EJSIT
European Journal of Science, Innovation and Technology
ISSN: 2786-4936
www.ejsit-journal.com
Volume 6 | Number 1 | 2026

A GIS and Space Syntax-Based Walkability Development Plan for The Heritage District of Taal, Batangas

Joseph Anthony A. Malabanan*
College of Architecture, Fine Arts and Design,
Batangas State University – The National Engineering University – Alangilan Campus,
Golden Country Homes Subdivision, Alangilan, Batangas City, Batangas, Philippines

ABSTRACT

This study developed a GIS- and Space Syntax–based Walkability Development Plan (WDP) for the Población Heritage District of Taal, Batangas, a heritage town where walking supports everyday mobility and tourism activity but is constrained by narrow streets, discontinuous sidewalks, and encroachments. Guided by local planning intentions that prioritize pedestrian connectivity while preserving heritage values, the research examined how spatial configuration relates to pedestrian movement and on-ground walkability conditions. A mixed-method convergent design integrated GIS-based spatial analysis, segment-based Space Syntax modeling, walkability audits, pedestrian counts, and perception surveys to assess pedestrian accessibility, safety, comfort, and infrastructure adequacy. Results show that pedestrian movement patterns align closely with spatial configuration: corridors with high global integration (Rn), high local integration (R3), and high choice (betweenness) correspond with observed pedestrian concentrations near major religious, commercial, and heritage nodes. However, audit and survey results indicate that many movement-critical streets exhibit poor walkability due to discontinuous or narrow sidewalks, obstructions, limited accessibility for persons with disabilities, and inadequate supporting amenities. The composite walkability index further indicates that very low walkability conditions occur in high-demand areas, clarifying the need for targeted and tiered interventions. Based on these findings, the study proposes a WDP that prioritizes corridors by urgency, classifies streets by functional typology, and outlines heritage-sensitive strategies for pedestrian space reallocation, traffic management, vendor regulation, inclusive accessibility, and monitoring mechanisms.

Keywords: walkability, heritage district, GIS, Space Syntax, urban mobility, Taal Batangas

INTRODUCTION

Walkability has gained increasing significance as a core component of sustainable urban mobility, particularly within heritage districts where pedestrian activity supports cultural experience, tourism, and local commerce. Globally, pedestrian-oriented initiatives demonstrate that heritage zones can improve accessibility while preserving cultural value, supporting a shift from car-centric development toward pedestrian-priority environments. In the Philippines, heritage towns have similarly demonstrated the potential of integrating walkability strategies into historic settings through planning and place-based design.

Taal, Batangas offers a relevant context for walkability planning due to the cultural importance of its Población heritage district, which contains major Spanish Colonial structures and heritage landmarks that attract local and international visitors. Local planning priorities recognize pedestrian connectivity as a key concern while maintaining heritage values. The municipal Tourism Circuit Plan includes a Cultural Heritage Walk intended to connect historical landmarks and enhance visitor experience and local economic resilience. Nevertheless, pedestrian mobility remains challenged by fragmented or absent sidewalks, inadequate street lighting, limited crosswalk provision, and recurring encroachments by vendors and vehicles. These conditions pose safety risks and reduce the overall walking experience, particularly in movement-critical corridors.

In response, this study applied Geographic Information Systems (GIS) and Space Syntax analysis, together with field-based audits and user surveys, to examine the relationship between spatial configuration, pedestrian movement, and walkability conditions. The research synthesized these findings into a Walkability Development Plan (WDP) designed to improve pedestrian mobility while remaining compatible with the heritage character and physical constraints of the district.

OBJECTIVES

This study aimed to develop a GIS- and Space Syntax–based Walkability Development Plan for the Población Heritage District of Taal, Batangas by:

(a) assess walkability conditions and spatial barriers in the Población of Taal;
(b) analyze spatial configuration using GIS and Space Syntax methodologies;
(c) formulate evidence-based walkability strategies for priority corridors, derived from spatial overlays, audit validations, and syntactic analysis; and
(d) develop a heritage-sensitive and policy-aligned Walkability Development Plan.

MATERIALS AND METHODS

Research Design

The study utilized a mixed-method convergent research design integrating quantitative and qualitative approaches to examine walkability within the Población Heritage District of Taal. Quantitative components included GIS-based spatial analyses, Space Syntax metrics, pedestrian counts, and descriptive statistics, while qualitative components consisted of perception surveys and insights gathered from local stakeholders and community members. Spatial modeling provided the analytical foundation of the study, and audit and survey results were used to validate and contextualize spatial findings.

