

Road Safety Projects Ranking Process Summary

Concord, Massachusetts



Prepared for:
Town of Concord
Transportation Advisory Committee (TAC)

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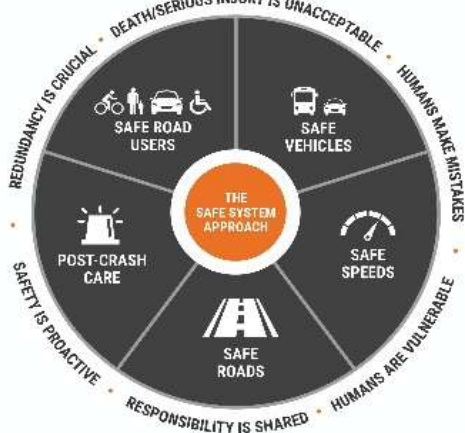


1 Executive Summary

Stantec has developed a ranking process to help the Town of Concord prioritize road safety improvements in a structured and objective way. This process involves compiling and managing incoming requests and current activities as they relate to road safety improvements. Multiple requests about a similar issue or location are grouped into a prospective project. These projects are then ranked relative to each other. This process is part of a dynamic and transparent workflow that is intended to inform the Traffic Management Group (TMG) and Traffic Advisory Committee (TAC) collectively, and to be used to identify potential locations for road safety improvement projects for recommendation to the Public Works Commission (PWC).

Town of Concord is working towards FHWA's Safe Systems Approach – a comprehensive roadway safety strategy focused on eliminating traffic fatalities and serious injuries by accounting for human errors and reducing crash severity through safer road design, speeds, vehicles, and behaviors.

Stantec developed and weighed three (3) key ranking criteria to assist the TMG and TAC with project deliberation and selection, all of which incorporate safety factors from varying sources. The first of these is infrastructure, the second is people, and the third is places. Infrastructure criteria ascertain severity of non-compliance infrastructure and absence of safety infrastructure, people criteria focus on socially vulnerable populations and the level of direct input from the public, and places criteria consider crash locations and areas highly used by cyclists, pedestrians, and vehicles.



FHWA - The Safe Systems Approach

Safety attributes are embedded in all three (3) criteria which consist of a combination of static and dynamic inputs. Within Infrastructure criteria, data on road, sidewalk, and intersection pavement conditions could be updated regularly and dynamically influence the ranking of a project. People criteria include community input from a fall 2023 public workshop and represents a snapshot of public concerns (typically safety in nature) from that time. Places criteria include static elements such as locations with high volumes of vehicle and pedestrian traffic (schools, libraries, and train stations), but also include dynamic factors such as crash locations, which can be updated regularly.

The data used for the ranking framework comes from several sources, including public works engineering infrastructure condition assessments (i.e. PCI, SCI, ADA accessibility), public input related to ongoing transportation planning efforts, census records of socially vulnerable populations, and state and local GIS mapping. All the datasets were analyzed and used to apply sub and overall weighted scoring to prospective roadway safety projects for TMG and TAC consideration.

The project rankings produced from this tool are intended to be a starting point for discussion for TMG, TAC. As the TMG works to make a final project(s) determination, rankings should be considered alongside costs, grant resources, alignment with transportation initiatives, and other subjective factors.



