

## AN EVALUATION OF SUDS GUIDANCE IN SCOTLAND

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### ABSTRACT

This paper summarises the findings of a project to evaluate the use in Scotland of guidance on Sustainable Urban Drainage Systems (SUDS) – work which was undertaken by Hyder Consulting Ltd (HCL), on behalf of Scottish Environment Protection Agency (SEPA), between February and August 2002. It also discusses SUDS guidance requirements, recent developments and future options. The purpose of the project was to provide a comprehensive and impartial assessment of SUDS guidance and its use in Scotland, based on information provided by key stakeholders. This evaluation of SUDS guidance in Scotland involved qualitative work (focus groups and structured interviews) and quantitative research (posted questionnaires). A total of 830 questionnaires were sent to selected contacts within 4 major stakeholder groups: developers and consultants; local authorities; the water authority; the environmental regulator. Of these, 160 were returned – equating to a relatively high response rate of 20%. The result is thought to be the first major evaluation of SUDS guidance of its type in the UK, which establishes the attitudes, perceptions and experiences of a wide range of practitioners and other experts.

**KEYWORDS** Urban BMPs; Guidance; Scotland; SUDS (Sustainable Urban Drainage Systems); evaluation.

### INTRODUCTION

In the UK, technical guidance on innovative techniques for managing stormwater runoff was initially provided by the Construction Industry Research and Information Association (CIRIA), with their publications on source control technology (e.g. CIRIA 1992). These publications were easily obtainable, alongside other standard engineering references such as Urbonas and Stahre (1993). In parallel, a series of conferences run by Chris Pratt from Coventry University (School of The Built Environment) brought in international expertise as well as presenting experiences of UK applications of source control and BMPs. More esoteric, for UK engineers but still accessible, US manuals such as Schueler 1992 and Horner et al 1994 were also available. In 1996, the diffuse pollution video *nature's way* was launched in the UK and endorsed by environment agencies there, and included promotion of urban BMPs. Nevertheless, initial attempts to introduce urban BMPs to Scotland were often frustrated by a lack of familiarity with the concept, and a lack of adequate UK technical guidance (D'Arcy and Roesner 1999). An initial survey of awareness of alternative stormwater drainage technologies (BMPs, source control, or SUDS as these systems have been variously known in Scotland) showed experience of developers, regulators and other stakeholder groups was very limited (McKissock, *et al* 1999). Roesner (1999) suggests that uncertainty in establishing an appropriate design concept at the outset for a development, is the principal cause of failures observed in the USA and elsewhere; adequate technical guidance is important.

In October 1997 the Scottish Environment Protection Agency (SEPA) together with the water utilities, developers and representatives of government and local authorities, formed the Sustainable Urban Drainage Scotland Working Party or 'SUDSWP', to co-develop acceptable solutions to urban drainage problems and the implementation of SUDS technology in Scotland. One of the first priorities of SUDSWP was to develop a design manual, and this was co-developed for Scotland and Northern Ireland, and published for the working party by CIRIA ('the manual' CIRIA 2000). The pivotal role of the CIRIA manual in Scottish SUDS implementation, and the requirement for it to be kept under review, are highlighted by SEPA Policy 15 (SEPA, 2001), which states that: 'SEPA shall refer to... the manual... as the primary source of authoritative information on sustainable urban drainage systems' and that it shall 'keep the content of... the manual... under review'. The manual is also referred to in government planning guidance (Scottish Executive, 2001); it is currently at the heart of relevant planning advice and national policies in Scotland.

The use of SUDS is now standard practice in Scotland (D'Arcy and Wild 2002). The growth in numbers of SUDS since 1995/96 has been impressive, with a recent survey finding that by the end of 2001, 767 SUDS sites and nearly 4000 individual systems had been implemented in Scotland (Wild et al, 2002). Findings from that survey also demonstrated that there are several issues that still need to be addressed (for example, the application of the 'surface water treatment train' concept has not yet become widespread; in-ground SUDS are predominant; and amenity aspects of SUDS have to some extent been neglected). This survey was undertaken to provide a basis for assessment and review of the technical guidance, as part of the continuing effort required to address SUDS implementation issues.

### METHODS

Qualitative and quantitative research methods were used to provide information about Scottish stakeholders in SUDS, and their opinions of guidance and reference materials, specifically: (1) knowledge and understanding; (2) experiences with

SUDS; (3) awareness and perceptions of SUDS options; (4) awareness and perceptions of the CIRIA SUDS Design Manual (C521). These four themes were used consistently throughout the project, to allow results to be compared and contrasted. Each method of data collection was specifically chosen to consolidate and verify the results gathered from the other methods.