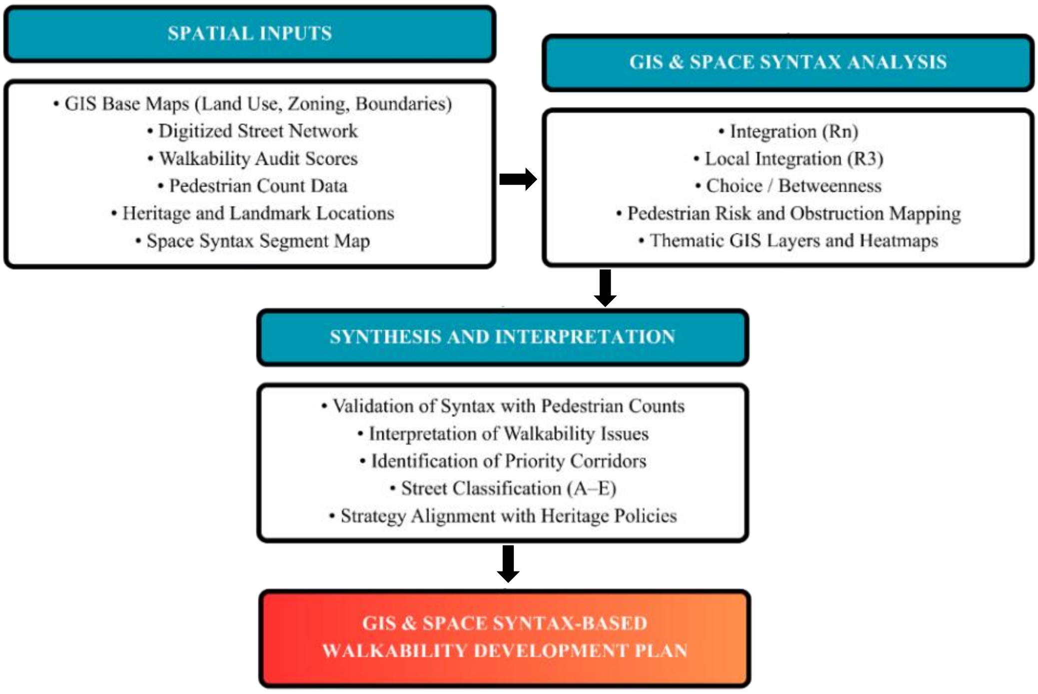

Figure 1. Research Model

Spatial and Field Data Collection

Spatial datasets were prepared using GIS workflows and segment-based street network modeling. Space Syntax analysis was conducted to compute global integration (Rn) *(Figure 2)*, local integration (R3) *(Figure 3)*, and choice (betweenness) *(Figure 4)*. Walkability audits were conducted to document on-ground pedestrian infrastructure conditions, including continuity, width, surface condition, lighting, vehicular risk, PWD accessibility, shade/comfort, and encroachments summarized by parameter scores.

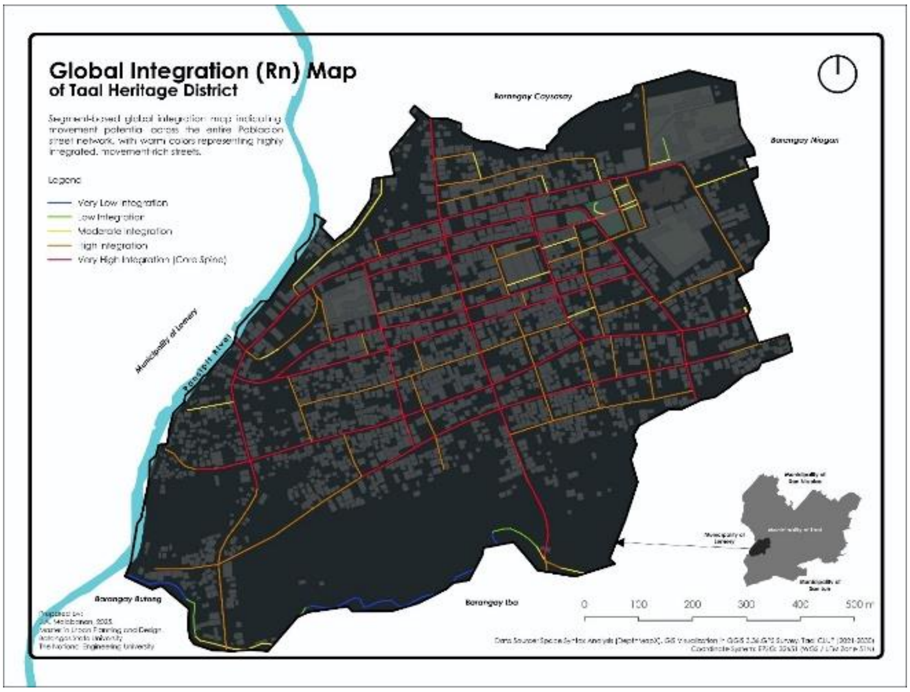

Figure 2. Global Integration (Rn) Map of Taal Heritage District

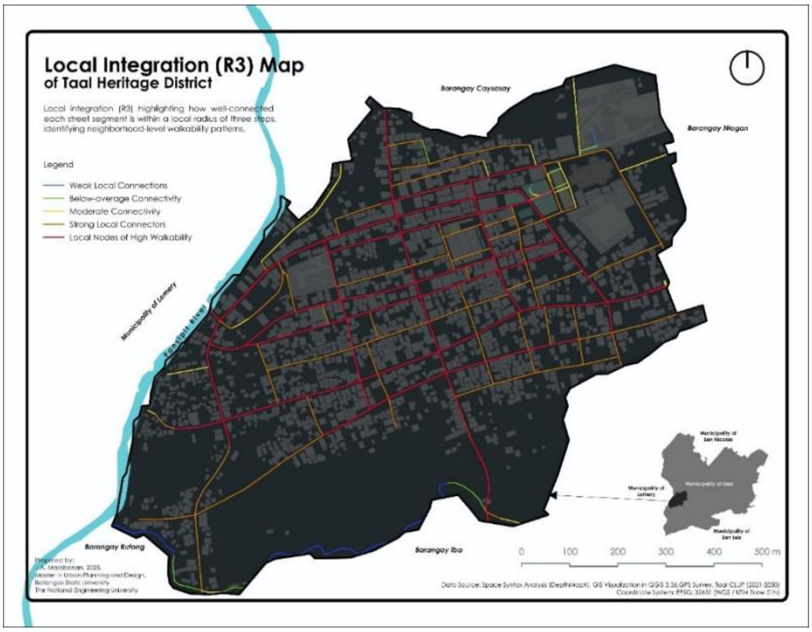

Figure 3. Local Integration (R3) Map

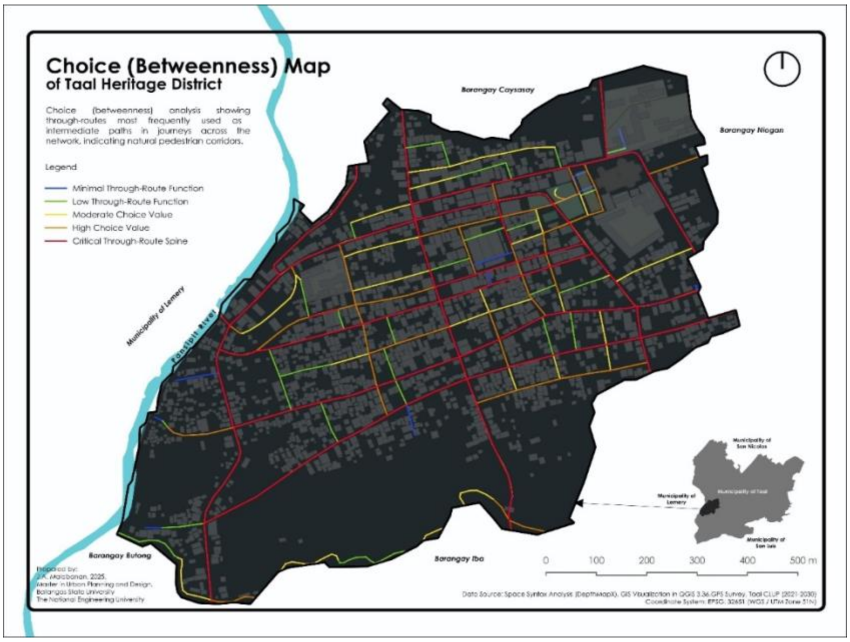

Figure 4. Choice (Betweenness) Map

Pedestrian movement was measured through weekday and weekend pedestrian counts and was visualized using Heatmaps (*see Figure 5; Figure 6).* These movement layers were interpreted in relation to Space Syntax metrics and land-use attractors such as religious, commercial, and heritage tourism nodes.

