An Equitable Siting Methodology for a Future Houston Bike Share System

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Introduction

Bike share systems are a key component in an urban active transportation network. However, Houston, the fourth largest U.S. city, no longer has a system after the closure of Houston BCycle in 2024. This research investigates how a new bike share network can balance ridership density, system efficiency, low-income and minority community inclusion, and equitable station distribution. Historically, systems prioritize either pure ridership or spread out too thinly to be useful. We need a reproducible spatial methodology for siting stations that mathematically balances efficiency with social equity.

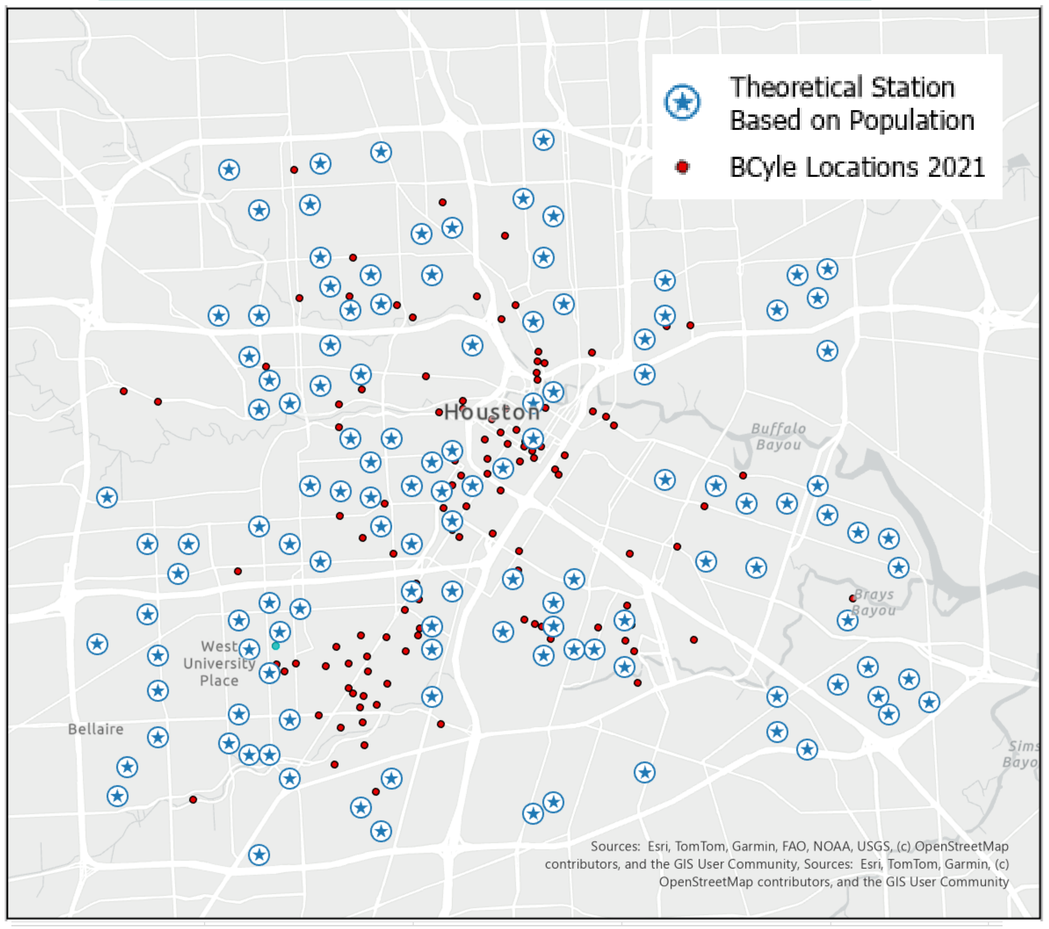
Method

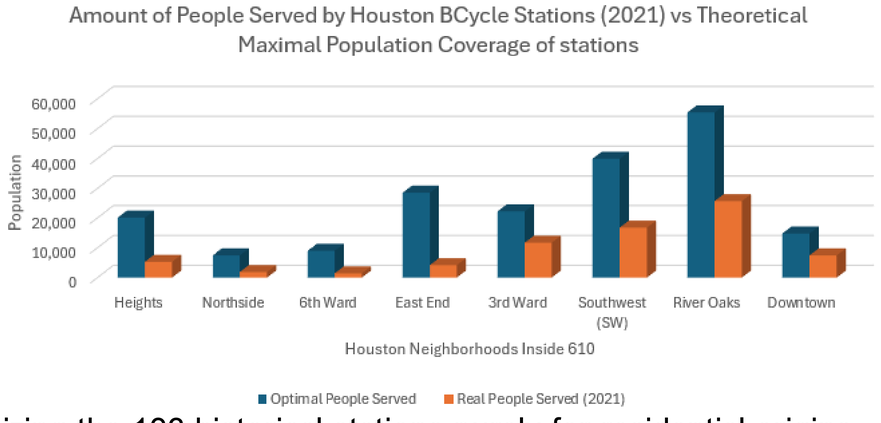
To control for spatial bias and the Modifiable Areal Unit Problem (MAUP), a uniform 50,000-square-meter hexagonal tessellation grid was generated across the Houston 610 Inner Loop. To isolate *residential accessibility* rather than commercial trip destinations, 2020 Census Block data was used to apportion high-precision population counts to the grid.

To manage the sprawling geography of Houston and ensure localized coverage, the study area was subdivided into eight historical neighborhoods. The historical 2021 system count of 123 stations was then proportionally allocated to each neighborhood based strictly on its percentage share of the total inner-loop residential population.

