

**APPENDIX F: Half-Mile Area Improvement Prioritization – Final Methodology Details**

After review of the process described in Appendix E, NCTCOG and the consultant team determined that the extensive editing required to the GIS shapefiles for existing sidewalks would not allow for the same level of effort at each of the 27 additional stations without compromising in other areas of the analysis. Data entry from field work could be reduced by bypassing the PLTS calculations. Finally, it was felt that some of the inputs were too speculative, despite the reasonable agreement between the existing condition model forecast and the recent DART ridership surveys.

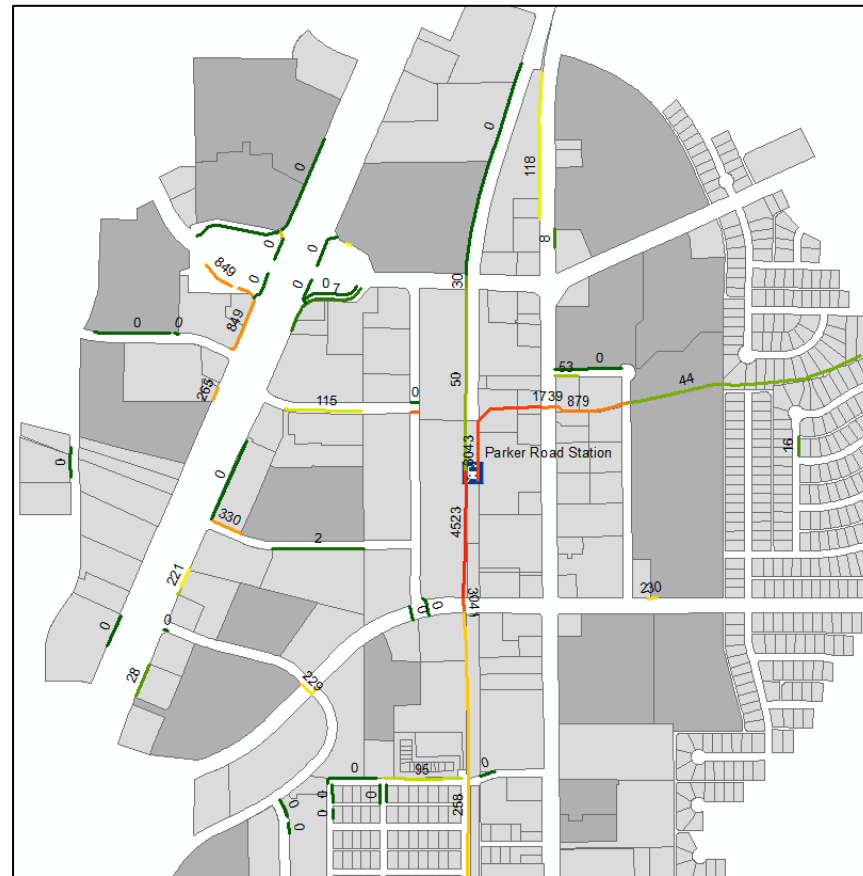
Consequently, the prioritization process was simplified by providing separate scores for employment and population density without attempting to correlate these to ridership levels. The methods described previously were used to identify the parcel employment and population tributary to each sidewalk and crosswalk segment, without using a proximity factor or PLTS scores. Distance of each improvement from the station (measured linearly in a straight line for greater simplicity) was separated into a distinct scoring criterion, along with other scoring criteria for walkshed trip length reduction, land use types, key destinations, crash history, safety benefits, and equity. The weighting given to each criterion is shown in Table 1, in Section 2.9 of the report.

**Employment & Population Density**

**Figure F1** illustrates the process used to score improvements on the first criterion in Table 1, employment and population density. It shows the parcels in the Parker Road Station area, with darker shades of gray representing higher population/ employment totals. Note that, while some of the improvements shown in Figure F1 and other figures that follow, such as the sidewalk, pedestrian hybrid beacon, and shared use path to the east of the station, were later revised based on input from the City of Plano, the principles illustrated still apply.

In the figure, each sidewalk and crosswalk improvement link is shown in red, orange, yellow, or green colors depending on the total employment plus population that would be “tributary” to the station via the improvement once all proposed improvements are constructed. The tributary employment plus population values are shown next to each link, with the red links closest to the station having the highest values.