2 Road Safety Requests and Activity Log

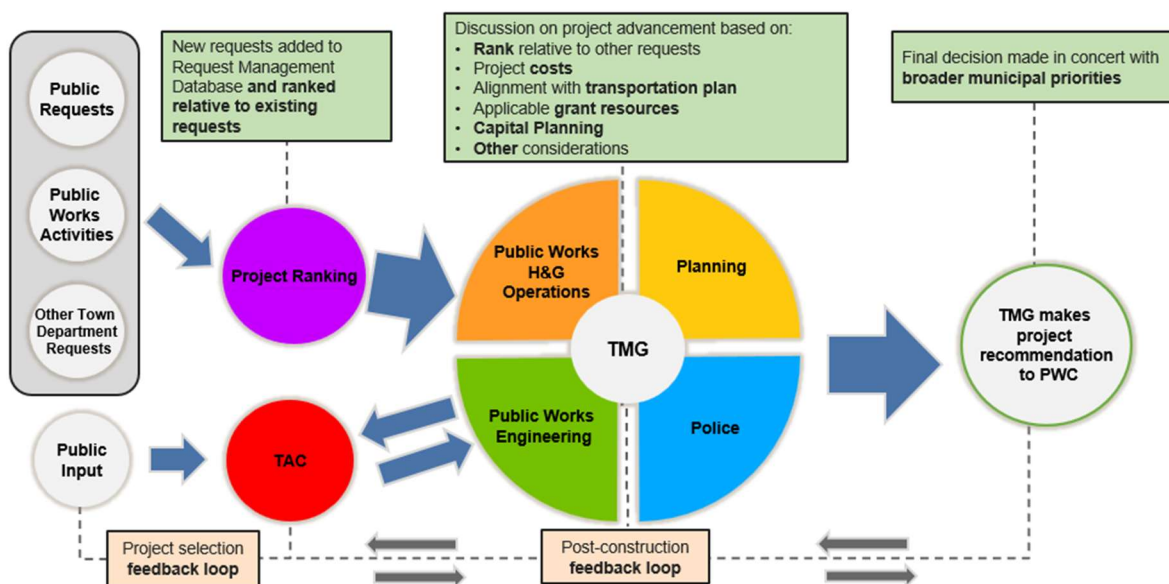
On behalf of TMG, Stantec is maintaining the Town's road safety requests and activities in a dynamic centralized database. Requests have been compiled from a variety of sources including existing plans such as the Complete Streets Prioritization Plan (2019), the [Concord Cut-Through Traffic Study](#) (2019), Mothers Out Front (2024), Safe Routes to Schools (2024/2025). This also includes requests that have come to the Transportation Management Group (TMG) and the database can accept any new requests not already compiled.

To date, 178 activities related to public safety have been identified. 134 are considered "open" or not assigned, 20 remain as "active" or have a pathway to being implemented (i.e., being designed, awaiting award, under construction, etc.) and 24 have been "complete" and constructed.

Multiple requests related to the same issue/complaint and location "open" activities are grouped into a single prospective project for ranking. To date, 103 projects have been identified. Their combined cost of \$27.4M was estimated based on a rough magnitude of similar transportation infrastructure improvements in town. While the Town has appropriated additional funding (\$2.5M) beyond the normal budget cycle for the next 5 years, this funding will not allow all 103 projects to be addressed and require TMG and TAC to decide on which projects to move forward with and how to solicit additional funding to phase in future projects.

To assist with an objective evaluation of projects, Stantec developed a ranking process and score for each project as a starting point for further review and determination. Below is a current simplified workflow illustrating how the Project Ranking fits into the existing request management communication workflow. Note: Road safety projects have distinct public feedback loops between the Town and the Public at various intervals during project life cycle, including project selection, current "Active" project status, and pre- and post-construction.

Road Safety Request Management Workflow Communication



3 Ranking Criteria

Stantec utilized data from several sources to develop an objective ranking process framework. The data includes infrastructure condition data such as Pavement Condition Index (PCI), Sidewalk Condition Index (SCI), transportation public workshop meeting input, census records of socially vulnerable populations, and GIS mapping. Utilizing this data, Stantec developed a web-based GIS tool for TMG and TAC to easily screen, identify and visualize high priority projects to begin formulating a road safety project schedule and plan.

Stantec developed three (3) key ranking criteria: The first of these is infrastructure, the second is people, and the third is places. All three (3) criteria utilize safety factors varying in sources and degrees. Below is a detailed description of each key criteria and sub-criterion weighting.

a. Infrastructure Score

The first criterion that was established was Infrastructure. It represents a significant dataset and each infrastructure asset (pavements, sidewalks, and intersections) has its own condition score which is further broken down by various subcomponents or data attributes.

