Appendix F: Multimodal Needs Assessment Technical Appendix

This Appendix explains the methodology and data used in the development of the Needs Assessment for the Multimodal Transportation Master Plan.

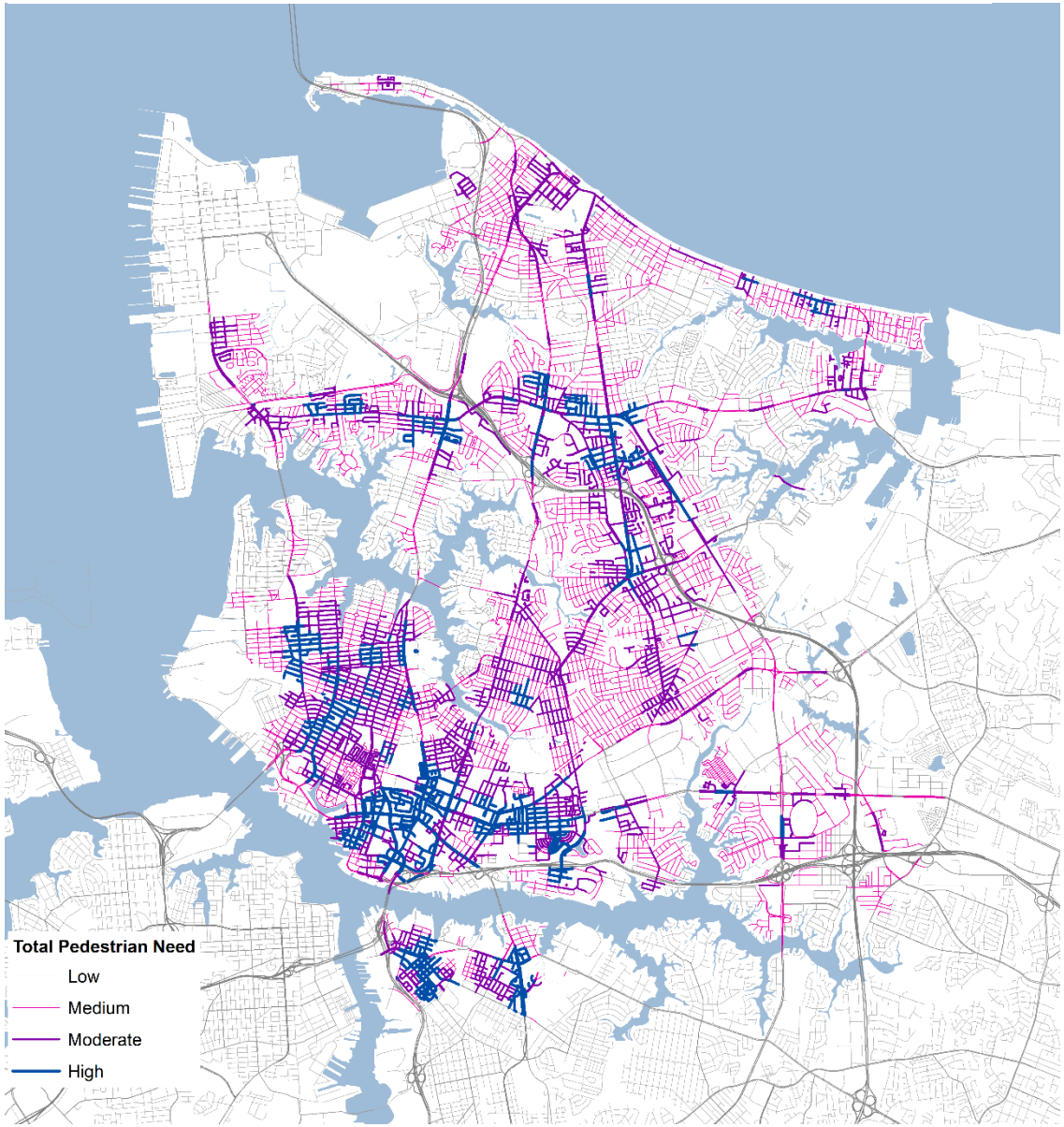
Chapter 12, the Multimodal Needs Assessment includes the map of pedestrian needs for Norfolk (shown again in this Appendix as **Figure F-1**) and the map of bicycle and scooter needs (**Figure F-2** shown on the next page).

The maps show Norfolk's streets classified into four levels of need:

- Low
- Medium
- Moderate
- High

This Appendix first describes the analysis of pedestrian needs and bicycle/scooter needs in more detail. It also describes the approach for the development of the Transit Needs Assessment, which was done as part of the Transit System Redesign portion of this project.