Perception Survey and Analysis

A perception survey was administered to evaluate pedestrian experiences and perceived barriers. Survey results were summarized using descriptive statistics for indicators and respondent characteristics.

RESULTS AND DISCUSSION

Composite Walkability Conditions

The composite walkability index synthesized audit parameters and revealed pronounced spatial disparities in walkability (*Figure 7*). Very low walkability conditions were concentrated in corridors that also experience the highest pedestrian demand, particularly near the market area and heritage-commercial strips. These deficiencies are consistent with audit patterns on sidewalk continuity and width, surface condition lighting, vehicular risk, PWD accessibility, shade/comfort, and encroachments.

These findings indicate a mismatch between the spatial potential of streets (as reflected by Space Syntax) and their actual usability for pedestrians, emphasizing the need for targeted improvements prioritized by movement importance and severity of deficiencies.

Pedestrian Movement Patterns and Spatial Configuration

Weekday pedestrian activity was concentrated around major activity clusters, including the Basilica, market area, educational institutions, and government buildings (*Figure 5*), reflecting routine movement for work, school, errands, and religious worship. Peripheral streets exhibited minimal activity, aligning with low spatial integration. Weekend maps showed a substantial increase in pedestrian density, with tourism and religious activities intensifying movement along heritage corridors (*Figure 6*), especially those connecting the Basilica, Caysasay Shrine, and heritage house clusters.

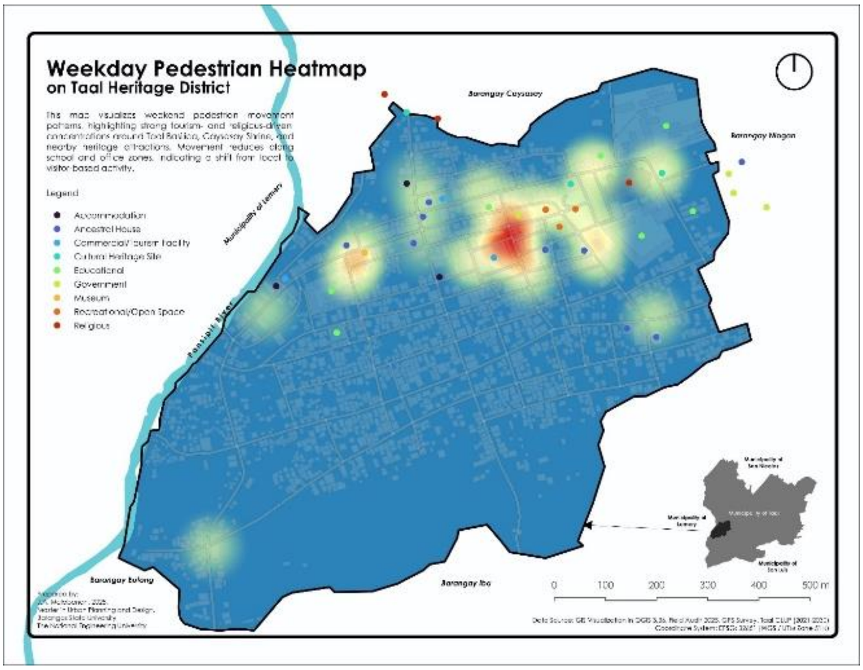

Figure 5. Weekday Pedestrian Volume Heatmap

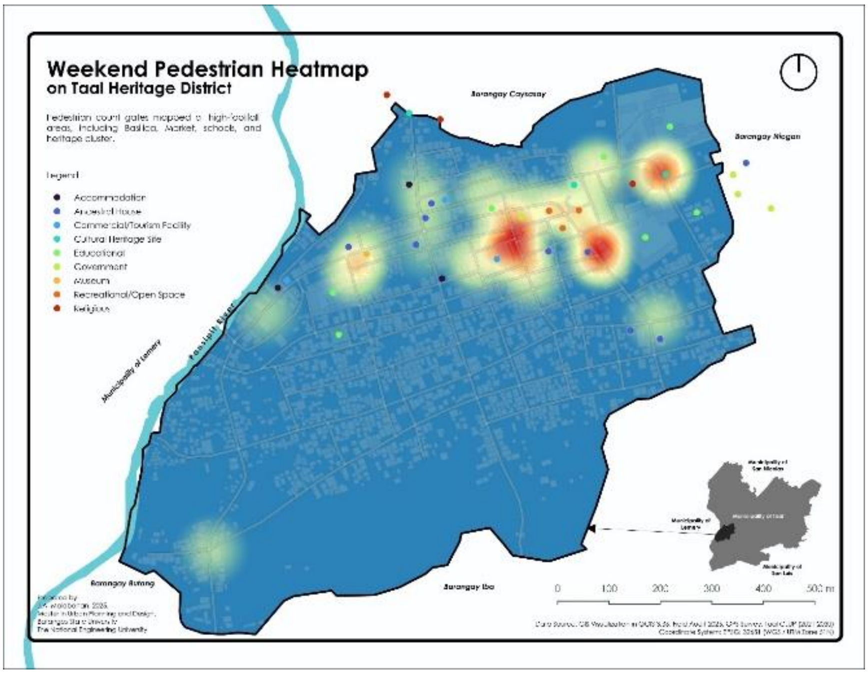

Figure 6. Weekend Pedestrian Volume Heatmap

Movement patterns align with spatial configuration: high integration (Rn), high local integration (R3), and high choice (betweenness) corridors correspond with high pedestrian activity However, the same corridors experiencing the greatest movement intensity often exhibit the poorest walkability conditions, creating high-risk environments where pedestrian–vehicle interactions and obstructions become most acute.