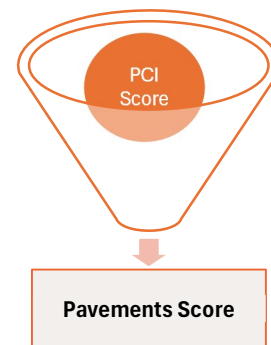
i. Pavements

Pavements were assigned infrastructure scores based on a single criterion. This criterion was pavement condition, and scores were equivalent to the Pavement Condition Index (PCI). The PCI is on a score of 0-100, and the thresholds within determine which repair treatment a roadway should get. As PCI decreases, pavements fall into more expensive repair categories, and the cost of repair increases with each fall into the next treatment band. Timing is the key. Repairing the right roads at the right time allows communities to maximize their roadway budget.

Thus, the higher the PCI, the higher the pavement infrastructure score. Below are the scores, broken down into treatment band ranges as used by the Town of Concord.

Pavement Condition Index (PCI) Score:

- Do Nothing
 - Excellent Condition – in need of no immediate maintenance.
 - 100-89 points
- Routine Maintenance
 - Good Condition - in need of crack sealing and/or minor localized patch repair.
 - 88-75 points
- Preventative Maintenance
 - Fair Condition - pavement surface in need of patching and thin overlay or surface treatment.
 - 74-52 points



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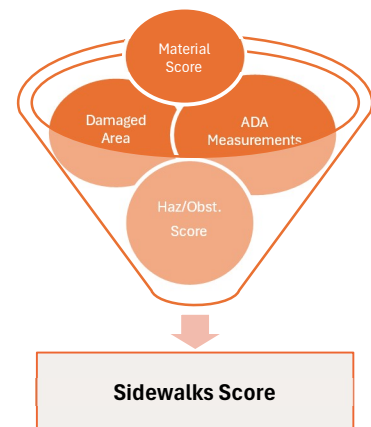
- Structural Improvement
 - Poor Condition - pavement structure in need of cold planing and new thick pavement overlay.
 - 51-43 points
- Base Rehabilitation
 - Failure Condition - in need of full depth pavement reconstruction or reclamation.
 - 42-0 points. Pavement in this condition is considered unsafe for vehicles and cyclists.

Note: The inverse PCI score was assigned to the infrastructure ranking score and PCI score was the main driver for establishing the annual 5-year pavement management plan (PMP). The intent is to cross-check the 5-year PMP project candidates with road safety requests and activity log to identify which priority road safety requests can be implemented in conjunction with the pavement plan. Additionally, low-cost safety improvements including localized sidewalk repairs and/or traffic calming measures such as speed tables which are not on the safety request list may be identified and implemented without a significant impact to the paving schedule.

ii. Sidewalks

Sidewalks were assigned infrastructure scores based on sidewalk measurements, conditions, and hazards and obstructions within the sidewalk. Below are the criteria which were used to assign sidewalk infrastructure scores.

- **American with Disabilities Act (ADA) Measurements:**
 - Cross Slope – Sidewalks with non-compliant cross slopes were assigned weights based on the degree or severity of non-compliance. For sidewalks with cross slopes >2%, a weight of 50 points was applied, while sidewalks with cross slopes > 5% were given a weight of 100 points.
 - Width – Sidewalks with non-compliant widths were assigned weights based on the magnitude of non-compliance. For sidewalks width <5 feet, a weight of 100 points was applied, while sidewalks with width <3 feet were given a weight of 200 points.
- **Damaged Area (SCI):** Sidewalk conditions were determined from sidewalk condition scores from a previous inspection, and sidewalks which were reinspected in 2024. For sidewalks which were reinspected, a percentage of damaged area was collected. This was on a scale of 0-100. For example, a sidewalk with a percentage damaged area of 70, this means that 70% of the sidewalk is damaged. After collecting data, the percentage of damaged areas was converted to a Sidewalk Condition Index (SCI). This was done by inverting the damaged area; so, a damaged area of 70 converts into an SCI of 30. For those sidewalks which were not previously inspected, a deduct was applied to determine current SCI. The SCIs were then broken into repair categories based on treatment needed.
 - Do Nothing (100-80) – For these no repair is required, so these have no weight.
 - Localized Repair (79-50) – These were assigned a weight of 100 points.
 - Full Reconstruction (49-0) – These were assigned a weight of 200 points. Sidewalks in this category are considered unsafe for pedestrians.