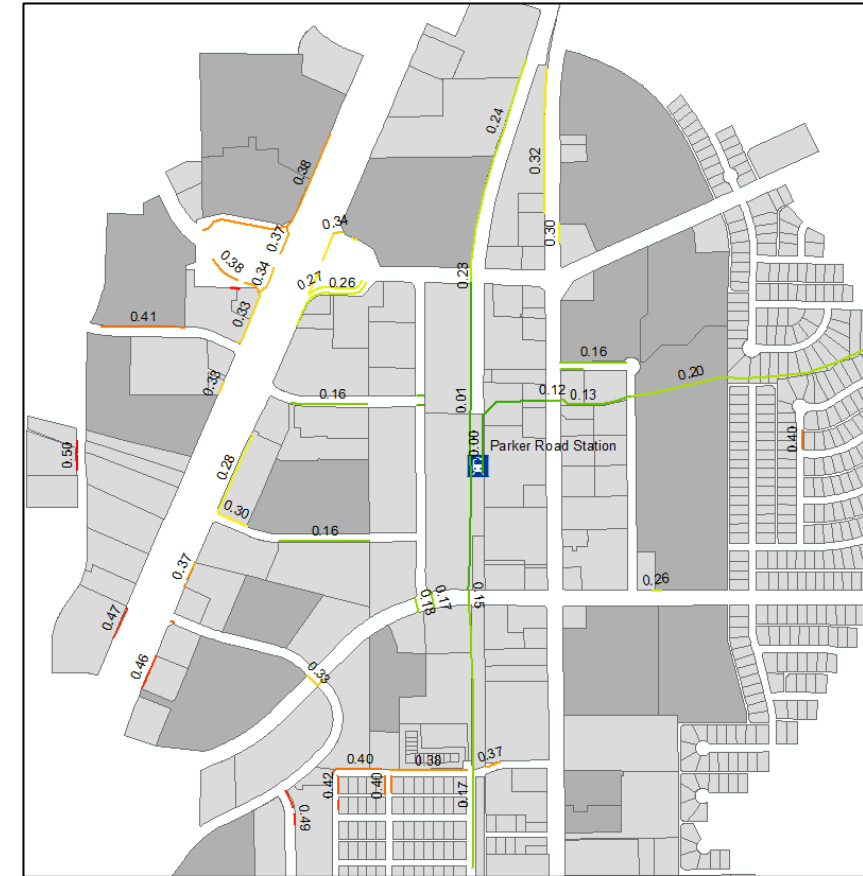
**Figure F1: Employment and Population “Tributary” to Sidewalk & Crosswalk Improvements**



As a simplifying assumption, parcels straddling the half-mile boundary from the station were included in their entirety without any reductions, but parcels beyond the half-mile boundary were not considered to contribute to the analysis even though some travelers (particularly bicyclists) may be willing to travel without a car for longer distances.

Note that some improvements would have zero expected employment and population because the links connect to parcels that are currently vacant or to parcels that were assumed to have redundant, shorter routes to the station via another street or via the opposite side of the same street.

**Figure F2: Proximity of Improvements to Station**



Each improvement was assigned a score of 0-50 points, interpolated linearly based on the relative level of employment and population for the improvement, ranging from 0 to the maximum project-wide estimated value of 11,787.

**Distance**

**Figure F2** illustrates the process used to score improvements on the second criterion in Table 1, distance to the station. Each improvement is shown color-coded based on the distance of its midpoint to the station, measured linearly “as the crow flies” for simplicity. Improvements that connect directly to the station have a distance of 0.0 miles. The figure shows the closer improvements shown in green and the most distant improvements in red. Points were assigned to each improvement on a linear scale ranging from 25 points for 0 miles from the station to 0 points at 0.5 mile from the station.