Table-based interpretation of Space Syntax metrics further supports these relationships: high global integration (Rn) corresponds with high weekday and weekend density near the Basilica and market; high local integration (R3) corresponds with dense movements in heritage clusters that form natural walkable loops; and high choice (betweenness) corresponds with heavy conflicts on commercial corridors where through-routes intensify pedestrian–vehicle interactions.

Survey-Based Walkability Perceptions

Survey results indicate that respondents generally disagreed that pedestrian walkways are adequate and reported continuing concerns related to obstructions and safety exposure. Respondent profile and behavioral summaries provide additional context for interpreting these perceptions.

Specific findings reinforce the audit results. Obstructions were strongly identified as a major mobility barrier (M = 3.86), reflecting the impact of encroachments on effective pedestrian space and perceived safety. Additional indicators highlight challenges in physical accessibility and street support amenities, including low ratings for PWD ramps (M = 1.22), seating (M = 1.66), and limited improvements for street lighting (M = 2.05). Thermal comfort remains a concern based on shading ratings (M = 2.91), alongside other perceived inadequacies such as pedestrian signage (M = 2.51).

Implications for Walkability Planning in Heritage Districts

Taken together, the findings indicate that walkability challenges within the Taal heritage district are spatially concentrated and systemically linked to the district's movement structure and on-ground constraints. Corridors that are structurally central to movement and most used by pedestrians require the most immediate interventions, but these interventions must be heritage-sensitive and consistent with physical constraints, as reflected in the WDP prioritization outputs (*Figure 7)* and street typology mapping (*Figure 8).*

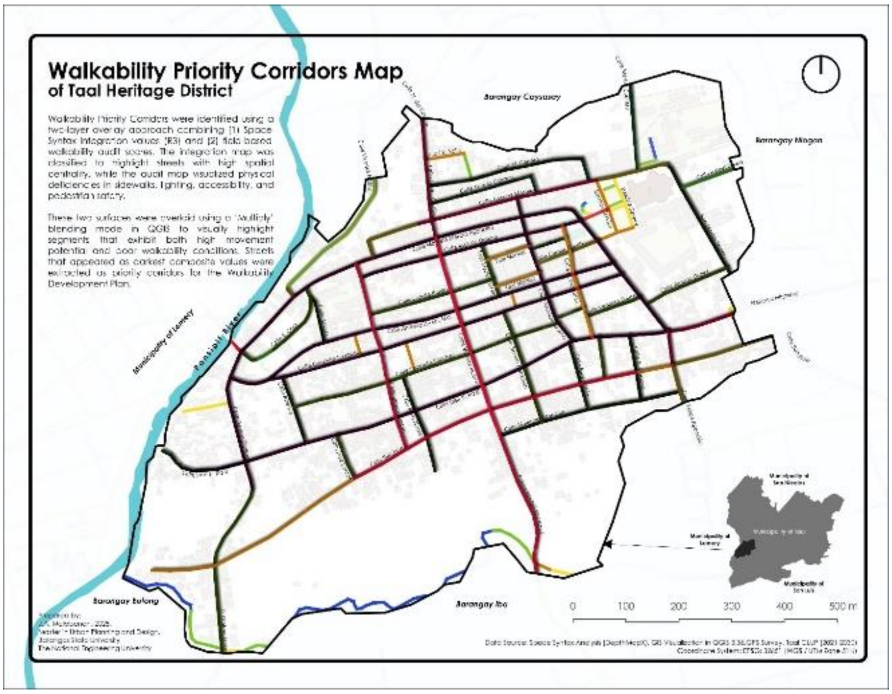

Figure 7. Walkability Priority Corridors Map of Taal Heritage District.

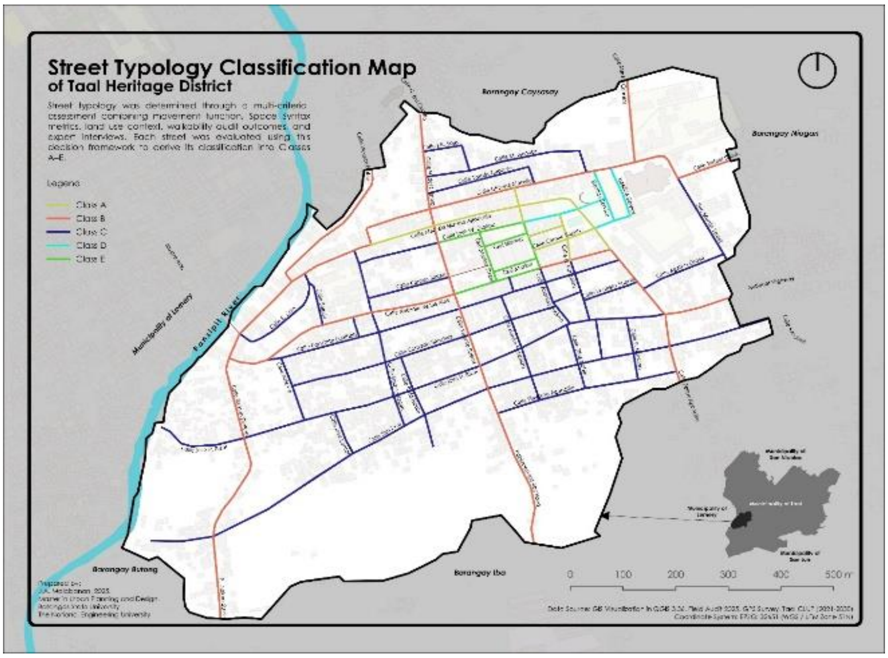

Figure 8. Proposed Street Typology Classification Map (Class A–E)

