

EA Project Summaries and Findings Report Project

Project 5 – Roof Top Harvesting and Stormwater Disbursement over the Edwards Aquifer Recharge Zone: A Retrofit for Previously Untreated Impervious Cover

Project Summary

Author: UTSA

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Funding Amount

\$1,057,401

1 Summary

This project involved the construction and retrofit of a treatment train comprised of low impact development (LID) facilities to treat 9.7 acres of impervious cover on the University of Texas at San Antonio (UTSA) main campus. The LID facilities were intended to reduce peak flooding and pollutant transport downstream during runoff events on the campus, which is located over the Edwards Aquifer Recharge Zone (EARZ). The project also aimed to serve as a demonstration project for the feasibility of implementing LID facilities on a university campus. The LID facilities installed included cisterns, a bioretention basin, a grassy channel and a bioswale, connected through flow pathways in a treatment train approach as shown in Figure 1. Flow attenuation and pollutant removal effectiveness of the bioretention basin was evaluated. The project also involved the installation of informational signs describing the operation and purpose of the LID facilities and a separate business plan discussing cost considerations and recommendations for implementation on other university campuses.

Stated objectives of the study – *The project will retrofit rooftops, parking lots, roadways, and sidewalks at UTSA Main Campus through diversion of stormwater runoff into a newly constructed suite of connected projects including cisterns, pervious pavement, a vegetated bioswale and forebay, a rain garden, and a bioretention and sand filtration area.*

Justification for the study – *The original design of the Main Campus called for stormwater to be conveyed away from the property through a system of storm drains and open swales that ultimately outfall into Leon Creek. The original campus development pre-dates current regulatory compliance for water quality and impervious cover treatment and is considered Previously Untreated Impervious Cover (PUIC), which does not require treatment. Originally 108 acres of the original campus is PUIC, including the area to be treated through this project.*