**Walkshed Trip Length Reduction**

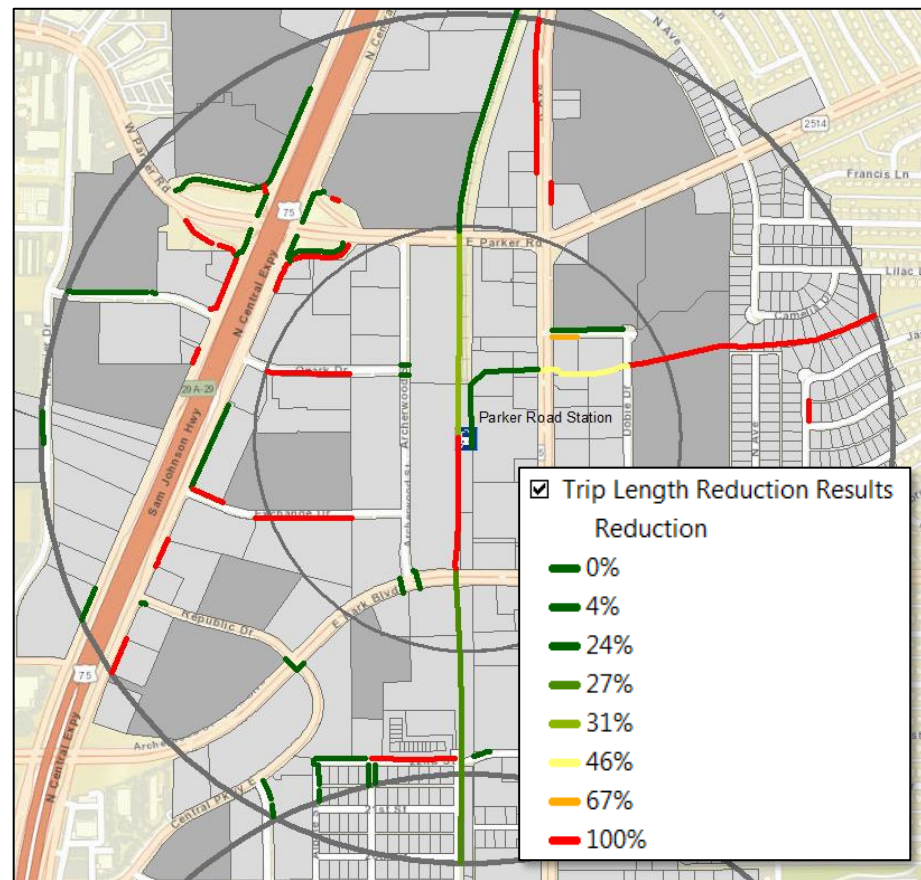
**Figure F3** illustrates the process used to score improvements on the third criterion in Table 1, walkshed trip length reduction. Each improvement is shown color-coded based on the percentage reduction in walking distance to the station that would occur for the population of a reference parcel selected as representative of most parcels tributary to the improvement in question. In general, the highest population parcel was chosen. When most parcels were of similar population, such as in single-family home neighborhoods, the farthest parcel was usually selected.

For each improvement, the walking distances from the reference parcel to the station along the existing and proposed pedestrian networks were measured using Network Analyst in ArcGIS. The difference between the two values was calculated as the walkshed trip length reduction.

Consideration had been given to creating a weighted average trip length reduction for all parcels, but this would have required tedious measurements and/or custom macros in ArcGIS. Therefore, this idea was abandoned for the final analysis.

In Figure F3, improvements that would reduce trip length by a high percentage are shown in red or orange. These include improvements that would connect parcels with no existing sidewalk access to the station, which was considered for scoring purposes a 100% reduction (to avoid divide by zero errors). Lower percentages of trip length reduction are shown in yellow and shades of green. Scores for this category were assigned ranging from 0 points for no reduction in walking distance to 5 points for either a newly connected reference parcel or a reduction in walking distance greater than 40%.

**Figure F3: Walkshed Trip Length Reduction**



**Access to Land Use Types & Key Destinations**

The fourth criterion for scoring improvements was access to other land use types and key destinations. Proximity to residential and employment uses had already been accounted for in the first criterion. However, other land uses with a high number of visitors also needed to be accounted for. Land uses and destinations deserving of special access consideration were as follows:

- Hospitals, clinics, urgent care
- Places of worship
- Schools
- Government buildings<sup>3</sup>
- Libraries, museums
- Grocery stores, malls, supercenters, hotels, motels
- Entertainment, fine arts, parks, landmarks, athletic facilities
- Senior living, community centers, gardens
- Bus stops with >25 daily boardings

A shapefile was created for locations in the above categories. Bus stop boarding information in GIS format was obtained from DART for analysis. Bus stops immediately adjacent to the DART rail

<sup>3</sup> in categories with an assumed high number of visitors, such as courthouses

stations were excluded as being redundant to the distance prioritization criteria, which already prioritizes proximity of the improvement to the station.

For each improvement, the number of key destinations within 250 feet were tabulated. Also tabulated for improvements greater than ¼ mile from the station were the number of bus routes within 50 feet of the improvement. The intent of this last criterion was to add emphasis on routes that would more often save time for those walking or biking to the station. Routes closer than ¼ mile were generally considered less useful for this purpose, since a walk to the station would more frequently take less time than waiting for the next bus.