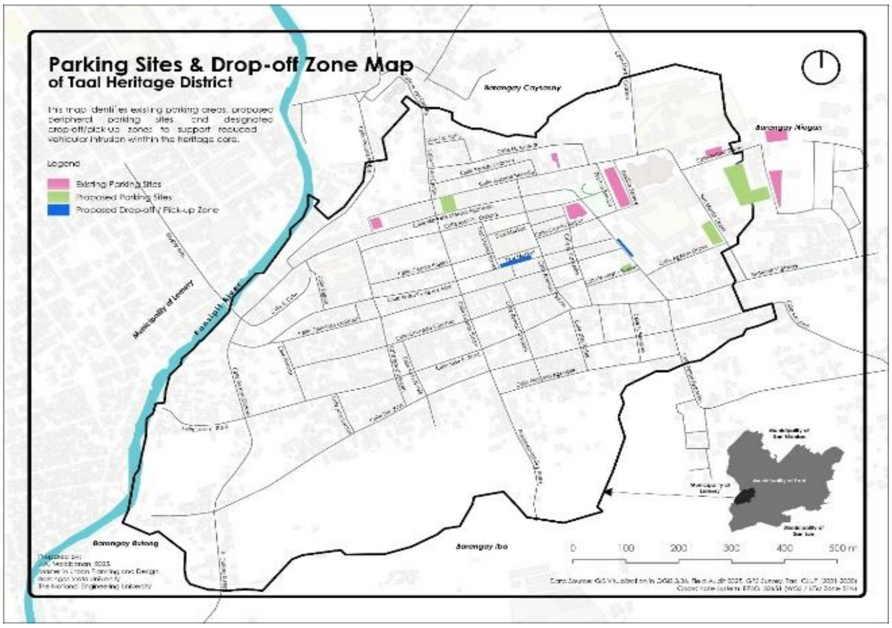

Figure 9. Parking Sites & Drop-off Zone Map of Taal Heritage District

CONCLUSIONS

This study developed an evidence-based Walkability Development Plan for the Población Heritage District of Taal, Batangas using GIS-based spatial analysis, Space Syntax modeling, walkability audits, pedestrian counts, and perception survey results. The findings demonstrate that pedestrian movement aligns closely with spatial configuration, as shown in the Space Syntax outputs and the pedestrian volume heatmaps (*Figure 5–Figure 6*).

However, the study also established a consistent mismatch between movement-critical corridors and walkability quality. Very low walkability conditions are concentrated in market and heritage-commercial strips and are characterized by audit-documented deficiencies Survey results corroborate these conditions and highlight persistent perceived barriers.

RECOMMENDATIONS

Based on the integrated spatial, audit, movement, and perception findings, the study recommends the implementation of a Walkability Development Plan that:

(1) prioritizes interventions in movement-critical corridors where pedestrian demand is highest and walkability conditions are poorest *(Figure 7*);

(2) addresses systematic barriers such as sidewalk discontinuity, obstructions, inadequate lighting, and limited accessibility for persons with disabilities;

(3) applies heritage-sensitive street design and management approaches through typology-based interventions (*Figure 8*), supported by shared-street management guidance where applicable;

(4) supports the proposed Heritage Walking Loop through coordinated corridor and node interventions (*Figure 10; Figure 11*) and mobility access planning, including parking and drop-off controls (*Figure 9*); and

(5) institutionalizes implementation through policy, governance, and monitoring mechanisms (*Figure 12–Figure 15*).

