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MEMORANDUM

November 30, 2022

To: Bryan Davis
Organization: Chittenden County Regional Planning Commission (CCRPC)
From: Jake Berman, Theja Putta, Lucy Gibson, Michael Blau
Project: Chittenden County Regional Planning Commission Active Transportation Plan Update

Re: Task 4.1: Bicycle Network Recommendations – FINAL DRAFT

Bicycle Network Recommendations

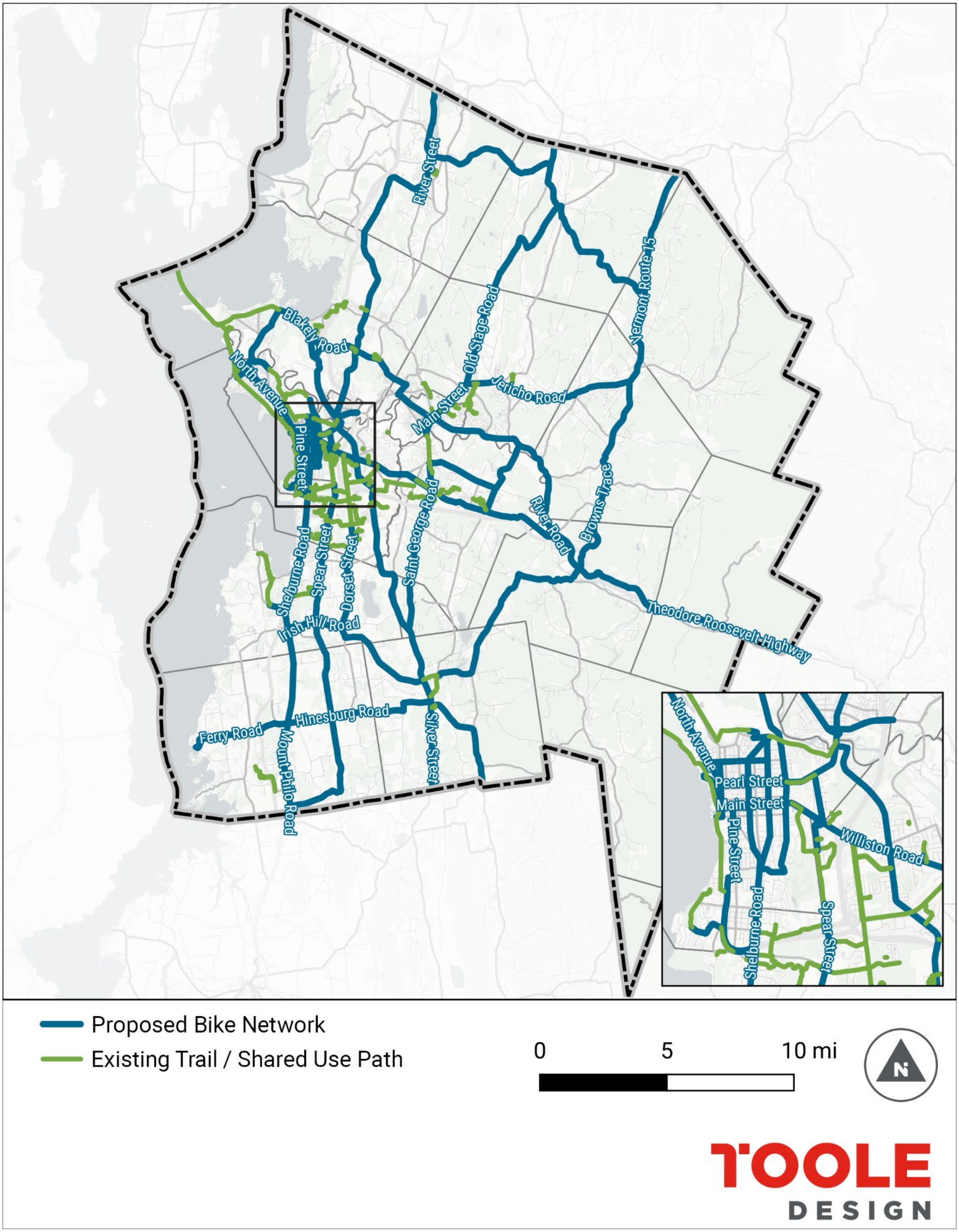
Developing infrastructure and policy recommendations for the 2022 ATP was a joint effort between CCRPC staff, the project team, and the Advisory Committee. Bicycle and pedestrian network recommendations were based on findings from earlier analysis and research, including the Trip Potential Analysis and Bicycle Network Analysis, as well as presence of existing facilities, Transportation Improvement Program (TIP) and Metropolitan Transportation Plan (MTP) project locations, and important destination locations. CCRPC staff also conducted extensive outreach with local government and other key stakeholders as part of network development. That outreach led to an understanding of local active transportation needs and many of the proposed projects and ideas that are part of this plan.