### ***Phase 1 - qualitative research***

The aim of the first phase of the project was to provide baseline information and to identify issues to be evaluated in phase 2. Relevant information was obtained from focus groups and interviews. Discussions within each focus group and interview were based on the 4 common themes, described earlier. During the first phase of the project, 7 focus groups, 2 semi-structured interviews and 4 telephone interviews were held. The purpose of the focus groups was to generate an understanding of participants' experiences, perceptions and attitudes through informal group discussions. The focus groups and interviews were conducted in parallel to provide quality controls and to highlight key issues, which were then used to develop the questionnaire (used in phase 2 of the study). In total, 45 people attended focus groups. Data obtained during focus groups and interviews were analysed using QSR NUD.IST (Non-numerical Unstructured Data Indexing Searching and Theorising) software. This software provides support in the qualitative research process by aiding exploration, categorisation and coding of large amounts of data.

### ***Phase 2 - quantitative research***

Phase 2 of the research involved the use of quantitative methods. A postal questionnaire was employed with the aim of generating detailed information. The design of the questionnaire was based upon the findings of the interviews and focus groups carried out in phase 1. Precise and unambiguous questions were formulated to minimise any potential misunderstanding. Closed questions were designed with a meaningful scale, selected to provide a good spread of answers. Potential responses were balanced, using a scale with end points which were opposites and equal intervals between each point (e.g. essential, very important, important, fairly important, insignificant). The design, administration, processing and analyses of questionnaire results were carried out using 'Sphinx Survey' software. The software was used to analyse responses to all closed- and open-ended questions.

## **RESULTS AND DISCUSSION**

### ***Phase 1 - qualitative research***

Results from phase 1 of the research provided remarkably good information, that closely matched the more detailed findings of the quantitative phase 2 survey.

#### Awareness and perceptions of general guidance

The main issues arising from focus groups and interviews were that: (1) available UK guidance can be too general and is not always of high quality; (2) guidance must be improved and refined in the light of increasing experience; (3) the guidance material which was available needed to be publicised; (4) there is a need for more case studies from Scotland (5) deterrents to the use of SUDS include adoption and maintenance, land take, and safety issues. A few participants also referred to US guidance, and the IAWQ (IWA) diffuse pollution video *Natures Way* was mentioned in focus groups.

#### Awareness and perceptions of the CIRIA SUDS Design Manual

Almost all the participants in focus groups and the interviewees were aware of the CIRIA manual C521. Perceptions of the manual varied. Although many were critical, they were usually constructive too. Some individuals were very positive about the manual. One participant felt that the manual was much needed and that it pulled together information that previously had been disparate: "I think before we had the manual, (we) were tending to pull information from a wide range of sources, references...the hope was that the manual would pull everything together. A frequently voiced criticism was that the manual was lacking in terms of design and engineering details. For instance: "I do not think it is detailed enough for engineers". Another criticism was that certain sections of the manual can be, and are, interpreted differently by different stakeholders; although recognising the need for some flexibility, the manual is not sufficiently prescriptive.

### ***Phase 2 - quantitative research***

#### Questionnaire responses

A total of 830 surveys were sent either by e-mail or post, and 160 were returned, equating to a response rate of 20%. Table 2 summarises the number of responses. Responses from Scottish Water were limited due to a major reorganisation which was ongoing at the time of the survey. More responses were received from consultants than any other group (responses from consultants = 66 of 160; 41%).

#### Awareness and expertise of the sample population

Most respondents to the questionnaire had a good understanding of the term sustainable urban drainage and were aware of at least one source of information on this subject. Moreover, one half of all respondents (50%) indicated that they had been involved in the development of 6 or more SUD systems (Figure 1). This not only highlights that SUDS appear to be routine business in Scotland, but also that this survey reached the correct target people.

