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Water-Sensitive Landscape Design in Educational Campuses

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Abstract

Educational campuses contain substantial areas of roofs, roads, parking surfaces, pedestrian paths, lawns, sports grounds, courtyards, and landscaped open spaces that collectively influence stormwater runoff, potable-water demand, groundwater recharge, thermal conditions, biodiversity, and environmental learning. Conventional campus drainage commonly treats rainfall as a waste flow to be removed rapidly through pipes and channels, whereas water-sensitive landscape design seeks to retain, infiltrate, cleanse, store, reuse, and visibly integrate water within the landscape. This paper develops a conceptual–methodological framework for applying water-sensitive design principles to educational campuses. The framework combines permeable surfaces, bioswales, rain gardens, bioretention systems, rainwater harvesting, detention landscapes, native and climate-responsive vegetation, green roofs, and stormwater reuse with institutional maintenance and educational interpretation.

A structured synthesis of water-sensitive urban design, low-impact development, green infrastructure, and sustainable drainage literature is used to identify five campus design domains: source control, infiltration, treatment, storage and reuse, and learning-oriented landscape integration. Because no measured campus hydrological dataset was supplied, quantitative results are explicitly simulated. The scenario analysis indicates that increasingly integrated interventions can progressively reduce campus runoff while improving water-resource resilience and landscape multifunctionality.

The study argues that educational campuses are especially suitable for water-sensitive design because landscape infrastructure can perform simultaneously as drainage infrastructure, ecological habitat, public space, climate-adaptation infrastructure, and a living educational laboratory. Successful implementation nevertheless requires site-specific soil and rainfall assessment, maintenance planning, safety considerations, water-quality controls, and clear institutional responsibility. The resulting framework provides a basis for future empirical campus audits, hydrological modeling, monitored demonstration projects, and comparative landscape-performance studies.

Keywords: water-sensitive landscape design, educational campus, stormwater management, green infrastructure, rainwater harvesting, bioswales, permeable pavement, sustainable drainage.

1. Introduction

Educational campuses function as miniature urban districts. Universities, colleges, schools, and institutional learning complexes frequently contain buildings, roads, parking areas, pedestrian networks, sports facilities, gardens, courtyards, and utility systems distributed across a relatively defined landholding. These surfaces alter the natural movement of rainfall by increasing impervious cover, accelerating runoff, reducing infiltration, and concentrating stormwater into engineered drainage systems. Brown, Keath, and Wong's urban-water-transition research demonstrates how conventional urban water systems historically evolved toward centralized supply and drainage arrangements, whereas more sustainable regimes increasingly seek integrated, adaptive, and locally sensitive water management.

Water-Sensitive Urban Design provides a broader alternative to conventional drainage by treating rainfall, stormwater, landscape, ecosystems, and urban form as interconnected components of the water cycle. Wong and Brown identify water-source diversity, ecosystem services, and socio-political capacity as important foundations of water-sensitive urban development. Their perspective shifts attention from simply disposing of stormwater toward designing settlements that conserve water, support ecological processes, improve resilience, and encourage water-sensitive behavior. Educational campuses are particularly appropriate environments for applying these principles because institutions often possess both substantial land-management authority and long-term responsibility for their sites.

The terminology surrounding sustainable stormwater design differs internationally. Related approaches include Water-Sensitive Urban Design, Low Impact Development, Sustainable Drainage Systems, Best Management Practices, and green infrastructure. Fletcher and colleagues demonstrate that although these terms developed within different geographical and professional contexts, they share significant concern with moving urban drainage away from rapid centralized conveyance and toward more distributed systems that manage runoff closer to its source. For educational campuses, the precise terminology is less important than the underlying principle that landscape surfaces should contribute actively to water management.

Campus landscapes also have functions extending beyond hydrology. Vegetated stormwater systems can support habitat, shade, visual quality, thermal comfort, outdoor learning, and environmental awareness. Research examining public perceptions of low-impact stormwater landscapes indicates that naturalness, visual quality, maintenance appearance, and interpretive signage influence appreciation and understanding of these systems. This finding is especially relevant to campuses because students, staff, visitors, and surrounding communities interact with the landscape daily. A bioswale beside a walkway or a rain garden near an academic building can therefore operate both as infrastructure and as a visible demonstration of environmental design.

