban Runoff Program (Torno, 1984).

The original intent of LID was to achieve a 'natural' hydrology by use of site layout and integrated control measures. Natural hydrology referred to a site's balance of pre-development runoff, infiltration, and evapotranspiration volumes, achieved through a "functionally equivalent hydrologic landscape" (US Environmental Protection Agency, 2000). LID discouraged the then common practice of large end-of-catchment solutions, because of their inability to meet this catchment-wide hydrologic restoration.

Perhaps the most influential early use of the term was in Prince George's County, Maryland, USA in the early 1990s (e.g. Prince George's County Department of Environmental Resources, 1993). The term LID was used to distinguish the site-design and catchment-wide approach from the common stormwater management approach at that time, which typically involved conveyance to large end-of-pipe detention systems. In contrast, LID was characterised by smaller scale stormwater treatment devices such as bioretention systems, green roofs and swales, located at or near the source of runoff. Similar approaches were applied elsewhere, notably in New Zealand, guided by the publication of the Low Impact Design Manual (Shaver, 2000) by the then Auckland Regional Council. The adoption of the term LID in New Zealand is explained by the move of a key champion, Earl Shaver, from the USA to Auckland.

By the mid 1990s, LID was in common use and came of age when the Low Impact Development Center opened in 1998. Around the same time, the Prince George's County, in an effort to increase adoption of LID, produced a municipal *Low Impact Development Design Manual* (Coffman, 1997). This was soon republished and distributed to a national audience (Coffman, 2000). This activity was part of a wider movement that developed more or less independently in North Carolina (Tetra Tech Inc., 2000), Florida (Rushton, 1999) and abroad (e.g. Shaver, 2000).

By the end of the 1990s and due to influence of the design community, the interpretation of LID had strayed from its original meaning to encompass any set of practices that treated stormwater (typically in small catchments of 1 ha or less). Between 2005 and 2010, US researchers again tried to push LID back to its original intent (Davis et al., 2012; DeBusk et al., 2011; Dietz, 2007; Shuster et al., 2008). The most recent Low Impact Development manuals (NC State University, 2009) re-establish hydrologic targets for both retrofit and new urban developments and provide design options to meet and sustain these objectives. Finally, the use of LID was codified in legislation throughout North America (Toronto Region Conservation Authority, 2010; United States of America, 2007). LID has therefore become a mainstream, though not ubiquitous, means of stormwater management in the USA and in Canada. Some jurisdictions, such as North Carolina, Toronto and Ontario, now have an older manual on *Best Management Practices* or general stormwater management (e.g. Ontario Ministry of Environment, 1991), and a newer one dealing with LID (Credit Valley Conservation Authority & Toronto Region Conservation Authority, 2010; Ontario Ministry of the Environment, 2003). The distinction perhaps represents the original focus of LID being on using site design to minimise impervious areas and retain natural areas.

Throughout the evolution of the term, there were similarities and subtle differences in its meaning in other parts of the world. For example in New Zealand the emphasis was on site design to avoid *pollution* (rather than management of the *flow regime*) (Shaver, 2003). The national 'clean-green image' in New Zealand led to a focus on ecosystem health (van Roon, 2011) and the history of dialogue between settlers and indigenous Maori promoted engagement with diverse perspectives (Allen et al., 2011). This was part of a research programme branded Low Impact Urban Design and Development, or LIUDD (Eason et al., 2006). LIUDD was considered to sit comfortably with the Maori concept of the environment (Barlow, 1993; Gabe et al., 2009; Ulluwishewa et al., 2008).

The very label LID implies some impact, albeit an impact that is implicitly lower than that of normal practice. It will be interesting to see how the definition of this term evolves with the emerging trend of densification of existing urban areas, as opposed to the 'urban sprawl' which was prevalent at the time LID emerged (Poelmans & Van Rompaey, 2009). Perhaps significantly, the term LID does not contain the word 'water'. In some ways, this may have helped in engaging other disciplines, such as architecture, planning, economics, ecology and social sciences.

2.2. Water sensitive urban design (WSUD)

The term water sensitive urban design (WSUD) began to be used in the 1990s in Australia, with the first known reference to it being by Mouritz (1992) and then shortly after in a report prepared for the Western Australian Government by Whelans et al. (1994). The objectives of WSUD were listed by Whelans *et al.* as being to:

1. "manage the water balance (considering groundwater and streamflows, along with flood damage and waterway erosion),
2. maintain and where possible enhance water quality (including sediment, protection of riparian vegetation, and minimise the export of pollutants to surface and groundwaters),
3. encourage water conservation (minimizing the import of potable water supply, through the

harvesting of stormwater and the recycling of wastewater, and reductions in irrigation requirements), and
4. maintain water-related environmental and recreational opportunities".

In the years that immediately followed, the concepts of WSUD were fleshed out through a series of position papers by Wong and others (Lloyd, 2001; Wong, 2000, 2001, 2002). Lloyd et al. (2002, p. 2) describe WSUD as a "philosophical approach to urban planning and design that aims to minimize the hydrological impacts of urban development on the surrounding environment. Stormwater management is a subset of WSUD directed at providing flood control, flow management, water quality improvements and opportunities to harvest stormwater to supplement mains water for non-potable uses". It cites the objectives of WSUD (from the Victorian Stormwater Committee, 1999) as including:

1. protection and enhancement of natural water systems in urban developments,
2. integration of stormwater treatment into the landscape by incorporating multiple use corridors that maximise the visual and recreational amenity of developments,
3. protection of water quality draining from urban development,
4. reduction of runoff and peak flows from urban developments by employing local detention measures and minimising impervious areas, and
5. adding value while minimising drainage infrastructure development costs.

Lloyd *et al.* (2002) also distinguish between the broader principles and objectives of WSUD and the techniques used to meet these objectives, where they use the existing terms best management practices (BMPs) and best planning practices (BPPs).

Despite the definition of WSUD being originally quite broad, its principal application in the early years of its development appears to have been around stormwater management. This does not imply an innate criticism of WSUD nor its practitioners; it simply represents that in its early days, primarily professionals within the urban drainage community in Australia were driving the WSUD movement. In more recent references, however, several authors have reiterated the need to consider stormwater management within an integrated framework considering the entire urban water cycle (Mouritz et al., 2006; Wong, 2007), with Mouritz et al. (2006, p. 4.1) arguing that "in its broadest context, WSUD encompasses all aspects of integrated urban water cycle management, including water supply, sewerage and stormwater management. It represents a significant shift in the way water and related environmental resources and water infrastructure are considered in the planning and design of cities and towns, at all scales and densities". In Australia, the term WSUD is now often used in parallel with the term water sensitive cities. However, there is a subtle but important distinction between these two terms; water sensitive city describes the destination (the objective), while WSUD describes the process (Brown & Clarke, 2007).

