GEO 4427

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Project Proposal: CoNB Walkability

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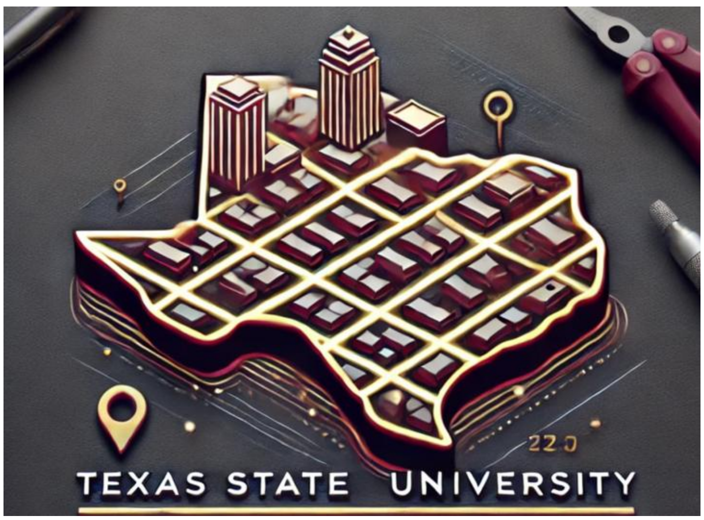


Table of Contents

1.0 Introduction

The City of New Braunfels is undertaking the development of a Student Pedestrian Walkability GIS dataset to support planning and transportation initiatives. This project aims to leverage high-resolution city imagery and street view photography to create a comprehensive inventory of sidewalk and crosswalk assets through heads-up digitizing through GIS. The primary objective is to enable network connectivity analysis, generate relevant metrics, and produce map end products that address key questions regarding student access to schools and parks with accessibility in mind.

This effort will provide valuable insights into existing pedestrian infrastructure and identify connectivity gaps, ultimately informing plans and policies promoting walkable development around designated centers. The data ascertained from this project will be used as foundational information to help the city of New Braunfels' five-year plan to address sidewalks and pedestrian movement. Furthermore, this project offers student participants valuable learning opportunities in data architecture, asset digitization, network analysis, quality control, and deliverable creation, fostering real-world GIS skills development and exposure to local government applications of geospatial technology.

2.0 Literature Review

The increasing focus on promoting walking as a central element of urban mobility has led to a surge in research dedicated to understanding and improving walkability. Walkability, defined as the extent to which the built environment supports and encourages walking, is a complex concept influenced by a multitude of factors. Researchers employ various methodologies, often leveraging the power of Geographic Information Systems (GIS), to assess and visualize walkability, aiming to create more pedestrian-friendly urban spaces. This review examines the evolution of walkability assessment, highlighting the critical role of GIS in these efforts.

Early approaches to walkability assessment often relied on time-consuming and resource-intensive methods like direct audits and surveys (Telega). While valuable, these methods presented limitations in scalability and efficiency. Simpler indicators like Walk Score, while offering a readily accessible measure of amenity accessibility, often overlook crucial factors such as recreational areas, public transport proximity, and the quality of pedestrian infrastructure (Telega). More recent research has focused on developing comprehensive, GIS-based indices that incorporate a wider range of variables (Tsiompras). These indices typically consider factors like population density, pathway connectivity, land use mix, proximity to amenities, and pedestrian infrastructure characteristics (e.g., pathway width, condition, and obstacles) (Telega). GIS facilitates the integration and analysis of these diverse datasets, enabling a more nuanced understanding of walkability.

A key debate within the field revolves around the weighting of index parameters. While some studies employ equal weighting, others argue for the importance of assigning weights based on the relative importance of different factors to pedestrians. Studies employing weighted indices often utilize surveys and methods like the Borda count to elicit pedestrian preferences and derive appropriate weights (Telega). For example, research has shown that proximity to basic urban destinations is often highly valued by pedestrians, while population density may be considered less critical (Tsiompras). GIS plays a crucial role in applying these weights to spatial data, generating composite walkability indices that reflect the varying importance of different factors (Telega). This allows for a more accurate representation of the pedestrian experience and facilitates targeted interventions (D'Orso).