FIGURE F-1: MAP OF PEDESTRIAN NEEDS ANALYSIS RESULTS



Pedestrian and Bicycle/Scooter Needs

The pedestrian and bicycle/scooter needs maps are based on a variety of data sources that reflect Norfolk's three vision themes for multimodal transportation:

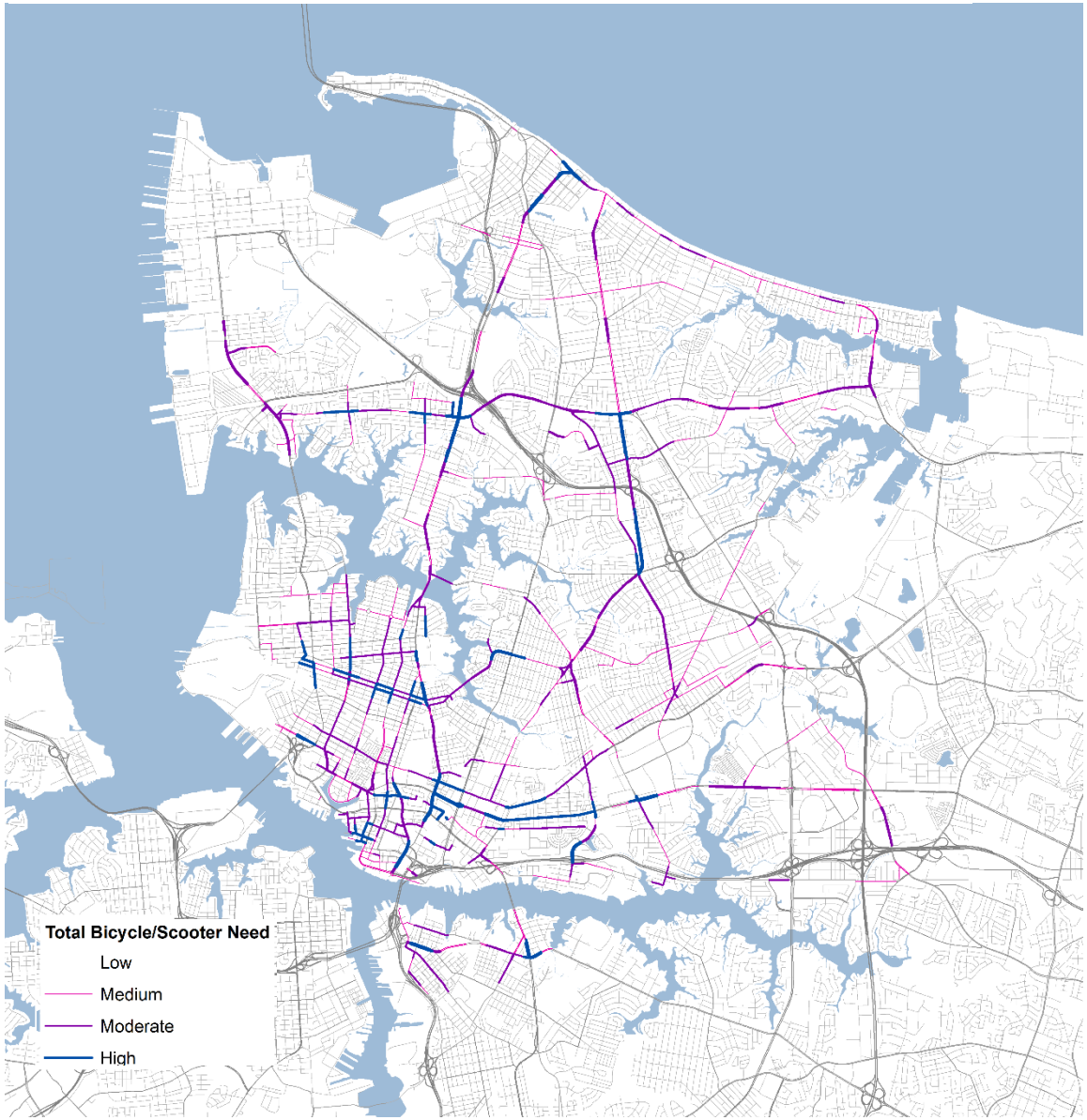
- Safety
- Connectivity
- Equitable Prosperity

The Needs Assessment uses data based on these three vision themes, as well as public input, to calculate a needs score for each street segment in the City.

The final maps based on this analysis are shown in **Figures F-1 and F-2**. The analysis methodology and data that were used to arrive at these final maps are described below. The pedestrian needs were analyzed separately from the bicycle and scooter needs, but both assessments follow a similar analysis method.

The following sections explain the analysis methods for both the pedestrian needs and the bicycle/scooter needs.

FIGURE F-2: MAP OF BICYCLE & SCOOTER NEEDS ANALYSIS RESULTS



Pedestrian and Bicycle/Scooter Needs Data & Analysis

As shown in tables **Table F-1 and F-2,** the three primary vision themes for the project were used as the basis for collecting datasets that were then used to calculate a needs score for that vision theme.

The data used in the Pedestrian Needs Assessment is listed in **Table F-1** and the data used in the Bicycle/Scooter Needs Assessment is listed in **Table F-2**.

The data was compiled, analyzed, and applied to each segment of Norfolk's streets. Maps were then created for each vision theme that summarized all the datasets in that theme.

Figures F-3 and F-4 show the levels of need for the Safety vision theme for pedestrian and bicycle/scooter modes, respectively. **Figures F-5 and F-6** show the levels of need for the Connectivity vision theme. **Figures F-7 and F-8** show the levels of need for the Equitable Prosperity vision theme.