**Table 1. Number of responses to postal questionnaires (ranked by replies)**

Stakeholder group	Sent	Replied
Consultant Engineers	273	66
Architects	157	25
Councils	69	25
Builders & Developers	178	21
SEPA	32	8
Landscape Architects	88	6
Academics	15	5
Scottish Water	18	4
TOTAL	830	160

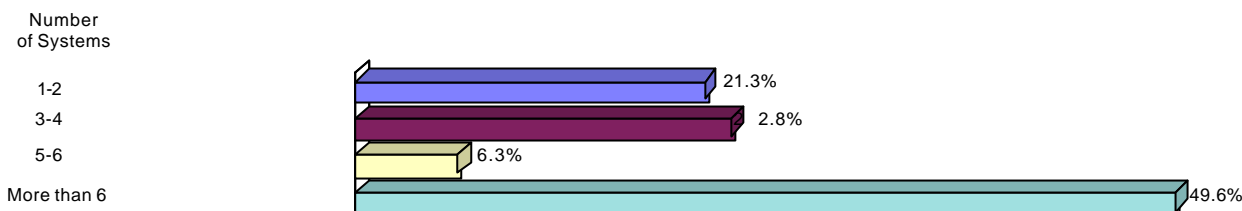


Figure 1. Respondents' SUDS experience: number of developments in which stakeholders had played a role

Despite this finding, the majority of respondents were unaware of whether or not adequate guidance was available on the sources and impacts of diffuse pollution (Figure 2). This hints at the possibility of a large number of people being involved in developing SUD systems, without fully understanding the problems which these systems are supposed to be addressing. In autumn 2000 a major UK report was published to address that need (D'Arcy *et al.* 2000), but clearly did not raise awareness with consulting engineers and others surveyed for this work.

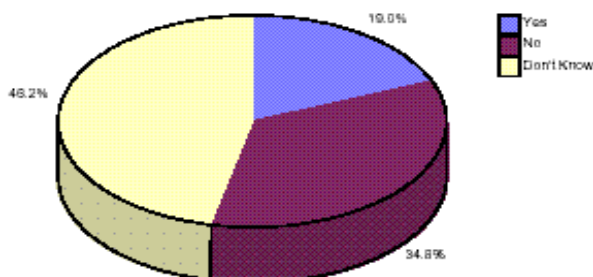


Figure 2. The respondents opinions on the availability of adequate information describing the sources and impacts of urban diffuse pollution

**Perspectives: deterrents to SUDS implementation**

Many respondents felt that a lack of clarity about who was responsible for adoption and maintenance of SUDS had been the main deterrent to their use. One participant stated that: "SUDS is an essential step forward for the benefit of the environment, however there is still a vale of cloud hanging over this design system regarding... adoption and future maintenance" (Respondent to questionnaire). Respondents were encouraged to name several different deterrents to SUDS implementation. This resulted in a total of 455 citations. The adoption and maintenance issue was identified as being the greatest deterrent (Figure 3: 90 of 455 responses). Land take was also found to be a significant deterrent (64 responses). Importantly for this survey, only 31 individuals responded that lack of guidance was a deterrent to the use of SUDS. This indicates that whilst participants could identify potential improvements to guidance, lack of guidance was not a significant barrier to SUDS implementation (although probably of major importance for effectiveness and appropriateness of SUDS facilities!).

Despite these deterrents, respondents were still willing to recommend SUDS types (Figure 4). Swales, porous paving and infiltration trenches were the most popular recommendations, information which can be compared with the actual numbers of each type currently in place in Scotland (Figure 5) The differences between figures 4 and 5 reflect the difficulties in getting public authority adoption of some types of SUDS (e.g. swales) as well as other constraints such as type of development or soil.

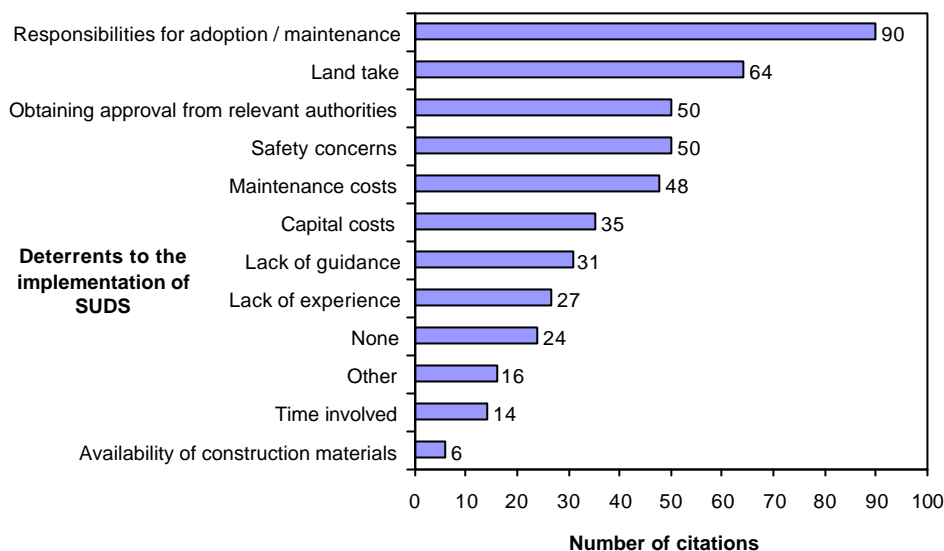


Figure 3. Deterrents to SUDS implementation (N.B. multiple responses allowed; total number responses = 455)