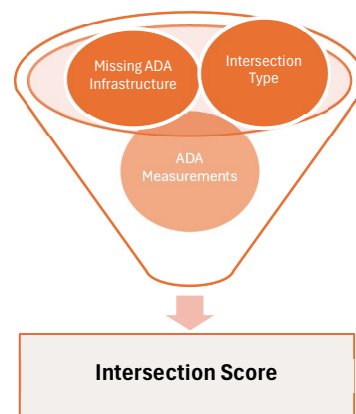
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- **Material Score:** Weights were assigned based on the material of the sidewalk. The weight of each material was determined based on feedback received from the Town Engineering Division. Stone dust was deemed the highest priority and thus was given the highest weight of 250 points. This was followed by a weight of 150 for bituminous concrete, 100 for brick, and 50 for cement concrete. The stone dust presence on the sidewalk causes uneven surfaces and safety issues for mobility.
- **Hazard/Obstruction Score:** The hazards and obstructions found within sidewalk segments that were inspected by Stantec, were assigned weights based on the type of hazard or obstruction. These weights were then summed up based on the count of each hazard/obstruction within a sidewalk segment. All the hazards/obstructions mentioned are major issues for accessibility and safety of the sidewalk users. Below are weights assigned to the hazards and obstructions.
 - Fixed pinch point <48" sidewalk width – A score of 50 points was applied.
 - Fixed pinch point <36" sidewalk width – A score of 100 points was applied.
 - Valve/Gate Hazard – A score of 50 points was applied.
 - Sidewalk Surface Hazard – A score of 75 points was applied.
 - Tree Root Hazard – A score of 100 points was applied.
 - Vegetation – A score of 25 points was applied.

iii. Intersections

Intersections were assigned safety infrastructure scores based on ramp attributes, ramp measurements, and intersection configuration. Below are the criteria which were used to assign sub-scores.

- **Missing ADA Infrastructure:** Missing ramps were assigned a weight of 350 points. Missing ramps between two (2) sidewalks serve as a severe barrier to senior and disabled folks.
- **Intersection Type:** This criterion denotes the type of intersection configuration. There are three (3) main types of intersections in the Town of Concord: Y-intersection, mid-block, and non-mid-block. The Y-intersections were deemed the highest priority and were given a weight of 200 points, followed by mid-blocks which were given a weight of 100 points.
- **ADA Measurements:** Several ADA measurements taken during ramp inspection were utilized to prioritize intersections.
 - Landing Existence – Ramps with insufficient or missing landings were assigned a weight of 200 points where no landing exists.
 - Apron Running Slope (max) – Ramps with steep apron running slopes (including left- and right-side aprons) were assigned a weight of 50 points if the slope was >8.7%, and 100 points if the slope was >15%.
 - Landing Slope (max) – Ramps with a maximum landing slope were assigned a weight of 50 points if the slope was >2.5%, and 100 points if the slope was >5%.
 - Ramp Position – Ramps were assigned weights based on their positioning. Diagonally facing ramps (those with no crosswalk present and facing toward the middle of the intersection) were given a weight of 150 points. Skewed ramps (those with no crosswalk present and facing slightly skewed from their reciprocal ramp) were given a weight of 50 points.



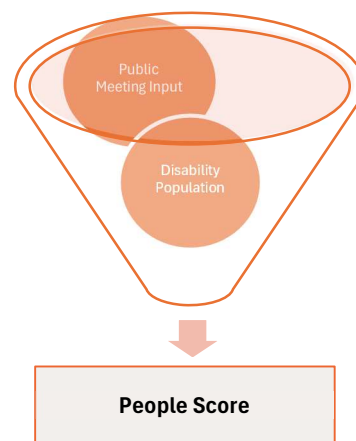
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Missing ADA infrastructure and poor design of intersections and curb ramps create safety issues because they force people with disabilities to move in an alternate direction or mislead them into the center of the intersection instead of using the safest way.