Public input was also incorporated into the needs scores. As explained in Chapter 12, residents and other members of the public identified multimodal transportation needs through a variety of opportunities, including an interactive online map; email, voice, and text messages; civic league and task force meetings, and virtual town hall meetings. Over 800 comments on multimodal transportation needs were received.

TABLE F-1: PEDESTRIAN NEEDS DATA

Safety Vision Theme	Connectivity Vision Theme	Equitable Prosperity Vision Theme	Public Input
• Pedestrian crashes • Pedestrian fatalities • VDOT Pedestrian Safety Action Plan priority corridors • Distance to crosswalks • Sidewalks • Traffic volume • Traffic speed • Interstate ramps • Signalized intersections without pedestrian signals • ADA curb ramps	• Pedestrian trip generators (parks, schools, libraries, etc.) • Transit stops • Transit ridership • Activity (population and jobs) • Multimodal centers	• Zero-vehicle households • Populations of color • Low-income households	• Public comments

TABLE F-2: BICYCLE/SCOOTER NEEDS DATA

Safety Vision Theme	Connectivity Vision Theme	Equitable Prosperity Vision Theme	Public Input
• Bicyclist crashes • Bicyclist fatalities • Bicycle facilities • Traffic volume • Traffic speed • Interstate ramps	• Pedestrian trip generators (parks, schools, libraries, etc.) • Transit stops • Transit ridership • Activity (population and jobs) • Multimodal centers	• Zero-vehicle households • Populations of color • Low-income households	• Public comments

All comments were reviewed and considered. The number of public comments received was a final criterion in the needs mapping. **Figures F-9 and F-10** show the levels of need based on the number of comments received.

As explained in Chapter 4, all streets in the City of Norfolk have pedestrian modal emphasis, except interstates and limited access highways.

However, not all of Norfolk's streets have bicycle/scooter modal emphasis. The streets with bicycle/scooter modal emphasis were based on a separate methodology and represent a potential fully connected network of streets and paths that bicyclists and scooter riders could use to travel safely and comfortably across the entire city. These streets represent the most critical bicycle connections. Many street segments with bicycle/scooter modal emphasis are rated with either medium, moderate or high need levels. Streets without bicycle/scooter modal emphasis are shown as having low needs in the bicycle/scooter needs maps.