GIS has become an indispensable tool in walkability research, enabling the precise identification of areas requiring infrastructure improvements (Tsiompras). Researchers utilize GIS to map pedestrian networks, analyze connectivity, assess access to amenities, and evaluate the quality of pedestrian infrastructure (Telega). By integrating data from various sources, including OpenStreetMap, Google Street View, and satellite imagery, GIS facilitates the creation of detailed walkability maps (Tsiompras). These maps can then be used to inform spatial planning decisions, prioritize infrastructure investments, and evaluate the impact of new developments on walkability (Telega). Furthermore, GIS allows for the analysis of walkability in relation to other urban characteristics, such as building density and land use patterns, providing valuable insights for urban planners and policymakers (Tsiompras). As research continues to refine walkability assessment methodologies, GIS will undoubtedly remain a central platform for data integration, analysis, and visualization, ultimately contributing to the creation of more walkable and livable cities (D'Orso).

3.0 Data & Methodology

3.1 Master Data List

Entity	Attributes	Spatial Object	Status	Source	Unit	Year
fcWalkabilityEditing	OBJECTID MSAGname sideOfStreet featureType featureType2 sidewalkWidth Shape_Length	polyline	available	City of New Braunfels GIS	Survey Feet	2025
fcWalkabilityExisting	OBJECTID MSAGname sideOfStreet facilityType facilityType2 sidewalkWidth assetID Comments Shape_Length	polyline	available	City of New Braunfels GIS	Survey Feet	2025
fcWalkabilityPrimary	OBJECTID MSAGname sideOfStreet featureType featureType2 sidewalkWidth Shape_Length	polyline	available	City of New Braunfels GIS	Survey Feet	2025

Notes:

fcWalkabilityEditing - The dataset where edits will be conducted. Features are to be edited in this location.

fcWalkabilityExisting - Existing dataset provided by the CoNB. Features are to be attributed and gaps are to be digitized. QA/QC of the existing features.

fcWalkabilityPrimary - The primary dataset where completed grids will be appended to following the QA/QC of the completed grid. Grids are to be connected to adjacent grids.

3.2 Data

Field	Attribute	Definition
LengthShape()		Automatic attribute assigned by software.
OBJECTID		Automatic ID number is assigned by the software
MSAGNamee		The street name is derived from the street centerlines dataset.
sideOfStreet	Left, Right	Directional side of the street.Z
featureType	Sidewalk	
	Crosswalk	The portion of the street or highway right-of-way beyond the curb is intended for pedestrian usage.
featureType2	Connected	A sidewalk or crosswalk segment that seamlessly connects to another segment of sidewalk or crosswalk on both ends.
	Gap (Sidewalk only)	A section where the sidewalk ends and resumes within the same block, but continuity is interrupted.
	Disconnected (Sidewalk only)	The terminal 10 feet of a sidewalk or crosswalk segment that does not connect to another segment or a crossing point at an intersection.
sidewalkWidth		Measurement in feet between the two edges of a sidewalk.

3.3 Methodology

The problem we will address is digitizing the City of New Braunfels sidewalks, crosswalks, and gaps between sidewalks. The data will be processed by members assigning themselves a grid within the City of New Braunfels. These grids are outlined at the priority level by the client and will be processed as such, starting with high-priority and ending at low-priority grids. Next, members will update their tracking grid to “claim” the grid, ensuring that it isn't manipulated by someone else while being edited by the user. This beginning process is essential because it ensures that workflow is efficient and without conflict. During the initial phase, members should stick to their pre-assigned grids, as outlined in **section 3.5**.

After assigning a grid, the next step is to begin digitizing features in, **fcWalkabilityEditing**, using ArcGIS Pro within the assigned grid. To digitize the features, use the Walkability Edit Map to create features along sidewalks imaged in the Imagery/OrthoImagery layer. The general rules outlined by the client, City of New Braunfels, are as follows:

- Avoid bends/curves or arcs, and use right angles when possible.
- Start and end segments at ramps, crosswalks, medians, bridges(or pedestrian refuge islands), etc.
- Try to draw lines down the center of the feature.
- Map sidewalks parallel to the street when creating sidewalks by a park (Not through).
- Map external sidewalks adjacent to a school building (Do not map sidewalk entrances leading to a building or internal walkways).

