A Decision support approach to the selection of sustainable drainage systems

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Abstract

Relevant and robust decision support tools are extremely valuable in the detailed selection and implementation of site drainage design. A web-based Adaptive Decision Support System (ADSS) to help the end-user decision-making process to identify possible BMP/SUDS solutions for urban stormwater management has been incorporated into the SUDSLOC selector tool within the SWITCH Stomrwater Management theme. The DSS approach adopts generic sustainability criteria referenced against those parameters related to the water quantity, water quality and ecology/amenity functions influencing BMP/SUDS performance. The controlling criteria (or Areas of Concern, AoC) for the MCA are Site Characteristics, Technical, Environmental, Economic, Operation and Maintenance, Social and Urban Community Benefits and Legal and Urban Planning. These seven criteria are subdivided into indicators and benchmarked using appropriate threshold values or units as indicated in Table 1.

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CRITERIA (AoC)	INDICATORS
Technical	Storage and Flood Control
	Pollution Control
	System Adaptability
Environmental	Receiving Water Volume Impact
	Receiving Water Quality Impact
	Ecological Impact
Operation and Maintenance	Maintenance and Servicing Requirements
	System Reliability and Durability
Social and Urban Community Benefits	Public Heath and Safety Risks
	Sustainable Development
	Public/Community Information and Awareness
	Amenity and Aesthetics
Economic	Life Cycle Costs
	Financial Risk/Exposure
	Long Term Affordability
Legal and Urban Planning	Adoption Status
	Local Building and Development Issues
	Urban Stormwater Management Regulations

Table 1. Criteria and Indicators within the MCA

Table 2 illustrates an example of the range of indicators and benchmarks that are considered to provide points-of-reference for the Technical (AoC) Criteria grouping.

Criteria	Indicator	Benchmark	1.1.1.1 Units
Technical	Storage and flood control	Overflow frequency	1...n
		Design storm return interval	RI yrs
		Extreme event control	H/M/L
	Pollution control	Dissolved pollutant capture	%; H/M/L
		Solid(s) pollutant capture	%; H/M/L
	System Adaptability	Ease of retrofitting	H/M/L
		Design freeboard	% ; Volume, m^3

Each benchmark requires that it be appropriately scaled for the selected threshold unit or value and this has been achieved through re-iterative discussions with experts in the specific AoC or by reference to available national or other standards. Figure 1 illustrates the benchmarking scaling technique approach being used within the current MCA methodology in respect of the Storage and Flood Control Indicator based on the “Level of Protection” (LoP) as determined by the design storm return interval (RI).

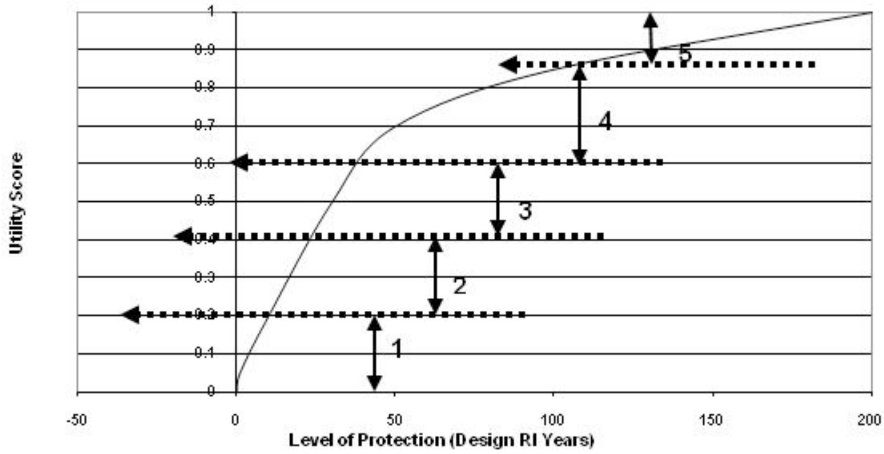

Figure 1. Derivation of MCA Utility Scores and Ranking Value for the Storage and Flood Control Indicator

Protection against 30 RI events (3.33% annual probability) was considered as being adequate for most urban developments and this LoP has been allocated a utility score value of 0.5. Relative to this, the 1:50 RI and 1:100 RI events are given values of 0.7 and 0.85 respectively. The 100% annual probability (1:1 RI event) is the highest probability event that might be considered to ensure that flows to the receiving water are tightly controlled for these more frequent but dominant channel-forming events. It is possible to directly use the utility score as derived from the plot or to standardise the MCA matrix scoring within a grouped scale (e.g 1 –5) as shown in Figure 1. The final step in the procedure is the determination of the range of LoPs afforded by varying BMP/SUDS controls based on consideration of their volumetric capacity and storage potential for varying levels of storm recurrence intervals.