FIGURE F-3: PEDESTRIAN SAFETY NEEDS

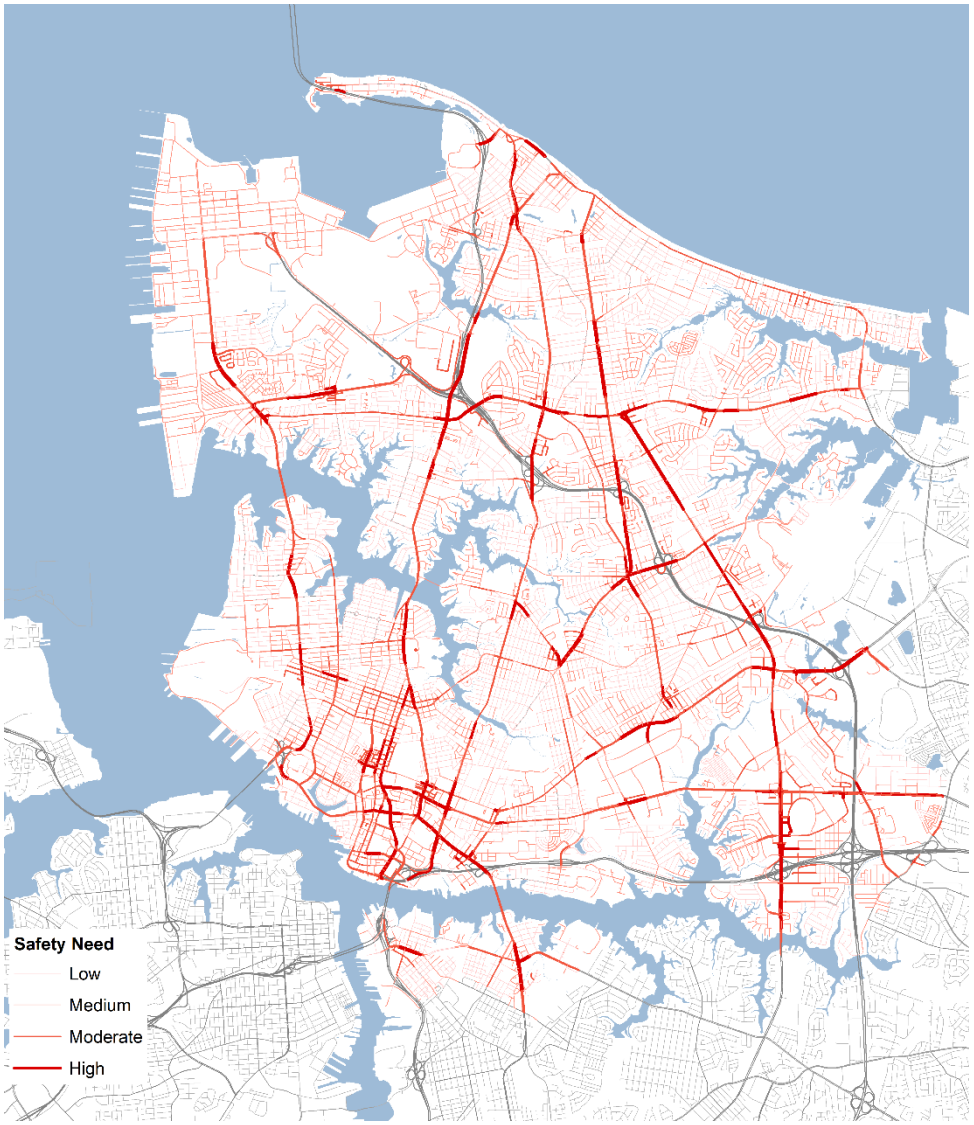


FIGURE F-4: BICYCLE/SCOOTER SAFETY NEEDS

Figure F-5: Pedestrian Connectivity Needs

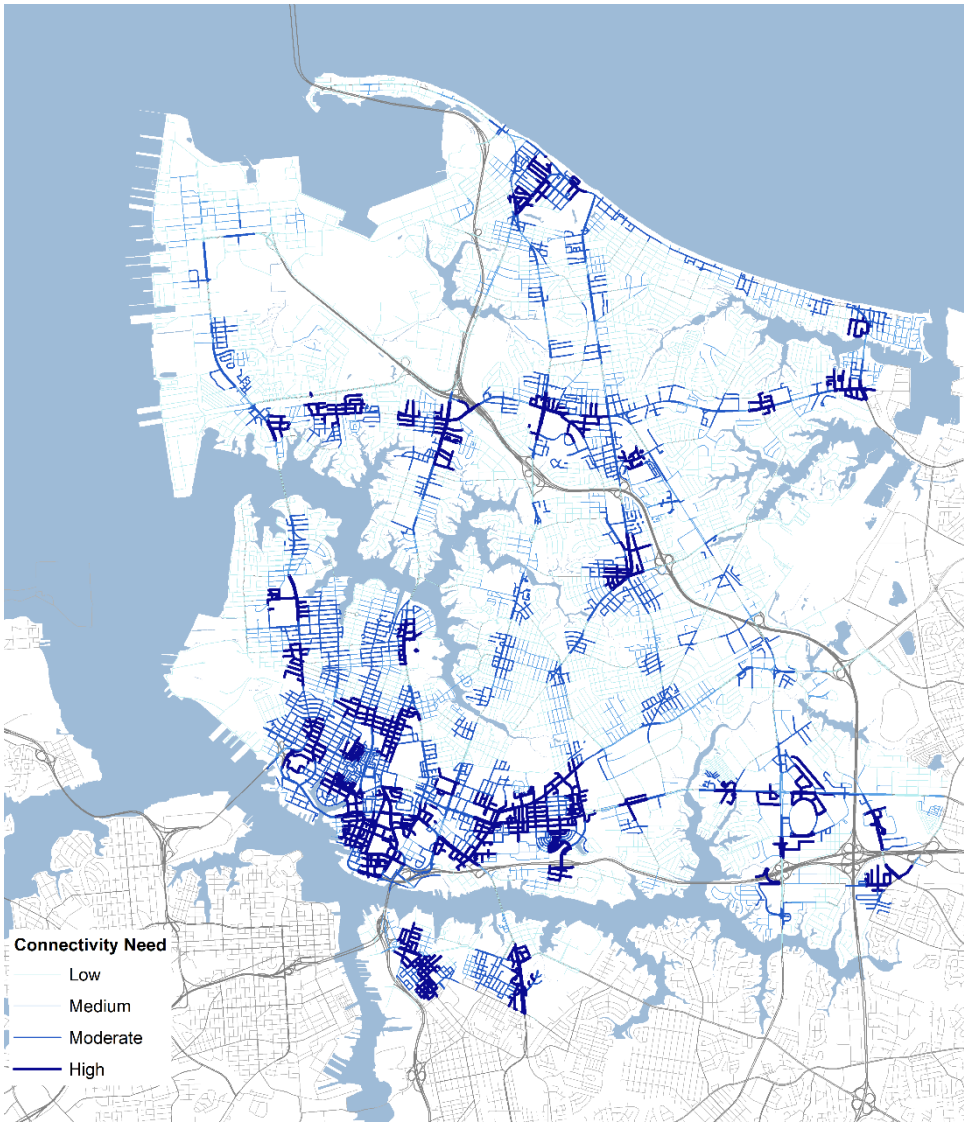


Figure F-6: Bicycle/Scooter Connectivity Needs

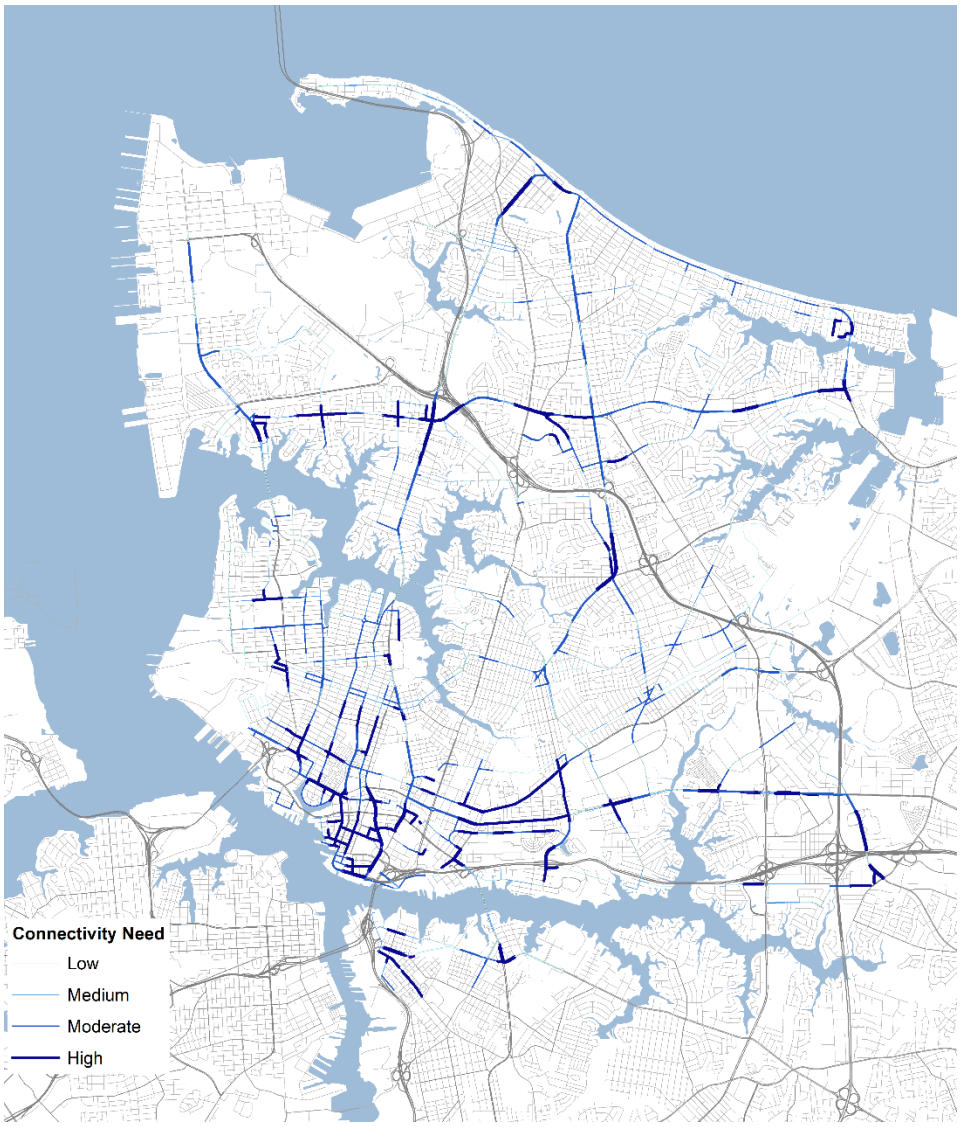


Figure F-7: Pedestrian Equitable Prosperity Needs

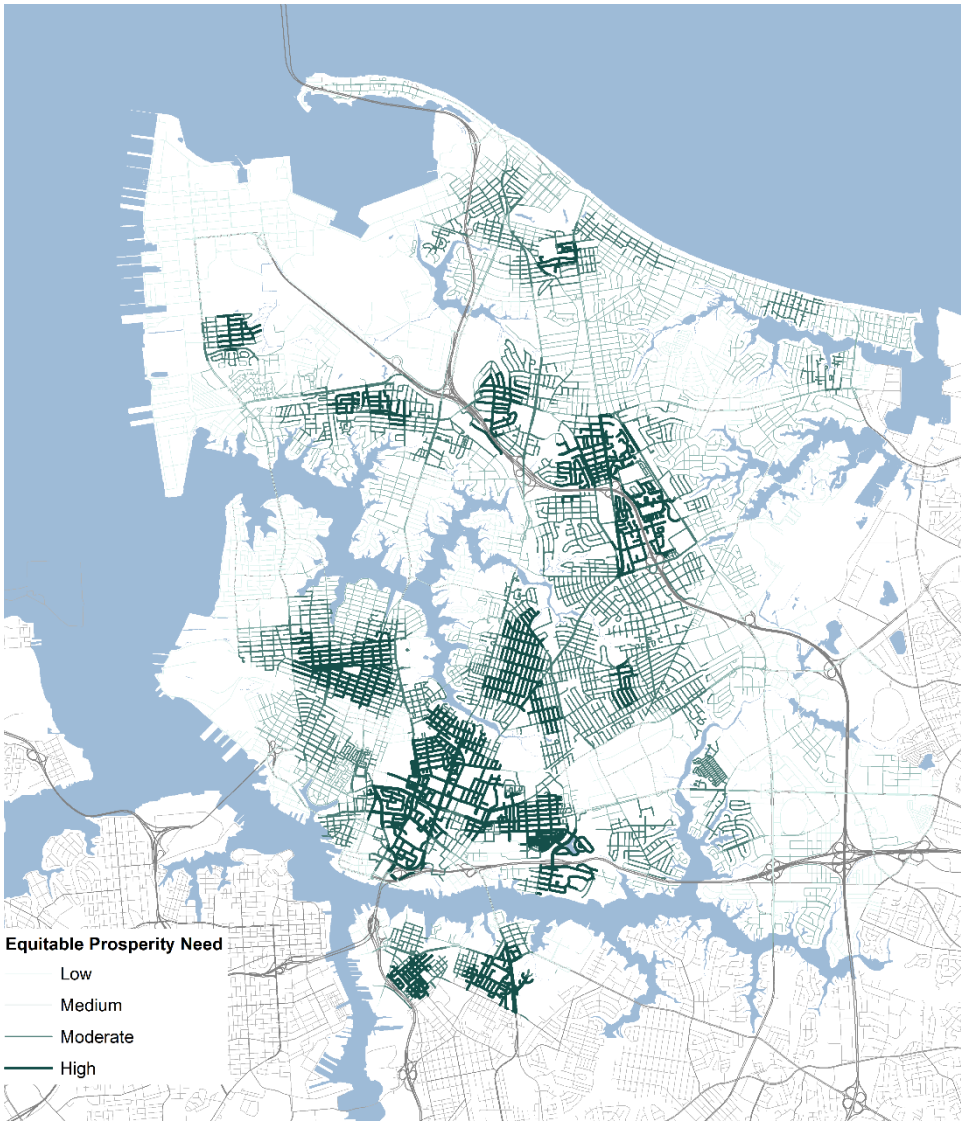


Figure F-8: Bicycle/Scooter Equitable Prosperity Needs

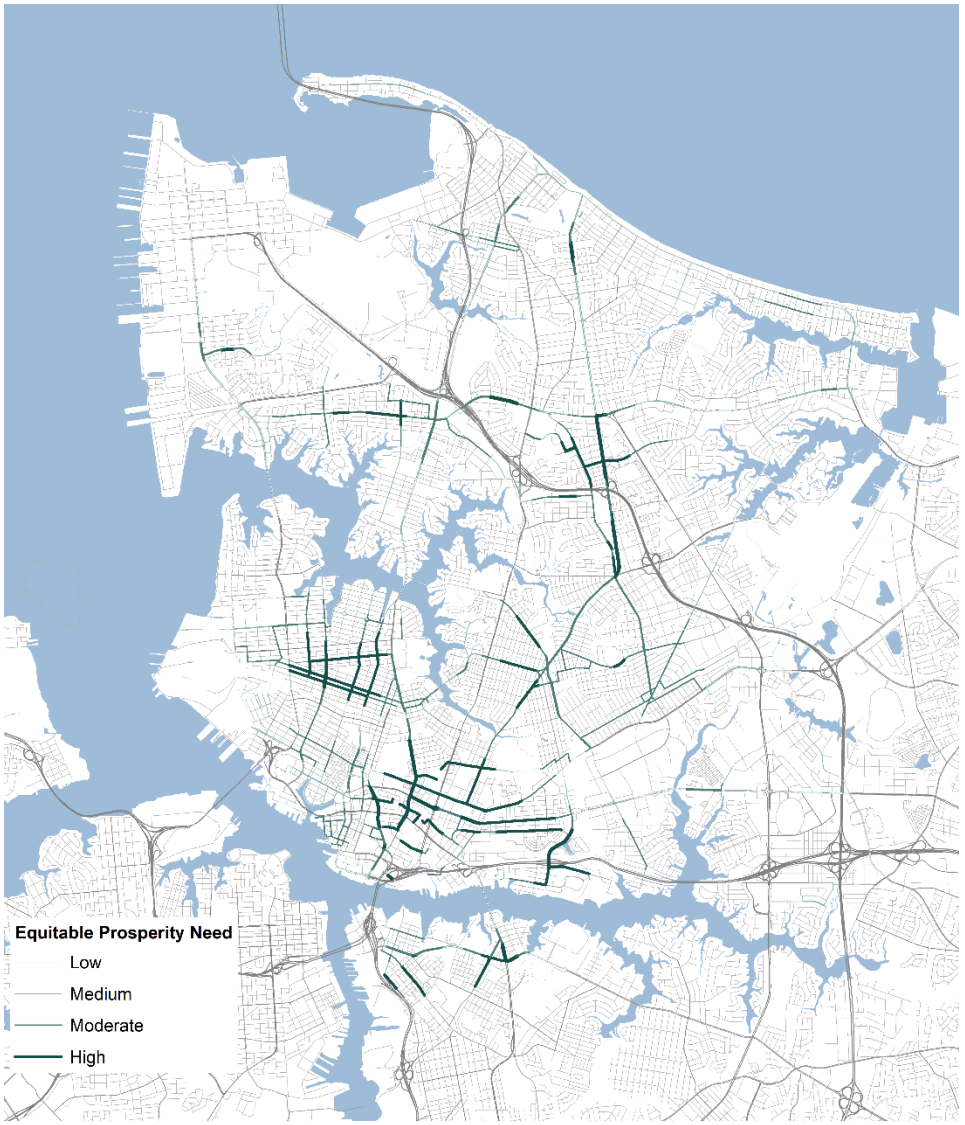


FIGURE F-9: PEDESTRIAN PUBLIC GUIDANCE NEEDS

FIGURE F-10: BICYCLE/SCOOTER PUBLIC GUIDANCE NEEDS

Calculating the Pedestrian and Bicycle/Scooter Needs Scores

Tables F-3 and F-4 provide more information on how the pedestrian needs and bicycle/scooter needs, respectively, were analyzed.

The Metric column in the **Tables F-3 and F-4** describes how each dataset was calculated.