The project team overlaid Trip Potential Analysis and BNA results to manually develop the preliminary countywide bicycle network. These routes were drawn through cities and towns to ensure intercity connectivity as an essential part of this network. Local pedestrian recommendations will be added during network revisions/updates after client review.

The proposed countywide bicycle network (Figure 1) includes about 200 miles of streets that would allow users of all ages and abilities to traverse the County on comfortable bicycle facilities. It includes routes along specific roadways and regional trails that create a logical and convenient network to improve connectivity across the County.

The projects are similar to many of the high priority corridors identified in the 2017 Proposed Regional Active Transportation Network, further highlighting the need for active transportation upgrades on these streets. Existing off-street shared-use paths and trails were also included in Figure 1 to highlight the high-comfort network connectivity that will be achieved once the network is implemented.

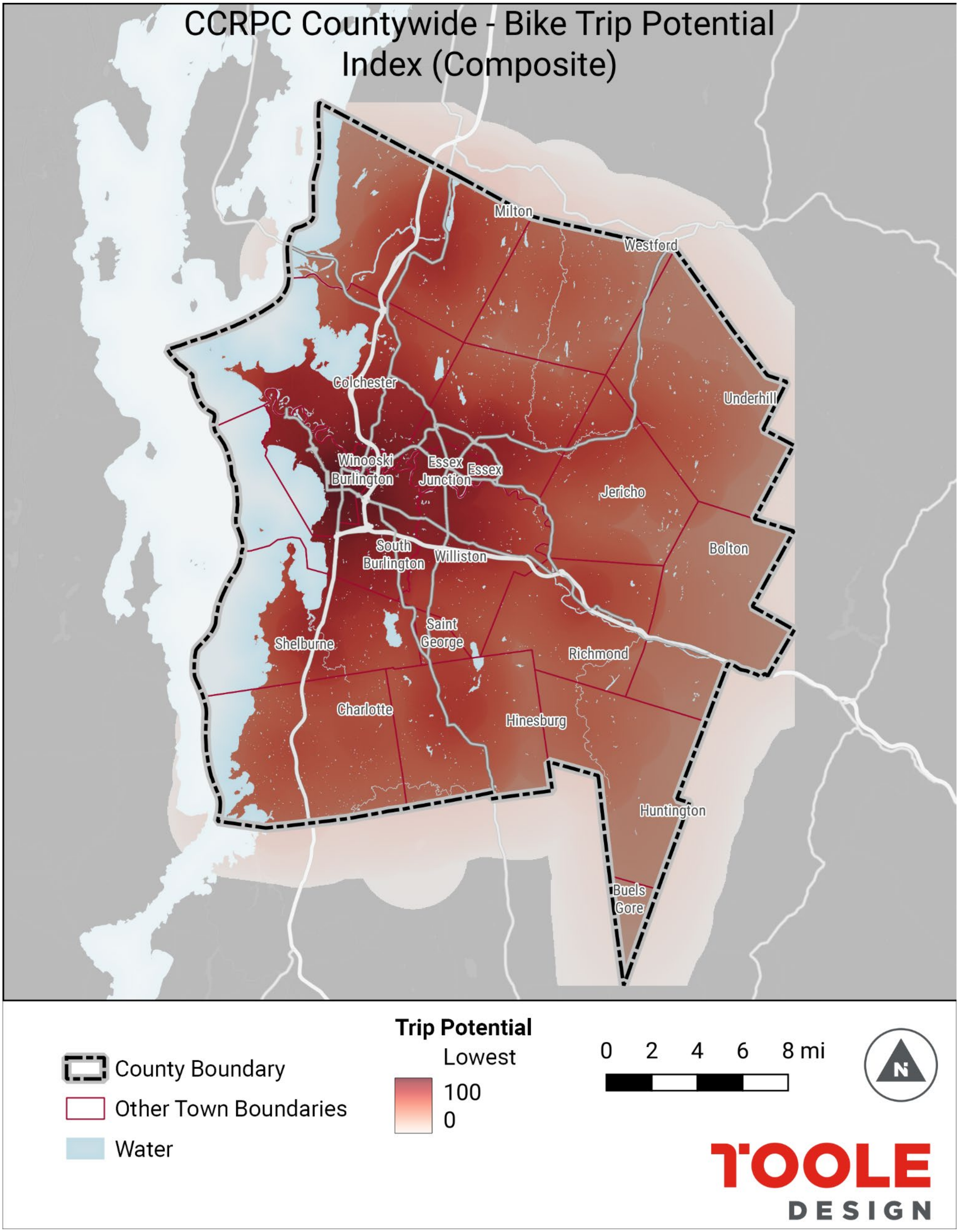
Figure 1: Bicycle Network Recommendations