2. Objectives of the Study

2.1 Development of an Integrated Campus Water-Sensitive Design Framework

The first objective is to develop a landscape-planning framework that connects hydrological functions with the physical structure of educational campuses. Rather than viewing roofs, roads, parking lots, lawns, gardens, and pedestrian areas as independent site components, the framework examines how runoff generated from one surface can become a resource for another.

The framework further seeks to distinguish functions that are frequently combined under the general label of green infrastructure. Runoff reduction may occur through infiltration, detention, evapotranspiration, reuse, or source avoidance, while pollutant reduction can require filtration, sedimentation, biological processes, or appropriate plant and media selection. Designing for a campus therefore requires matching each intervention with a clearly defined hydrological and institutional purpose rather than installing landscape features simply because they are visually associated with sustainability.

2.2 Evaluation of Progressive Landscape Adaptation

The second objective is to examine conceptually how increasing integration of water-sensitive measures may alter campus stormwater performance. The analysis compares conventional drainage with progressive intervention stages involving permeable surfaces, bioswales and rain gardens, stormwater harvesting and reuse, and an integrated campus-wide system. The simulated comparison is designed to show why combinations of decentralized measures can offer stronger performance than isolated demonstration projects.

A further objective is to examine institutional feasibility. Educational campuses differ in age, land availability, soil conditions, rainfall patterns, maintenance resources, pedestrian intensity, accessibility requirements, and building functions. Water-sensitive landscape strategies must therefore be selected according to local conditions. The study does not propose one universal percentage of landscape conversion but instead develops a decision structure that institutions can adapt through site surveys, modeling, monitoring, and phased implementation.

3. Review of Literature

3.1 Evolution from Conventional Drainage to Water-Sensitive Urban Design

Conventional stormwater engineering historically emphasized rapid drainage from developed surfaces to underground pipes or receiving waters. Such systems protect buildings and transport areas from localized flooding but can transfer high runoff volumes and peak flows downstream. Brown, Keath, and Wong describe urban water management as evolving through successive regimes, with water-sensitive approaches representing a more integrated stage that recognizes environmental, social, and institutional dimensions alongside engineering performance.

Wong and Brown further conceptualize the water-sensitive city through diverse water sources, ecosystem services, and community capacity for sustainable water behavior. Applied at campus scale, these principles imply that rainwater should be managed as a local resource where technically appropriate. Campus landscapes can slow runoff, support infiltration, harvest water for non-potable applications, and restore visible connections between rainfall and landscape processes.

Fletcher and colleagues' examination of WSUD, LID, SuDS, BMPs, and related terminology confirms that contemporary stormwater management has increasingly shifted toward distributed practices designed to approximate more natural hydrological behavior. This shared principle provides a useful foundation for campus planning because an educational institution can combine interventions from several traditions without being constrained by a single terminology.

3.2 Performance of Distributed Green Infrastructure

Low Impact Development commonly relies on distributed measures such as rain gardens, bioretention cells, permeable pavements, green roofs, vegetated swales, infiltration trenches, rain barrels, and cisterns. Ahiablame, Engel, and Chaubey's review identifies these measures as important strategies for reducing runoff and improving stormwater management while also emphasizing the need for continued performance evaluation and modeling. Eckart, McPhee, and Bolis similarly conclude that Low Impact Development has demonstrated considerable potential but that performance depends strongly on design, climate, implementation, maintenance, and scale.

Bioretention is particularly relevant for campuses because it can be integrated into planting beds, parking edges, courtyards, road verges, and open spaces. Research reviewing bioretention identifies urbanization-related increases in runoff volume and peak flow as key problems that distributed treatment systems seek to address. Bioretention media, plants, drainage configuration, and hydraulic loading must nevertheless be designed carefully because systems intended for infiltration or water-quality treatment can perform differently according to soil and climatic conditions.