Each street segment was assigned weighting points for each dataset, depending on the value. The Possible Points column in **Tables F-3 and F-4** shows how many points were possible for each dataset. This represents the weight of this dataset towards the needs score. The rightmost four columns show the values for each dataset for each possible point.

Spatial Analysis

The project team performed a series of GIS operations to calculate the values for each of the criteria.

Some datasets were calculated directly for each street segment. These are the "segment" datasets in the Geography column of **Tables F-3 and F-4.**

Other datasets were calculated and aggregated to an area, and that value was then assigned to the street segments. These are the "area" datasets in the Geography column.

To calculate the area-based metrics, a hexagonal grid of half-mile cells was created and overlaid on top of Norfolk's street grid. Scores for the area-based metrics were calculated and assigned to each cell in the grid. For example, the Transit Stops metric was calculated by counting the total number of transit stops in each hex cell.

Segment-based metrics were calculated using a GIS layer of Norfolk's streets where each block is an individual line segment.

The hexagonal grid and segments used to calculate the individual area- and segment-based safety metrics for pedestrian needs are shown as an example in the "Interim Map of Pedestrian Safety Needs" on this page.

The area-based scores were applied to individual street segments using a spatial join operation based on the location of each street segment's centroid. Each street segment received the area-based scores of the grid cell within which its center fell.

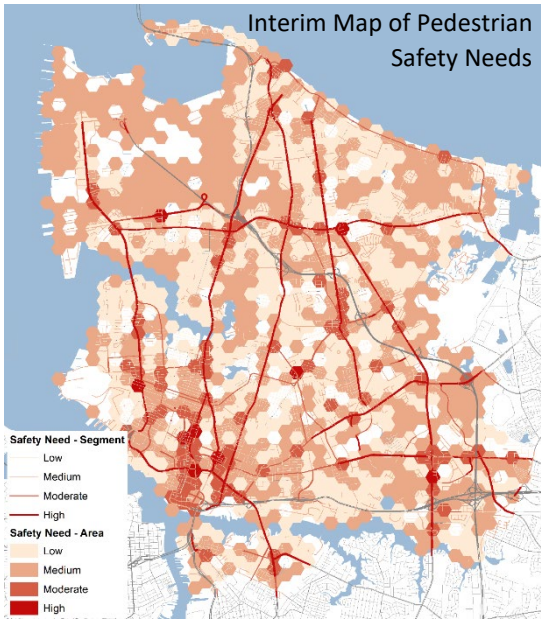
Finally, area-based and segment-based scores were summed up to calculate the total needs score for each street segment.

The modal emphasis networks were then overlaid to derive the total pedestrian needs scores and the total bicycle/scooter needs scores. Pedestrian needs scores were calculated for streets with pedestrian modal emphasis (all streets in Norfolk except interstates and limited access highways).

Bicycle/scooter needs scores were calculated for streets with bicycle modal emphasis. Streets that had not been assigned the relevant modal emphasis are considered low priority for each mode.

Each segment was assigned a modal priority of low, medium, moderate, or high based on its need score.

This analysis resulted in two maps, shown in **Figures F-1 and F-2** at the beginning of this Appendix. These maps represent the combined needs scores for pedestrian needs and bicycle/scooter needs.



This map shows the levels of needs calculated for the area-based datasets for pedestrian safety needs, displayed in the hexagonal grid, as well as the levels of needs calculated for the segment-based datasets.

