



Contributing work packages to the Sustainable Urban Drainage Subject Group

- WP 2.1: Technological options for storm water control under conditions of uncertainty (MU)
(ARUP;SUDECAP;UFMG;EPFL;IPS)
- WP2.3: Environmental change studies for stormwater control and reuse options (UNI-BHAM)
(UNESCO-IHE;MU)

Sustainable Urban Drainage (SUD)

Both WPs 2.1 and 2.3 address the use of sustainable approaches to:

- ▶ Control stormwater runoff flow quantity (runoff conveyance, capture and flow attenuation)
- ▶ Reduce contamination of surface- and ground-waters as a result of drainage discharges
- ▶ Contribute to the protection and/or enhancement of habitat/amenity aspects within the receiving water environment



Generic and specific links to other subject groups

Integrator team (WP1.1, 6.2, 6.3); City Water (WP 1.2, 1.3, 1.4); Institutional and financial instruments WP 3.1, 6.1, 6.4)

- ▶ **Urban Planning and Stormwater Management (WP2.2, 5.1):** by contributing to the opportunities which exist for enhancing the landscape within urban environments.
- ▶ **Natural Systems for Treatment (WP3.2, 3.3, 3.5):** extending our knowledge of the natural pollutant treatment capacities of soil and vegetation.
- ▶ **Decentralized Wastewater Systems (WP4.1, 5.2):** productive re-use (re-cycling) of urban water to increase availability and to reduce the operational costs of wastewater treatment.



Tasks/Deliverables completed in SUD task group since 3rd SWITCH Scientific Meeting)

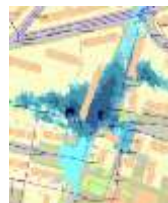
D2.1.2: A design manual incorporating best practice guidelines for stormwater management options (as part of IUWM) and treatment under extreme conditions.



Tasks/Deliverables completed in SUD task group (continued)

- D2.1.3: A technological modeling approach which assists the identification and targeting of the most appropriate stormwater solutions at a catchment scale.

The developed GIS tool (D2.3.2a) has been linked with an urban runoff flow prediction model (STORM) to facilitate the assessment of the benefits which can be achieved in terms of both quantity and quality aspects by the introduction of BMPs at appropriate locations within an urban sub-catchment; incorporation of a 1D/2D model allows the estimation of surface flooding impacts; future predictions can be made using stochastic rainfall series developed for the city of the future.

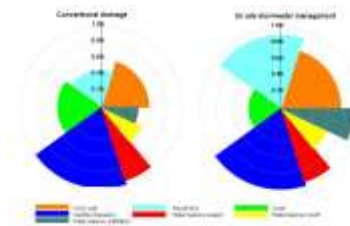


Tasks/Deliverables completed in SUD task group (continued)

- ▶ D2.1.4: Assessing future uncertainties associated with urban drainage using flexible systems – the COFAS method and tool.

The developed tool enables a comparison of the flexibility of alternative stormwater management options with regard to their adaptability to future changes e.g. climate change, urban dynamics. The benefits of decentralised solutions are demonstrated using a case study example.

The COFAS software is presented as part of the Deliverable.



Tasks/Deliverables completed in SUD task group (continued)

- ▶ D2.3.1.b: Extended data sets showing eco-hydrological development of a range of green and brown roof types

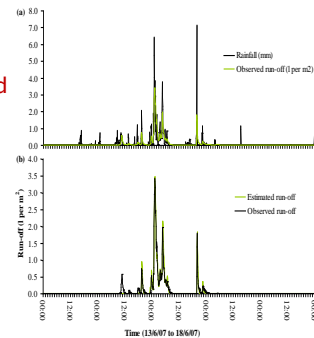
These data sets collected from experimental roof trays and from two demonstration roof sites provide the necessary evidence for evaluating the performance of brown roofs in terms of both biodiversity and hydrological functions.



Tasks/Deliverables completed in SUD task group (continued)

- ▶ D2.3.1.c: Report on the ecological benefits of green and brown roof systems relating to biodiversity
- ▶ D2.3.1.d: Report on the hydrology and effluent quality of green and brown roof systems

Detailed modelling of the ecological and hydrological processes relevant to green roof systems including the impacts of the raised community development and the water quality variations in the effluent water from the roof trays.