Permeable pavements provide another campus-relevant strategy because educational institutions contain extensive pedestrian surfaces, parking areas, plazas, and low-speed access roads. Kuruppu, Rahman, and Rahman show that pavement type, aggregate structure, sub-base depth, and system configuration affect hydraulic and structural performance. Permeable paving should therefore be treated as engineered stormwater infrastructure requiring proper design and maintenance rather than simply as an alternative surface finish.

3.3 Landscape Multifunctionality and Educational Value

Water-sensitive landscapes can produce benefits extending beyond stormwater control. Green roofs, for example, can retain rainfall, moderate runoff, contribute to building-energy performance, and improve landscape amenity, although their performance is affected by rainfall characteristics, substrate, vegetation, and environmental conditions. Similarly, vegetated drainage features can provide biodiversity value, microclimatic benefits, and visually identifiable green infrastructure.

The educational environment adds another dimension. Stormwater infrastructure located in visible campus spaces can become part of environmental teaching when design intent and hydrological function are clearly communicated. Research examining public appreciation of low-impact stormwater landscapes found that interpretive signage and aesthetically legible design can support environmental understanding. Campus interventions therefore offer an opportunity to integrate physical sustainability measures with academic learning, student engagement, landscape interpretation, and institutional environmental culture.

A practical example can be observed in Monash University's description of water-sensitive campus operations, where stormwater capture, reduced potable-water demand, peak-flow reduction, infiltration, and habitat restoration are integrated within campus landscape planning. The example demonstrates the institutional relevance of treating campus water management at a strategic landscape scale rather than as a collection of isolated drainage projects.

4. Research Methodology

4.1 Research Design and Evidence Selection

The study adopts a conceptual–methodological research design. It synthesizes peer-reviewed literature concerning Water-Sensitive Urban Design, Low Impact Development, Sustainable Drainage Systems, bioretention, permeable pavement, green roofs, stormwater harvesting, and landscape-based water management. The purpose is framework development rather than statistical inference from a measured campus sample.

Evidence was selected according to its relevance to distributed urban stormwater management, hydrological performance, landscape implementation, and campus applicability. Literature addressing fundamental principles was combined with technology-specific studies and reviews. Particular attention was given to interventions suitable for retrofit within educational landscapes, including parking areas, pedestrian zones, building edges, courtyards, lawns, gardens, and roof catchments.

4.2 Campus Landscape Assessment Framework

The analytical framework classifies interventions according to five functions: runoff-source reduction, infiltration, treatment, storage and reuse, and educational–ecological integration. These functions allow campuses to evaluate water-sensitive design according to performance objectives rather than according to appearance alone.

Table 1: Water-Sensitive Landscape Framework for Educational Campuses

Campus Design Domain	Typical Intervention	Primary Water Function	Additional Campus Benefit
Source control	Green roofs, reduced impervious cover, disconnected downpipes	Reduces or delays runoff generation	Thermal and landscape benefits
Infiltration	Permeable paving, infiltration trenches, planted depressions	Restores infiltration and reduces runoff volume	Groundwater support and reduced ponding
Treatment	Bioswales, rain gardens, bioretention cells	Filters sediment and selected pollutants	Habitat, planting diversity, visual amenity
Storage and reuse	Rain tanks, detention landscapes, storage ponds	Captures and stores stormwater	Irrigation supply and water-security support
Educational integration	Demonstration gardens, monitoring points, interpretive signage	Makes water processes visible	Student learning and environmental awareness

The framework assumes that multiple functions may be combined within one landscape intervention. A rain garden, for example, may temporarily store runoff, filter pollutants, support vegetation, increase evapotranspiration, create habitat, and serve as an educational demonstration. Nevertheless, designers should identify the principal engineering purpose because hydraulic sizing, overflow design, plant selection, and maintenance requirements depend on intended performance.