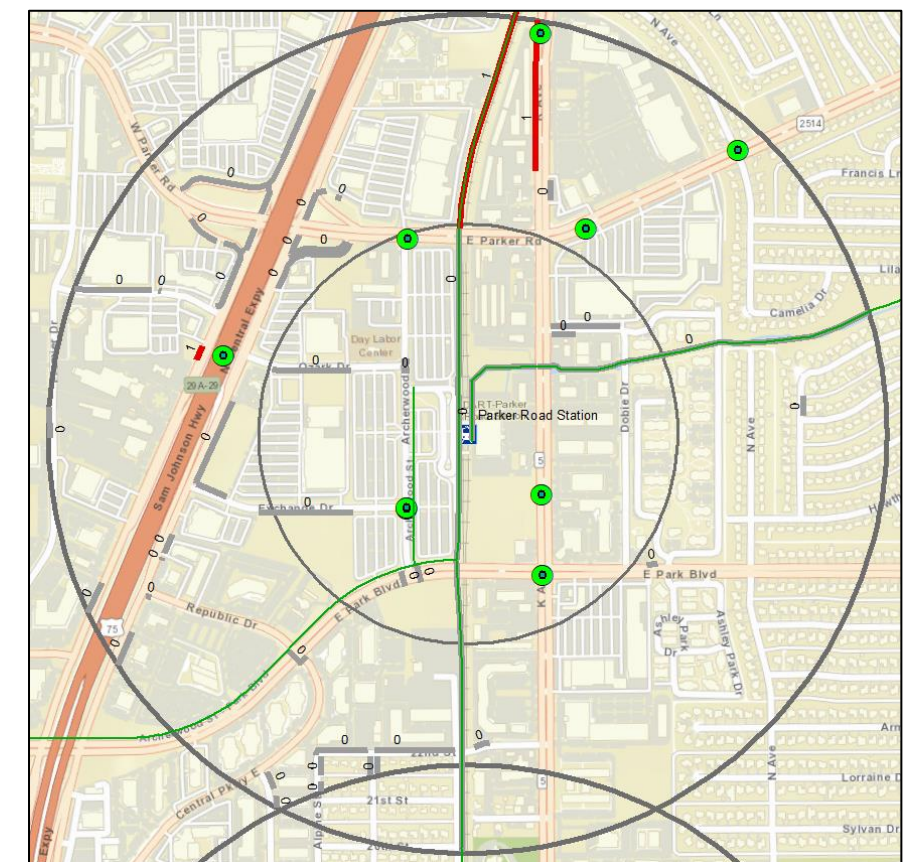
For the access criterion, points were assigned ranging from 0 points for no nearby destinations or qualifying bus routes to 5 points for 5 or more nearby destinations or bus routes. Since some arterial streets may have several bus routes without necessarily having many stops or destinations nearby, the number of points contributed by bus routes was limited to no more than 3 points.

**Crash History**

The fifth criterion for scoring improvements in Table 1 is crash history. A GIS shapefile was used containing the point location of all reported bicycle and pedestrian crash locations for the study area from 2013 to 2017.

Figure F4 shows that in many places, such as the Parker Road Station half-mile area, bicycle and pedestrian crashes shown by green circles are relatively rare and random occurrences. In areas of lower density development and pedestrian activity, the crashes tend to be scattered throughout the study area, mostly along major arterials. Other station areas with higher density development and greater multi-modal activity experienced higher numbers of pedestrian and bicycle crashes. Since it was not possible within the scope of this project to collect pedestrian volume data, the crash data was observed to serve as somewhat of a surrogate for pedestrian demand. Therefore, a cluster of crashes may be more indicative of a place where many people walk than of a place that's more dangerous to walk in terms of the risk to individual pedestrians.

**Figure F4: Relative Scarcity of Bicycle & Pedestrian Crashes**



Unfortunately, the available crash database had little detail on the nature of the crashes. For the crash shown along U.S. 75 in Figure F4, for example, the database indicated it involved a pedestrian with an incapacitating injury. However, the database did not detail what either the pedestrian or the driver involved were doing prior to the crash.

There is a sidewalk gap at this location, so perhaps the pedestrian was walking in the travel lanes of the southbound frontage road to avoid the gap. But the pedestrian could also just as well have been changing a flat tire or jaywalking across the freeway mainlanes. So, the crash data may offer some insights, but is still limited in its value for assigning relative benefits to different improvements.

The project team considered requesting police crash reports for the individual crashes and classifying them using the Federal Highway Administration's Pedestrian and Bicycle Crash Analysis Tool (PBCAT). This tool would allow for more significant insights to be drawn from a greater wealth of crash data, leading to better screening of which crash locations might be more or less susceptible to correction by certain countermeasures versus others. However, the extra effort required to code crashes was outside the scope of the project.

For the crash history criterion, improvements were scored from 0 to 5 points based on the number of bicycle- and pedestrian-related crashes within 250 feet of the improvement during the 5-year period analyzed. Figure F4 shows that only two improvements scored points near Parker Road Station. The two links in red each received 1 point for being near a single crash.

No differentiation was made in the scoring for bicycle versus pedestrian crashes or between crashes of different severity. While this data was available in the database, most bicycle and pedestrian crashes have a high potential for being serious or fatal, so it was determined any differentiation in the sparse data could be the result of statistical noise and was therefore less significant in differentiating which improvements would be of greatest benefit for positive safety outcomes.