Having originated in Australia, the term WSUD is now increasingly used internationally, particularly in the UK and New Zealand (Ashley et al., 2013); such evolution reflects strong collaboration between champions in the two countries. As further evidence of its international use, the Joint Committee on Urban Drainage formed a specific WSUD working group in 2004. The group aims to encourage better integration of all urban water streams within urban design. This approach works explicitly across all scales, and attempts to engage disciplines such as architects, planners, social scientists and ecologists. The term WSUD has also inspired a number of related concepts, such as climate sensitive urban design (Coutts et al., 2013).

2.3. *Integrated urban water management (IUWM)*

The concept of integrated urban water management (IUWM) is, by definition, considerably broader than those terms that relate purely or primarily to urban drainage management. IUWM derives from the even broader term, integrated water management, relating to the integrated management of all parts of the water cycle within a catchment (Biswas, 1981). In the urban context, it combines the management of water supply, groundwater, wastewater and stormwater (Fletcher et al., 2007), and considers the roles and interactions of the various institutions involved in management of the urban water cycle (Rogers, 1993). The IUWM term was first commonly used in the 1990s (Geldof, 1995; Harremoës, 1997; Niemczynowicz, 1996) and began to be widely discussed in a series of position papers which proposed new approaches for the management of urban water (Mitchell, 2006; Tejada-Guibert & Maksimovic, 2001; Vlachos & Braga, 2001). One of the earlier contributions to the concept underpinning IUWM was made by Geldof (1995), who attempted to spell out a logic framework, addressing the problems of scale, level (considering institutional and social aspects of management) and assessment. The principles on which IUWM is based vary to some extent between authors, but generally follow those outlined by Mitchell (2006, p. 590):

1. "consider all parts of the water cycle, natural and constructed, surface and subsurface, recognising them as an integrated system,
2. consider all requirements for water, both anthropogenic and ecological,

3. consider the local context, accounting for environmental, social, cultural and economic perspectives, and
4. strive for sustainability, aiming to balance environmental, social and economic needs in the short, medium and long term".

In current use, the term integrated urban water management is probably most closely linked with the terms WSUD, water sensitive cities and LID, all of which extend well beyond the management of urban drainage. The term integrated urban water management appears in the 2004 *Urban Drainage Multilingual Glossary* (Ellis et al., 2004), but only in French[3].

2.4. *Sustainable urban drainage systems (SUDS) or sustainable drainage systems (SuDS)*

Developments in changing the approach to stormwater management in the UK started in a concerted way in the late 1980s and in 1992 the "Scope for Control of Urban Runoff" (CIRIA, 2001) guidelines were published, giving guidance on a range of technical control options. During the 1990s, the acceptance of stormwater management advanced more rapidly in Scotland than England and Wales, including a strong regulatory push from the Scottish Environmental Protection Agency for implementation of stormwater BMPs in new developments. The concept of the sustainable drainage triangle (quantity, quality, habitat/amenity) was initially set out by D'Arcy (1998) and it is believed to be Jim Conlin of Scottish Water who first (October 1997) coined the term sustainable urban drainage systems (SuDS) to describe stormwater technology. Around this time, the principles of sustainable urban drainage more generally were also being fleshed out (Butler & Parkinson, 1997).

A major set of guidance documents was published in 2000, with similar but separate design manuals for Scotland and Northern Ireland, and England and Wales (CIRIA, 2000) and it was there that the term sustainable urban drainage systems (SUDS) was formalised. The most authoritative guide to SuDS is currently *The SuDS Manual* (CIRIA, 2007) which aims to provide "comprehensive advice on the implementation of SuDS in the UK". Some parties omit 'urban' from the term, referring to sustainable drainage systems (or SuDS) instead, although the meaning is essentially the same and this is now the terminology used in legislation effectively specifying the use of SuDS in England (Flood and Water Management Act, 2010). In part, this change reflects a desire to consider both rural and urban land uses (Smith, 2013, personal communication).

In UK practice, SUDS consist of a range of technologies and techniques used to drain stormwater/surface water in a manner that is (arguably) more sustainable than conventional solutions. They are based on the philosophy of replicating as closely as possible the natural, pre-development drainage from a site, consistent with the previously-described principles behind LID. Typically, SuDS are configured as a sequence of stormwater practices and technologies that work together to form a management train.

In Scotland, SuDS have been mandatory in most new developments since 2003 (WEWS, 2003). Although they were introduced to improve water quality in receiving waters, these systems are also required to safely convey design storms for a range of recurrence intervals up to 200 years. The Scottish EPA oblige developers to use a multi-element management train approach (SEPA, 2010) to manage water quality (Duffy et al., 2013). In England and Wales, SuDS are aimed more at water quantity than quality control (Defra, 2011), although they are deemed to comply with water quality standards provided they comprise appropriate components of a defined treatment train.

2.5. *Best management practices (BMPs)[4]*

In the North American (primarily the United States and Canada) context, best management practice (BMP) is used to describe a type of practice or structured approach to prevent pollution. In the United States, the term BMP was coined – yet never explicitly defined – as part of the Clean Water Act (CWA) (2011), when it was originally drafted in 1972. According to Ice (2004), the term "better management practices" was used all the way back in 1949, in reference to management of agricultural land (p. 1) "to restore a more favorable plant cover and soil structure if we wish to maintain land and stream conditions to serve our present and future needs for usable water". More specifically to urban drainage, the term has an historical basis in the management of wastewater treatment processes and was primarily focused on non-structural measures (e.g. operator training, maintenance, and standard operating procedures). Activities were focused on operation of centralized systems wastewater treatment plant operations.

The definition of BMPs has since matured into a more or less universal term referring to pollution prevention activities, consistent with the Pollution Prevention Act (United States of America, 1990). Accordingly, the term encompasses practices that possess both non-structural (operational or procedural practices; e.g., minimizing use of chemical fertilizers and pesticides) and structural (engineered or built infrastructure) attributes. BMPs may include ". . . . schedules of activities, prohibitions of practices, maintenance procedures . . . (including) treatment requirements, operating procedures, and practices to control plant site runoff, spillage or leaks, sludge or waste disposal, or drainage from raw material storage" (Environmental Protection Agency, 2011a).

