RCMOS – Revista Científica Multidisciplinar O Saber.
ISSN: 2675-9128. São Paulo - SP.
Year VII, v.1 2026 | Submission: July 4, 2026 | Accepted: July 7, 2026 | Publication: July 10, 2026

Green Solution for Flood Mitigation in Urban Areas: A Case Study of the Darcy Ribeiro Campus

Proposta de solução verde para mitigação de alagamentos em áreas urbanas: Estudo de caso Campus Darcy Ribeiro

Propuesta de solución verde para la mitigación de inundaciones en áreas urbanas: Estudio de caso del Campus Darcy Ribeiro

Faruk Lima Santos Abder Rahman Yasin Mohd Yasin – Universidade de Brasília
Newton Moreira de Souza – Universidade de Brasília
Eleudo Esteves De Araújo Silva Junior – Universidade de Brasília

Abstract:
Urbanization has significantly altered the hydrological cycle in cities, increasing surface runoff and the susceptibility to flooding. In this context, the present study proposes a green infrastructure solution to mitigate flooding in the Darcy Ribeiro Campus of the University of Brasília through the hydrological simulation of a permeable pavement system installed in the parking area of the Central Institute of Sciences. To this end, the campus drainage basin was delimited using topographic data, land use and land cover information, and the existing stormwater drainage network. The hydrological modeling was carried out in PCSWMM, considering the most intense rainfall event recorded during the period, which occurred on February 9, 2024. Two scenarios were compared: the current condition and a scenario implementing Low Impact Development (LID). The results indicated that the permeable pavement significantly reduced both the depth and inflow at contributing nodes, as well as the water depth in the analyzed subcatchments. A marked decrease in surface runoff was observed in the LID scenario, together with lower peak flows and reduced stress on the urban drainage system. The study concludes that the proposed solution is effective for flood control and represents an alternative to enhance hydrological resilience within the university campus.

Keywords:
Urban Drainage; Flooding; Stormwater Management; Permeable Pavement.

Resumo:
A intensificação da urbanização tem alterado o ciclo hidrológico nas cidades, aumentando o escoamento superficial e a suscetibilidade a alagamentos em áreas impermeabilizadas. Neste contexto, o presente estudo propõe uma solução verde para mitigação de alagamentos no Campus Darcy Ribeiro, da Universidade de Brasília, por meio da simulação hidrológica de um pavimento permeável implantado na área de estacionamento do Instituto Central de Ciências. Para isso, foi delimitada a bacia de drenagem do campus com base em dados topográficos e de uso e cobertura da terra, além do cadastro da rede de drenagem pluvial existente. A modelagem foi desenvolvida no PCSWMM, considerando o evento de precipitação mais intenso registrado no período analisado, ocorrido em 09 de fevereiro de 2024. Foram comparados dois cenários: a condição atual e um cenário com Low Impact Development (LID). Os resultados indicaram que a adoção do pavimento permeável reduziu significativamente a profundidade e a vazão de entrada nos pontos de contribuição da rede, bem como a lâmina d'água nas sub-bacias analisadas. Observou-se diminuição expressiva do escoamento superficial, no cenário com LID, além de redução das vazões máximas e do potencial sobrecarga da drenagem urbana. Conclui-se que a solução proposta apresenta eficiência no controle de alagamentos e constitui alternativa técnica para promover maior resiliência hídrica no campus universitário.

RCMOS – Revista Científica Multidisciplinar O Saber.
ISSN: 2675-9128. São Paulo - SP.
Year VII, v.1 2026 | Submission: July 4, 2026 | Accepted: July 7, 2026 | Publication: July 10, 2026

Palavras-chave:
Drenagem Urbana; Alagamentos; Manejo de águas Pluviais; Pavimento Permeável.