### Safety Benefit

A more recent development in transportation safety research that is designed to combat the drawbacks of traditional crash analysis mentioned in the previous section is the concept of "systemic safety." Systemic safety is a term that refers to safety approaches that are data driven, network-wide, and which consider improvements at locations with similar characteristics to high crash locations, even if the locations where improvements are to be considered or proposed don't themselves have significant crash history. The process is somewhat akin to extrapolating where it is believed crashes are more likely to occur over a longer period of perhaps 20 or 30 years, based on risk factors identified at the locations of recent crashes.

The scope for this project is in itself somewhat systemic in that areas within a half mile of light rail stations were generally observed to show higher bicycle- and pedestrian-related crash frequency than were other areas of the Dallas-Fort Worth region in general. Again, this result is not surprising due to the expected higher prevalence of multi-modal travel demand near transit stations.

As a second measure of systemic safety, the project team opted to use the posted speed limit of the roadway adjacent to sidewalk improvements or crossed by crosswalk improvements. Vehicular speed is widely regarded as having a high correlation to safety outcomes in bicycle and pedestrian crashes, as illustrated by a popular graphic in **Figure F5** from the Seattle Department of Transportation.

**Figure F5: Generalized Relationships between Impact Speed & Pedestrian Survival Rates**

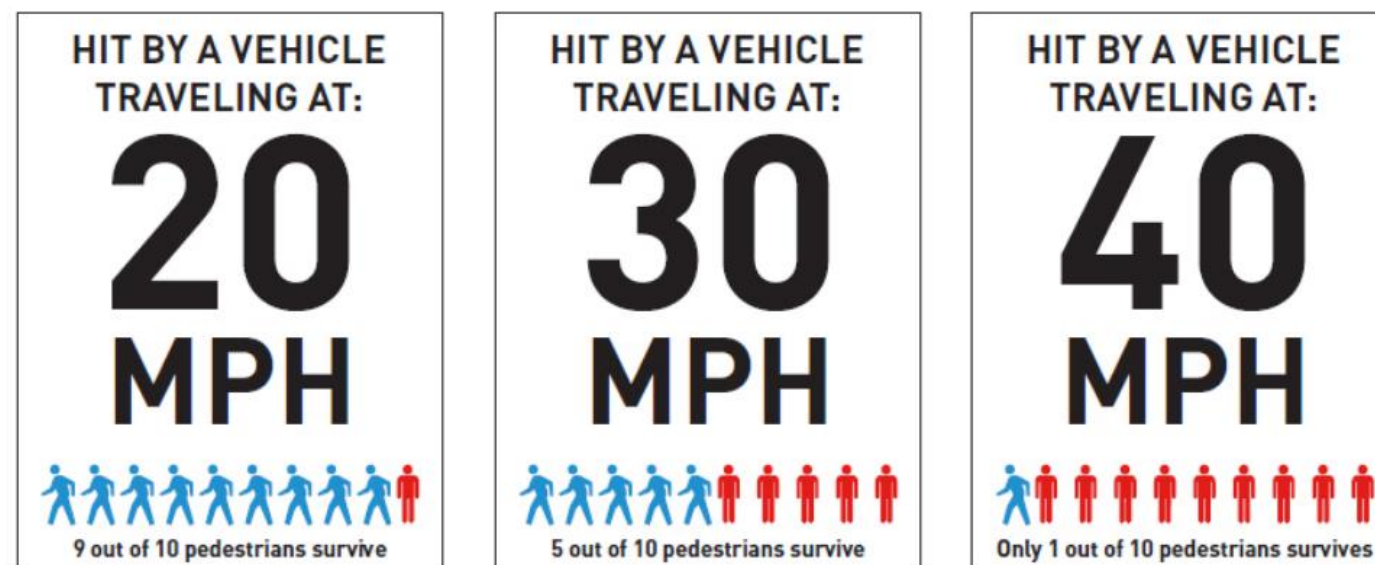


Image: Seattle Department of Transportation

The project team felt that posted speed limit was the single most important safety variable that could be easily measured and isolated, since data on posted speed was readily available in a GIS shapefile. While other variables such as 85<sup>th</sup> percentile speed and traffic volumes may be important to consider in a more detailed systemic safety study, they were determined to be outside the data collection scope of this project.

The associated scores for the safety benefit criterion ranged from 0 points at or below 20 mph to 5 points at or above 45 mph.

Shared use paths or sidewalks not adjacent to roadway alignments received 0 points for this category. Some consideration was given to assigning points for these types of off-street facilities or sidewalks along low-speed streets to prioritize safer alternatives to walking along high-speed roads. However, ultimately it was decided that inverting the scoring system in this way would de-prioritize existing gaps along higher speed streets, which are typically the "weakest links" in the multi-modal network that lead to the greatest number of decisions to avoid pedestrian and bicycle trips.