4.3 Scenario Development and Simulation Logic

Five hypothetical campus scenarios were developed to illustrate progressive water-sensitive adaptation. The baseline represents a largely conventional landscape characterized by high imperviousness and direct drainage. Successive scenarios introduce permeable surfaces, bioswales and rain gardens, stormwater harvesting and reuse, and ultimately an integrated water-sensitive campus network.

The equation is presented to clarify the analytical logic rather than to claim measured hydrological performance. Actual campus runoff requires site-specific rainfall data, catchment area, soil infiltration characteristics, slope, imperviousness, drainage connectivity, antecedent moisture, vegetation, and system storage. The scenario values used in this study are therefore explicitly illustrative.

5. Analysis

5.1 Spatial Opportunities within Educational Campuses

Educational campuses provide a diverse set of retrofit opportunities because water moves repeatedly between roofs, roads, plazas, parking surfaces, landscaped areas, and drainage networks. Roof runoff may be captured for irrigation or directed into planted treatment areas. Parking lots can be interrupted by bioretention islands. Pedestrian zones can incorporate permeable pavement. Road edges can be redesigned as vegetated swales, while underused lawn areas can function as temporary detention landscapes during rainfall events.

The distributed nature of these interventions is consistent with Low Impact Development principles. Eckart, McPhee, and Bolis emphasize that LID seeks to manage stormwater through distributed controls and natural hydrological features rather than relying solely on centralized drainage. This characteristic is advantageous for campuses because implementation can occur incrementally during building renovations, road resurfacing, parking upgrades, landscape renewal, or utility projects.

The effectiveness of any intervention nevertheless depends on its spatial relationship to the runoff source. A rain garden that receives little drainage contributes less hydrological value than one correctly positioned downstream from a roof or paved catchment. Campus planning should therefore begin with a water-flow map identifying catchment boundaries, drainage pathways, ponding areas, soil conditions, existing pipes, irrigation demand, and opportunities for gravity-fed treatment.

5.2 Simulated Performance of Progressive Campus Strategies

Table 2: Simulated Annual Stormwater Runoff Reduction

Campus Landscape Scenario	Simulated Runoff Reduction (%)	Principal Design Change
Conventional landscape	0	Direct conveyance through conventional drainage
Permeable-surface retrofit	17	Increased infiltration across selected paths and parking areas

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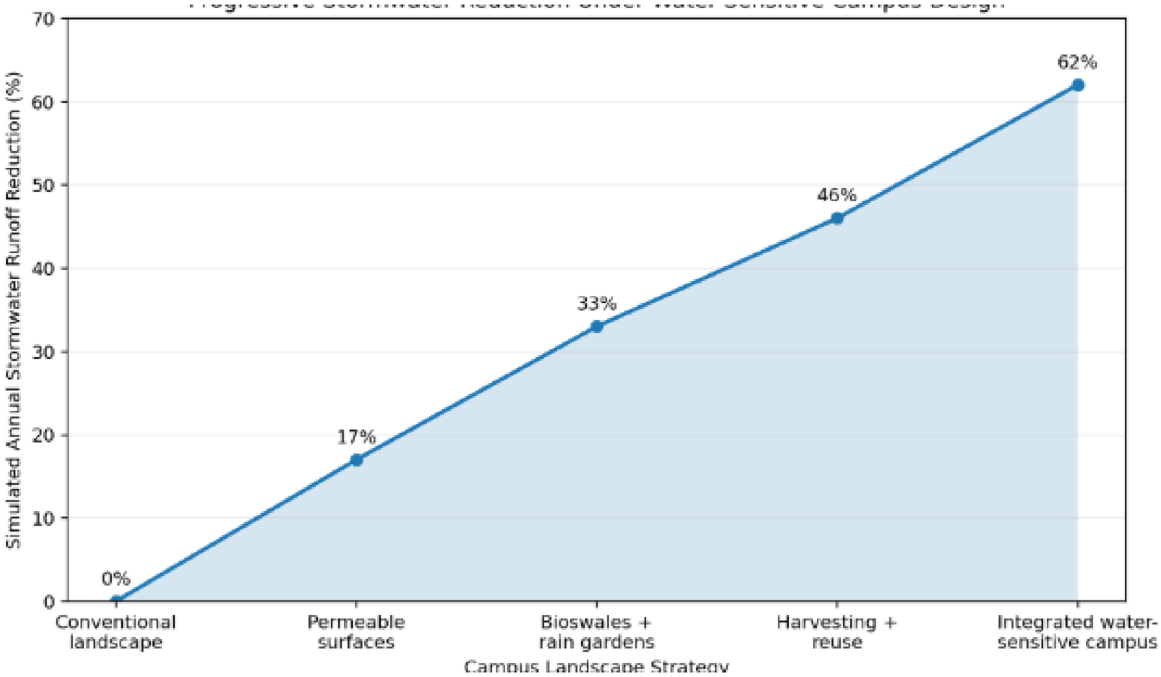
Campus Landscape Scenario	Simulated Runoff Reduction (%)	Principal Design Change
Bioswale and rain-garden network	33	Distributed detention, filtration, and infiltration
Harvesting and reuse integration	46	Additional capture for landscape and non-potable demand
Integrated water-sensitive campus	62	Coordinated source control, treatment, storage, infiltration, and reuse