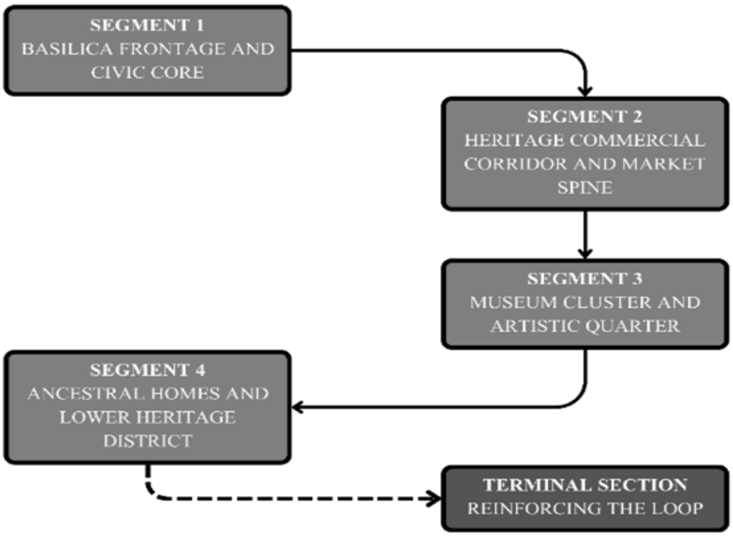

Figure 10. Proposed Heritage Walking Loop

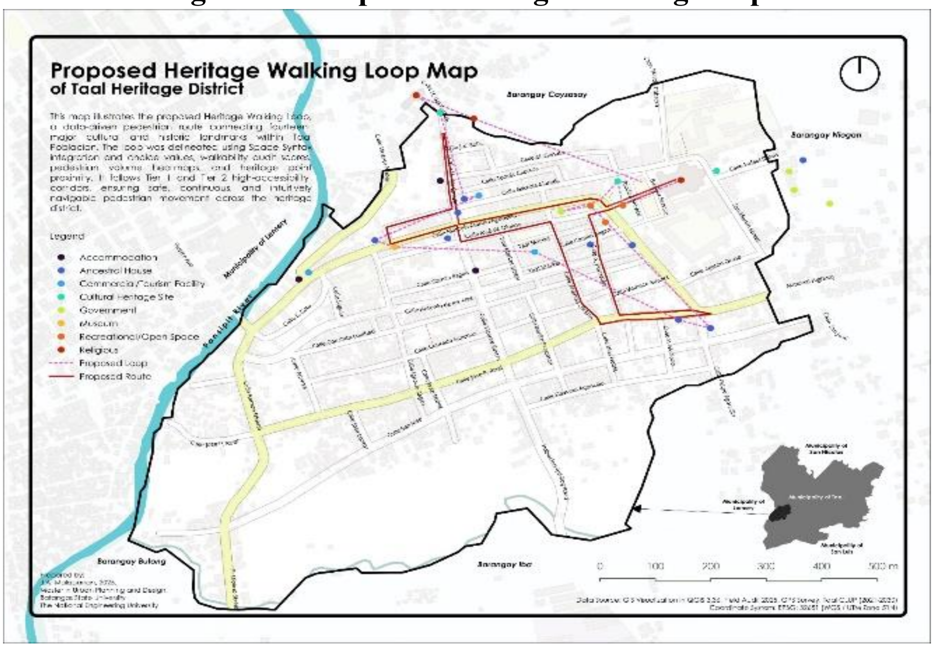

Figure 11. Proposed Heritage Walking Loop Map

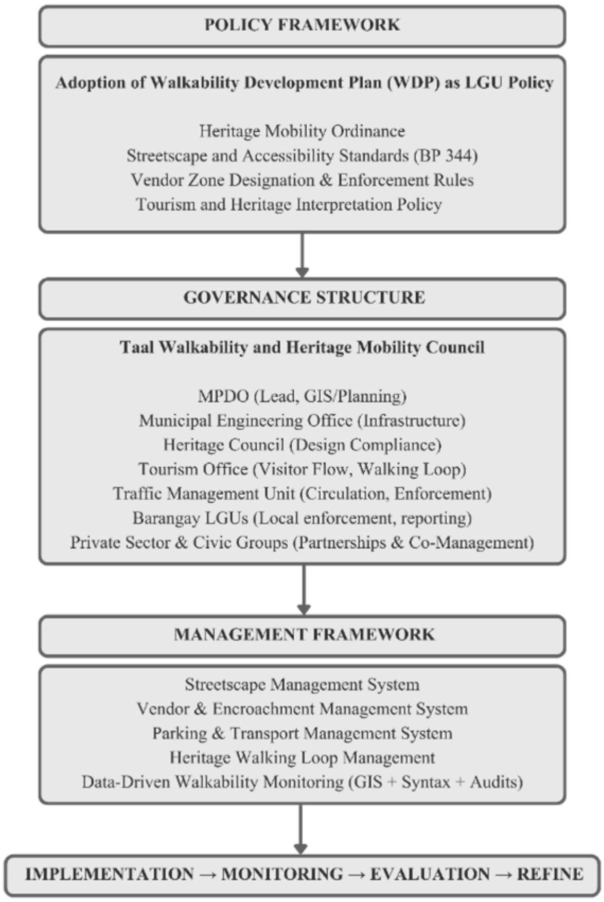

Figure 12. Policy, Governance, and Management Framework Diagram

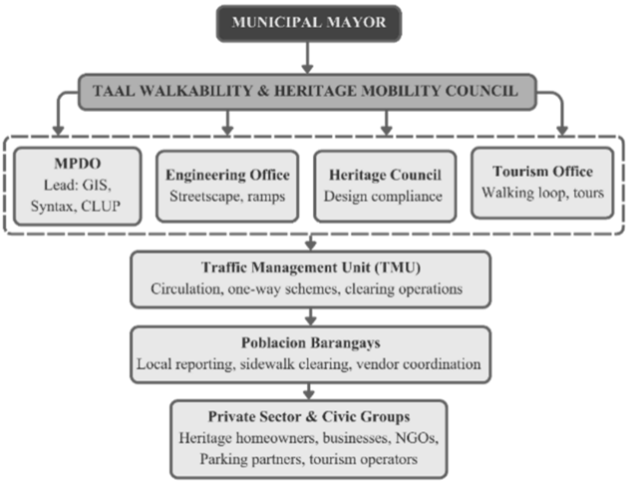

Figure 13. Multi-Agency Governance Structure Diagram

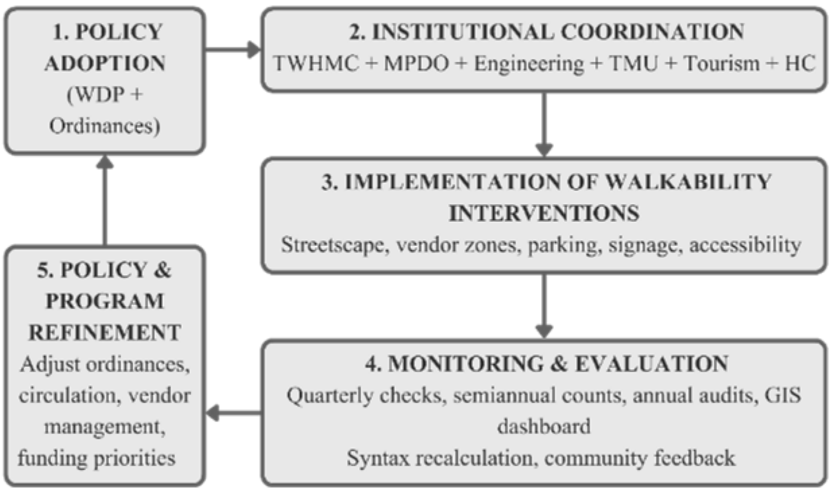

Figure 14. Policy-Governance-Management Cycle Diagram

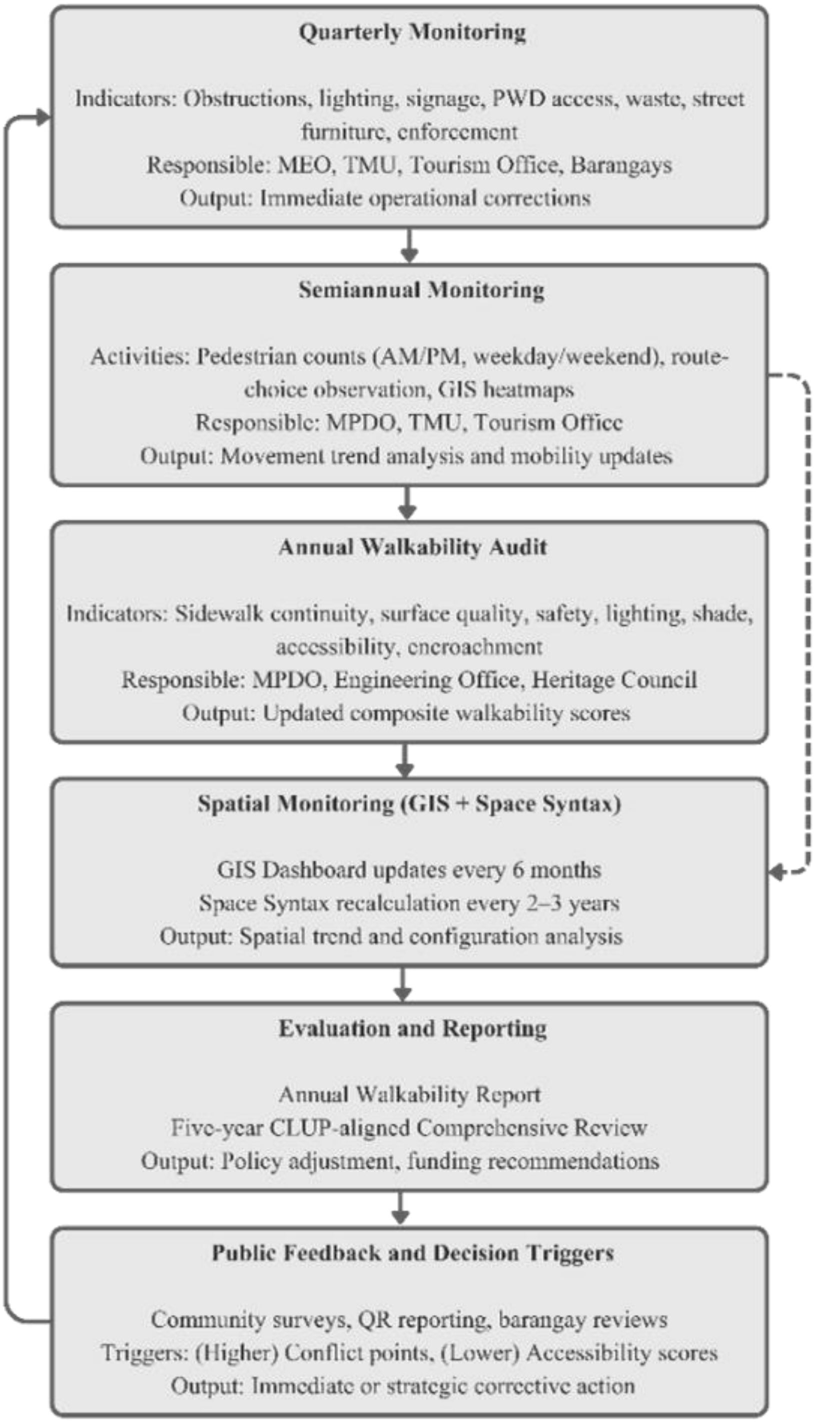

Figure 15. Monitoring and Evaluation Framework

Where cross-sectional and visualization drawings are used to communicate recommended street redesign approaches, these may be referenced as the design basis for Class A–E interventions (Figure 16–Figure 29).

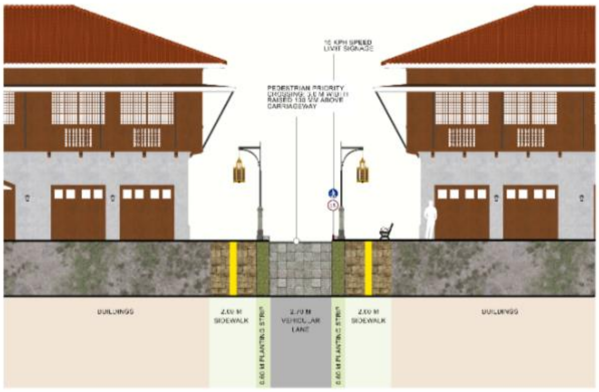

Figure 16. Cross-Section of Class A Streets - Primary Movement Spine

