Methodology for Prioritizing Sidewalk Maintenance with GIS Overlay Analysis

Executive Summary

This report presents the methodology used by the Public Works Department to prioritize sidewalk maintenance and installation projects as part of the City's 5-Year Sidewalk Plan. Using a Geographic Information System (GIS) overlay analysis, the study combines sidewalk condition data collected by City staff in 2025 with community influence factors, including pedestrian traffic generators, locations of severe and fatal pedestrian and cyclist crashes, and social vulnerability indicators from the CDC's Social Vulnerability Index (SVI). By weighing and aggregating these diverse data sources, the analysis produces an "Overall Score" for each sidewalk segment, ranking them based on both physical need and community impact. This score-driven approach ensures that projects selected for funding and construction address areas of highest priority, considering safety, equity, and pedestrian mobility, while still allowing staff to adjust for engineering feasibility during implementation.

Methodology for Prioritizing Sidewalk Maintenance with GIS Overlay Analysis

This document describes the methodology used by the Public Works Department to prioritize locations for the upcoming sidewalk maintenance plan. The analysis is based on the 2025 citywide sidewalk condition survey conducted by City staff and combines multiple data sources to identify high-priority areas. Using a GIS overlay approach, the analysis incorporates pedestrian traffic generators, severe and fatal pedestrian and cyclist crash locations, and social vulnerability data from the CDC. These factors are spatially linked to each sidewalk segment, resulting in a dataset that ranks sidewalks by both physical condition and community need at the street block level.

GIS Inputs:

- **Pedestrian Traffic Generators (Point Features):**
  - Bus Stops
  - State Assisted Living Facilities
  - Housing Choice Voucher Program Locations
  - Schools
  - Registered Paratransit Homes
  - Major Destinations (Grocery stores, Shopping, Government, Library, etc.)

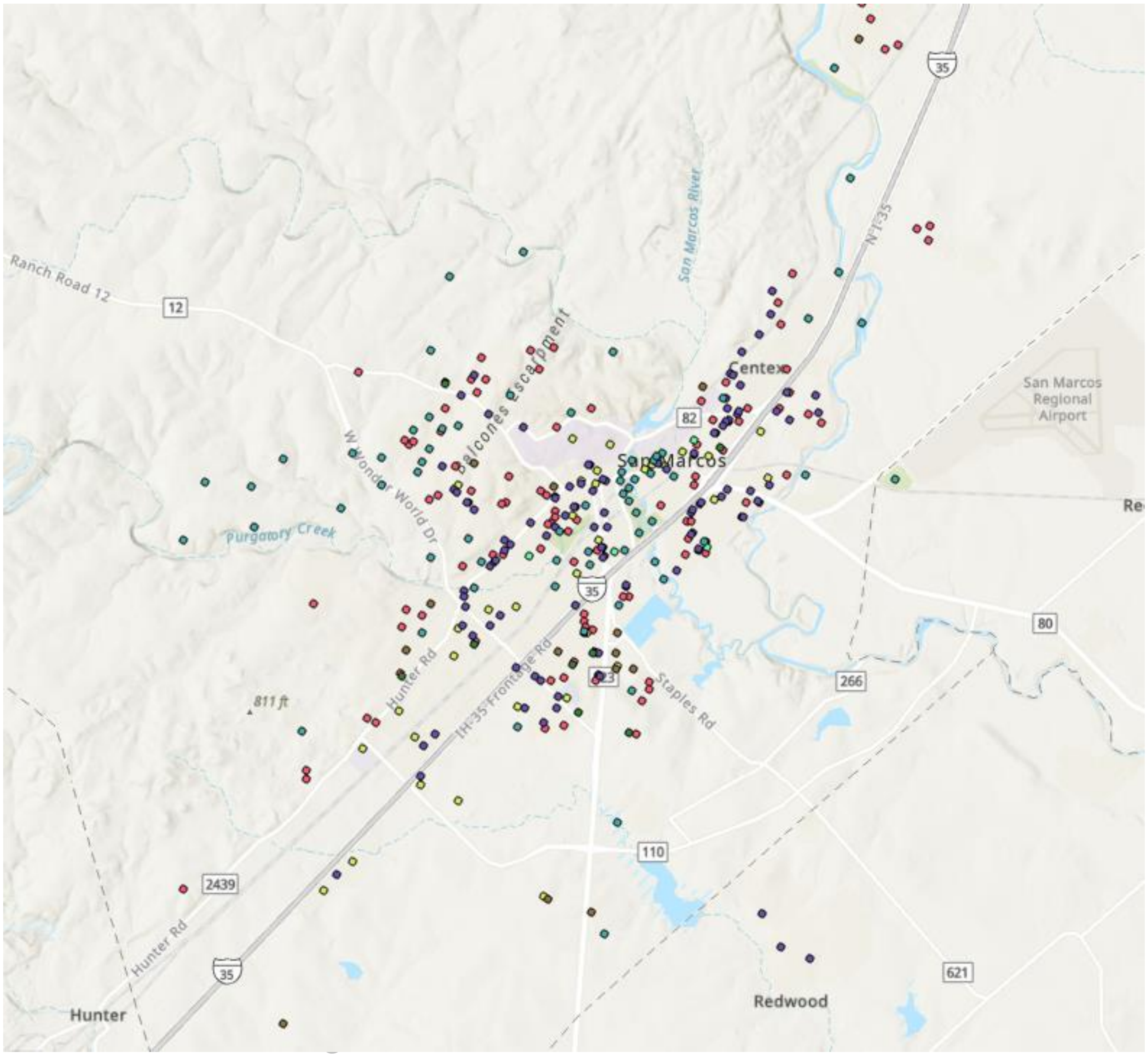
- **Pedestrian and Cyclist Crashes from TxDOT CRIS database (Point Features):**
  - Only fatal and severe crashes where included spanning 2020-2025

- **Sidewalk Survey GIS dataset (Polygon Features):**
  - In 2025 City staff assessed all sidewalks in the city limits for overall condition by observing several criteria: Uplift, Cracking, Cross Slope, Running Slope, Ramps, and Gaps.
  - Polygons were generated at each street block and for each side of the road to provide a geometry for the assessment.
  - Each block was assessed by recording the score for the worst occurrence of each category. For example, if a block had a single occurrence for an uplift of greater than 2 inches, the block received the worst score (4) for that category. See appendix.