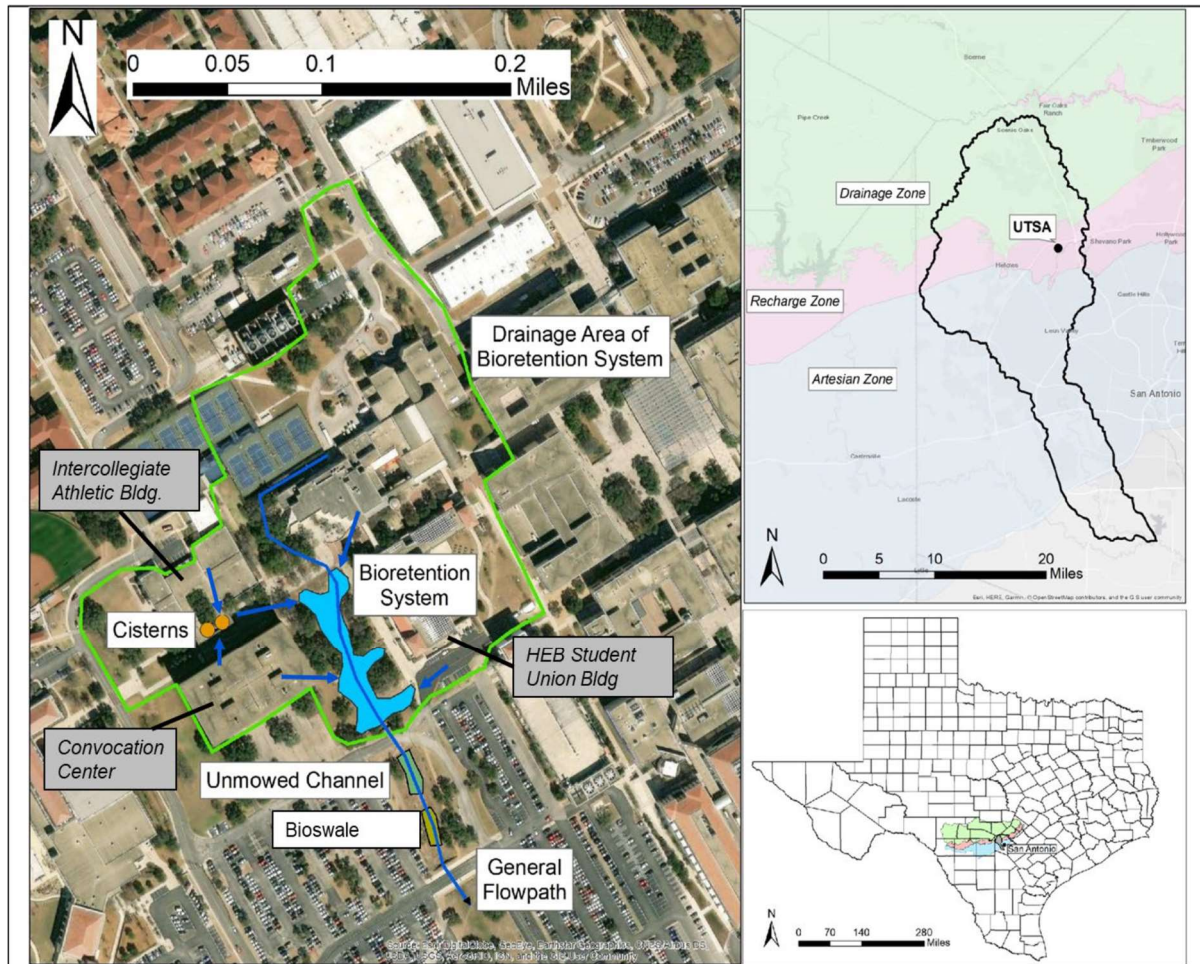


Figure 1 – Project Site and Treatment Train

1.1 Methods

Construction was completed in November of 2020 and followed the San Antonio River Authority (SARA) LID technical design guidance manual. Water quality sampling was conducted with the goal of determining how effective the bioretention system is at treating stormwater runoff and comparing this performance with pre-project conditions. Samples were collected from storm events that occurred both before construction and after the project was completed. Samples were collected throughout the storm events so that they could be analyzed for differences in the first flush of runoff which may have higher concentrations versus a composite of samples taken throughout the event at even time intervals. The samples collected after construction were collected upstream and downstream of the bioretention basin. The pre-construction samples were collected upstream and downstream of the bioswale that became the bioretention basin.

The samples were analyzed for several typical water quality components such as nutrients, metals, total suspended solids, and bacteria. Flow through the system was also measured. Statistical analysis was also performed to determine if the difference in concentrations was statistically significant. This analysis was performed on samples collected during the first flush of the storm event as well as on a composite of samples taken throughout the storm event.

The business plan goes into further detail on the implementation of the project and the additional benefits beyond the stormwater quality and volume reductions. LID green spaces can offer improved aesthetic qualities as well as a setting for student engagement through research opportunities and community building. The plan also details the strategy, including a cost analysis and how to demonstrate value, to garner support from leadership involved in funding infrastructure projects in a campus setting.

1.2 Findings

The authors report that construction was successfully completed, and that the system is working as designed based on desired hydrology and aesthetics. Water quality concentrations for all components were within expected ranges for stormwater runoff.

For preconstruction samples, some first flush water quality components were significantly higher or lower from upstream to downstream whereas others did not show a significant difference. For example, pH, total suspended solids (TSS), and zinc were statistically lower downstream; however, total dissolved solids (TDS) and total organic carbon (TOC) were statistically higher. Nutrients were not significantly changed. Bacteria was not sampled during pre-construction.

For postconstruction samples, TSS and bacteria were statistically lower downstream. For the constructed north basin, the authors found that the treatment efficiency for nitrate (NO_3^-) averaged 57%, for TSS averaged 13%, and for *E. coli* bacteria averaged 78%. TDS, ammonia, and barium were statistically higher at the outfall. Other nutrients, TOC, and pH were not significantly different.

Findings presented in the business case provide lessons learned for successful implementation of future projects. The project team provides tips during the design and construction phases, as well as recommendations for ongoing maintenance once the LID facility is online. Key takeaways include the importance of presenting an accurate cost analysis and budget to provide predictability and emphasizing the LID facility's potential to provide student engagement, campus improvement, and research opportunities. They also recommend assigning an owner's representative during construction to monitor LID installation and verify that the systems are built per specifications and that the proper preventative measures are taken to minimize deficiencies that can lead to maintenance issues.

1.3 Challenges and Limitations

Storm event sampling has inherent challenges due to the unpredictability of storm event timings and magnitude but has important value in establishing the effectiveness of different LID systems and designs. The samples may have been collected from areas that received a combination of treated outflow from the bioretention basin and untreated overflow. Additional monitoring at more locations would be beneficial to determine the effectiveness of water quality treatment of the treatment train. Storm event flow rates and overall system storage capacity should also be measured. The design and construction costs for all systems should be tracked and potentially made available to further aid other entities considering similar retrofits.

2 Benefits

This project provides water quality benefits, additional data, analysis, and public education / outreach for water quality treatment efforts in the EARZ. In addition, the study provides

information for entities interested in retrofitting an area with LID facilities. The effort also provided data about discharge from an urban area with high foot traffic.

The benefits of the project include:

- The project provides insight into pollutants of concern and potential treatment design opportunities in urban developments within the EARZ.
- This project serves as a local example to generate interest with other similar developments in the region. This could result in an increase in local adoption, due to the high foot traffic and informational signs.
- The retrofit system improved water quality in the UTSA campus. If adopted by other developments in the area, it could have a compounding positive impact on local surface water and the Edwards Aquifer.
- The researchers expanded the local dataset of pollutant removal effectiveness for bioretention basins.
- The business plan document provides valuable tools and guidance to other campuses interested in implementing LID on campus.
- The project treats stormwater on the UT San Antonio campus and provides pollutant reduction benefits for stormwater runoff.

Project Deliverables:

Laub, B. G., Garcia, M., May, L. (2022). Roof top harvesting and stormwater disbursement over the Edwards aquifer recharge zone: A retrofit for treatment of previously un-treated impervious cover. The University of Texas at San Antonio.

Laub, B. G. (2023). Business plan: stormwater control in a campus setting. The University of Texas at San Antonio.

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Fact Sheet

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Project Graphic

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Low impact development (LID) system constructed to treat stormwater runoff