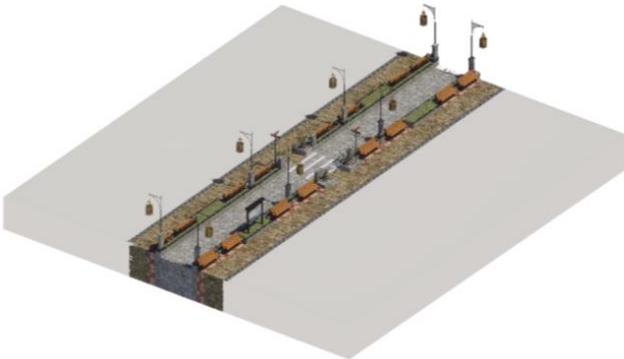

Figure 17. Isometric View of Class A Streets - Primary Movement Spine

Figure 18. 3D Visualization of Class 'A' Streets - Primary Movement Spine

This configuration creates a fully walkable spine with clear pedestrian zones, reduced vehicle dominance, and heritage character elements. The design accommodates peak pedestrian flows while maintaining controlled vehicular access.

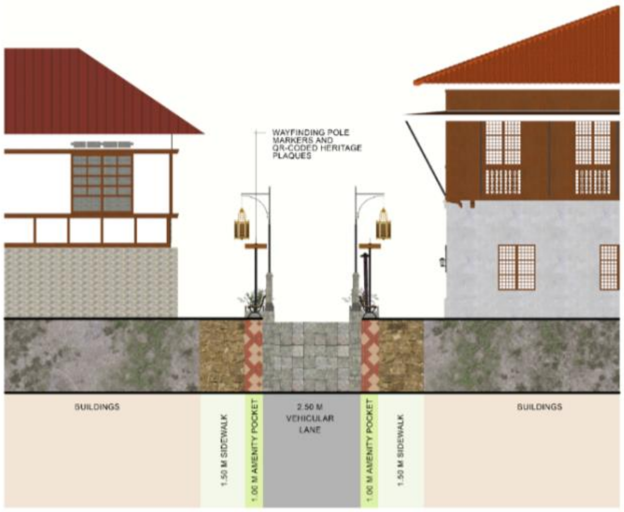

Figure 19. Cross-Section of Class B - Heritage Connector

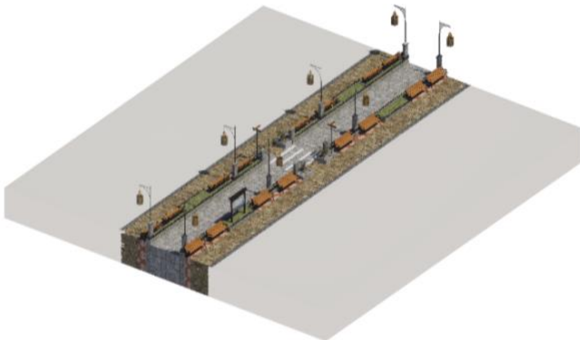

Figure 20. Isometric View of Class B Streets - Heritage Connector

Figure 21. 3D Visualization of Class 'B' Streets - Heritage Connector

These connectors emphasize heritage experience over speed. The narrower lane and textured paving serve as passive traffic calming measures. Wayfinding signage supports tourism flows.