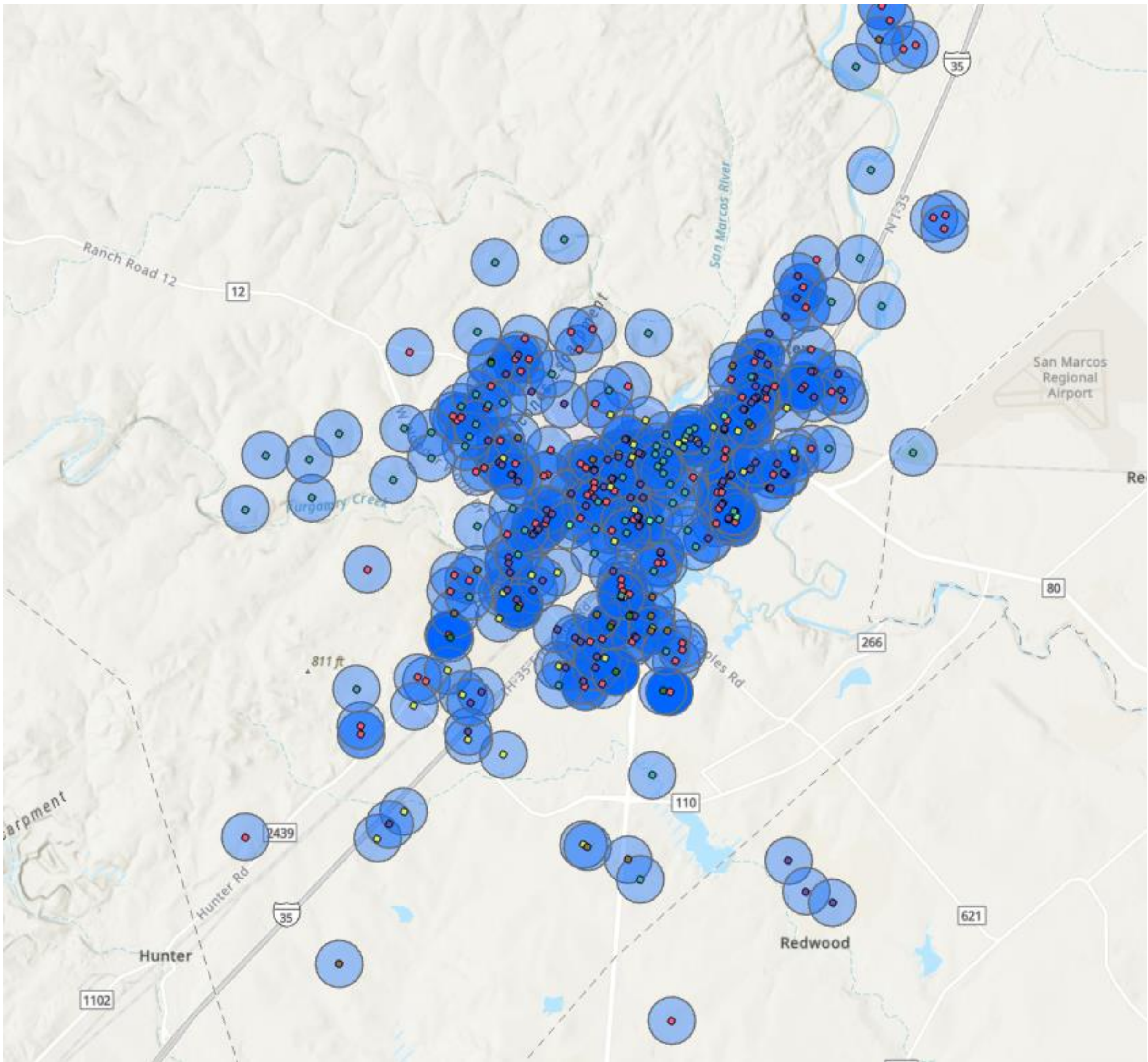
- **CDC Social Vulnerability Index (Polygon Features):**
  - Sum of all Flags Index and % of Households with No Vehicle

Pedestrian Generators

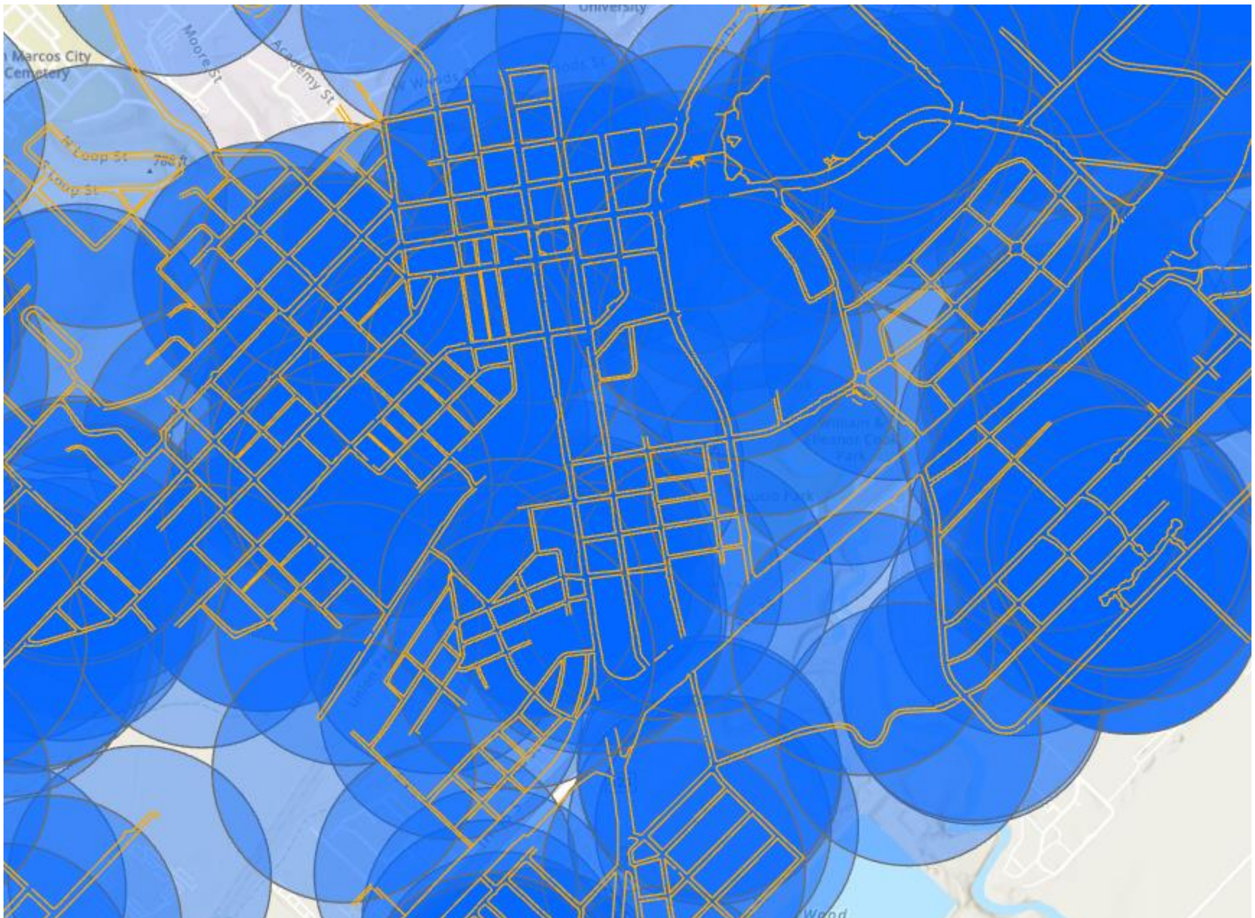
1) Add the Pedestrian Traffic Generators point feature class to the map. There are a total of 436 points.