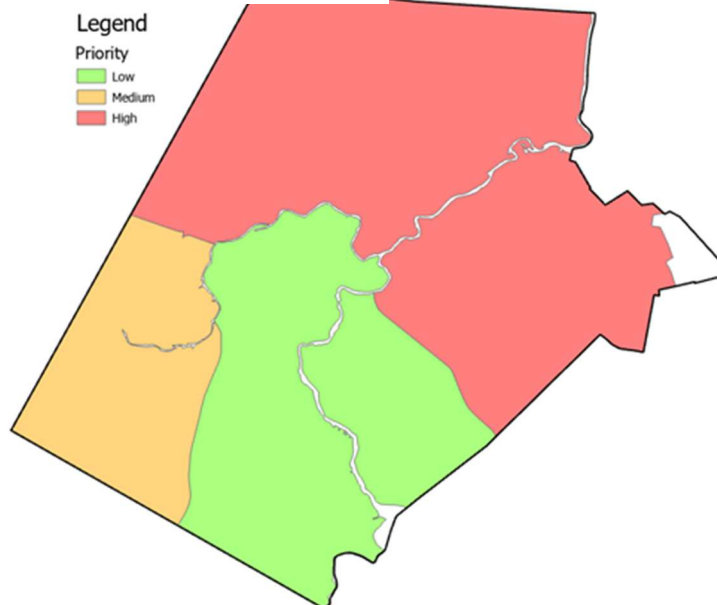
b. People Score

The second prioritization criteria category that was utilized was People. The people category focuses primarily on social equity, areas of the Town with the highest density of disabled individuals and feedback from the community. Two (2) sub-categories, disability population and community input - were used.

- **Disability Population:** This sub-category looks at the Town of Concord's population tracts, as obtained from *U.S. Census Bureau's American Community Survey (ACS) 2019-2023 5-year estimates*. These tracts contain census population data based on a variety of attributes; for this analysis we were most interested in the disability population. There are three (3) population blocks within the town, and thus it was decided to use three (3) priority ranges based on the percentage of the population with a disability. Below are the priority ranges and their corresponding scores.
 - Low (lowest % disabled population) – 50 points
 - Medium (middle % disabled population) – 100 points
 - High (highest % disabled population) – 150 points



Map 1: Disabled Population



- **Community Input:** The other sub-category that is included in the People score was related to community input gathered from a widely advertised and well attended community workshop and survey in the fall of 2023. The workshop was the first of two engagement events organized as part of the ongoing Comprehensive Transportation Plan. At this workshop, over 100 residents provided thoughts on challenges and issues with transportation in Concord. The survey was available online and on paper in the fall of 2023 and received

nearly 400 responses, including a component where people could identify issues and opportunities for improvement on a map. Stantec compiled these lists of locations and compared them to criteria in the Places score, in some cases adding new Places category from the Town's



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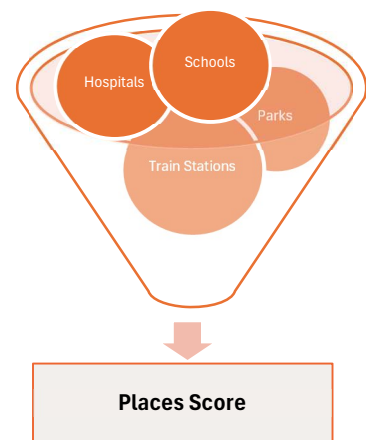
GIS (ex. high density residential zone) as needed. For locations not inherent in the Places score, these were weighed as follow, otherwise the request/project does not have a people score.

- Streets or intersections mentioned multiple times - 100 points
- Other identified locations - 50 points.
- Missing sidewalks - 200 points

c. Places Score

The third prioritization criteria category is Places. This category considers the proximity of road safety requests to important locations and destinations, such as schools, train stations, and recreational areas. Most of the places were assigned buffers to prioritize based on walking distance. It is important to note that the Places score also reflects community input; many participants in the fall 2023 outreach indicated specific destinations in Concord that they felt were a priority for transportation improvements. Below are the places which were used, their buffer size, and the weight applied:

- Public/Private Schools
 - Low priority – A buffer of 0.75 miles was used and a weight of 100 points was applied.
 - Medium priority – A buffer of 0.5 miles was used and a weight of 200 points was applied.
 - High priority – A buffer of 0.25 miles was used and a weight of 400 points was applied.
- Train Stations
 - Low priority – A buffer of 0.75 miles was used and a weight of 100 points was applied.
 - Medium priority – A buffer of 0.5 miles was used and a weight of 200 points was applied.
 - High priority – A buffer of 0.25 miles was used and a weight of 400 points was applied.
- Crash Clusters – These are the areas of significant concern for safety.
 - Bike Clusters – A buffer of 250 feet was used and a weight of 1,000 points was applied.
 - Car Clusters – A buffer of 250 feet was used and a weight of 500 points was applied.
- Crossings – Locations where different road users travelling at varying speeds intersect, presenting an increased risk of conflict.
 - Trail Crossings
 - Minor, Connection – A buffer of 250 feet was used and a weight of 50 points was applied.
 - Minor, Cross-over – A buffer of 250 feet was used and a weight of 150 points was applied.
 - Major, Connection – A buffer of 250 feet was used and a weight of 100 points was applied.
 - Major, Cross-over – A buffer of 250 feet was used and a weight of 250 points was applied.
 - Bike Trail Crossings – A buffer of 250 feet was used and a weight of 400 points was applied.
 - Railroad Crossings – A buffer of 250 feet was used and a weight of 400 points was applied.
 - River Crossings – A buffer of 250 feet was used and a weight of 100 points was applied.
- Zones
 - Historical Districts – A weight of 200 points was applied.
 - Business Zones – A weight of 200 points was applied.