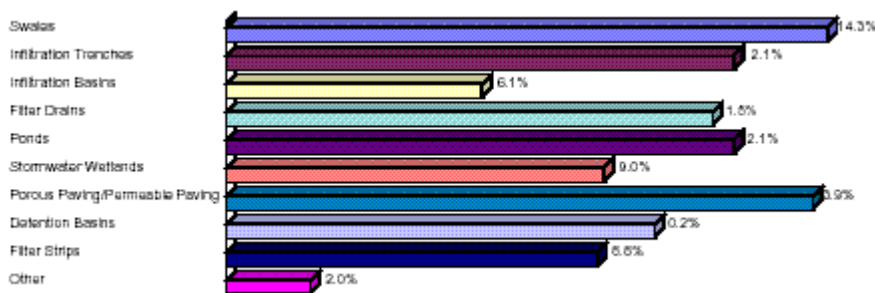


Figure 4. Percentage of the respondents who would recommend each type of SUDS

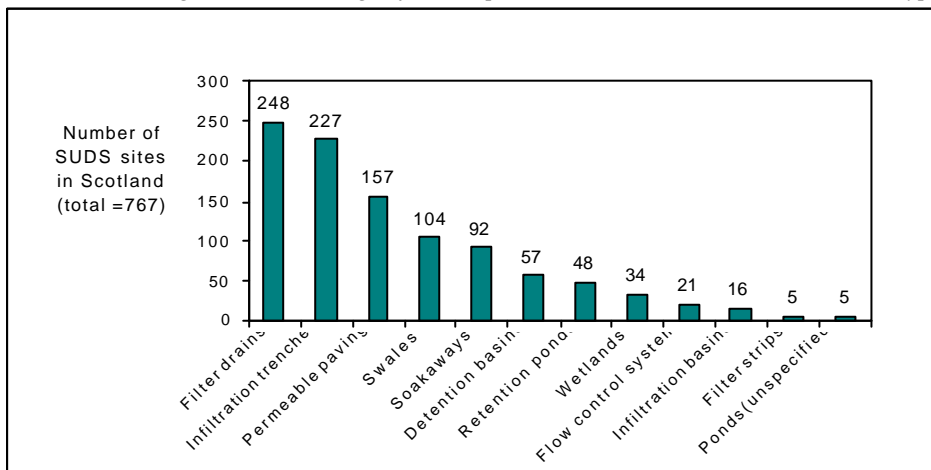


Figure 5. Numbers of each type of SUDS site in Scotland - 01/01/2002 (Wild, Jeffries and D'Arcy 2002).

**Popular sources of SUDS guidance**

SEPA references and CIRIA publications were the most popular source of SUDS guidance. Again, respondents were encouraged to select one or more options. In total, 470 responses were received. Of these responses, 107 were citations of SEPA documents, and 103 related to CIRIA publications (Figure 6). The primacy of anything produced by the regulator, SEPA, is clear, together with the regulator's recommend technical guidance (CIRIA 521). Very few respondents used web sites or US publications

**Perceptions of the CIRIA SUDS Design Manual – C521**

*Use of the manual :*

Although more than one half of respondents indicated that they had used the manual in their professional capacity (93 of 155 = 60%), a significant proportion (40%) of the intended audience of the manual had not. Less than half of the individuals who had constructed 1 or 2 systems had used the manual (42%), whilst the majority of individuals having

experience of 6 or more systems had used the manual (92%); in Scotland individuals with considerable SUDS experience are using the manual.