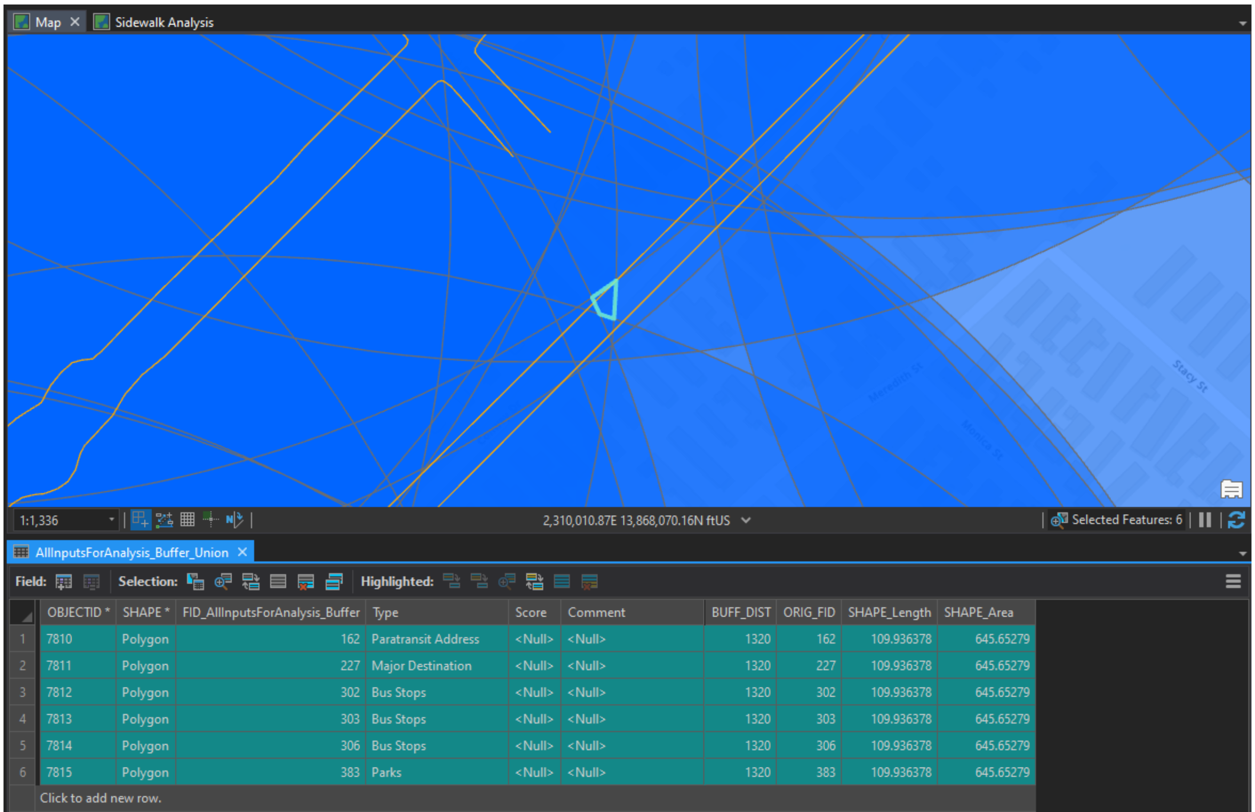
2) Next, buffer the points with ¼ mile radius, producing circular polygons. Quarter mile was chosen as this value is generally agreed upon by Transit experts to be the furthest distance most pedestrians choose to walk when traveling to bus stops and destinations. References to the ¼ mile distance can be found in this [article (https://savethedinky.org/walking-distance/)](https://savethedinky.org/walking-distance/). Result below shows a ¼ mile buffer per pedestrian traffic generator, for a total of 436.



3) Add the updated sidewalk survey layer (Polyline). The sidewalk survey layer includes information such as whether the line represents existing sidewalk or gap, and the overall condition of the sidewalk.

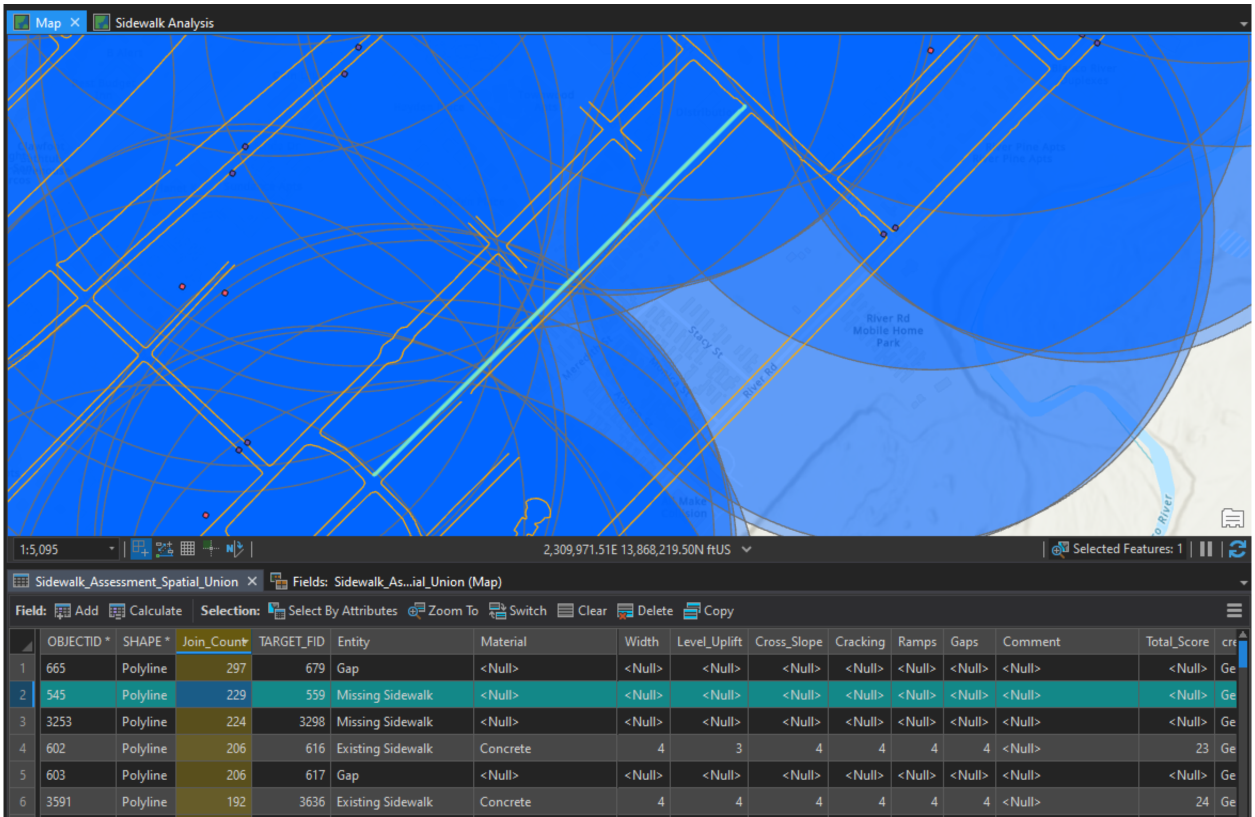


4) Execute the “Union” geo-processing tool on the previously created buffers. Essentially the Union tool creates a new polygon for each buffer type (bus stop, assisted living, schools, etc.) everywhere the buffers overlap. See example below where the small polygon selected from the Union tool output is 6 different polygons, representing the different pedestrian generator buffers that occur at that spot. There are only 436 pedestrian generator buffers, but after running the Union tool, the output contains over 48,000 polygons. Read more about the Union tool [here](https://desktop.arcgis.com/en/arcmap/10.6/tools/analysis-toolbox/union.htm). (https://desktop.arcgis.com/en/arcmap/10.6/tools/analysis-toolbox/union.htm)



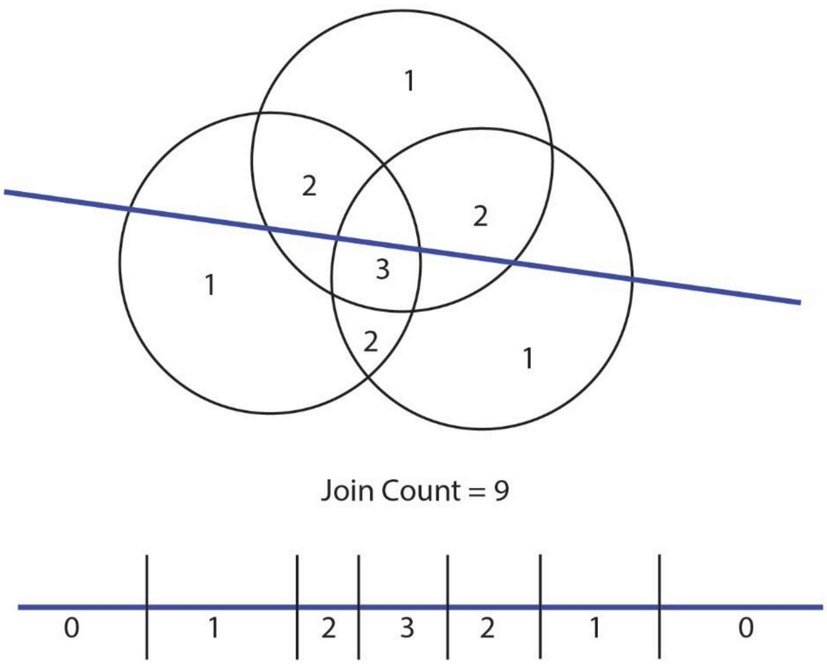
	OBJECTID *	SHAPE *	FID_AllInputsForAnalysis_Buffer	Type	Score	Comment	BUFF_DIST	ORIG_FID	SHAPE_Length	SHAPE_Area
1	7810	Polygon	162	Paratransit Address	<Null>	<Null>	1320	162	109.936378	645.65279
2	7811	Polygon	227	Major Destination	<Null>	<Null>	1320	227	109.936378	645.65279
3	7812	Polygon	302	Bus Stops	<Null>	<Null>	1320	302	109.936378	645.65279
4	7813	Polygon	303	Bus Stops	<Null>	<Null>	1320	303	109.936378	645.65279
5	7814	Polygon	306	Bus Stops	<Null>	<Null>	1320	306	109.936378	645.65279
6	7815	Polygon	383	Parks	<Null>	<Null>	1320	383	109.936378	645.65279