Resumen:
La intensificación de la urbanización ha alterado significativamente el ciclo hidrológico en las ciudades, aumentando la escorrentía superficial y la susceptibilidad a las inundaciones en áreas impermeabilizadas. En este contexto, el presente estudio propone una solución de infraestructura verde para mitigar las inundaciones en el Campus Darcy Ribeiro de la Universidad de Brasilia mediante la simulación hidrológica de un pavimento permeable instalado en el área de estacionamiento del Instituto Central de Ciencias. Para ello, se delimitó la cuenca de drenaje del campus utilizando datos topográficos, información sobre el uso y la cobertura del suelo, así como la red existente de drenaje pluvial. La modelación hidrológica se realizó en PCSWMM, considerando el evento de precipitación más intenso registrado durante el período analizado, ocurrido el 9 de febrero de 2024. Se compararon dos escenarios: la condición actual y un escenario con Low Impact Development (LID). Los resultados mostraron que la adopción del pavimento permeable redujo significativamente la profundidad y el caudal de entrada en los puntos de contribución de la red, así como la lámina de agua en las subcuencas analizadas. También se observó una marcada disminución de la escorrentía superficial, junto con una reducción de los caudales máximos y de la sobrecarga del sistema de drenaje urbano. Se concluye que la solución propuesta es eficaz para el control de inundaciones y constituye una alternativa técnica para promover una mayor resiliencia hidrológica en el campus universitario.

Palabras clave:
Drenaje Urbano; Inundaciones; Gestión de Aguas Pluviales; Pavimento Permeable.

INTRODUCTION

The intensification of urbanization has significantly altered the hydrological cycle in cities, reducing rainwater infiltration and increasing surface runoff, which favors the occurrence of flooding in impermeable areas (Tucci, 2001). In this context, nature-based solutions and green infrastructure have gained prominence for their ability to mitigate hydrological impacts, increase local precipitation retention, and contribute to urban adaptation to intense rainfall events. On the Darcy Ribeiro Campus in Brasília, the presence of extensive paved areas and the concentration of buildings and roads favor the accumulation of water at critical points during rainfall events (Souza, 2021). Thus, this study proposes a green solution for flood mitigation through hydrological modeling and evaluation of a permeable pavement in a parking area, with the aim of reducing surface runoff and providing technical support for the sustainable planning of urban drainage.

RCMOS – Revista Científica Multidisciplinar O Saber.
ISSN: 2675-9128. São Paulo - SP.
Year VII, v.1 2026 | Submission: July 4, 2026 | Accepted: July 7, 2026 | Publication: July 10, 2026

MATERIALS AND METHODS

This chapter will describe the materials used in the research, including the source, type and forms of data, format, data used, and description.

The object of study in this work was the University of Brasília (UnB), more precisely the Darcy Ribeiro Campus, located in Brasília, which is an area of academic and institutional relevance, characterized by its territorial extension and diversity of buildings and complex infrastructure. During the rainy season, between November and March, this region functions as a drainage point for rainwater, where part of the precipitation coming from the north wing converges towards the university campus, which frequently cannot handle this high demand.

The drainage basin corresponds to the hydrographic contribution area where surface waters converge, by gravity, to the catchment points of the campus drainage system. Historically, studies such as that of Souza (2021) have demonstrated that this campus is significantly influenced by flows from Asa Norte, frequently exceeding the carrying capacity of the internal system. Thus, the 1-meter scale topography provided by SEDUH/DF (2026) was used for the complete determination of this area of influence and drainage basin. Figure 1 shows the location of the university within the drainage basin of the region.



Figure 1Drainage Basin, University of Brasília. Source: Author's own.

RCMOS – Revista Científica Multidisciplinar O Saber.
ISSN: 2675-9128. São Paulo - SP.
Year VII, v.1 2026 | Submission: July 4, 2026 | Accepted: July 7, 2026 | Publication: July 10, 2026

For this work, the event with the highest recorded precipitation in the 25-year period, which occurred on February 9, 2024, was selected and adopted as a reference for the simulations developed in this study and is available on the SIMCURB platform (2026).

Furthermore, information on land cover was obtained from the Geoportal (SEDUH/DF, 2026). For each type of land cover, it was necessary to define Manning's roughness, which represents resistance to runoff. In general, the suggested values ranged from 0.015 (rivers and lakes) to 0.24 (grassland formations), according to Rossman (2010). It was also necessary to assign a CN value to each type of cover, which ranged from 73 (forest formation) to 98 (built-up area), according to Pezan (2022).