**Figure F6** shows the Parker Road Station area with the speed limit of the adjacent or crossed street identified next to each improvement, which is color-coded based on the speed limit. Red and orange improvements are near roadways with speed limits of 45 mph or greater, yellow improvements are along or crossing 40 mph roadways, and improvements are shown in green for 30 mph streets.

### Equity

The final criterion for prioritizing projects was equity, which seeks to emphasize improving communities with populations that have not historically received equal access to resources. The consultants were provided spatial data covering the project area for an equity metric, the Environmental Justice Index. This index is compiled by NCTCOG to comply with federal rules for identifying Environmental Justice populations. It is based on data from the 2013-2017 American

Community Survey, aggregated at the census block level. Each census block is categorized if the percentage of its residents is higher than the regional average for minority population, low income, or both. **Figure F7** shows a map of Environmental Justice Index areas for the areas including the 28 half-mile station areas for the Red & Blue Lines Last Mile Connections project.

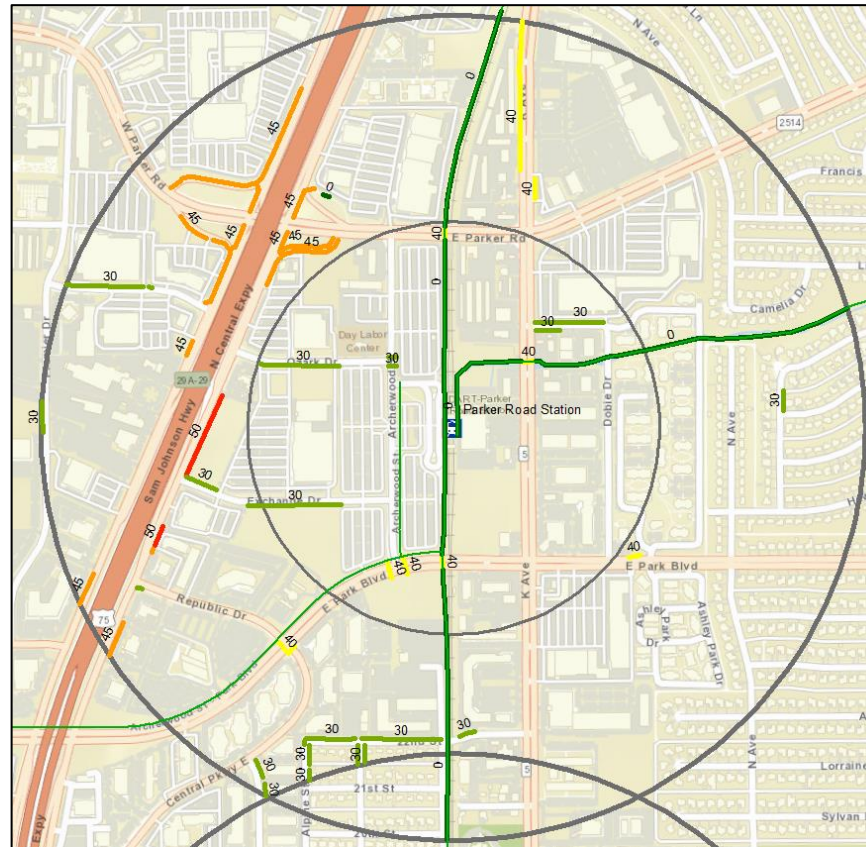
The map shows yellow areas with an above average percentage of low income residents, blue areas with an above average percentage of minority residents, and green areas with an above average percentage of both low income and minority residents. For areas where the map background is visible without any yellow, blue, or green color, no points were scored for the equity criterion. For low income and minority areas (yellow and blue), 3 points were scored for each improvement. For areas with both a higher than average percentage of low income and minority residents (green), 5 points were scored for each improvement.

### Gaps to Remain

The consulting team categorized some segments where gaps in the pedestrian network had been identified by NCTCOG during preliminary GIS work to be gaps to remain for the final project listing. This decision was based on field conditions that would be impractical to analyze or would make sidewalk construction extremely cost-prohibitive. Examples include:

- Segments not connecting to the station without exiting the half-mile area.
- Right-of-way would be needed from a cemetery.
- Widening of existing bridge structures would be required without significant likely pedestrian demand.
- A building structure would need to be removed or modified.
- Parallel pedestrian access is provided a short distance away by a trail or another sidewalk such that new sidewalk adjacent to the street would be redundant.
- Street function is as a fire lane, service drive, or alleyway exclusively for vehicular use and pedestrian access is provided by sidewalk on the opposite side of the building.
- Inadequate space exists for sidewalk between roadway edge and DART tracks, without sufficient right-of-way or spare capacity to recommend a road diet.
- Environmental obstacles such as slopes down to creekbeds.
- Excessive impacts to residential properties (particularly those in older single-family home neighborhoods with very small yards, very short setbacks between the street and home and/or no garages or on-street parking width).
- Locked code-controlled pedestrian gates providing sidewalk access through private property (typically apartment complexes). These were modeled as gaps for the general public while still providing access to apartment residents.
- Sidewalk not needed due to lack of developable adjacent land use and existence of parallel sidewalk on opposite side of street.