- MSAGname is identified as parallel to the sidewalk, ramp, or crosswalk direction.
- Map sidewalks parallel to the street when by a Business (Not the business's private sidewalks).
- If geoImagery is poor and can not measure the width, put in comments.
- If a sidewalk or buffer width varies in measurement, put in comments.
- Editing should only be on sidewalks.
- The side of the street is determined by the direction of the street, characterized by an arrow.
- Ramps- Fill out the location if applicable.
- Crosswalks - Fill out Location and Traffic control.
- Only measure the width of the driveway when the sidewalk is visible on it.
- Driveways perpendicular to the sidewalk passing through it are digitized as sidewalks, not crosswalks.
- Do not map ramps going to parking lots with no adjacent sidewalk connectivity.
- Crosswalks can exist only if ramps are on both sides of the street.
- Crosswalks with ramps will be marked as connected even without markings.
- Only sidewalks can be marked as gaps.

The key question to be answered here is: “whether pedestrian facilities connect people to key destinations, and if not, where are the gaps in connectivity?”

When digitizing the sidewalk and crosswalk features in the designated grid, members should continually update the attribute features according to the above data list in **section 3.2**, detailing whether sidewalks are connected or disconnected, whether gaps are present, the side of the street, and whether crosswalks are present. The most important method to this part is to efficiently digitize the features in the centerline of sidewalks, because of the nature and the size of the area this step in the methodology will take the longest by far, but is relatively simple.

After completing the assigned grid's digitization, members should perform a quality assurance and quality control process. Sampling the area for correct attributes defined, and sidewalk digitization is correctly placed on features. This is to ensure that completed grids are correctly georeferenced, minimizing the need for QA/QC during the final portions of the project. However, QA/QC will still be conducted at the end to ensure the utmost standard of data delivery.

The next step is to append the data to the existing primary grid, **fcWalkabilityPrimary**, by uploading it to the ArcGIS Online platform, updating the tracking grid, and updating the tracking document to show that the selected grid has been completed. This process also includes appending the grid to the adjacent grids.

Group members will be also responsible for editing and appending new attributes to the current existing grids, **fcWalkabilityExisting**, provided by the City of New Braunfels. This process will include digitization but will be more involved in appending features to define connected, disconnect, crosswalks, and gaps. The existing features are defined in a way that demonstrates more of where sidewalks are instead of where gaps in connectivity are, the data should be manipulated to display the latter.

To finalize the project all group members will then complete a QA/QC of their grids ensuring connections are made between grids and that features are correctly attributed. The data will then be provided to the City of New Braunfels in a final dataset, **fcWalkabilityPrimary**.