TABLE F-3: PEDESTRIAN NEEDS DATA, METRICS, AND SCORES

Vision Theme	Dataset	Metric	Geography	Normalizing Factor	Possible Points	0	1	2	3
Safety	Pedestrian Crashes	# of pedestrian crashes	Area	10%	3	0	1 - 2	3 - 5	6+
	Ped Fatalities	# of pedestrian fatalities	Area	10%	3	0	1	2 - 3	4+
	VDOT PSAP Corridors	Linear ft. of PSAP corridors weighted by rank	Segment	10%	3	Not PSAP	3	2	1
	Distance to Xwalk on PSAP Corridors	Linear distance to Xwalk on PSAP corridors	Area	10%	2	< 600	600 - 1200	1200 +	
	Sidewalk Present?	Is a sidewalk present on at least one side of street	Segment	10%	3	Yes			No
	Traffic Volume	ADT	Segment	10%	3	0 - 1,999	2,000 - 4,999	5,000 - 7,999	8,000 +
	Traffic Speed	Speed Limit	Segment	10%	3	< 25	25	26-35	36+
	Interstate Ramp	Is there an interstate ramp present? (Yes/No)	Area	10%	2	No	Yes		
	Signals without Ped Signals	# of signalized intersections with no ped signals	Area	10%	3	0	1	2	3+
	ADA Curb Ramps	Ratio of curb ramps per intersection within cell	Area	10%	2	3.01 +	0.01 - 3	0	
Vision Theme	Dataset	Metric	Geography	Normalizing Factor	Possible Points	0	1	2	3
Connectivity	Trip generators	# of parks, schools, libraries, etc. in vicinity	Area	20%	3	0	1	2	3+
	Transit Stops	# of HRT stops in vicinity	Area	20%	3	0	1	2	3+
	Transit Ridership	# of boardings and alightings in vicinity	Area	20%	3	0	1 - 10	11 - 50	51+
	Activity	# of residents + # of jobs in vicinity	Area	20%	3	0	1 - 100	101 - 1,000	1,001+
	Multimodal Center	Yes/No inside or out of MM Center	Area	20%	3	No			Yes
Vision Theme	Dataset	Metric	Geography	Normalizing Factor	Possible Points	0	1	2	3
Equitable Prosperity	Zero Vehicle Households	# of zero-vehicle households in cell	Area	33%	3	0 - 24	25 - 75	76 - 150	151+
	Populations of Color	# of non-white residents in cell	Area	33%	3	0 - 24	25 - 300	301 - 599	600+
	Low-Income Households	# of low-income households in cell	Area	33%	3	0 - 24	25 - 200	201 - 399	400+
Vision Theme	Criteria	Metric	Geography	Normalizing Factor	Possible Points	0	1	2	3
Public Guidance	Of concern to public or stakeholders	# of comments on the Needs Assessment survey map	Area	100%	3	0	1	2	3-4

TABLE F-4: BICYCLE/SCOOTER NEEDS DATA, METRICS, AND SCORES

Vision Theme	Dataset	Metric	Geography	Normalizing Factor	Possible Points	0	1	2	3
Safety	Bike Facilities Present	What type of bike facility is present?	Segment	20%	3	Bike Lane		Sharrow	None
	Bicyclist Crashes	# of bicycle crashes	Area	20%	6	0	1 – 2*	3 – 5*	6+*
	Bicyclist Fatalities**	# of bicyclist fatalities	Area	-	-				
	Traffic Volume	ADT	Segment	20%	3	0 - 1,999	2,000 - 4,999	5,000 - 7,999	8,000 +
	Traffic Speed	Speed Limit	Segment	20%	3	< 25	25	26-35	36+
	Interstate Ramp	Is there an interstate ramp present? (Yes/No)	Area	20%	2	No	Yes		
Vision Theme	Dataset	Metric	Geography	Normalizing Factor	Possible Points	0	1	2	3
Connectivity	Trip generators	# of parks, schools, libraries, etc. in vicinity	Area	20%	3	0	1	2	3+
	Transit Stops	# of HRT stops in vicinity	Area	20%	3	0	1	2	3+
	Transit Ridership	# of boardings and alightings in vicinity	Area	20%	3	0	1 - 10	11 - 50	51+
	Activity	# of residents + # of jobs in vicinity	Area	20%	3	0	1 - 100	101 - 1,000	1,001+
	Multimodal Center	Yes/No inside or out of MM Center	Area	20%	3	No			Yes
Vision Theme	Dataset	Metric	Geography	Normalizing Factor	Possible Points	0	1	2	3
Equitable Prosperity	Zero Vehicle Households	# of zero-vehicle households in cell	Area	33.3%	3	0 - 24	25 - 75	76 - 150	151+
	Populations of Color	# of non-white residents in cell	Area	33.3%	3	0 - 24	25 - 300	301 - 599	600+
	Low-Income Households	# of low-income households in cell	Area	33.3%	3	0 - 24	25 - 200	201 - 399	400+
Vision Theme	Criteria	Metric	Geography	Normalizing Factor	Possible Points	0	1	2	3
Public Guidance	Of concern to public or stakeholders	# of comments on the Needs Assessment survey map	Area	100%	3	0	1	2	3-4

** Bicyclist Crashes provide a total of 6 possible points. Each weighted score bucket is worth double. Cells with 1-2 crashes earn 2 points, 3-5 crashes earn 4 points, and 6 or more crashes earn 6 points.*

*** The Bicycle and scooter rider needs formula includes a metric for bicyclist fatalities but there are no bicyclist fatalities recorded in the current version of Norfolk's crash dataset, which at the time of analysis included crashes from 2015 through 2019.*