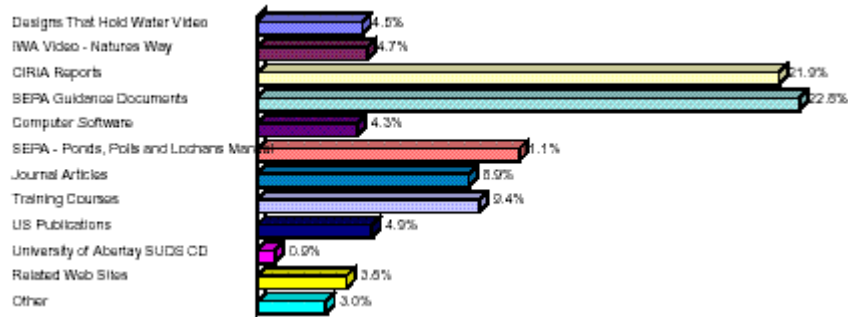


Figure 6. Usage of reference material

In contrast SEPA staff were also surveyed in order to ascertain how often they came across developers who knew of the manual. None of the respondents indicated that they had never encountered reference to the manual, only 17% said frequently; the majority (52%) stated that developers only referred to the manual occasionally. This probably represents the movement of SUDS from being a specialist area to more routine in Scotland.

*Perceived effectiveness of the CIRIA manual :*

In general, respondents thought that the manual was fairly effective, or effective, in meeting its purpose (Fig.7; ‘fairly effective’: 48 of 95 responses = 50%; ‘effective’: 34 of 95 = 36%). The research project included a series of questions about detailed aspects of the CIRIA manual: how easy to use; which sections most useful; ideal length; how much detail (too much , too little etc); which produced valuable information. Nearly half the respondents (49%) said the manual was not technical enough, whereas only 31% thought it was at the correct technical level.

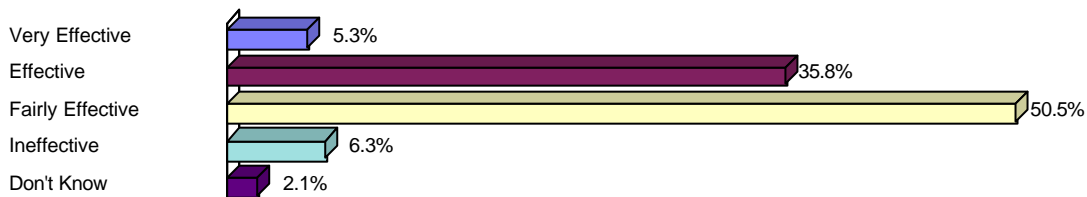
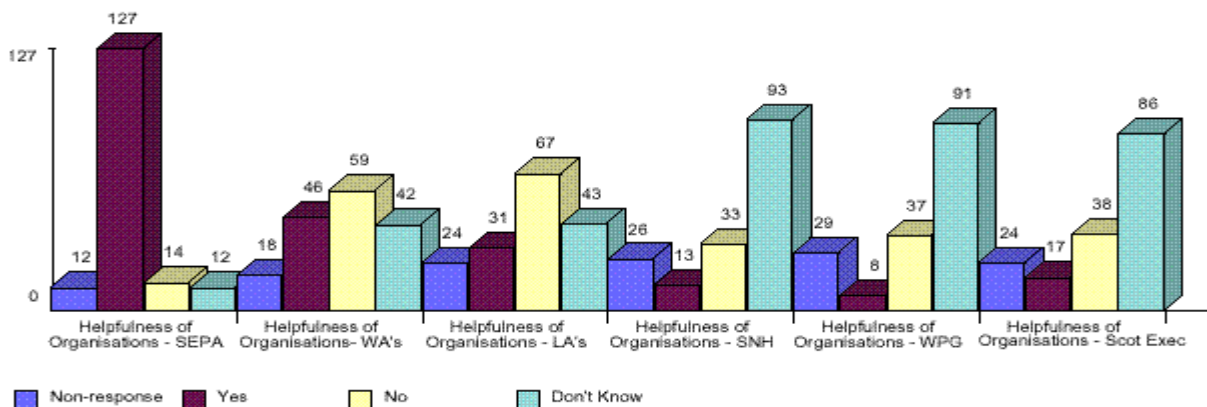


Figure 7. Perceived effectiveness of the manual

The Effectiveness of the SUDS Partnership Approach

SUDS in Scotland have been developed using a partnership approach involving a number of bodies (SUDSWP). The responses shown below (Fig.8) indicate the importance of the regulator as a source of information and guidance, with 83% of responses finding SEPA helpful.