5) Next, perform a spatial join between the sidewalk survey layer (as the target features in the tool) and the Union polygons (join features) on a one to one basis. The result is a copy of the sidewalk survey layer with a [Join_Count] field. The value in the join count field represents the number of Union polygons created previously, that the sidewalk intersects.

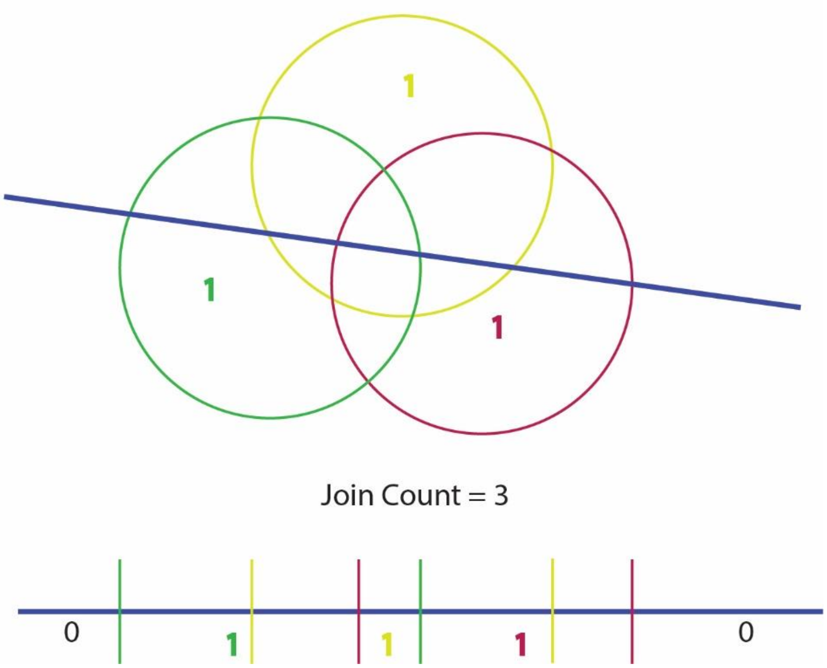


This is the same area as demonstrated previously in step 4. Above demonstrates the sidewalk survey layer output after the spatial join with the Union pedestrian generator buffers. Notice the [Join_Count] field for this segment of "missing sidewalk". It ranks 2nd when ordered from highest joint count to lowest, with a total of 229. There aren't 229 pedestrian generators at this location, but there are 229 instances of pedestrian generator buffer overlaps. This creates "zones of influence" that act as spatial-weighting mechanisms. See example image on next page demonstrating how join count values differ depending on whether the polygons are "unioned" or not.

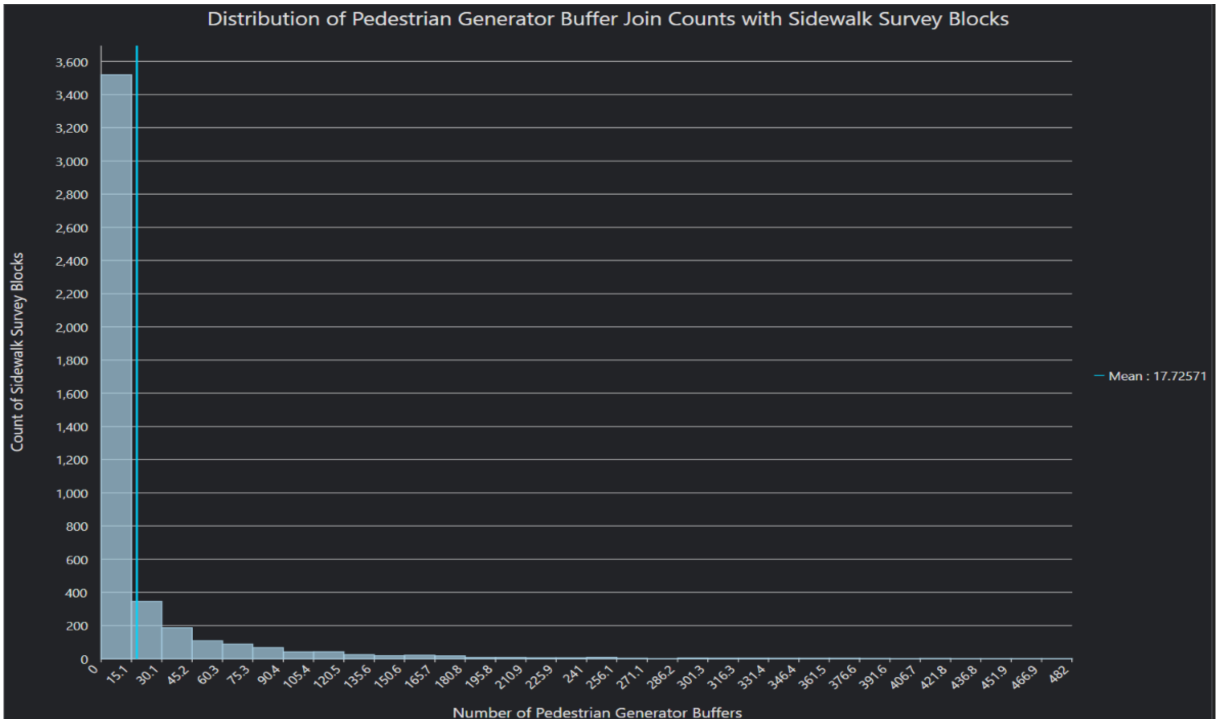
Spatial Joining Sidewalk to Unioned Polygons