The Water Quality Control Indicator is developed by benchmark referencing to the BMP/SUDS performance for the removal of a full suite of stormwater priority pollutants (TSS, BOD, COD, nutrients, faecal coliforms, metals, PAHs, pesticides and other organic pollutants (Revitt et al, 2004)). In this instance the utility score is benchmarked by the ranking of the BMP/SUDS in terms of its performance as determined from a detailed consideration of the efficiency potential of the primary removal processes for each pollutant (adsorption, sedimentation, filtration, microbial degradation, solubility, volatilisation, photolysis and plant uptake) in respect of each BMP type. The pollutant removal and BMP performance rates are initially classified as high, medium or low (or non-applicable) using a scaling technique. This classification is then converted into a quantitative scale by summing the individual pollutant and BMP/SUDS removal process potentials to derive an overall single value for each BMP/SUDS device which can then be ranked to the common 1 to 5 scale.

The MCA performance matrix is displayed on-line with the matrix cells carrying either pre-assigned default values (Mode 1) or values can be entered by the user (Mode 2). Figure 2 illustrates part of the screen display prior to the assignation of any values. The highlighting (which appears in red on the actual display screen) of specific BMPs/SUDS in the title columns indicates that these have been pre-identified as being inappropriate from consid initial Site Characteristics screening. Following completion of the matrix scores, weightings can be applied to reflect the importance placed on each criterion and/or indicator by the stakeholders. If a particular criteria or indicator is not to be considered within the MCA for some reason, it can be eliminated by allocation of a 0% weighting.

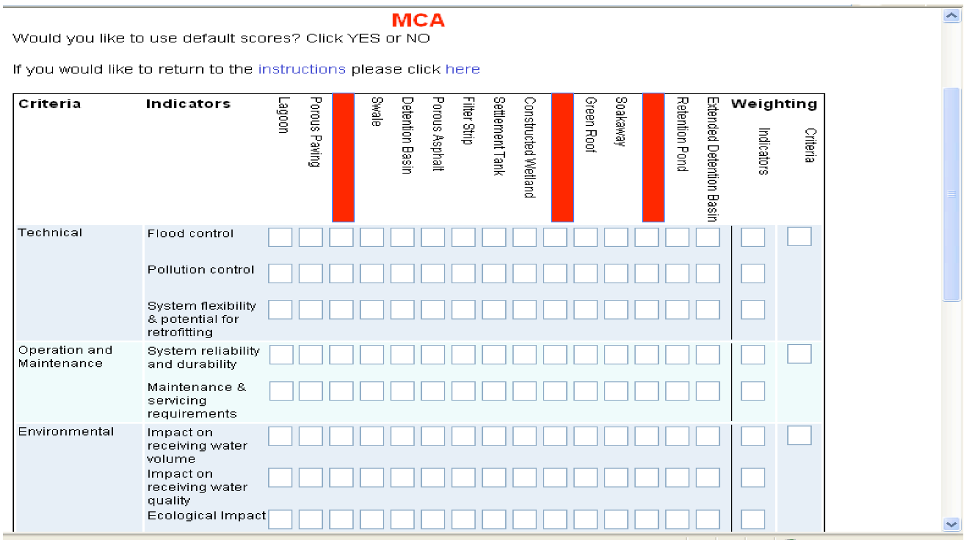

Figure 2. Screen Display of the MCA Matrix

If a consensus on weights cannot be reached, the MCA may be repeatedly run using different weightings which reflect differing views to ascertain the effect that this has on the generated BMP order of preference. Although the MCA method greatly facilitates the comparison of drainage alternatives and scenarios against a wide range of criteria in a quantifiable and auditable manner, the problem of defining the level of sustainability of each individual option still remains. This is primarily due to limitations in the current state of knowledge whereby an absolute target value of sustainability for a given set of criteria within a given situation is very difficult to determine. In addition, the generated results are not directly comparable in terms of the values produced i.e the MCA may inform that option one is more preferable than option two, but it cannot identify the degree of distinction between them.