Tasks/Deliverables completed in SUD task group (continued)

- ▶ D2.3.2a: A GIS data integration tool for assessing stormwater management options: User Guide

A decision support tool designed to assist practitioners in the selection of stormwater BMPs for a defined catchment area



Topics currently underway in SUD task group

- ▶ T2.3.3 Innovative methods for the adsorptive removal of heavy metals from stormwater (UNESCO-IHE).

Laboratory based batch adsorption experiments to assess heavy metal removal from stormwater and groundwater:

- ▶ The impact of pH, calcium and bicarbonate concentration on the adsorption of copper, cadmium, chromium (III and VI), manganese by iron oxide coated sand (IOCS) and granular ferric hydroxide (GFH).
- ▶ Effect of pH and silica on arsenic removal and fulvic acid on arsenic and chromium removal by IOCS.



Published MSc theses

- ▶ Devendra Yadav (2007) Adsorptive Removal of Heavy Metals from Urban Storm Water Run-off. (UNESCO-IHE MSc thesis MWI-2007-23).
- ▶ Rupa Shrestha (2008) Optimization of IHE family filter for manganese removal under laboratory conditions (UNESCO-IHE MSc thesis MWI-2008-031)
- ▶ Mohammed Ahmed Abdullah Bakhamis (2009) Adsorption of Copper and Cadmium from Urban Stormwater Runoff on Iron Oxide Coated Sand and Granular Ferric Hydroxide (UNESCO-IHE MSc thesis MWI-2009-04)
- ▶ Kumar Thapa (2009) Effect of Water Quality Matrix on Chromium Removal (UNESCO-IHE MSc thesis MWI-2009-03)
- ▶ Yonas Berhe Gebreyowhannes (2009) Effect of Silica and pH on Arsenic Removal by Iron-Oxide Coated Sand (UNESCO-IHE MSc thesis MWI-2009-13)
- ▶ Dibyo Saputro (2010) Effect of Fulvic Acid on the Adsorptive Removal of Arsenic and Chromium from Groundwater by Iron Oxide Based Adsorbents. (UNESCO-IHE MSc thesis MWI-2010-028).
- ▶ Nikola Stanić (2010) Critical Review on the Adsorptive Removal of Heavy Metals by Iron Oxides Based Media (UNESCO-IHE MSc thesis MWI-2010-029)

Stormwater related Tasks/Deliverables completed in WP 2.2 since 3rd SWITCH Scientific Meeting)

► D2.2.3a: Evaluation of decision-making processes in urban stormwater management

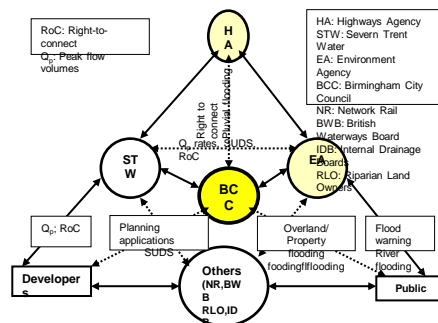
Focuses on selected demonstration cities to highlight the opportunities and problems for diverse stakeholder engagement in stormwater management and to develop a vision statement which helps to identify the primary indicators of relevance to the achievement of integrated urban drainage management for the city-of-the-future.



Stormwater related Tasks/Deliverables completed in WP 2.2 (continued)

► D2.2.3b: Guidelines for the preparation of an institutional map for cities identifying areas which currently lack power and/or funding with regard to stormwater management.

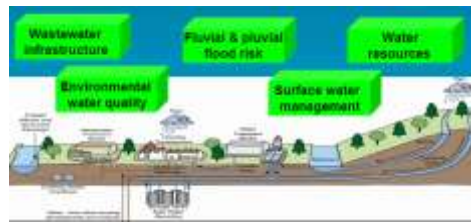
Provides guidelines which are intended to assist partners in the preparation of an institutional map for their selected city where there is currently an identified lack of power and/or funding with respect to stormwater management.



Stormwater related Tasks/Deliverables completed in WP 2.2 (continued)

► D2.2.4: Stormwater as a valuable resource in the urban water cycle.