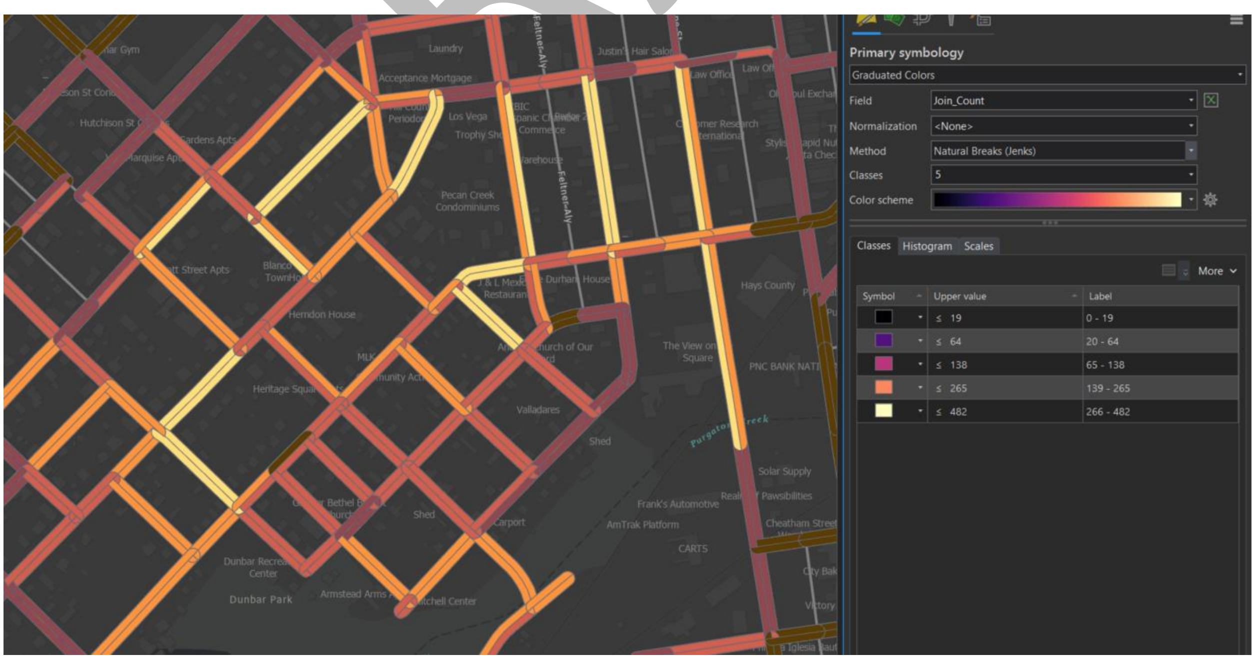
Spatial Joining Sidewalk to Polygons



Graph demonstrating the distribution of join count values across the entire sidewalk survey layer.



Map showing the join count field symbolized using graduated colors with natural breaks classification. Orange/Yellow indicates a higher join count.

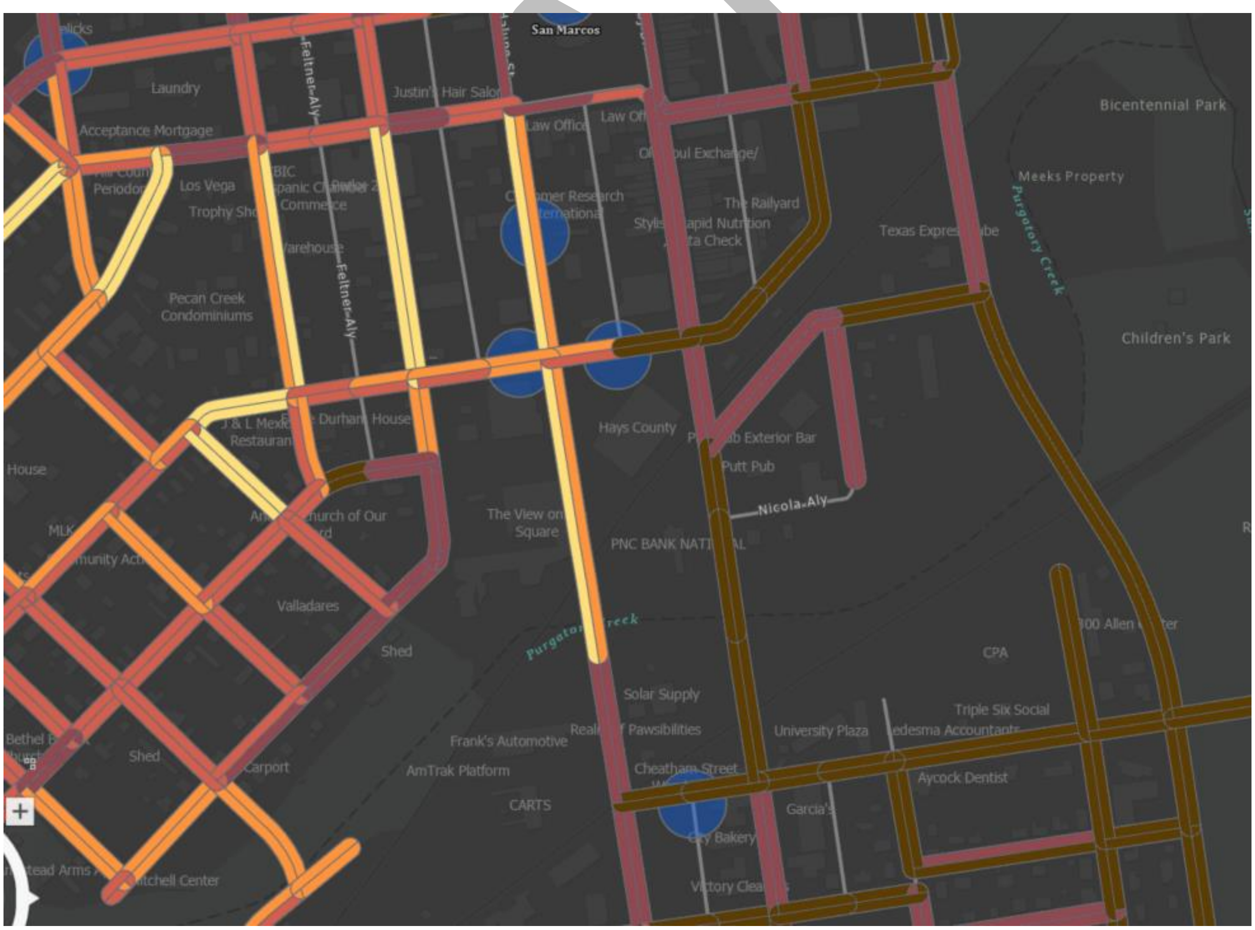


Incorporating Pedestrian Crash Data

The original sidewalk assessment data collected by staff during 2025 has been assessed for proximity to pedestrian traffic generators and given a count value. The next step in the analysis is to utilize pedestrian crash data and identify sidewalks that are proximate to crash locations. Only crash locations that involved a fatality or serious injury to either a pedestrian or a cyclist over the years spanning 2020-2025 were used. No weight preference was given to a crash based on severity. Severe injuries and fatal crashes each add 100 points to the final score of the sidewalk block they are proximate to. Often the difference between a severe injury and a fatality is a fine line and it was the goal of the analysis not to give a severe injury any less influence than a fatality. The pedestrian crash data used in this analysis was obtained from the Texas Department of Transportation's CRIS (Crash Records Information System) for San Marcos from January 2020 to January 2025.

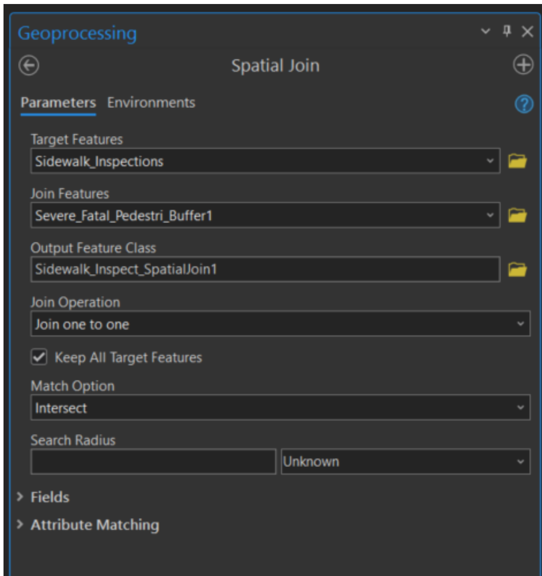
A total of 36 pedestrian and cyclists' crashes occurred over the 5-year query for San Marcos for both fatalities and severe injury. The data schema includes fields for both address, and latitude and longitude value.