**Figure F6: Improvement Scoring by Adjacent or Crossing Posted Speed Limit**



- Off-street parking for small businesses blocking the way of sidewalk where parking removal would likely cause significant harm to the business.

In most cases where sidewalk obstacles exist, the likely challenges were documented for each improvement in notes designed to guide future planning and selection of improvements for actual projects. In some cases, the obstacles might be overcome by narrowing the roadway pavement or lane widths. If this was deemed potentially feasible, the Gap to Remain category was not used. Only where obstacles were deemed exceedingly challenging or sidewalk was judged highly unlikely to be used by anyone was the Gap to Remain category used.

### Prioritization Scoring

Improvements were scored using a Microsoft Excel spreadsheet program and sorted based the overall score. The spreadsheet also summarized information on multiple consecutive GIS sidewalk

**Figure F7: NCTCOG Environmental Justic Index Mapping**

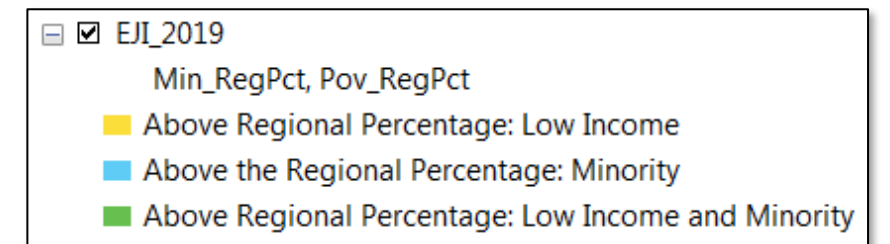
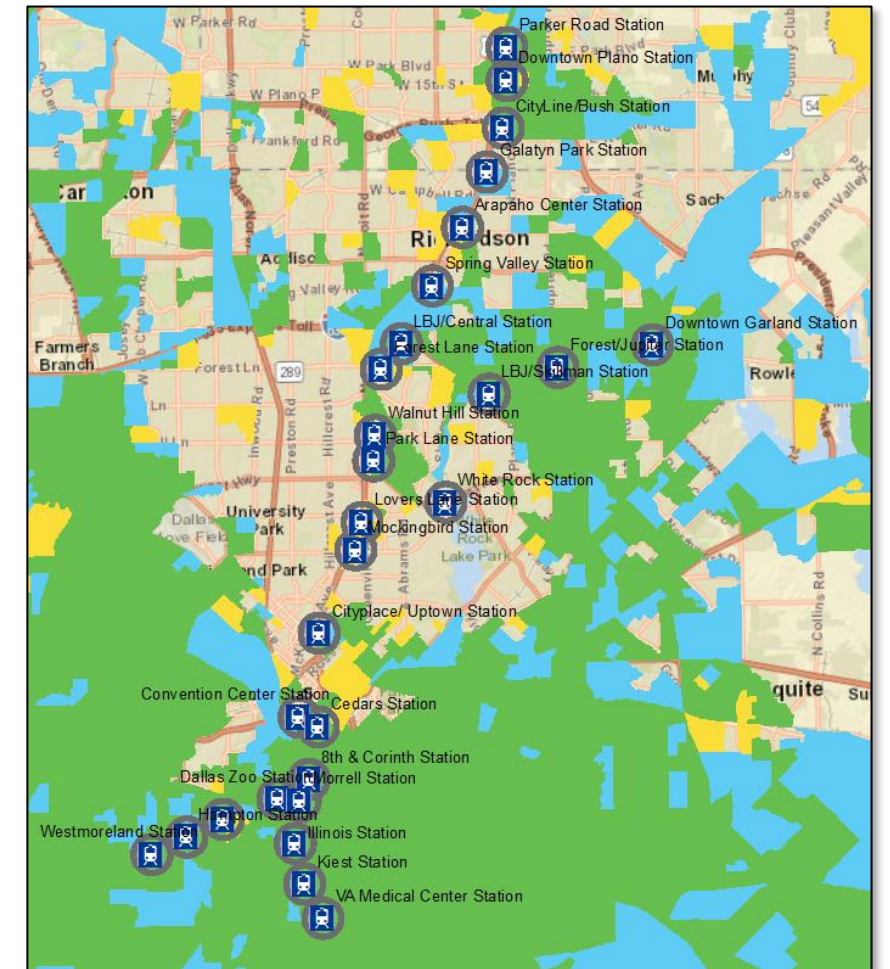