3.4 Implications

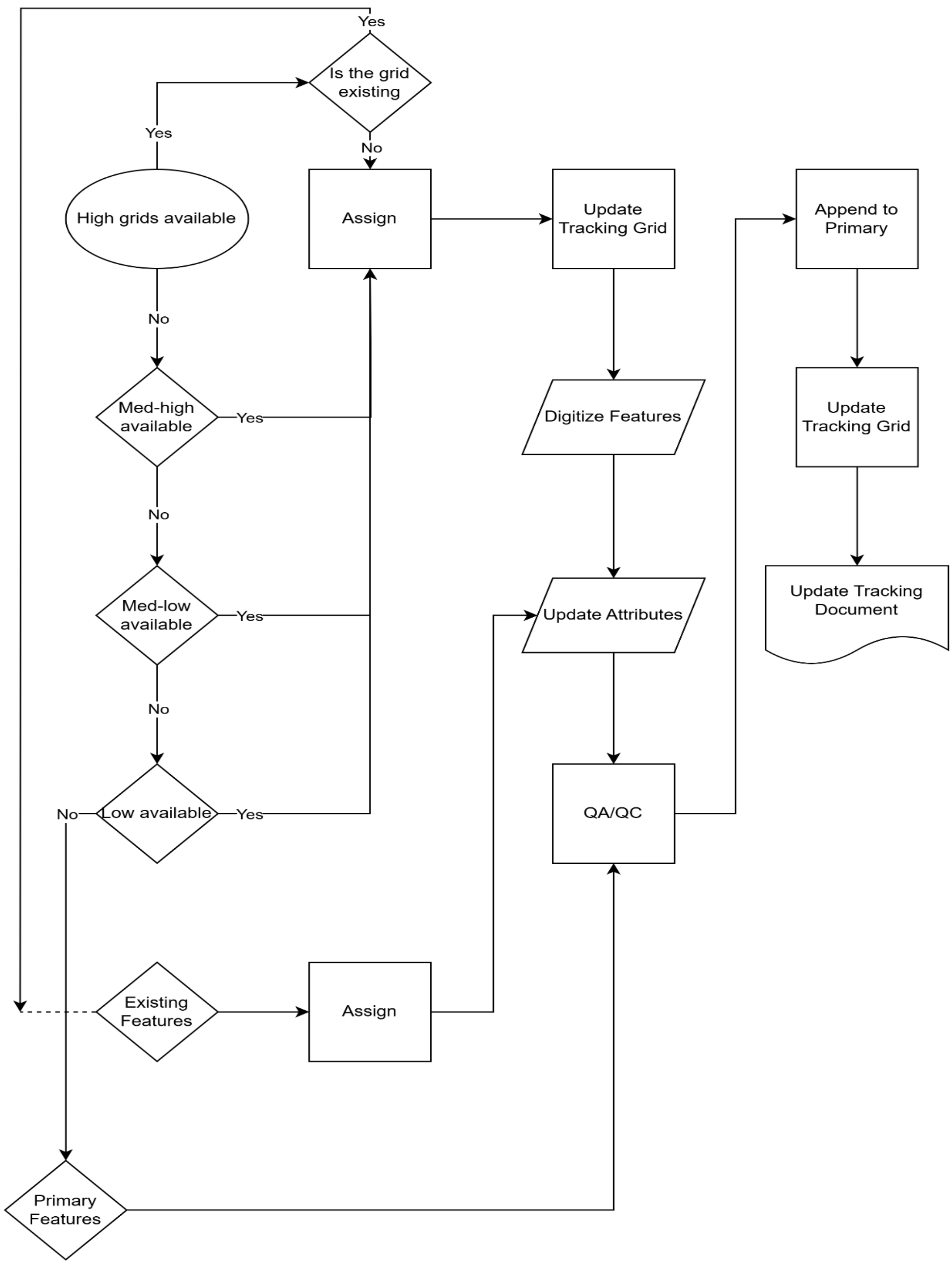
The implications of this research are to continue in the City of New Braunfels' 5-year plan to develop the city. It will lay the foundation for the city's sidewalk feature and assist in knowing where development efforts should be concentrated. The overall benefit will be connecting people between locations with safe ways of travel. The most important implication is the ability to assist in efforts to connect schools to homes in no transportation zones, areas that buses don’t travel to, so that school children can safely travel to and from school without the hazard of being forced to walk on the road or on undeveloped surfaces.

3.5 Grid Index Breakdown

Name	High	Mid-high	Mid-Low
Avery Bouskila	**85**, **87**	68, 69, 83, 127	121, 132
Audrey Hurtado	**100**, **102**	86, 99, 101, 138	98, 111, 112
Josh Faircloth	113, 126	125, 136, 144,	115, 88, 104
Evan Riojas	137,**145**	84, 114, 146	43, 44, 59

**bold numbers represent fcWalkabilityExisting grids.*

3.6 - Workflow


Yes
Is the grid existing
Yes
No
High grids available
Assign
Update Tracking Grid
Append to Primary
No
Med-high available
Yes
Digitize Features
Update Tracking Grid
No
Med-low available
Yes
Update Attributes
Update Tracking Document
No
No
Low available
Yes
QA/QC
Existing Features
Assign
Primary Features