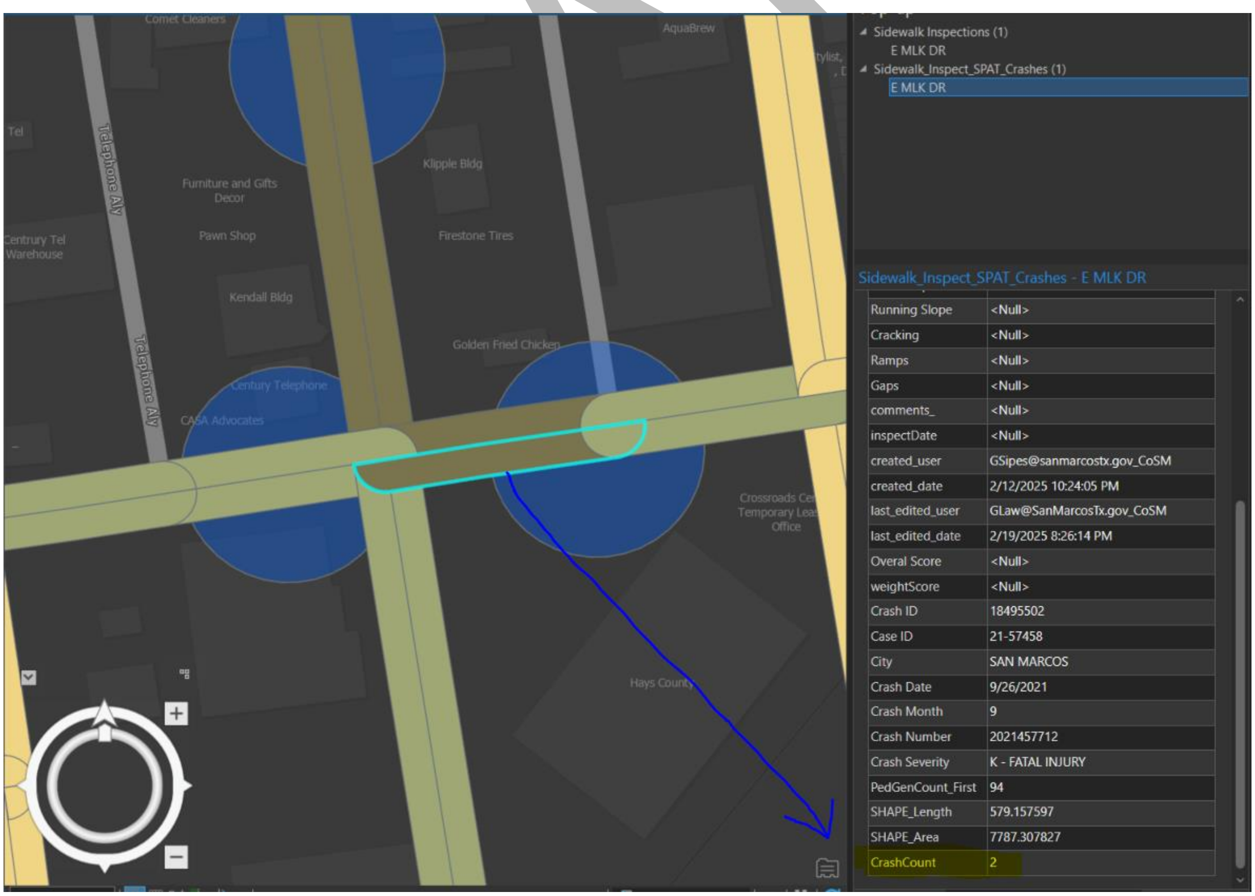
Step 1. Plot the crashes as points on a map, and buffer them 100 feet (radius = 100 ft., diameter = 200 ft.) A value of 200 was chosen to ensure that sidewalks on wide roads such as Wonder World Drive were influenced. Picture below are the buffers and the sidewalk analysis line layer.



Step 2. [Spatial Join](#) the pedestrian crash buffer features to the sidewalk survey features, one to one. The resulting output contains a field that aggregates the number of crashes intersecting each sidewalk survey block feature.

Spatial Join Tool Parameters and Output Example.

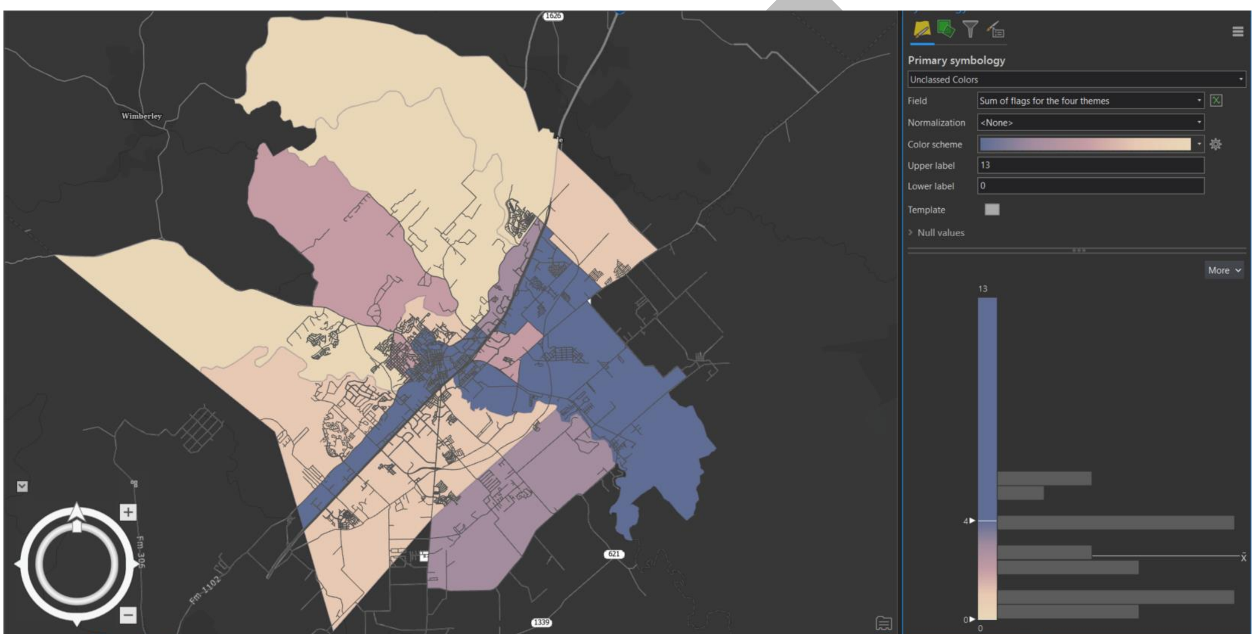




Incorporating Social Vulnerability Index

The CDC Social Vulnerability Index (SVI) is a tool developed by the Agency for Toxic Substances and Disease Registry (ATSDR) to help identify communities that may need support before, during, and after disasters. It measures the relative social vulnerability of every census tract in the United States based on 16 variables grouped into four key themes: socioeconomic status (including poverty, unemployment, income, and education), household composition and disability (such as age and disability status), minority status and language (race, ethnicity, and English proficiency), and housing type and transportation (including multi-unit structures, mobile homes, crowding, and access to vehicles). The SVI is updated approximately every two years, using data primarily from the U.S. Census Bureau's American Community Survey (ACS).

Map of the Census Tracts from the SVI used in this analysis.