A theoretical ridership baseline was established by adapting the Maximal Covering Location Problem (MCLP) (Frade & Ribeiro, 2015). Using an ArcGIS Pro Location-Allocation solver with a realistic 400-meter (5-minute) pedestrian street network impedance, optimal station networks were generated for each neighborhood to maximize pure residential coverage. These theoretical models were then directly compared against the real-world coverage of the 2021 BCycle network.

Results

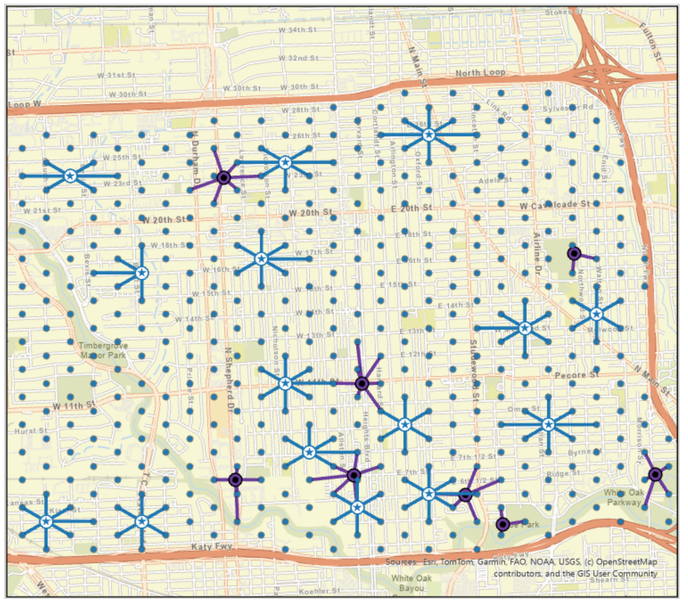




Optimizing the 123 historical stations purely for residential origins captured 197,385 residents within a 5-minute walk-shed, compared to the 2021 historical network's 74,304 residents. This represents a 2.65x average city-wide increase in accessibility.

The most profound improvements occurred in dense residential areas that were bypassed by the original system's commercial focus. The East End saw a 6.9x increase in coverage (4,167 to 28,553 residents), while the 6th Ward saw a 6.4x increase (1,413 to 8,996 residents)

Neighborhood: Houston Heights



The Greater Heights area contains approximately 63,000 residents, representing 12% of the total Inner Loop study area. Following the proportional methodology, 15 of the historical stations were allocated to this zone.

The historical BCycle placement successfully served only 5,286 residents within a 5-minute walk-shed.

The theoretical 15-station network, optimized purely for residential density, captured 20,079 residents.

References

Frade, I., & Ribeiro, A. (2015). Bike-sharing stations: A maximal covering location approach. *Transportation Research Part A: Policy and Practice*, 82, 216-227.

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