Between 1979 and 1983 the USEPA conducted the national urban runoff program. This was largely in response to Congress leaving out the need to treat urban stormwater from the Clean Water Act enacted in 1972 (United States of America, 1972, 1983). The programme provided evidence on the poor quality of urban stormwater runoff and the extent to which it contributed to degraded water quality in waters of the US. The national urban runoff program quantified the performance of urban stormwater BMPs, grouped into four categories (detention devices, recharge devices, housekeeping practices and others).

The US Environmental Protection Agency requires BMPs to satisfy wastewater permit applications, with the advent of national pollution discharge elimination system (NPDES) phase II regulations (Environmental Protection Agency, 2011b). Therefore, the operational definition of BMPs was expanded such that NPDES permits would specify or be fulfilled by BMPs for the control of storm water discharges (Environmental Protection Agency, 2011b). For the particular application of BMPs to stormwater management, the EPA offered a more specific definition such that a BMP would include a technique, process, activity, or structure to reduce the pollutant content of stormwater discharge, and could be implemented singly or in tandem to maximize effectiveness. In this context of stormwater management, BMPs link non-structural methods (e.g., good housekeeping and preventive maintenance) with structural deployments (such as bioretention systems or green infrastructure) to achieve the overall goal of pollution prevention.

The use of the superlative 'best' in BMP can be misleading, as there is no set standard against which to measure the effectiveness or performance of a BMP. This syntactical shortcoming has not prevented the institutionalization of this term in North America and arguably throughout the world. For example, it has been used extensively in European research projects over the past decade (e.g. Scholes et al., 2008; Thévenot, 2008). In everyday practice, the term stormwater BMP is used to describe management practices that aim to deal with one or both of the water quantity and water quality stressors caused by stormwater.

By the early 1990s the term BMP had been adopted in nearly every jurisdiction's stormwater design manual and consequently the range of practices described by the general term BMP was implemented across North America, thereby solidifying the customary use of the term. In some jurisdictions BMPs were actually required to be monitored, or local agencies took on performance evaluations as a way to determine benefit-cost profiles for BMPs. The US BMP database (Clary et al., 2002), formed to compile BMP performance data nationwide, is now used worldwide, and itself likely contributes to the continuing use of the term. Such performance data could also be used to guide refinements in both existing BMPs (e.g., use of data to specify mid-term corrections to improve field performance), and also to revise the design guidance for specific practices; namely, the more innovative practices such as bioretention (Hunt et al., 2011) and permeable pavement (ICPI, 2013), whose basic concepts can be adapted to different climate and soil zones. Yet, there are few BMPs which have design standards that are accepted at the national level. This may be due to the wide variation in local landscape and soil hydrologic characteristics that affect design specifications, and which may discourage the development of anything broader than a state- or local-level guidance.

2.6. Stormwater control measures (SCMs)

The incorporation of the term BMP into US regulation meant that nearly every US state adopted the term BMP in its stormwater control guidance. However, as BMPs were installed, it was recognized that (i) much of what was constructed was clearly not 'best practice' and (ii) the term BMP was far too vague. Partially in response to the lack of an objective approach to stormwater management, the US National Research Council of the National Academies of Engineering and Science commissioned a comprehensive review of stormwater management practice (National Research Council, 2008). One of the key findings was a universal agreement to abandon the term BMP in favour of stormwater control measure (SCM), to refer to both structural (e.g. bioretention systems) and non-structural (e.g. residential downspout disconnection programmes) control measures. One key element of the term is that it does not convey a judgement as to whether a selected practice functions 'best'. Since the release of the 2008 NRC report, many entities have adopted the term SCM, including the US Federal Highway Administration, many state departments of transportation, academic publications (e.g. Davis *et al.*, 2012), and several "higher end" consultancies. However, the term SCM has not replaced BMP completely, as the latter, although perhaps now considered somewhat outdated, persists in many state design manuals and in the design community–at-large.

2.7. Alternative techniques (ATs) or compensatory techniques (CTs)[5]

The term alternative techniques (ATs) or techniques alternatives (TAs) in French, began to be used in the early 1980s in French speaking countries to describe a new paradigm of urban drainage (STU, 1981, 1982), moving away from the traditional 'rapid disposal' approach. The expansion of towns and suburbs, particularly in Paris, along with the costs of reinforcing or constructing traditional networks (IAURIF, 1981) and a concern about environmental impacts, created a push for more natural solutions, termed ATs. They were promoted not only to solve drainage and pollution problems, but also for their potential to improve quality of life. One of the first French guidelines was called "Stormwater runoff control: solutions to improve the quality of life" (STU, 1982). The term 'alternative' was meant in the sense of 'unconventional', and somewhat even in the sense of 'against' conservative solutions.

Alternative techniques aimed to counteract the effect of urban expansion by (i) optimising urban land use and (ii) limiting investment costs. They were thus also called compensatory techniques, since they were considered to compensate for the impacts of urbanisation. This term was particularly used in Bordeaux (France) from the 1980s and in some other countries such as Brazil (Baptista et al., 2005). The compensation aim described the objective to reduce runoff volume, peak flows and more generally reduce the vulnerability of urban areas to flooding, and to a somewhat lesser extent, to protect the quality of receiving environments. Thus the focus was primarily on human benefits, rather than ecosystem benefits. One of the main initial principles was that compensatory techniques should maintain the same flow rates as occurred under natural conditions. From this point of view, the concept was similar to the LID approach (see Section 2.1 above).

This approach had the consequence that every urban design project began to include flow management (detention, attenuation, infiltration, source control retention) and the use of multi-function stormwater management corridors (Azzout *et al.*, 1994). The original concept was really seen as a new paradigm of urban design very close to the concept of WSUD, albeit without a focus on water supply.

However in practice, the original concept was not always well understood by practitioners, with the original meaning becoming somewhat lost. This meant that all technical solutions based on infiltration or /and retention were often considered to belong to the same *AT* family (from the 'end of pipe' hydraulic underground basin made of concrete to the vegetated source control system). This highlights the importance of the cultural background in which terms are employed, which can lead to misunderstandings in practice.