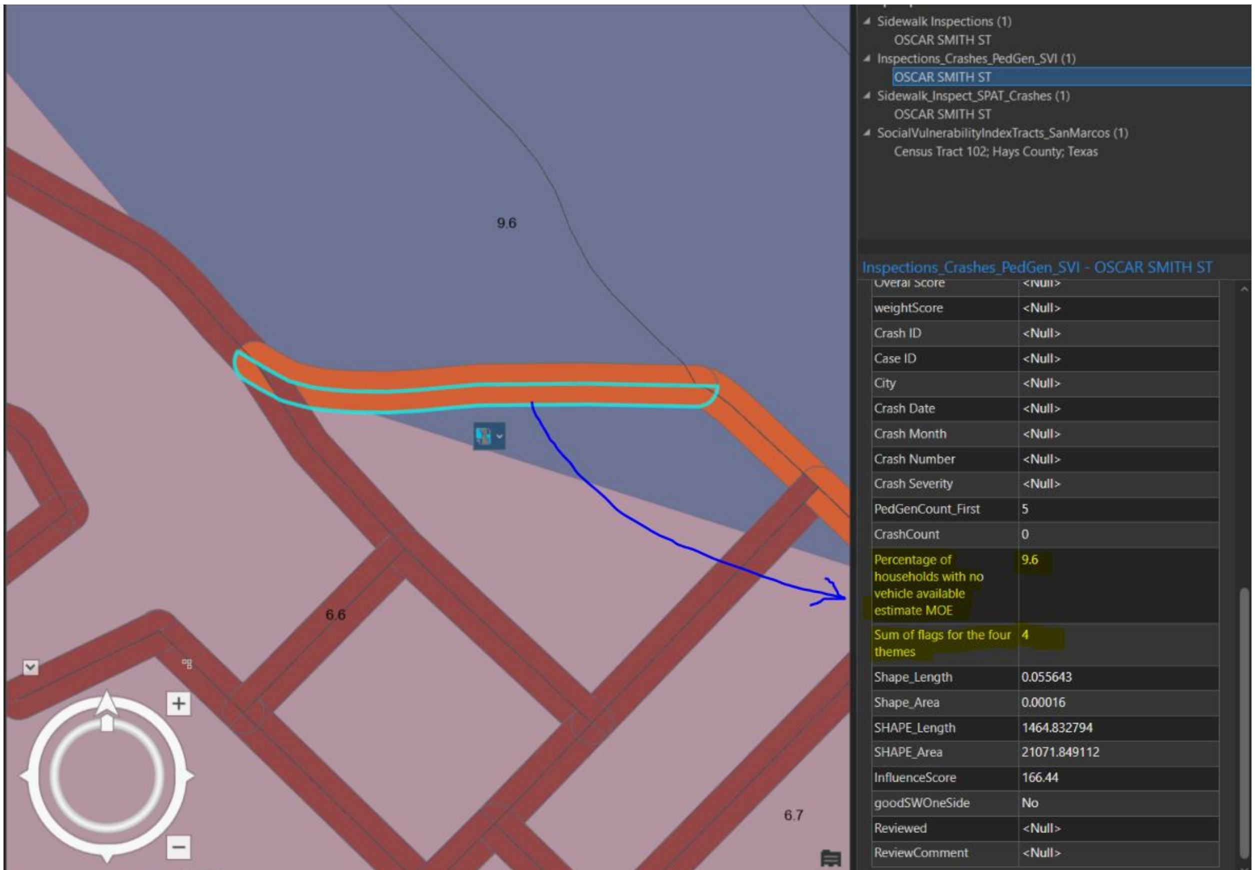


For this analysis we used two of the SVI metrics, one for “Sum of Flags for the Four Themes”, and another for “Percent of Households without a Vehicle”. The **Sum of Flags for the four themes** is a count of how many of the four SVI themes a census tract ranks in the top 10% (most vulnerable) nationally. This metric highlights areas that face compounded vulnerability by flagging tracts that are highly vulnerable across multiple themes. The **percentage of households with no vehicle** metric represents the proportion of households in an area that do not have access to a vehicle. In the context of the sidewalk survey project, the percentage of households with no vehicle highlights areas where residents are more dependent on walking and transit, helping prioritize sidewalk improvements and pedestrian safety upgrades in communities with the greatest need for accessible and reliable walking infrastructure. Within the study area, the Sum of Flags metric had a maximum value of 6, and the percentage of households with no vehicle reached a maximum of 10.1. To scale these metrics for calculation, each was converted to a multiplier by dividing 1 by its respective maximum value. For Sum of Flags metric that meant a multiplier of 16.6 and for percentage of homes no vehicle a multiplier of 9.9.

Step 1. Spatially join the sidewalk survey data to the Sum of Flags for the four themes data to obtain a count for the number of flags for the sidewalk for each block.

Step 2. Spatially join the sidewalk survey data to the Percentage of households with no vehicle data to obtain a percentage for the sidewalk for each block.

The result of these two steps was an output that contained a value for each of the SVI inputs used.



At this point the sidewalk analysis layer contains data on the following properties:

- The number of pedestrian generators intersected by the sidewalk survey block layer.
- A count of severe and fatal pedestrian and cyclist crashes intersected by the sidewalk survey block layer.
- A relative physical condition score for each sidewalk (excellent, good, fair, poor)
- An SVI value for the two metric: Sum of Flags for the Four Themes, and Percentage of Households with no Vehicle.

Final Analysis – Calculating the Overall Score

The final steps to produce an output that factors in all the criteria as outlined in this document for prioritization of sidewalk maintenance and installation.

Step 1. Add two new fields to the sidewalk analysis layer, “Total Condition Score” and “Overall Score”.

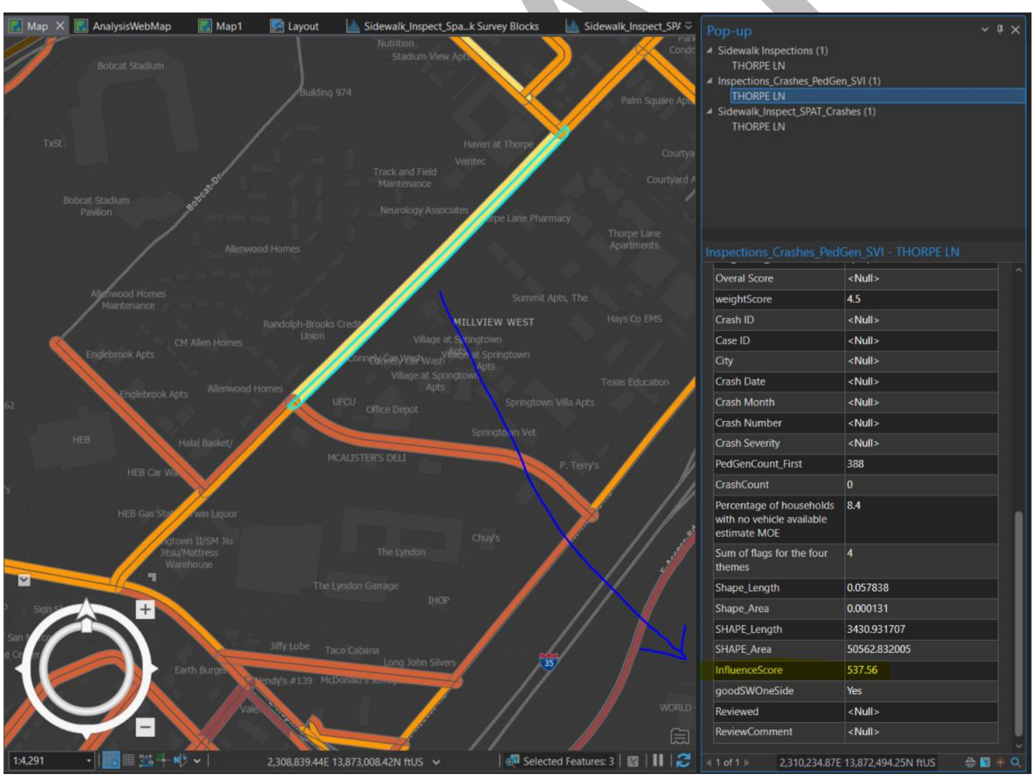
Step 2. Perform a field calculation on the Total Condition Score field as follows:

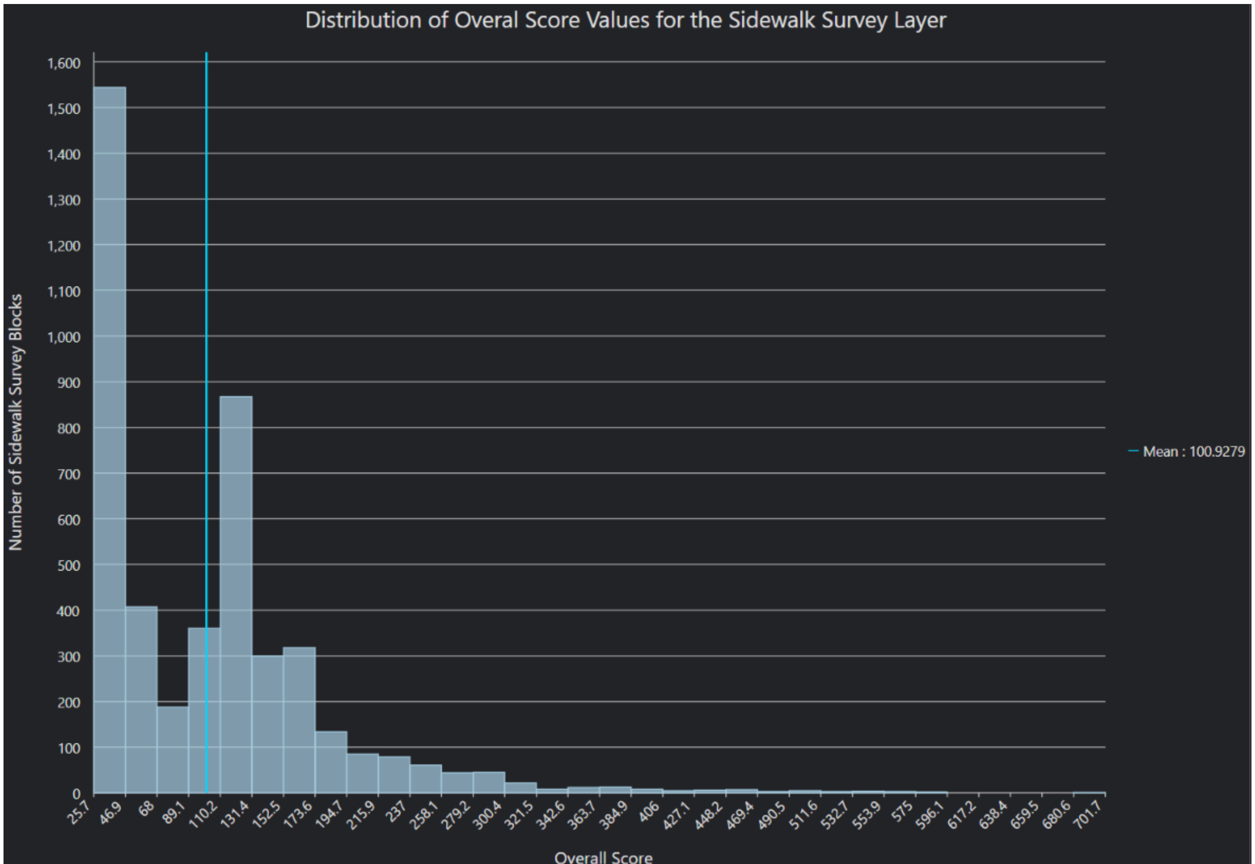
> Weighted Sidewalk Condition Score Calculation:
>
> (Uplift * 1.5) + Cross Slope + Running Slope + Cracking + Ramps + (Gaps * 2)

Step 3. Perform a field calculation on the Overall Score field, combining the result from step 2 (condition score) with the community influence scores (crashes, SVI, pedestrian generators):

> Overall Score Calculation:
>
> Pedestrian Generator Score + (Crash Count *100) + (Sum of Four Flags * 16.6) + (Percentage of Households no Vehicle *9.9)

Sidewalk Analysis Layer symbolizes the total value aggregated across all criteria.





Conclusion

The final sidewalk prioritization layer produced through this analysis offers a data-driven foundation for selecting sidewalk segments for maintenance and installation within the City's 5-Year Sidewalk Plan. By integrating physical condition assessments with proximity to pedestrian generators, crash history, and social vulnerability indicators, the methodology ensures that locations with the greatest community impact and need are elevated in the ranking. The resulting "Overall Score" field provides a clear, repeatable, and transparent means to guide investment decisions while allowing City staff the flexibility to further refine selections based on engineering feasibility and on-the-ground conditions. This approach not only supports equitable infrastructure improvements but also aligns with broader goals to enhance pedestrian safety and mobility across the city.

Appendix

Sidewalk Condition Assessment

***Entire block range of sidewalk should receive condition score equal to the worst occurrence surveyed for each criteria. Take photos for any occurrences that meet condition score of 4.**

Criteria	Condition Score = 0	Condition Score = 1	Condition Score = 2	Condition Score = 3	Condition Score = 4	Evaluation Score
Changes In Uplift (weighted 1.5x)	None	Primary uplift ≤ ¼”	Primary uplift > ¼” and ≤ 1”	Primary uplift > 1” and ≤ 2”	Any uplift > 2”	
Cross Slope	<= 2%	>2% and <=4%	>4% and <=6%	>6% and <= 7%	>8%	
Running Slope	<= 2%	>2% and <=4%	>4% and <=6%	>6% and <= 7%	>8%	
Cracking	None	Primary cracking ≤ ¼” wide	Primary cracking > ¼” and ≤ 1” wide	Primary cracking in level > 1” and ≤ 2” wide	Primary cracking > 2” wide	
Ramps	ADA compliant ramps at intersections	Ramps present with nominal ADA compliant issues	Ramps present with significant ADA compliant issues	Ramps present with significant ADA compliant issues and exhibit severe quality issues	No ramps present	
Gaps/Missing Sidewalk (weighted 2x)	Sidewalk extends full length of the block with no discontinuities	Discontinuities ≤ 10% exists that may impact mobility	Discontinuities > 10 and ≤ 25% exists that may impact mobility	Discontinuities > 25% and <= 50% exists that impact mobility	Discontinuities > 50% exists that impact mobility	

TOTAL	

Sidewalk Condition Rating:

Sidewalk Condition Rating (including weighting)

Excellent 0 - 4

Good 5 - 10

Fair 11 - 18

Poor 19 - 30

Weighting:

Gaps/Missing Sidewalk (2.0x) is the most critical since missing sidewalks can completely disrupt mobility.

Changes in Level/Uplift (1.5x) is given more weight than cracking, as significant uplift can create serious tripping hazards.

Cracking & Ramps (1.0x) remain at a standard weight.

Influence Score Calculation:

!PedGenCount_First!+(!CrashCount!*100)+(!F_TOTAL!*16.6)+(!MP_NOVEH!*9.9)

Weighted Score Calculation:

(!uplift!*1.5)+!crossSlope!+!runningSlope!+!cracking!+!ramps!+(!gaps!*2)

Analysis Criteria Scores

Criteria	Factors and Scores for Final Calculation
Pedestrian Crash Severity	
Fatality/Severe Injury	100 (factor)
Pedestrian Generator Counts	0 – 482 (score)
Sidewalk Condition Score (Includes Weights)	
Poor	19 – 30
Fair	11 – 18
Good	5 – 10
Excellent	0 – 4
Social Vulnerability Index	
Sum of 4 flags	16.6 (factor)
% of homes with no vehicle	9.9 (factor)

Texas Department of Transportation C.R.I.S data for download

https://cris.dot.state.tx.us/public/Query/app/home