In surveying the stormwater drainage network, the works of Souza (2021) and Damasceno (2021) were used. Both works compiled valuable information on the pipe registry provided by the Urban Development Company of the New Capital of Brazil (NOVACAP). For modeling purposes, the drainage network was represented by linear and nodal elements, corresponding to galleries, collectors, catch basins, and manholes, respecting the topology of the previously registered system. It is important to emphasize that Sub-Basin 1 (S1) drains water to J703, Sub-Basin 2 (S2) drains water to J380, Sub-Basin 3 (S3) drains water to J705, Sub-Basin 4 (S4) drains water to J375, and Sub-Basin 5 (S5) drains water to J528. Figure 2 shows the location of the studied pipes and entry points. All data modeling and processing took place within the PCSWMM software.

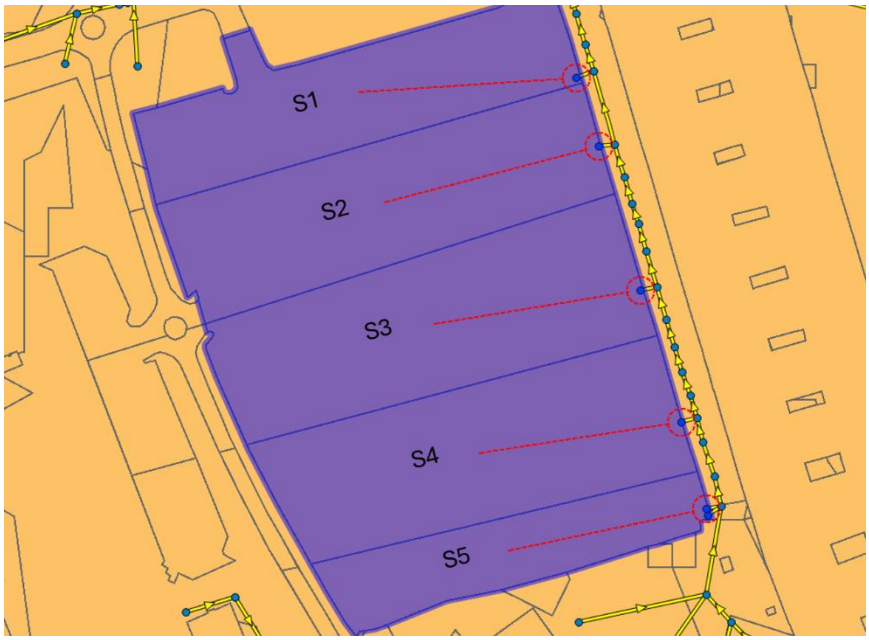

Figure 2. Location of ducts and entry points. Source: Author's own.

The green infrastructure solution for stormwater management chosen for this scenario is " Low Impact "LID Development ", focusing on water control at the source, promoting

RCMOS – Revista Científica Multidisciplinar O Saber.
ISSN: 2675-9128. São Paulo - SP.
Year VII, v.1 2026 | Submission: July 4, 2026 | Accepted: July 7, 2026 | Publication: July 10, 2026

infiltration, retention, and detention of water where it precipitates. Thus, permeable pavement treatment was chosen, which consists of porous asphalt materials or hollow blocks that allow surface infiltration, reducing runoff and pollutants, implemented in the north parking lot of the Central Institute of Sciences. The total area of the parking lot is approximately 44,887 m². The following parameters were adopted for the permeable pavement layer, according to Fernandes (2020): Surface Roughness equal to 0.013, Surface Slope (%) equal to 3.6, Thickness (mm) equal to 100, Void Ratio (%) equal to 14.1, Permeability (mm/h) equal to 3704, Base Height (mm) equal to 350, Infiltration Rate (mm/h) equal to 36.

RESULTS AND DISCUSSION

Two simulations were performed for the same precipitation interval, an event on 09/02/2024, consolidating two scenarios: the current scenario and the scenario with a long-term impact indicator (LID).

Table 1 presents comparative data between the entry points that receive rainfall from the ICC parking lot in the northern part of the building, within the two scenarios studied.