Figure 22. Cross-Section of Class C Streets - Local Shared Residential Street (Woonerf Concept)

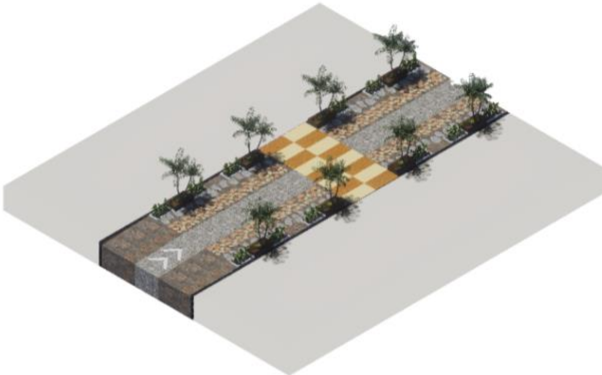

Figure 23. Isometric View of Class C Streets - Local Shared Residential Street (Woonerf Concept)

Figure 24. 3D Visualization of Class 'C' Streets - Local Shared Residential Street (Woonerf Concept)

This design promotes a neighborhood-friendly environment where pedestrians have priority and vehicles travel at very low speeds. Perfect for residential heritage areas.

Figure 25. Cross-Section of Class D Streets - Ceremonial / Promenade Street

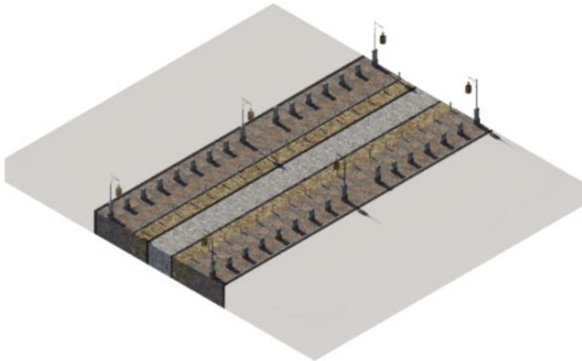

Figure 26. Isometric View of Class D Streets - Ceremonial / Promenade Street

Figure 27. 3D Visualization of Class 'D' Streets - Ceremonial / Promenade Street

Class D streets reinforce the ceremonial identity of Taal. Vehicle use is secondary, occasionally restricted during festivals and religious events.

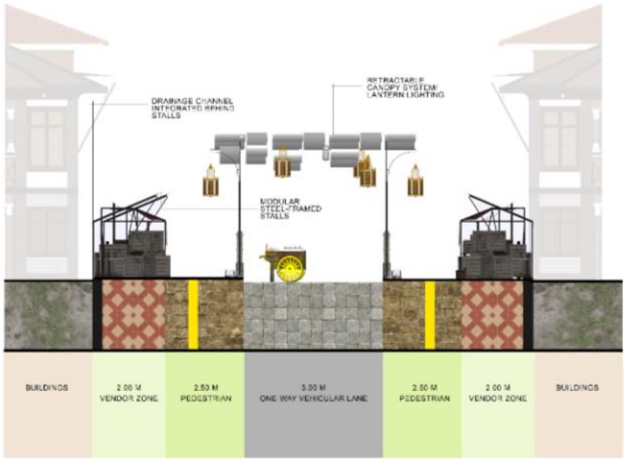

Figure 28. Cross-Section of Class E Streets - Market Shared Street

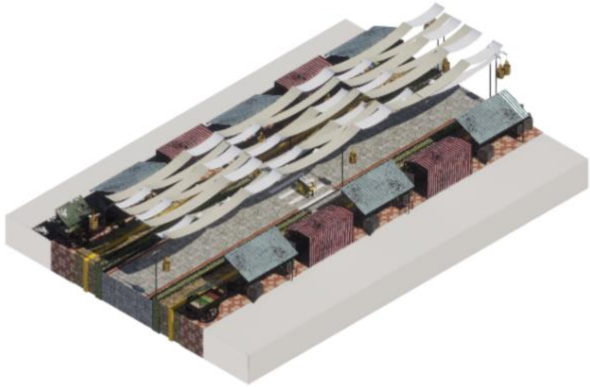

Figure 29. Isometric View of Class E Streets - Market Shared Street

Figure 30. 3D Visualization of Class 'E' Streets - Market Shared Street

Class E streets formalize market activity. Pedestrians are given safe passage while vendors retain regulated, clearly bounded spaces.

REFERENCES

Cervero, R., & Kockelman, K. (1997). Travel demand and the 3Ds: Density, diversity, and design. *Transportation Research Part D: Transport and Environment, 2*(3), 199–216. https://doi.org/10.1016/S1361-9209(97)00009-6

Frank, L. D., Sallis, J. F., Saelens, B. E., Leary, L., Cain, K., Conway, T. L., & Hess, P. M. (2010). The development of a walkability index: Application to the Neighborhood Quality of Life Study. *British Journal of Sports Medicine, 44*(13), 924–933.

Gehl, J. (2010). *Cities for people*. Island Press.

Hillier, B. (1996). *Space is the machine: A configurational theory of architecture*. Cambridge University Press.

Hillier, B., & Hanson, J. (1984). *The social logic of space.* Cambridge University Press.

Litman, T. (2017). *Evaluating accessibility for transportation planning: Measuring people's ability to reach desired goods and activities* (Report No. 170). Victoria Transport Policy Institute. https://vtpi.org/access.pdf

Municipality of Taal, Batangas. (2021). *Comprehensive land use plan (CLUP) 2021–2030: The land use plan.* Municipal Planning and Development Office (MPDO).

Southworth, M. (2005). Designing the walkable city. *Journal of Urban Planning and Development, 131*(4), 246–257. https://doi.org/10.1061/(ASCE)0733-9488(2005)131:4(246)

Speck, J. (2013). *Walkable city: How downtown can save America, one step at a time*. Farrar, Straus and Giroux.

UNESCO. (2011). *Recommendation on the Historic Urban Landscape.* United Nations Educational, Scientific and Cultural Organization. https://whc.unesco.org/en/activities/638

Vale, D. S., Saraiva, M., & Pereira, M. (2016). Active accessibility: A review of operational measures of walkability and bikeability. *Journal of Transport and Land Use, 9*(1), 209–232. https://doi.org/10.5198/jtlu.2015.593