The use of the term 'techniques' in ATs perhaps led to misunderstandings, with differences in interpretation between those taking a structural-solution-only view, while others considered it a broader urban design philosophy (e.g. Alfakih, 1990; Azzout et al., 1994; Azzout *et al.*, 1995; Baladès & Raimbault, 1990; Hérin, 2000; Piel & Maytraud, 2004; Sibeud, 2001). Interestingly, in France, the design rules for *ATs* are still limited to hydraulic aspects, primarily for the reduction of flooding with a high return period (Petrucci, 2012), ignoring ecological and landscape amenity aspects. Local authorities apply increasingly stringent outflow thresholds (e.g. 2 L/s/ha on a given area), but the principle of 'pre-development' conditions or 'water balance restoration' is not commonly held to, due to a desire to set standards that are considered equitable and readily-achievable for all developers (Petrucci et al., 2012). Despite these limitations, there is a move, stimulated primarily by other disciplines such as landscape architects, to increasingly consider the concepts of 'source control' or 'integrated urban water management', such that the term *ATs* is now becoming less favoured.

2.8. *Source control*[6]

The term *Source Control* was initially used to make a distinction between on-site stormwater systems and practices, to be used at the source where runoff is generated, as opposed to larger detention basins that are constructed at the downstream end of a drainage network. Early literature for stormwater management planning in North America (American Public Works Association, 1981; Whipple et al., 1983) focused on detention to mitigate increased runoff, treating on-site (or source control) practices as a subset of detention techniques with essentially only quantity control as the objective. Finnemore and Lynard (1982) summarised urban stormwater pollution control, with a focus on both structural and non-structural source control techniques and Ellis also provided a summary of source control practices, with a strong focus on non-structural or semi-structural practice, as part of a state-of-the-art article on urban drainage (Ellis, 1985). Source control as a term was then the focus of the *Urban Drainage Design Guidelines* published by Ontario and Vancouver in Canada (MetroVancouver, 2012; Ontario Ministry of Natural Resources, 1987).

With the advent of LID in the beginning of the 1990s, the term source control became associated with the use of small-scale practices disseminated throughout the watershed in order to reproduce or maintain pre-development hydrological conditions. In Canada, the updated 1994 *Stormwater Management Practices Planning and Design Manual for the Province of Ontario* (Ontario Ministry of Environment and Energy, 1994) presented a hierarchy of preferred stormwater management practices, as allotment-scale (source) controls, conveyance controls and end-of-pipe facilities, similar to the hierarchy recommended in Australia (ARMCANZ & ANZECC, 2000). More recent guidelines (Ontario Ministry of the Environment, 2003) use the same continuum of techniques from at-source to end-of-pipe, but the most recent have used *LID* in their title (Toronto Region Conservation Authority, 2010), albeit retaining a focus on source-control. In French Canada, the terms 'pratiques de gestion optimales' (optimal management practices) have been chosen deliberately for the province of Québec to encompass the complete spectrum of techniques, applied as holistically as possible (MDDEP, 2011).

As described in Rivard et al. (2005), the desire to take into account sustainable development principles has led to consideration of the impacts of runoff in a more holistic and integrated way. Source control is considered to help mitigate stormwater impacts on receiving waters, by promoting flow control, evapotranspiration and infiltration as close to the source as possible, minimizing the hydrologic and water quality impacts of development.

The term source control is also a good example of the confusion that can arise over time, with multiple meanings ascribed to the same term. Source control has been used by authors to refer to both structural and non-structural methods of dealing with stormwater. Source control was originally used to describe pollution prevention (e.g. Eriksson et al., 2011; WEF & ASCE, 1998). The emphasis was thus on *non-structural* measures, such as site design or choice of building materials, with the aim to minimize the source of pollutants and therefore *prevent* pollution (Chocat et al., 2001; Ellis, 1985). However, the same term, source control, has since been widely used in the literature to mean *at-source* (or close-to-source) structural stormwater treatment measures (e.g. Argue, 2009), and indeed is defined as such in the Urban Drainage Multilingual Glossary (Ellis et al., 2004). In grammatical terms, this use of the term is not source control *per se* (as the source is not controlled) but at-source control or at-source treatment. It is likely that the term *at-source* has been simply shortened over time because it is a little clumsy. The result is different meanings attributed to the same term, source control, and careful reading of the meaning implied by the author is necessary to understand whether they refer to treatment devices or pollution prevention.

Source control for stormwater management (SOCOMA) is the name given to the international working group of the IAHR/IWA Joint Committee on Urban Drainage, which was established in 1990s as a forum to discuss and exchange information on structural and non-structural measures applied at or close to the source.

2.9. Green infrastructure

The term green infrastructure (GI) emerged in the USA in the 1990s (e.g. Walmsley, 1995) and is a concept that goes far beyond stormwater. Indeed, GI seems to have origins in both landscape architecture, where it has been promoted as a network of green spaces (Benedict & McMahon, 2006), and in landscape ecology (Forman, 1999). Benedict and McMahon (2006) suggest that GI is both a concept and a process. The GI concept influences urban planning and layouts to maximise the inclusion of green space hubs and corridors, but the GI process also attempts to maximise the benefits of such green spaces, identifying their potential ecosystem services (Center for Neighborhood Technology, 2010). Among these services, the potential usage of GI to assist stormwater management was realised by the US EPA (2012) and others and now the term is often used interchangeably with BMPs and LID (Struck et al., 2010).

GI is defined variously in the US stormwater management literature as “a network of decentralized stormwater management practices, such as green roofs, trees, rain gardens and permeable pavement, that can capture and infiltrate rain where it falls, thus reducing stormwater runoff and improving the health of surrounding waterways” and is now “more often related to environmental or sustainability goals that cities are trying to achieve through a mix of natural approaches” (Foster et al., 2011). In Seattle, the term GSI (green stormwater infrastructure) is used in design codes which specify its use to the “maximum extent feasible” – which means GI is to be fully implemented, constrained by the opportunities and physical limitations of the site, practical considerations of engineering design, and reasonable consideration of financial costs and environmental impacts (Tackett, 2008).