Table 1 – Comparative data between entry points – ICC North

Parameter evaluated	J703		J380		J705		J375		J528	
	Current Scenario	LID Scenario	Current Scenario	LID Scenario	Current Scenario	LID Scenario	Current Scenario	LID Scenario	Current Scenario	LID Scenario
Maximum Flow Rate of Input (m³/s)	0.19	0.04	0.19	0.07	0.13	0.05	0.20	0.07	0.35	0.05

Table 2 presents comparative data between the studied sub-basins that receive rainfall from the ICC parking lot in the northern part, within the two scenarios studied.

Table 2 – Comparative data between the studied sub-basins – ICC North

Parameter evaluated	S1		S2		S3		S4		S	
	Current Scenario	LID Scenario	Current Scenario	LID Scenario	Current Scenario	LID Scenario	Current Scenario	LID Scenario	Current Scenario	LID Scenario
	103	5	92	10	60	4	104	10	411	15

RCMOS – Revista Científica Multidisciplinar O Saber.
ISSN: 2675-9128. São Paulo - SP.
Year VII, v.1 2026 | Submission: July 4, 2026 | Accepted: July 7, 2026 | Publication: July 10, 2026

Parameter evaluated	S1		S2		S3		S4		S	
	Current Scenario	LID Scenario	Current Scenario	LID Scenario	Current Scenario	LID Scenario	Current Scenario	LID Scenario	Current Scenario	LID Scenario
Flow height (mm)										
Peak flow rate (m^3/s)	0.18	0.04	0.19	0.07	0.13	0.06	0.20	0.07	0.35	0.05

FINAL CONSIDERATIONS

In short, the permeable pavement solution proved effective in controlling flooding at UnB. There was a considerable decrease in the amount of water flowing into the storm drains, approximately 29%, and surface runoff was almost entirely reduced, from values such as 49 mm to less than 1 mm, preventing this runoff from reaching the university's interior.

However, future studies recommend a more detailed analysis of the urban drainage network, the use of other flood mitigation solutions, such as green gardens, and testing other forms of permeable pavements.

Finally, it is understood that the research fulfilled its objective by proposing a solution to mitigate flooding within the University of Brasília.

REFERENCES

ADASA/DF (2026). Presentation. Available at: https://www.adasa.df.gov.br/superintendencia/apresentacao. Accessed in June 2026.

COSTA, MEL (2013). Monitoring and modeling of urban drainage waters in the Paranoá lake basin. Master's thesis in Environmental Technology and Water Resources, University of Brasília, Brasília, DF, xxiv , 179 p.

DAMASCENO, FL (2021). Evaluation of the stormwater management system at the University of Brasília using 1D-2D simulations. Undergraduate Thesis (Bachelor's Degree in Environmental Engineering), University of Brasília, Brasília, DF, 72 p.

FERNANDES, GS (2020). Use of permeable concrete pavement with C&D aggregates in flood mitigation: case study of the parking lot of the Central Institute of Sciences of UnB. Master's Dissertation in Architecture and Urbanism, University of Brasília, Brasília, DF, xiv , 129 p.

Year VII, v.1 2026 | Submission: July 4, 2026 | Accepted: July 7, 2026 | Publication: July 10, 2026

PEZAN, VF (2022). Determination of the SCS-Curve Number using observed hydrological data from Brazilian river basins. Master's Dissertation, Postgraduate Program in Hydraulic and Sanitary Engineering, Area of Concentration in Hydraulics and Sanitation, School of Engineering of São Carlos, University of São Paulo, São Carlos, SP, 2022.

ROSSMAN, LA; HUBER, W. C. (2010). Storm Water Management Model Reference Manual, Volume I – Hydrology (Revised). US Environmental Protection Agency, Cincinnati, OH.

SEDUH/DF (2026). GeoPortal - DF. State Secretariat for Urban Development and Housing. Available at: https://www.geoportal.seduh.df.gov.br/mapa/#. Accessed in June 2026.

SOUZA, APBC (2021). Study of rainwater runoff in the northern part of the Darcy Ribeiro campus - UnB. Undergraduate Thesis (Bachelor's Degree in Environmental Engineering), University of Brasília, Brasília, DF, 89 p.

ACKNOWLEDGEMENTS

The authors express their gratitude to the University of Brasília (UnB), especially the PPGG, and to CAPES for their institutional support, as well as to all the professors and researchers who contributed, directly or indirectly, to the development of this work.