4.0 Budget and Timeline

4.1 Budget

GIS Analysts

Total Hours (16 hours/week * 14 weeks * 4 analysts) - 896

Hourly Pay - $32.00

Total - $28,672.00

Project Manager

Total Hours (16 hours/week * 14 weeks *1 PM) - 224

Hourly Pay - $42.00

Total - $9,408.00

TOTAL COSTS: $38,080

4.2 Timeline

Phase 1: Digitizing

The first and largest of the phases will be about 7 weeks of digitization work. The entirety of the project revolves around this work as we specifically look for and fix gaps in sidewalks in high priority "no-travel" zones as well as other lesser prioritized zones farther away from school zones. Thanks to the diligent work of the City of New Braunfels GIS Department we already have the necessary collected data and just need to process it where needed.

Phase 2: Quality Control

The second phase will happen concurrently with the first phase as our work is checked and corrected for any possible user errors. Individual periods of QC after digitization should be no more than a week or two long and will also fall along the beginning of phase 3.

Any possible errors which might be beyond the ability of the team to fix will also be recorded and saved to bring up to the City of New Braunfels team during the weekly meeting for assistance.

Phase 3: Analysis

The third phase will be roughly 3-4 weeks and analyzing the results of our complete digitization process. In this phase we will draw conclusions from which grids require the most attention based on criteria such as: multiple incomplete sidewalks, inadequate ramps, and proximity to school zones.

Phase 4: Final Project Report

The final phase will be a 4 week period where we work on the final report from our fully digitized data and analysis. The final report will consist of a written report of 15-20 pages, a website, and all necessary files to be included as deliverables to Dr. Yuan and the City of New Braunfels.

Timetable

January 2025						
Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
			1	2	3	4

January 2025						
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	***22***	23	24	25
26	27	28	29	30	31	

February 2025						
Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	***24***	25	26	27	28	

March 2025						
Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
						1
2	3	4	5	6	7	8
9	10	11	12	13	***14***	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	***31***					

April 2025						
Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	***23***	24	25	26
27	***28***	29	30			

Important Dates:

January 22 - First client visit

February 24 - Second client visit

March 14 - Digitization deliverables due to City of New Braunfels

March 31 - Third client visit

April 23 - General final deliverables due

April 28 - Final client visit/Presentations

5.0 Expected Results and Deliverables

This section outlines the deliverables that will be provided alongside the project.

The digitization of the sidewalks and their gaps will allow for the City of New Braunfels to identify where sidewalks need to be built to increase walkability. A digitized map of the City of New Braunfels sidewalks' with gaps. Charts within the map layers to summarize statistics. Student walkability analysis/measures informs the city of places that need sidewalks more than others. Improved feature classes along with a geodatabase for walkability.

6.0 Conclusion

In conclusion, this project benefits everyone in the city although it is aimed for students in no transport school zones. The digitization of sidewalks and their gaps will allow for the city to improve their infrastructure. Metrics and statistics will allow for the city to identify which areas need sidewalks the most and the size of the sidewalks. The assignment of grids to each team member at the beginning of the project is crucial for efficient workflow.

6.1 References

Telega, Agnieszka, et al. "Measuring Walkability with GIS—Methods Overview and New Approach Proposal." *Sustainability*, vol. 13, no. 4, 9 Feb. 2021, p. 1883, https://doi.org/10.3390/su13041883.

Tsiompras, Alexandros Bartzokas, and Yorgos N. Photis. "What Matters When It Comes to "Walk and the City"? Defining a Weighted GIS-Based Walkability Index."

Transportation Research Procedia, vol. 24, 2017, pp. 523–530, https://doi.org/10.1016/j.trpro.2017.06.001.

D'Orso, Gabriele, and Marco Migliore. "A GIS-Based Method for Evaluating the Walkability of a Pedestrian Environment and Prioritised Investments." *Journal of Transport Geography*, vol. 82, Jan. 2020, p. 102555, https://doi.org/10.1016/j.jtrangeo.2019.102555.

6.2 Participation

The following paragraph provides a breakdown of what each member of the group contributed to this proposal. Avery took care of the introduction, literature review, and grid index breakdown. Evan handled data, methodology, implications, and workflow. Josh developed the budget and timetable, and Audrey lastly completed expected results, deliverables, references, and conclusions.