The term GI is increasingly being used in the stormwater literature in a way that is almost synonymous with LID, as exemplified by the numbers of GI papers at the 2008 LID conference in Seattle compared with the use of GI at the 2010 LID conference in San Francisco. Most recently, the term was recognized by the US EPA (2012): “Green infrastructure is an approach that communities can choose to maintain healthy waters, provide multiple environmental benefits and support sustainable communities. Unlike single-purpose grey stormwater infrastructure, which uses pipes to dispose of rainwater, green infrastructure uses vegetation and soil to manage rainwater where it falls. By weaving natural processes into the built environment, green infrastructure provides not only stormwater management, but also flood mitigation, air quality management, and much more”.

A central tenet of green infrastructure is of course the use of vegetated systems to deliver desired ecosystem services. Such techniques are often referred to as phytotechnologies (Tsao, 2003; Zalewski, 2002), and this area in itself has spawned a whole new field of terminology and research.

Green infrastructure is increasingly being adopted by governments around the world (Amati & Taylor, 2010; Carter & Fowler, 2008; Kambites & Owen, 2006), not only for its stormwater management benefits, but for its much broader role in enhancing urban amenity, human health (Tzoulas et al., 2007), (US Environmental Protection Agency, 2013) and even social equity (Keeley et al., 2013). There is a positive feedback loop between these two practices, with stormwater policy requirements often motivating the use of green infrastructure (ibid), and green infrastructure initiatives leading to consideration of stormwater management objectives. Widespread adoption of green infrastructure is likely to drive stormwater management towards a more distributed and at-source application of stormwater management.

2.10. *Stormwater quality improvement devices (SQIDs)*

One term that received significant local use in Australia was stormwater quality improvement device (SQID). The term appears to have been first coined by Brisbane City Council in their SQIDS monitoring report (1998). The term has since been used in the wider literature (Begum & Rasul, 2009; Begum et al., 2008; Van Drie, 2002), although primarily in conference communications, and almost exclusively in relation to Australian studies. Its use has diminished in recent years, in part because of the increasing focus on managing both flow and water quality, meaning that stormwater quality improvement describes only partially the goals of such systems, which typically also target hydrological control.

2.11. *Examples of terms in other languages*

In many non-English speaking countries, internationally accepted terms, or direct translations thereof, have often been used. However, local context and language often provide useful insights into the motivation and objectives of local practices. This section provides a few examples to illustrate local evolution of terminology.

In Sweden, the term BMP is commonly used by authors in the international literature (Stahre, 1993). However, practitioners have also adopted the Swedish terms *Lokalt omhändertagande av dagvatten* (LOD; local handling of stormwater) and *öppen dagvattenavledning* (open stormwater drainage) in local policy and planning documents. LOD refers to source or site control, largely local disposal though infiltration, whereas the latter refers to surface drainage infrastructure such as ponds, wetlands and swales for detention and conveyance.

In Denmark, the term *Lokal Afledning af Regnvand* (LAR; local diversion of stormwater) was introduced in the 1990s (Anthonisen et al., 1992) and has been widely adopted. It is similar but not identical to the Swedish term, LOD, in that it linguistically focuses on diverting rather than storing water and thus reflects only a limited range of perspectives and technologies, compared with terms such as SUDS and WSUD. For this reason the acronym LAR has recently been given another meaning, *Lokal Anvendelse af Regnvand* (local use of stormwater) (LAR, 2013). Another term, VADI, has come into use recently for swale-trench systems, transferred from Dutch water engineering where the form WADI is used. The inspiration comes from the Arabic term 'wadi', which refers to a dry (ephemeral) river bed that contains water only during heavy rainfall, but it has a further meaning in Danish (V = vand (water), A = afløb (runoff), D = Dræning (drainage), I = infiltration (infiltration)).

In Germany the change towards low impact strategies and techniques started in the early 1980s, initially with a focus on individual technologies, including infiltration, green roofs and rainwater harvesting. Integrated concepts combining a range of decentralised techniques for stormwater management in urban planning were then developed during the 1990s (Dreiseitl, 1993; Geiger & Dreiseitl, 1995; Harms & Uhl, 1996; Uhl, 1990). Such approaches are now highlighted by the German national stormwater management guidelines (DWA-A 100, 2006) as an obligatory component of integrated storm water management. The highest federal water law *Wasserhaushaltsgesetz* (WHG, 2009) requires to avoid, infiltrate or detain stormwater runoff on-site whenever possible. This evolution in practice has been accompanied by the development and use of specific German terminology. The set of techniques were at the beginning simply called *Alternativen zur Regenwasserableitung* (alternatives to stormwater drainage) (Grotehusmann et al., 1994; Sieker, 1993; Uhl, 1990) to illustrate the change of paradigm in stormwater management. Terms like *naturnahe Regenwasserbewirtschaftung* (nature-like stormwater management) (Grotehusmann et al., 1992; Kaiser & Stecker, 1997; Sieker, 1996b) emphasise the aim of maintaining pre-development hydrology by source-control based stormwater management. Synonyms such as *naturnahe Konzepte* (nature-orientated concept) and *naturnahe Regenwasserbewirtschaftung* (nature-orientated stormwater management) are also occasionally used. The term *dezentrale Regenwasserbewirtschaftung* (decentralised stormwater management) (Schmitt, 2007; Sieker, 1996a; Stecker, 1997) has over time become most widely used, both in terms of specific technologies and in referring to the overall concept.

In international publications, German authors have mostly used literally translated terms to paraphrase the German terms and concepts. They have done this rather than directly adopting the existing English expressions, mainly due to (i) the heterogeneity of use and meaning of the English terms (as discussed throughout this paper), and (ii) difficulty in establishing new English terms able to represent German concepts in a sufficiently precise manner. The direct use of English expressions – no matter how influential they may be in their English-speaking 'territories' – is likely to be counterproductive to the aim of seeing the integrated stormwater management concepts adopted in local guidelines, regulations, and practice.