Identifies the contribution that stormwater management strategies can make in meeting the needs of, and in reducing the stress on, stakeholders involved in other components of the urban water cycle. In particular, the the processes and measures that facilitate or hinder the implementation of integrated stormwater management (IUSM) and associated sustainable mitigating approaches are examined.



Stormwater related Tasks/Deliverables completed in WP 2.2 (continued)

► D2.2.5: Development of generic Best Management Practice (BMP) Principles for the management of stormwater as part of an integrated urban water resource management strategy.

The key elements of a sustainable stormwater management strategy are clearly set out through the development of generic Best Management Practice (BMP) principles. The advantages and disadvantages associated with different decision-making processes are described, and the conflict between an integrated approach and engagement with local stakeholders is recognised.

Technical	Environmental	Community	Costs	Planning
<ul style="list-style-type: none"> ↓Pollution and flooding ↓Runoff volumes to CSOs, WWTPs ↓Impermeable surface area ↑Stormwater storage volumes 	<ul style="list-style-type: none"> ↑Maintaining receiving water volumes ↑Water quality ↑Wildlife habitats ↑Biodiversity and landscape 	<ul style="list-style-type: none"> ↑Environmental education, information and training ↑Stakeholder Consultation ↑Community participation 	<ul style="list-style-type: none"> ↓Drainage system costs ↓O&M costs ↓WWTP runoff treatment costs ↓Retrofit costs 	<ul style="list-style-type: none"> ↑Landscape & flood management planning ↑Control of impermeable surfaces ↑Surface water drainage

Demonstration activities closely linked to SUD subject group



These are focussed on:

- ▶ Birmingham (Eastside regeneration area and green roofs)
- ▶ Belo Horizonte (stormwater source control devices and wetlands)
- ▶ the Emscher region (stormwater technologies and water sensitive urban design)
- ▶ Lodz (natural treatment systems as part of the development of eco-hydrological approaches for the re-naturalisation of water ecosystems, particularly involving the Sokolowka and Ner Rivers).
- ▶ Alexandria; strategic planning process with the emphasis for stormwater being on reuse and rainwater harvesting.

Training courses linked to SUD subject group

- On-line learning course on Stormwater Management (organised by UA with contribution from MU)
- The course is aimed at supporting the needs of Learning Alliance members including municipal officers, drainage engineers, policy-makers, urban planners and designers, water industry, environmental regulators and property developers as well as providing research/educational material for university staff and research students
- Heiko Sieker participated in a 1 week training course on stormwater in Johannesburg (May 2010) organised in conjunction with the Training Toolkit.

Training workshops linked to SUD subject group

- ▶ Birmingham: Green roofs and biodiversity
Stormwater re-use seminar
Actions to combat climate change and benefit biodiversity in an urban environment
Green roof implementation
Planning for stormwater management in the cities of the future
Risk matrix approaches to stormwater flooding
Coupled modelling approaches for identifying surface water drainage control strategies
- ▶ Lodz : Stormwater Management and GIS DSS in UWM
Stormwater and natural systems
Sustainable stormwater management
- ▶ Belo Horizonte: SUDS and Integrated Urban Water Management
Integrated urban water management in the city of the future
Innovation in stormwater management: a SWITCH in concepts and practices
- ▶

Training workshops linked to SUD subject group (continued)

- ▶ Essen: Developments within urban stormwater management under the SWITCH project
- ▶ Mexico City: Training activities on SUDS and flood management. Workshop organised by the SWITCH International Research School for Urban Water Management (IRS-UWM).

Papers (journals and conference proceedings) in 'Sustainable Urban Drainage'; 2009 – 2010