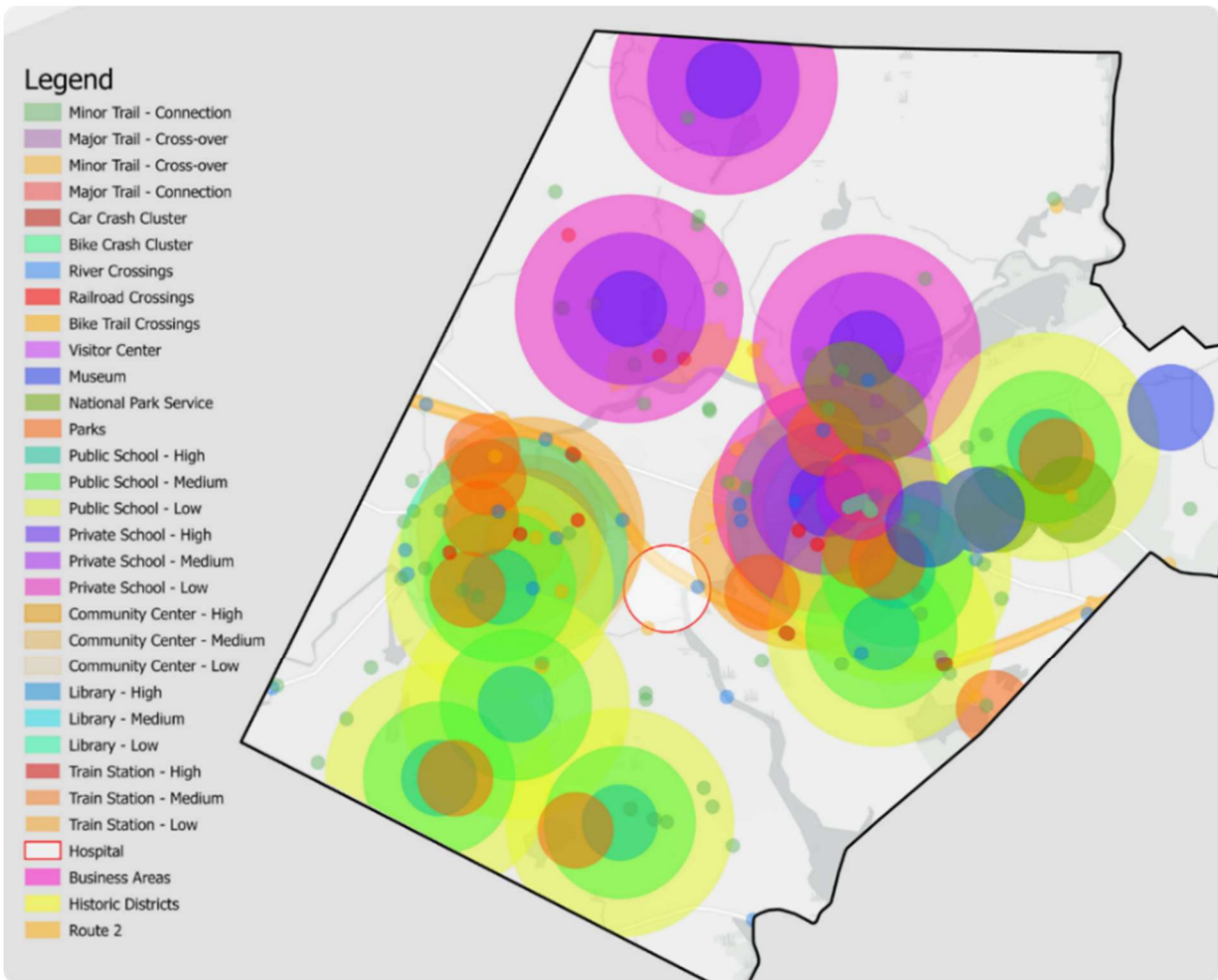


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- Route 2 – A buffer of 150 feet was used and a weight of 500 points was applied.
- Historical Parks & Rec. Areas
 - National Park Service – A buffer of 1,500 feet was used and a weight of 200 points was applied.
 - Museum – A buffer of 1,500 feet was used and a weight of 200 points was applied.
 - Visitor Center – A buffer of 1,500 feet was used and a weight of 200 points was applied.
- Parks – A buffer of 0.25 miles was used and a weight of 100 points was applied.
- Library
 - Low priority – A buffer of 0.75 miles was used and a weight of 100 points was applied.
 - Medium priority – A buffer of 0.5 miles was used and a weight of 200 points was applied.
 - High priority – A buffer of 0.25 miles was used and a weight of 400 points was applied.
- Hospital – A buffer of 1,500 feet was used and a weight of 300 points was applied.
- Community Center
 - Low priority – A buffer of 0.75 miles was used and a weight of 100 points was applied.
 - Medium priority – A buffer of 0.5 miles was used and a weight of 200 points was applied.
 - High priority – A buffer 0.25 miles was used and a weight of 400 points was applied.

Map 2 below shows the areas and distance buffers of the places.