3. Discussion

3.1. *The evolution of terms across disciplines, time and space*

There has been approximately exponential growth in the use of urban drainage terminology in the literature (Figure 1). This growth is clear evidence of an increase

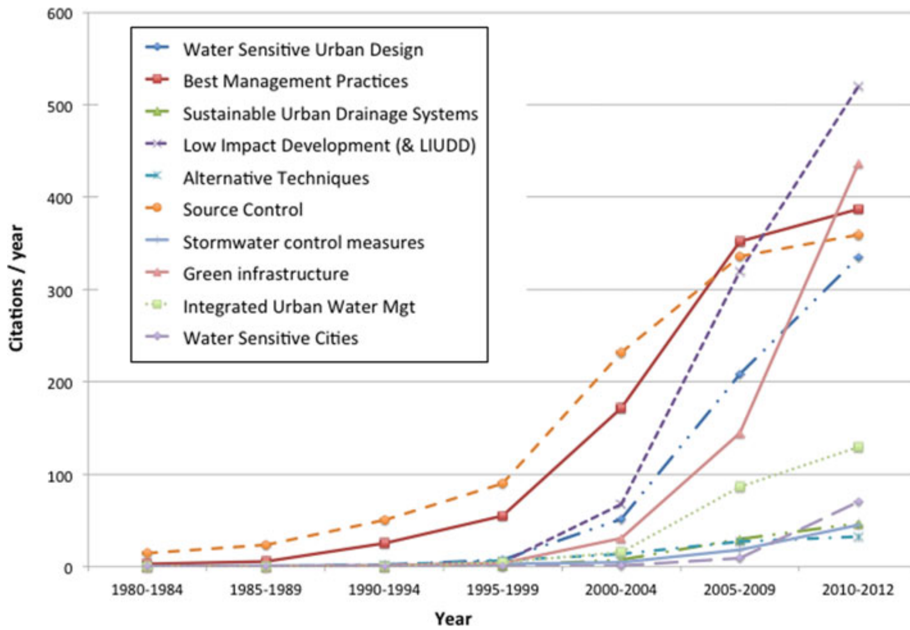

Figure 1. Evolution of new urban drainage terminology in the 32 years from 1980 to 2012. The data were extracted from Google Scholar on 23/09/2012. The terms were searched as exact phrases (in Scholar's advanced search option) and included only those that were accompanied by the term "stormwater" (or *eaux pluviales* in the case of the French term, *Techniques Alternatives*, translated here as alternative techniques).

in the societal interest in urban stormwater management over recent decades. It also demonstrates the increasingly integrated nature of urban drainage as a discipline (Figure 2), historically part of civil engineering, with a growing focus on the ecology of receiving waters (and their drivers such as water quality and flow regimes) and the delivery of multiple benefits (USEPA, 2013). This broadening of perspectives reflects engagement by a broader range of disciplines, such as architects, landscape architects, planners, ecologists and social scientists. As an example, approximately 25% of the citations to LID between 2005 and 2012 include reference to architecture, while 58% of the citations to WSUD include the term 'social' or 'economic'.

While particular terms have a given region of origin (e.g. BMPs from North America, SuDS from the UK), many have been adopted widely. For example, of the 352 citations per year to BMP in the stormwater literature from 2005–2009, 93 referred to either Australia or Europe. Similarly, the term WSUD, which originated in Australia,

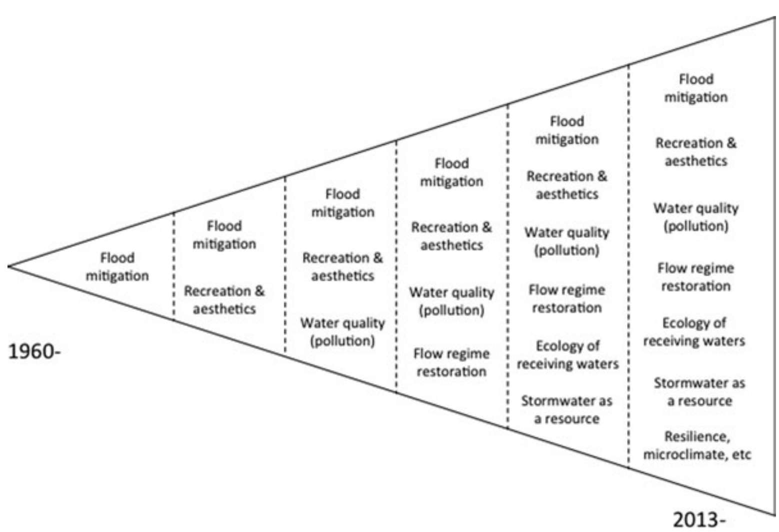

Figure 2. Increasing integration and sophistication of urban drainage management over time (adapted from Whelans et al., 1994).

was cited 335 times per year in the 2010–2012 period, of which 75 refer to European practice. However, it should be noted that the use of a particular term in the international literature might not always represent real adoption of that term. Non-English speaking authors will choose the term they feel is most closely linked to the term used in their native language. As described in previous sections, the choice of terms is often not based on an exact translation, but reflects the knowledge, reading and international collaborations of the authors.

3.2. *Classifying terms by scope and principles*

There is significant overlap between various terms (Figure 3). Indeed, all terms are generally underpinned by two broad principles: (i) mitigation of changes to hydrology and evolution towards a flow regime as much as feasible towards natural levels or local environmental objectives, (ii) improvement of water quality and a reduction of pollutants. Combined, these two principles aim to improve both ecology and channel geomorphology. There are, however, both subtle differences in how these underpinning principles are expressed, based on their local development and institutional context. The overlap in terms of specificity and breadth of application illustrates the extent of similarity of underpinning ideas, as well as the dynamic and multi-dimensional nature of terms used. Broadly speaking, the focus of terms spans a range from those describing techniques (e.g. stormwater control measures in the USA or ATs in France) through to those describing overarching principles (e.g. water sensitive cities from Australia, LID from the USA and New Zealand and IUWM worldwide).

Terms that have evolved primarily from descriptions of techniques and practices include BMPs, SCMs, SUDS, TAs and SQIDs. Terms such as BMPs which have become primarily associated with structural measures (e.g. ponds, swales) in fact originated primarily from a non-structural perspective (United States of America, 1972). Indeed, design manuals advocate for non-structural approaches to be considered first (Shaver, 2000), but the strong engineering focus of urban drainage has led to a focus on devices, potentially to the detriment of more sustainable outcomes. Equally, while in Australia there was once a perception that WSUD was primarily about stormwater management devices, its original definition was in fact very broad and went far beyond the design of structural techniques. Despite this, practitioners often refer to "the construction of a WSUD", as if WSUD describes a single technology. In contrast, the term green infrastructure (GI) would seem to describe a technology (or group of technologies), and yet has been defined much more broadly in recent use, referring to a conceptual approach to urban planning and layout (US EPA, 2012).