- › B Shutes, M Revitt, B Ellis and L Scholes. 2009. The role of constructed wetlands in sustainable urban stormwater management. Paper presented at Symposium on Sustainable Development of Wetlands for Hong Kong ahead of 2010, 5 May 2009, Hong Kong.
- › Helm, B., Tränckner, J., Sieker, H., Krebs, P. 2009. Flexibilität als Bewertungskriterium, KA – Korrespondenz Abwasser, Abfall – 2009 (56) – 4
- › N Nascimento, M Seidl, A Silva and L Vieira. 2009. Infiltration and detention systems for stormwater control: an assessment of performance. 33rd IAHR Congress, August, 9–14, 2009, Vancouver, Canada (www.iahr.net).
- › Vieira, L., Silva, A. and Nascimento, N. 2009. Avaliação da Eficiência Hidráulica de Duas Técnicas Alternativas de Drenagem Urbana, estudo de caso de um trecho da bacia do Mergulhão, na Pampulha. Proceedings of XVIII ABRH National Symposium on Water Resources, November, 22–22, 2009, Campo Grande, Brazil (www.abrh.org.br)
- › Silva, A., de Oliveira Nascimento, N., Seidl, M. and Vieira, L. 2009. Caracterização do Escoamento Urbano de Origem Viária e Remoção de Seus Poluentes por Meio de Técnicas Compensatórias
- › B Shutes, M Revitt, B Ellis and L Scholes. 2009. The role of constructed wetlands in sustainable urban stormwater management. Paper presented at the CIWEM Symposium on Sustainable Development of Wetlands for Hong Kong Ahead of 2010, 5 May 2009, Hong Kong.
- › Getta, M., Badermann, S., Denneborg, M. (2009): Drainage-Versickerungs-System zur kombinierten Regen- und Grundwasserbewirtschaftung, KA – Korrespondenz Abwasser, Abfall – 2009 (56) – 2
- › Sieker, H., Sieker, F. (2009): Dezentrale Regenwasserbewirtschaftung versus Regenbecken – Teil 1: Systemalternativen und Vergleich, KA – Korrespondenz Abwasser, Abfall – 2009 (56) – 9
- › Sieker, H., Sieker, F. (2009): Dezentrale Regenwasserbewirtschaftung versus Regenbecken – Teil 2: Anwendungsbereiche, KA – Korrespondenz Abwasser, Abfall – 2009 (56) – 11
- › N Nascimento et al (2009). Paper presented at the 33rd IAHR Congress, August 2009, Vancouver, Canada.
- › N Nascimento et al (2009). Two papers presented at the XVIII ABRH Symposium on Water Resources, November 2009, Campo Grande, Brazil.

Papers (journals and conference proceedings) in 'Sustainable Urban Drainage'; 2009 – 2010

- › Sieker, F., Sieker, H. (2009): Reformschritte zu einem Paradigmen- und Systemwechsel bei der Regenwasserbewirtschaftung – Teil 1: Regenwasserbewirtschaftung im Rahmen des neuen Wasserhaushaltsgesetzes, bundeseinheitliche Anforderungen, Eigenschaften und Wirkungen des dezentralen Prinzips, gwf-Wasser|Abwasser 2009 – 10
- › Sieker, F., Sieker, H. (2009): Reformschritte zu einem Paradigmen- und Systemwechsel bei der Regenwasserbewirtschaftung – Teil 2: Reformschritte bei Begriffen, Anschluss und Benutzungszwang, Technische Regeln und Honorarordnung, gwf-Wasser|Abwasser 2009 – 11
- › JB Ellis and DM Revitt. The management of urban surface water drainage in England and Wales. 2010. *Water and Environment Journal*, 24, 1–8.
- › B. Shutes, B. Ellis, M Revitt and L. Scholes. 2010. Sustainable Stormwater Management in the City of the Future. Proceedings of International Forum on Construction of Water System and Waterfront Living Environment in Urban Areas, Kaohsiung, Taiwan, 4–5 March 2010, pp 153–166.
- › JB Ellis, DM Revitt and L Scholes. 2010. A risk assessment approach for prioritising stormwater control strategies. Paper presented at 1st European IAHR Congress, Edinburgh, 4–6 May 2010
- › C Viavattene, B Ellis, M Revitt, H Seiker and C Peters. 2010. The application of a GIS-based BMP selection tool for the evaluation of hydrologic performance and storm flow reduction. Presented at NovaTech 2010, 7th International Conference on Sustainable Techniques and Strategies in Urban Water Management, 27 June – 1 July 2010, Lyon, France.
- › JB Ellis, DM Revitt and C Green. 2010. Identifying success factors in urban surface BMP implementation: Mission impossible? Presented at NovaTech 2010, 7th International Conference on Sustainable Techniques and Strategies in Urban Water Management, 27 June – 1 July 2010, Lyon, France.