Key

LA = Local Authorities, WA= Scottish Water, SNH = Scottish Natural Heritage, WPG+Wildlife Protection Group, Scot Exec = Scottish Executive

Figure 8. Whether organisations had been helpful in providing guidance material

**Suggested improvements to guidance**

The following list of potential improvements to guidance is derived from suggestions made by respondents within their completed questionnaires, or during focus groups and interviews (Table 2). They are not presented in any particular order, and for the sake of brevity, several comments have had to be omitted. These suggestions do however represent the most frequently recorded comments:

**Table 2. Suggested improvements to guidance**

<b>General SUDS guidance:</b>
1. Provide low cost guidance material, to facilitate greater access;
2. Make available information on Scottish case studies;
3. Improve guidance for SUDS in brownfield and industrial sites;
4. Produce a 'landscaping specification' for SUDS;
5. Provide guidance about the integration of SUDS and grey water / water reuse;
6. Address inconsistencies in advice provided by stakeholders;
7. Produce and regularly update a summary of available guidance;
8. Regularly obtain feedback on the use of the manual and other guidance on SUDS;
9. Regularly review the quality of guidance, in light of increasing SUDS experience; and
10. Arrange training events for all stakeholders, and short seminars to raise awareness of SUDS.
<b>CIRIA SUDS Design Manual for Scotland and Northern Ireland (C521):</b>
1. Reduce the cost of the manual and provide greater access to guidance (e.g. via internet);
2. Revise the selection tool (table on page 39) in the manual;
3. Include more case studies and practical examples;
4. Specify types of SUDS that are acceptable in different scenarios;
5. Provide more information on the design of inlets and outlets;
6. Improve explanations of hydraulic calculations;
7. Include more information about system performance (especially in-ground systems);
8. Include more details on the ecological aspects of SUDS (e.g. habitat enhancement);
9. Improve the quality of particular drawings; and
10. Arrange training seminars at which free copies of the manual are distributed.

**SUBSEQUENT DEVELOPMENTS****Adoption and maintenance**

At the time of the project, the term SUDS did not exist in law and consequently responsibility for adoption and maintenance of public SUDS was unclear. On 29<sup>th</sup> January 2003, the Scottish Parliament passed the Water Environment and Water Services Act (Scotland). Part of 2 of that Act amends the Sewerage (Scotland) Act 1968 so that Scottish Water assumes responsibility for maintaining public SUDS that meet the construction and design standards that ministers will set. That is a huge step forward. In practice the pre-requisite design standards document that is needed to establish a basis for public adoption and maintenance by Scottish Water, will become the new Scottish design manual.

**Revision of existing guidance and provision of new guidance**

Good SUDS guidance should in theory allow developers and those acting on their behalf to implement more sustainable drainage practices, whilst maintaining a level playing field (so different decisions/interpretation don't give economic advantage to rival businesses). The Scottish research described in this paper highlighted a request from developers and consulting engineers for more prescriptive guidance: accordingly SEPA has produced a SUDS guidance document (D'Arcy and Wild 2003). CIRIA also have their manuals under review (there is a similar one for England and Wales, CIRIA 523). Work is also in hand to write up results of 5 years of monitoring SUDS sites in Scotland; that data, on performance and maintenance needs, will also feed into new technical guidance (C. Jeffries, in prep.)

**CONCLUSIONS**

The evaluation of SUDS guidance found that the vast majority (98%) of respondents to a postal questionnaire were familiar with the term 'SUDS' and half (50%) had been involved in the development of 6 sites. SEPA guidance, and the CIRIA SUDS Design Manual appear to be used widely by SUDS stakeholders: 60% of participants in the survey had used the manual. 40% had not, perhaps because of their limited experience of SUDS, or restricted access to this guidance. Many respondents (42%) described the manual as being expensive. 92% of individuals who had been involved in the development of 6 sites had used the manual. As more stakeholders are involved with SUDS implementation, they are more likely to purchase a manual.

The most frequently cited perceived deterrent to the use of SUDS was 'responsibility for adoption and maintenance' (90 of 455 responses). Recent amendments to the Scottish legislation have been made which resolve that issue, with a clear remit for Scottish Water. The second most frequently cited perceived deterrent to SUDS implementation was land take. Interestingly, only 31 of 455 responses cited 'lack of available guidance' as being a deterrent to the use of SUDS; it is evident consulting engineers and others are confident enough to have a go at anything, with or without adequate guidance.

The use of qualitative and quantitative research as part of this project provided quality data and ensured coverage of the target participants across a wide geographical area. Focus group research, supplemented by a few target interviews, provided very similar information to the follow-up questionnaire. Overall, the outputs give a useful insight into the effectiveness in Scotland of present SUDS guidance that will help with the development and delivery of new SUDS guidance.

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