Figure F8: Screen Capture (Excerpt) from Improvement Prioritization Spreadsheet

Improvement Number	Distance		Tributary Employment & Population		Trip Length Reduction		Access					Crash History		Systemic Safety		Equity		Total Points	Priority
	Distance	Points	Tributary Emplmt + Population	Points	Trip Length Reduction	Trip Length Reduction Points	Key Destinations (incl. high rider bus stops)	Key Destination Points	Bus Routes	Bus Routes Points	Access Points	Crashes	Points	Speed Limit	Points	EJI	Points		
1B-DP-SW-127	0.30	10	2	0	100%	5	2	2	0	0	2	0	0	30	2	Low Income and Minority	5	24	High
1B-DP-SW-128	0.34	8	10	0	100%	5	4	4	0	0	4	0	0	30	2	Low Income and Minority	5	24	High
1B-DP-SW-13	0.29	11	15	0	100%	5	0	0	0	0	0	1	1	30	2	Low Income and Minority	5	24	High
1B-DP-SW-131	0.28	11	39	0	100%	5	1	1	0	0	1	0	0	30	2	Low Income and Minority	5	24	High
1B-DP-SW-35	0.34	8	1,023	4	100%	5	0	0	0	0	0	0	0	30	2	Low Income and Minority	5	24	High
1B-DP-SW-40	0.24	13	40	0	15%	2	1	1	1	1	2	0	0	30	2	Low Income and Minority	5	24	High
1B-DP-SW-66	0.26	12	543	2	100%	5	0	0	0	0	0	0	0	30	2	Low Income	3	24	High
1B-DP-CW-93	0.21	15	0	0	0%	0	1	1	0	0	1	0	0	30	2	Low Income and Minority	5	23	High
1B-DP-CW-94	0.21	15	0	0	0%	0	1	1	0	0	1	0	0	30	2	Low Income and Minority	5	23	High
1B-DP-SW-129	0.32	9	2	0	100%	5	2	2	0	0	2	0	0	30	2	Low Income and Minority	5	23	High
1B-DP-SW-143	0.32	9	33	0	100%	5	0	0	0	0	0	0	0	40	4	Low Income and Minority	5	23	High
1B-DP-SW-145	0.34	8	124	1	100%	5	0	0	0	0	0	0	0	40	4	Low Income and Minority	5	23	High
1B-DP-SW-48	0.47	2	37	0	100%	5	0	0	1	1	1	5	5	45	5	Low Income and Minority	5	23	High
1B-DP-SW-108	0.33	9	5	0	100%	5	1	1	0	0	1	0	0	30	2	Low Income and Minority	5	22	Medium
1B-DP-SW-114	0.37	7	410	2	100%	5	1	1	0	0	1	0	0	30	2	Low Income and Minority	5	22	Medium
1B-DP-SW-120	0.34	8	22	0	100%	5	2	2	0	0	2	0	0	30	2	Low Income and Minority	5	22	Medium
1B-DP-SW-133	0.35	8	8	0	100%	5	2	2	0	0	2	0	0	30	2	Low Income and Minority	5	22	Medium
1B-DP-SW-33	0.37	7	784	3	100%	5	0	0	0	0	0	0	0	30	2	Low Income and Minority	5	22	Medium
1B-DP-SW-57	0.23	14	0	0	0%	0	0	0	1	1	1	0	0	30	2	Low Income and Minority	5	22	Medium
1B-DP-SW-98	0.28	11	7	0	100%	5	0	0	0	0	0	1	1	30	2	Low Income	3	22	Medium
1B-DP-VW-V03	0.26	12	114	0	100%	5	0	0	0	0	0	0	0	0	0	Low Income and Minority	5	22	Medium
1B-DP-SW-107	0.35	8	65	0	100%	5	1	1	0	0	1	0	0	30	2	Low Income and Minority	5	21	Medium

segments on each street block to simplify the resulting improvement tables. **Figure F8** shows a screen capture from the Excel spreadsheet for Downtown Plano Station. The figure does not represent a complete listing of all improvements for this station, but is shown for illustrative purposes only. The left-hand column in Figure F8 lists the identification number for each improvement.

Consultants evaluated each improvement for the seven criteria described above, as shown by the column headers in the top row of Figure F8. Points were assigned for each improvement based on the values of the reference inputs.

In Figure F8, the partial list of improvements is shown sorted by total points, with possible total values ranging from 0-100 points. The rows of the spreadsheet were color coded based on the priority of the improvement, with dark red for high-priority improvements, orange for medium priority, and light pink for low priority.