The simulation indicates that isolated surface interventions can produce useful improvement, but stronger runoff reduction emerges when landscape elements are connected. Permeable surfaces provide an illustrative reduction of 17%, which increases to 33% when bioswales and rain gardens are added. Harvesting and reuse raise the simulated reduction to 46%, while the fully integrated scenario reaches 62%.

Graph 1: Progressive Stormwater Reduction Under Water-Sensitive Campus Design



The graph demonstrates an important design principle: water-sensitive performance is cumulative when different interventions address different portions of the water cycle. Permeability reduces immediate runoff, bioretention provides treatment and temporary storage, tanks create reusable supply, and landscape integration creates additional infiltration and evapotranspiration opportunities. The values should not be interpreted as universal design benchmarks.

5.3 Maintenance, Safety, and Institutional Performance

Water-sensitive infrastructure requires active maintenance. Permeable surfaces can lose infiltration capacity when sediment accumulates. Bioretention systems may suffer from blocked inlets, inappropriate plant growth, erosion, damaged outlets, or media compaction. Storage systems require inspection, water-quality management, and safe overflow arrangements. Green roofs require vegetation and drainage maintenance. Reviews of LID and permeable pavement repeatedly identify design and maintenance conditions as important determinants of long-term performance.

Educational campuses also require careful attention to accessibility and safety. Ponding depths, side slopes, pedestrian crossings, nighttime visibility, mosquito risk, child safety where schools are involved, and emergency access must be incorporated into design. A water-sensitive campus cannot be considered successful if hydrological performance is achieved by creating unsafe or inaccessible spaces.
Institutional responsibility is therefore essential. Facilities departments, landscape contractors, engineering units, sustainability offices, academic departments, and campus planners should understand who is responsible for inspection, vegetation management, sediment removal, monitoring, and repair. Without such responsibility, visually attractive demonstration projects can progressively lose hydrological function.

6. Discussion

6.1 Campus Landscapes as Distributed Water Infrastructure

The principal implication of this study is that educational landscapes should be understood as infrastructure rather than as decorative space surrounding buildings. Conventional drainage often separates landscape architecture from water engineering: engineers size underground pipes while landscape designers address planting and amenity. Water-sensitive design deliberately integrates these functions.

Wong and Brown's water-sensitive principles emphasize ecosystem services and diversified urban water systems rather than dependence on a single centralized infrastructure model. At campus scale, this means that a network of rain gardens, tanks, swales, permeable surfaces, planted detention areas, and green roofs can work alongside existing drainage rather than necessarily replacing it completely.

Such distributed infrastructure can also increase resilience. If runoff is intercepted at multiple locations, the failure or capacity limitation of one drainage component is less likely to determine the behavior of the entire site. Distributed storage additionally creates opportunities to reduce irrigation dependence on potable water, although the practical value depends on rainfall seasonality and campus water demand.