The scope and nuance of terms and their application may provide insight into the institutional context of the region of origin. Terms that reflect holistic approaches are might be expected to come from regions with decen-

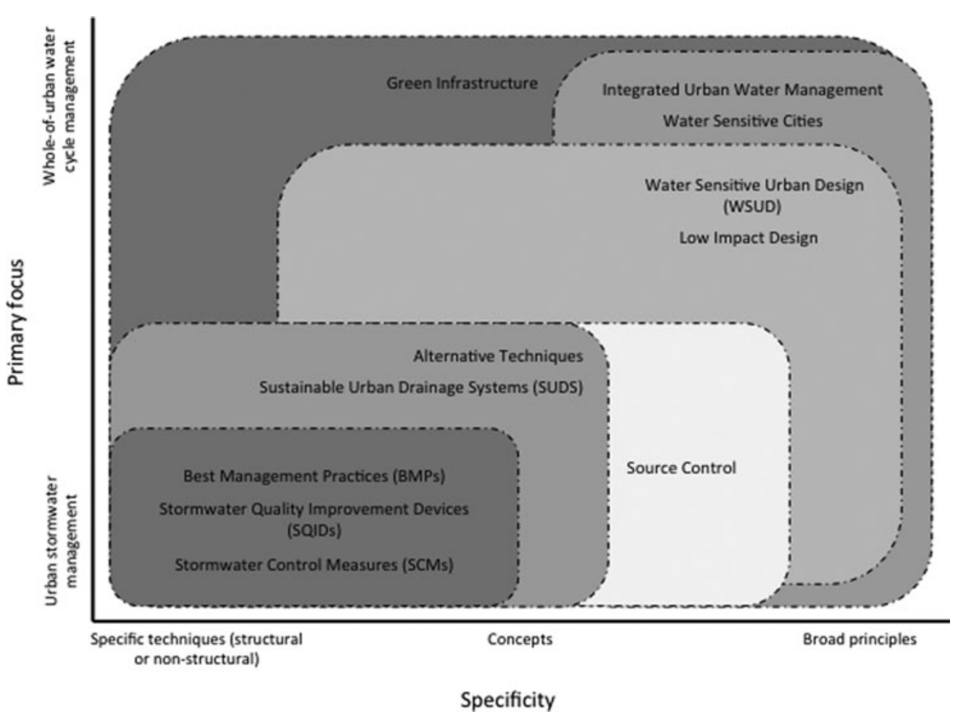

Figure 3. One possible classification of urban drainage terminology, according to their specificity and their primary focus. These classifications may change over time.

tralised institutional arrangements, while more centralised and 'top-down' approaches may result in narrower and more prescriptive approaches.

Artificially classifying terms is perhaps therefore not useful, but the schematic representation in Figure 3 classifies terms according to specificity (technique vs. broad principle) and range of application (urban stormwater vs. whole of urban water cycle management), and therefore provides a clearer framework for authors using these terms.

Such a classification is not fixed, but typically evolves over time, and therefore cannot be represented in a simple unique figure such as Figure 3. For example, some authors consider ATs and GI predominantly as descriptions of structural solutions, while others consider them part of a broader philosophy (e.g. Alfakih, 1990; Azzout et al., 1994; Azzout et al., 1995; Baladès & Raimbault, 1990; Piel & Maytraud, 2004; Sibeud, 2001; US EPA, 2012).

Even when describing specific techniques, being explicit about the underpinning philosophy is important, because otherwise technologies risk being applied for their own sake, without having clearly defined the environmental, social and economic objectives they aim to fulfil.

3.3. *The dynamic nature of terminology*

Our review of the origins and evolution of terminology has shown that, not surprisingly, the meaning and interpretation of terms often changes over time, as a function of interpretation and adaptation by various interest groups. Such an evolution is consistent with how language in general evolves (Calude & Pagel, 2011), with the interpretation of words associated with technical meanings typically evolving very rapidly, to match evolving understanding.

The risk with such rapid evolution is simply that some of the original intent can be lost, or that misunderstandings, particularly among those who are new to the field or not in close contact with the source of the terminology (for example, architects, planners, ecologists, social scientists), may develop. For example, despite the original motivation of ATs as being broad, with a focus on reducing environmental impacts, its application in French regulation is restricted to mitigating flood impacts, with ecological, landscape and social considerations ignored in official guidelines. Fortunately, this has not stopped broader interpretation by most scientists and practitioners. Similarly, despite the origins of the term BMPs being firmly based in *practices* in addition to *technologies* (Environmental Protection Agency, 2011a), it is often used in reference only to structural controls (Sample et al., 2002). Whilst this is less of a problem for those who are already familiar with the term, it leads to misunderstanding by those working in related disciplines or who are relatively new to the field. This may seem trivial, but since understanding will lead to perceptions about what is needed to manage stormwater, practitioners may become confused about what is required (Ellis & Marsalek, 1996) or perhaps worse, develop an understanding that is inconsistent with the principles and objectives which underpin specific terms.

This evolution of terminology might appear to contrast strongly with the very static approach taken by medicine (Stanfield & Hui, 1996), where terminology seems firmly rooted in Latin and is thus really only accessible within the discipline. However, in evolving areas of medicine, the search for a consensus of terminology is also common (Cinque et al., 2003). Urban stormwater management increasingly needs to engage with other disciplines, meaning that such an approach would be counter-productive. Indeed, formalising terminology in standards and regulation is not entirely positive. While it may help to promote or oblige the implementation of new concepts, it may also freeze practice for years, given the time between updates of regulations.

The increase in diversity of terminology over time reflects an evolution from a singular focus around the creation of constructed pipe networks, applied almost universally throughout the world (Bertrand-Krajewski, 2005). This paradigm was implemented by water and sanitary engineers, with limited involvement of other professions. The previously noted transition to new approaches to stormwater management, commencing in the 1970s and 1980s, required greater interactions with other disciplines. These new approaches have become increasingly ideologically driven, being more multi-purpose and locally driven, and thus reflect not only technical advances, but also constantly evolving cultural, social and political contexts.

Professionals within the urban drainage industry thus have a responsibility *not* to resist or attempt to stop evolution of urban drainage terminology – a development which is simply the expression of the profession's own evolution – but to ensure that the underpinning principles and objectives remain clearly stated. In this way, contradictions between the original intent of a term or concept, and its implementation in practice, will more likely be identified. Indeed, we note the need for a more critical culture in urban drainage; there is a paucity of critical reviews which examine whether concepts such as LID, WSUD and SUDS have been successful in meeting their objectives, such as the improvement of water quality, the protection of aquatic ecosystems and the mitigation of flooding.