Map 2: Places Prioritization

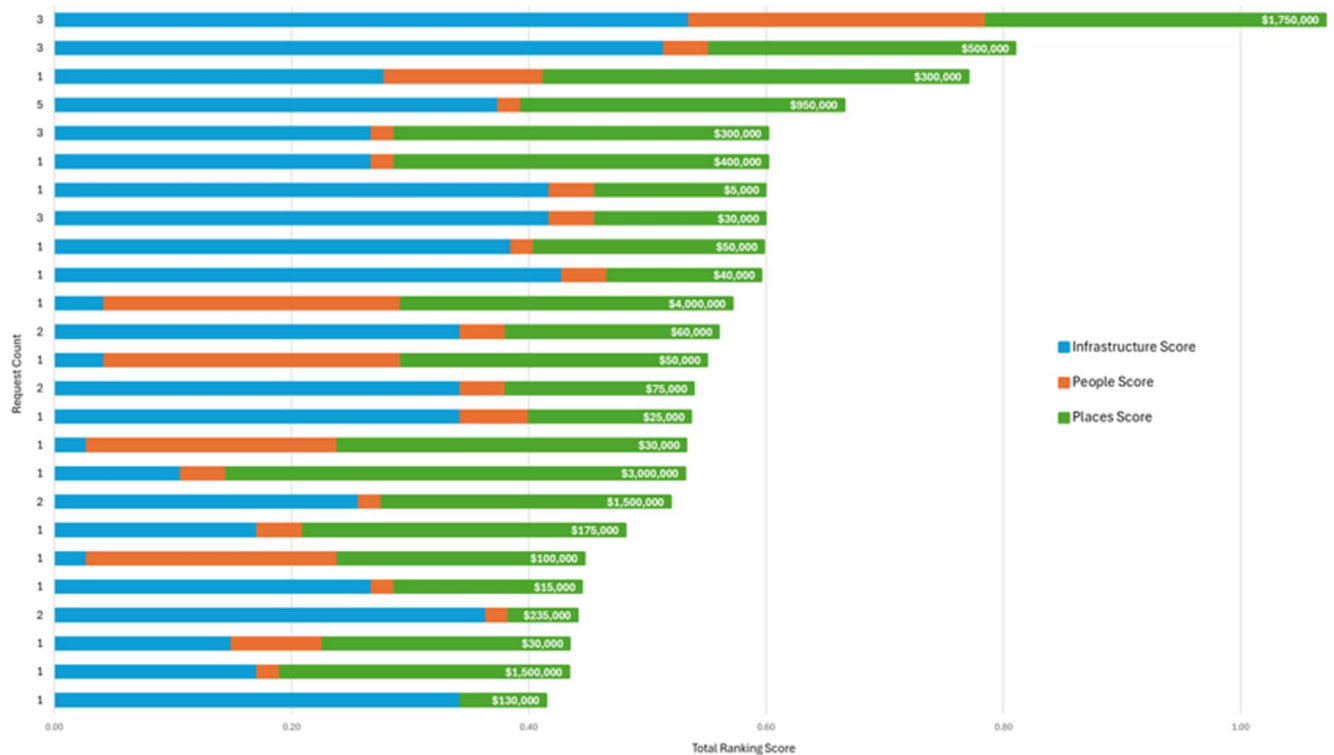


4 Overall Project Ranking Score and Next Steps

After each project received an Infrastructure, People, and Place score, Stantec developed an overall or composite score for each project using all three (3) ranking criteria. All the scores for each criterion were summed and normalized based on the maximum scores across all 3 assets (pavement, sidewalk, intersection). Then a weighted average of 75% to the Infrastructure score, 25% to the People score, and 50% to the Places score were applied.

The reason for Infrastructure score being the highest weighted is because it has factual and unbiased condition data in the form of PCI, SCI and ADA accessibility at intersections. The Places score comes at second highest since it also includes objective spatial data such as crash clusters, as well as physical proximity to town features such as schools, commuter rail stations, and community centers. The People score has a lower weight as its measures data gathered in a qualitative manner. While public input from the workshop represents areas of genuine concern among community members, it represents concerns at a particular point in time.

The overall ranking score is used to develop a list of major and minor projects to help the TMG and TAC make the final decision. Below is an example of Top 25 projects based on Stantec ranking.



The next step is for TMG and TAC is twofold: identify minor, low-cost safety improvements as part of the Town’s annual pavement management program (PMP - approximately 7 miles per year for 5 years); and identify larger, costly standalone projects requiring a longer-term schedule.

This upcoming paving season for the PMP, first year of a 5-year program, will be an accelerated program where the TMG will identify and select low-cost safety improvements as part of the PMP. This will include



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new line stripping, sharrows, crosswalks, pedestrian curb ramps and signage, but not limited to piloting new traffic calming solutions, both temporary and permanent, such as speed tables, raised crosswalks, and splitter islands as further Public Work Engineering evaluations are underway.

Stantec will provide TMG and TAC detailed project ranking lists to disseminate and sort project(s) for further review, determination and recommendation to the PWC. This process should include prioritizing major projects, get public feedback, and follow check-in milestones as determined by the TAC. As the PMP is rolled out this first year, inclusive of minor road safety projects, TAC should include milestones for public post-construction feedback.



5 ArcGIS Online Project Screening Tool

After ranking criteria were applied to Geographic Information System (GIS) layers, a dashboard was developed in ArcGIS Online for the purpose of screening and identifying high priority projects. This ArcGIS Online Project Screening dashboard was built in the ArcGIS Online environment. The tool was equipped with a map of the assets - pavements, sidewalks (present and missing), and intersections layers, info boxes with the backlog costs, and widget sliders for overall ranking score

This tool provides an easy and efficient way to add new requests, assign the projects, and filter projects based on a variety of criteria.

Figure 1: ArcGIS Online Project Screening Dashboard