6.2 Hydrological Performance Must Remain Site Specific

A second implication is that water-sensitive design should not be implemented through generic percentage claims. Green roofs, permeable pavements, swales, and bioretention systems do not deliver identical results in every climate or soil condition. Green-roof research, for example, shows that rainfall depth, substrate characteristics, and meteorological conditions influence retention. Permeable-pavement performance similarly depends on material design, sub-base configuration, and hydraulic conditions.

Campus design should therefore be preceded by hydrological and landscape investigation. Appropriate information includes rainfall patterns, design storms, soil infiltration, groundwater conditions, existing drainage capacity, slopes, catchment areas, plant suitability, pedestrian loads, and potential reuse demand. In some locations, infiltration may be desirable; in others, contaminated soils, shallow groundwater, expansive soils, or structural constraints may require lined detention or controlled discharge.

This need for site specificity does not weaken the case for water-sensitive design. Instead, it reinforces the importance of performance-based planning. The objective should be to choose the most appropriate water pathway for each portion of the campus rather than maximizing the number of visible green-infrastructure features.

6.3 Educational Campuses as Living Laboratories

Educational institutions possess an advantage that conventional commercial developments often lack: the landscape can become part of teaching and research. Stormwater storage levels, soil moisture, rainfall, runoff quality, infiltration, vegetation performance, and irrigation demand can be monitored and incorporated into student projects, engineering laboratories, environmental-science courses, landscape studios, or sustainability reporting.

Public-appreciation research indicates that interpretive design can improve recognition and understanding of low-impact stormwater landscapes. Campuses can therefore make hidden water processes visible through discreet signs, observation points, digital dashboards, or monitoring stations. The purpose should be educational clarity rather than excessive signage.

This living-laboratory approach can also improve infrastructure management. Student and faculty research may generate evidence concerning actual system performance, plant survival, water quality, runoff reduction, maintenance requirements, or user perceptions. Over time, the campus can develop its own evidence base rather than relying indefinitely on generalized assumptions from other climates and institutions.

7. Conclusion

Water-sensitive landscape design offers educational campuses an opportunity to transform conventional stormwater management from rapid drainage toward a more integrated relationship among rainfall, vegetation, soil, buildings, infrastructure, and institutional water demand. The approach is particularly compatible with campuses because these sites contain diverse surfaces under comparatively unified ownership and management, allowing interventions to be coordinated across buildings, parking areas, pedestrian zones, gardens, and open spaces.

The conceptual framework developed in this study identifies source control, infiltration, treatment, storage and reuse, and educational integration as five complementary dimensions of campus water-sensitive design. Permeable surfaces, bioswales, rain gardens, bioretention areas, rainwater tanks, green roofs, detention landscapes, and climate-responsive planting can each contribute to this system when selected according to site conditions and clearly defined performance objectives.

The simulated analysis illustrates the theoretical advantage of progressive integration, with the greatest modeled runoff reduction emerging when multiple interventions are connected across the campus landscape. These values are not empirical findings. Actual performance should be established through rainfall-runoff modeling, field monitoring, soil investigation, water-quality analysis, and post-construction performance evaluation. Future research should compare different campus typologies and climatic regions while examining both hydrological outcomes and the educational value of visible stormwater infrastructure.

Water-sensitive campus design should ultimately be understood as more than a drainage strategy. It provides an opportunity to create landscapes that conserve water, moderate runoff, support vegetation and habitat, strengthen climate resilience, improve campus amenity, and communicate environmental responsibility through everyday spatial experience. Educational institutions that combine sound hydrological engineering with thoughtful landscape design and long-term maintenance can convert their campuses into practical demonstrations of sustainable water stewardship.