3.4. *The role of terminology in engaging stakeholders*

The growth in the number of terms and in their frequency of use in urban drainage suggests that the choice of terms can have a major role in engagement not only of those within the urban drainage profession, but perhaps more importantly, of the broader community. Terms such as BMPs, SUDS and WSUD do more than communicate technical details or concepts; over time they create a "brand" which helps to engage politicians, decision-makers and society (Greene, 1992; Weigold, 2001). Terms such as BMP or WSUD thus create an image of success, or of care, respectively. Similarly, while the term IUWM does a very good job of describing its principles and objectives, it is much less compelling to the average person than the term water sensitive cities, which immediately conjures up a vision. Given the importance of these local 'brands', there will continue to be the need for different regions to adopt and adapt terms that suit the local social, insitutional and political context. Overlap and potential divergences between concepts in different regions of the world is therefore inevitable, but provided that new terms are clearly defined by authors who use them, professionals in other disciplines and in other regions should still be able to see the common connections between seemingly different approaches. It is clear that specific terms are needed in non-English speaking countries, taking into account the role of local context and culture. However, to enhance international exchange, it is necessary that the terms used internationally (which are essentially all in English) are clearly defined, with the underlying principles distinguishable from local particularities.

4. Conclusions

The urban drainage profession has undergone significant change over the last several decades, moving from an approach largely focussed on flood mitigation and health protection to one in which a wide range of environmental, sanitary, social and economic considerations are taken into account. The profession has thus developed and adopted new terms to describe these new approaches and is likely to continue to do so, as the transition to a more sustainable and integrated approach occurs.

This review has demonstrated that terminology has evolved in response to changes in urban drainage practice. However, the converse is also true; by acting to set the vision for a more sustainable approach and engaging stakeholders from other professions and from society more broadly, terminology has played an important part in driving and influencing this evolution. Terminology therefore both reflects and drives practice.

We observe that confusion can occur, with different authors using different terms to mean the same thing, or ascribing different meanings to a given term. To facilitate effective dialogue, authors and practitioners should therefore be explicit about what they mean by a particular term so that the audience understands its meaning and its context. For example, in describing the term SCM, it is helpful if the reader understands what the measure attempts to control, and for what purpose. This level and completeness of explanation will allow users to identify the meaning of the term in spite of the inevitable, subtle evolution in the meaning over time. Given the need for the urban drainage profession to increasingly engage with other professions, the potential for miscommunication can and should be minimised, through the careful and explicit use of terminology. At the same time, the profession should also accept the cultural and linguistic diversity that accompanies the evolution of the discipline towards more sustainable outcomes.

"It is often asserted that discussion is only possible between people who have a common language and accept common basic assumptions. I think that this is a mistake. All that is needed is a readiness to learn from one's partner in the discussion, which includes a genuine wish to understand what he intends to say. If this readiness is there, the discussion will be the more fruitful the more the partner's backgrounds differ."

(Popper, 1963) *Conjectures and Refutations*. London: Routledge & Kegan Paul

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Notes

1. The terms 'urban drainage' and 'urban stormwater' are used synonymously throughout this paper.
2. In this paper we do not discuss the technical terminology used to describe stormwater management techniques (e.g. bioretention systems, buffer strips, swales); the reader is referred to Ellis, J. B., Chocat, B., Fujita, S., Marsalek, J., & Rauch, W. (2004). *Urban drainage: a multilingual glossary.* London, UK: IWA Publishing, or local guidelines for definitions of these terms. It is also important to note that this paper has focussed primarily on terminology derived from English-speaking countries, with some input from Germany, France, French Canada, Sweden and Denmark.
3. Gestion intégrée des eaux pluviales (*Integrated stormwater management*): Ensemble de mesures (Conservation de zones perméables, mises en place de systèmes de stockage: noues, bassins, etc., développement de techniques d'interception des polluants: pièges à sédiments, bassins de décantation, zones humides, etc.), mises en œuvre pour atteindre différents objectifs de protection contre les inondations, d'approvisionnement en eau, de gestion écologique et paysagère des milieux récepteurs, de réalisation d'économies financières, etc.. Voir également "Gestion améliorée des eaux pluviales", "Technique alternative".

Extract from the Urban Drainage Multilingual Glossary (Ellis *et al.*, 2004, p. 244, in French only).

4. Best management practice (BMP): structural measures used to store or treat urban stormwater runoff to reduce flooding, remove pollution, and provide other amenities. Typical examples of BMPs include detention or retention facilities, infiltration facilities, *wetlands*, vegetative strips, filters, water quality inlets and others. (See also *Source control*).

   Extract from the *Urban Drainage Multilingual Glossary* (Ellis *et al.*, 2004, p. 13).

5. Technique alternative (*Alternative technique, Structural BMP*): Technique d'assainissement dont le concept s'oppose au principe du tout au réseau. L'objectif de ces techniques est non plus d'évacuer le plus loin et le plus vite possible les eaux de ruissellement mais de les retarder et/ou de les infiltrer . . . ces techniques constituent une alternative au réseau traditionnel de conduites, ce qui justifie leur nom. On parle également de solutions compensatoires (sous-entendu des effets de l'urbanisation). Les concepts utilisés varient beaucoup selon les pays et il est très difficile de trouver des correspondances entre les mots utilisés en français et en anglais. En particulier l'expression "*best management practice*" ou "*BMP*" a un sens légèrement différent. Technique compensatoire (*Compensatory technique*): Voir Technique alternative.

   Extract from the *Urban Drainage Multilingual Glossary* (Ellis *et al.*, 2004, p. 302, in French only)

6. Source Control: the term given to the range of approaches and techniques for local, on-site management and control of stormwater runoff at the point of rainfall. The inclusive definition of source controls would include three categories of urban *Best Management Practices:*

   (1) Housekeeping Practices (which keep pollutants from coming into contact with rainfall-runoff at source) . . .
   (2) Structural Site Controls (which are runoff and treatment controls serving individual developments such as shopping centres, commercial developments or residential areas of less than 2/3 hectares and often located immediately on or alongside the surfaces they serve) . . .
   (3) Structural Area or Regional Controls (which are often *end-of-pipe*, passive treatment structures appropriate for large scale development generally above 3/4 hectares such as industrial estates or major housing developments) . . .

   Extract from the *Urban Drainage Multilingual Glossary* (Ellis *et al.*, 2004, p. 149)

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