References

1. Lloyd, S. D., Wong, T. H. F., & Chesterfield, C. J. (2002). Water sensitive urban design—A stormwater management perspective. *Industry Report*, *Cooperative Research Centre for Catchment Hydrology*.
2. Brown, R. R., & Clarke, J. M. (2007). *Transition to Water Sensitive Urban Design: The Story of Melbourne, Australia*. Facility for Advancing Water Biofiltration, Monash University.
3. Wong, T. H. F. (2006). An overview of water sensitive urban design practices in Australia. *Water Practice & Technology, 1*(1).
4. Fletcher, T. D., Shuster, W., Hunt, W. F., Ashley, R., Butler, D., Arthur, S., et al. (2015). SUDS, LID, BMPs, WSUD and more—The evolution and application of terminology surrounding urban drainage. *Urban Water Journal*, *12*(7), 525–542.
5. Ahiablame, L. M., Engel, B. A., & Chaubey, I. (2012). Effectiveness of low impact development practices: Literature review and suggestions for future research. *Water, Air, & Soil Pollution, 223*, 4253–4273.
6. Dietz, M. E. (2007). Low impact development practices: A review of current research and recommendations for future directions. *Water, Air, & Soil Pollution*, *186*, 351–363.
7. Fletcher, T. D., Andrieu, H., & Hamel, P. (2013). Understanding, management and modelling of urban hydrology and its consequences for receiving waters: A state-of-the-art. *Advances in Water Resources, 51*, 261–279.
8. Davis, A. P., Hunt, W. F., Traver, R. G., & Clar, M. (2009). Bioretention technology: Overview of current practice and future needs. *Journal of Environmental Engineering*, *135*(3), 109–117.
9. Dietz, M. E., & Clausen, J. C. (2005). A field evaluation of rain garden flow and pollutant treatment. *Water, Air, & Soil Pollution*, *167*, 123–138.
10. Bratieres, K., Fletcher, T. D., Deletic, A., & Zinger, Y. (2008). Nutrient and sediment removal by stormwater biofilters: A large-scale design optimisation study. *Water Research*, *42*(14), 3930–3940.
11. Berndtsson, J. C. (2010). Green roof performance towards management of runoff water quantity and quality: A review. *Ecological Engineering*, *36*(4), 351–360.
12. Getter, K. L., & Rowe, D. B. (2006). The role of extensive green roofs in sustainable development. *HortScience*, *41*(5), 1276–1285.

13. Gill, S. E., Handley, J. F., Ennos, A. R., & Pauleit, S. (2007). Adapting cities for climate change: The role of the green infrastructure. *Built Environment*, *33*(1), 115–133.
14. Kabisch, N., Korn, H., Stadler, J., & Bonn, A. (Eds.). (2017). *Nature-Based Solutions to Climate Change Adaptation in Urban Areas*. Springer.
15. Frantzeskaki, N. (2019). Seven lessons for planning nature-based solutions in cities. *Environmental Science & Policy*, *93*, 101–111.
16. Alves, A., Patiño Gómez, J., Vojinovic, Z., Sánchez, A., & Weesakul, S. (2018). Combining co-benefits and stakeholders' perceptions into green infrastructure selection for flood risk reduction. *Environmental Modelling & Software*, *100*, 237–254.
17. Shelton, D. P. (2015). Integrating extension, teaching, and research for stormwater management education. *Journal of Contemporary Water Research & Education*, *155*(1), 25–34. This study is particularly relevant because it connects stormwater management, green infrastructure, landscape design education and university-based learning.
18. Jain, S., & Kamal, M. A. (2023). Storm water management through water sensitive urban design and planning: Case of a university campus in India. *Architecture Engineering and Science*, *4*(3), 168–182. The study specifically examines water-sensitive design opportunities at Aligarh Muslim University and discusses rain gardens, swales, infiltration trenches, permeable surfaces and campus-scale stormwater management.
19. Wong, T. H. F., Allen, R., Brown, R. R., Deletić, A., Gangadharan, L., Gernjak, W., et al. (2013). Blueprint 2013—Stormwater management in a water sensitive city. *Melbourne Water and CRC for Water Sensitive Cities*.
20. Hoyer, J., Dickhaut, W., Kronawitter, L., & Weber, B. (2011). *Water Sensitive Urban Design: Principles and Inspiration for Sustainable Stormwater Management in the City of the Future*. Jovis.