Trip Potential Analysis

The bicycle Trip Potential Analysis identifies areas where connections between land use factors, including commercial activity, employment, K-12 schools, parks, population, and transit, support bicycling trips regardless of current infrastructure. It is useful both for identifying where existing bicycling facilities are likely to support high activity or where improvements in infrastructure would be expected to increase activity. This process is outlined in greater detail in the Task 3.3 Trip Potential Analysis – FINAL memo. The results, shown in Figure 2, highlight areas with higher trip potential scores with darker shades of red, while lighter shades indicate areas with relatively lower trip potential. The urban core of Burlington, South Burlington, Winooski, Essex Junction, and Colchester has a high potential score, highlighting the need for a network to have dense connectivity in this area. Outside of the core, trip potential extends radially along corridors that lead towards town centers such as Shelburne, Hinesburg, Saint George, Richmond, Jericho, Essex, Underhill, and Milton. Results also show potential between some of these centers that are near each other, such as between Shelburne, Charlotte, and Hinesburg and between Richmond, Jericho, and Essex.

Figure 2: Countywide Bicycle Trip Potential, Composite



Bicycle Network Analysis

The BNA scores Census Blocks throughout the county based on whether people can ride their bicycle to important destinations on comfortable bicycling facilities. The project team used the BNA results in conjunction with the Trip Potential Analysis to identify areas where there is a high demand for bicycling but poor comfortable access. These areas indicate a need for better bicycling connectivity so people can bike to schools, shops, workplaces, medical care, and other important destinations.

The project team developed two BNA metrics: Measure 1 compares access to destinations on the high-comfort network against access to destinations on the full transportation network; and compares high-comfort access to destinations with destinations that also have low-comfort access; Measure 2 additionally compares access on the high-comfort network against destinations with no bicycling access. While Measure 1 may show high access scores where few destinations are reachable by bicycle at all, Measure 2 shows high scores only where destinations can be accessed on the high-comfort network. Please refer to Task 3.1 Bicycle Network Analysis – Revised Results memo for more detail. For the purposes of network development, Measure 2 was used to identify areas by total high-comfort bicycling access. These results, shown in Figure 3, identify areas with the lowest high-comfort bicycle access to destinations with BNA scores closer to 0 and highest access closer to 100. The towns around the urban core such as Charlotte, Saint George, Jericho, and parts of Shelburne, Williston, Essex, Colchester, and Milton as have the fewest destinations accessible to people biking on the high comfort network and therefore have the highest need for greater bicycling connectivity.

As part of the BNA, the project team developed scenarios showing how the BNA scores would change with bicycle facility improvements on targeted streets, which is outlined in greater detail in the Task 3.1 Bicycle Network Analysis – FINAL memo. While this process was completed independently from the bicycle network recommendations, both have overlaps with the eventual network. Scenario 1 shows how BNA scores change along Route 2 from Williston into Burlington; this corridor is already included in the Bicycle Network Recommendations.

The other scenario selects high-stress segments in areas with a high proportion of BIPOC population, households without vehicle access, and/or households with income below the poverty level to create an equity-focused scenario. Many of these segments overlap with segments selected in the Bicycle Network Recommendations, which are shown in Figure 4. In both scenarios, BNA scores increase to very high levels in the areas directly surrounding network improvements, but quickly decline to baseline levels outside those areas due to high-stress segments nearby. This scenario highlights the importance of a connected high-comfort bicycle network, which the Bicycle Network Recommendations intend to achieve.

Figure 3: BNA Score Measure 2

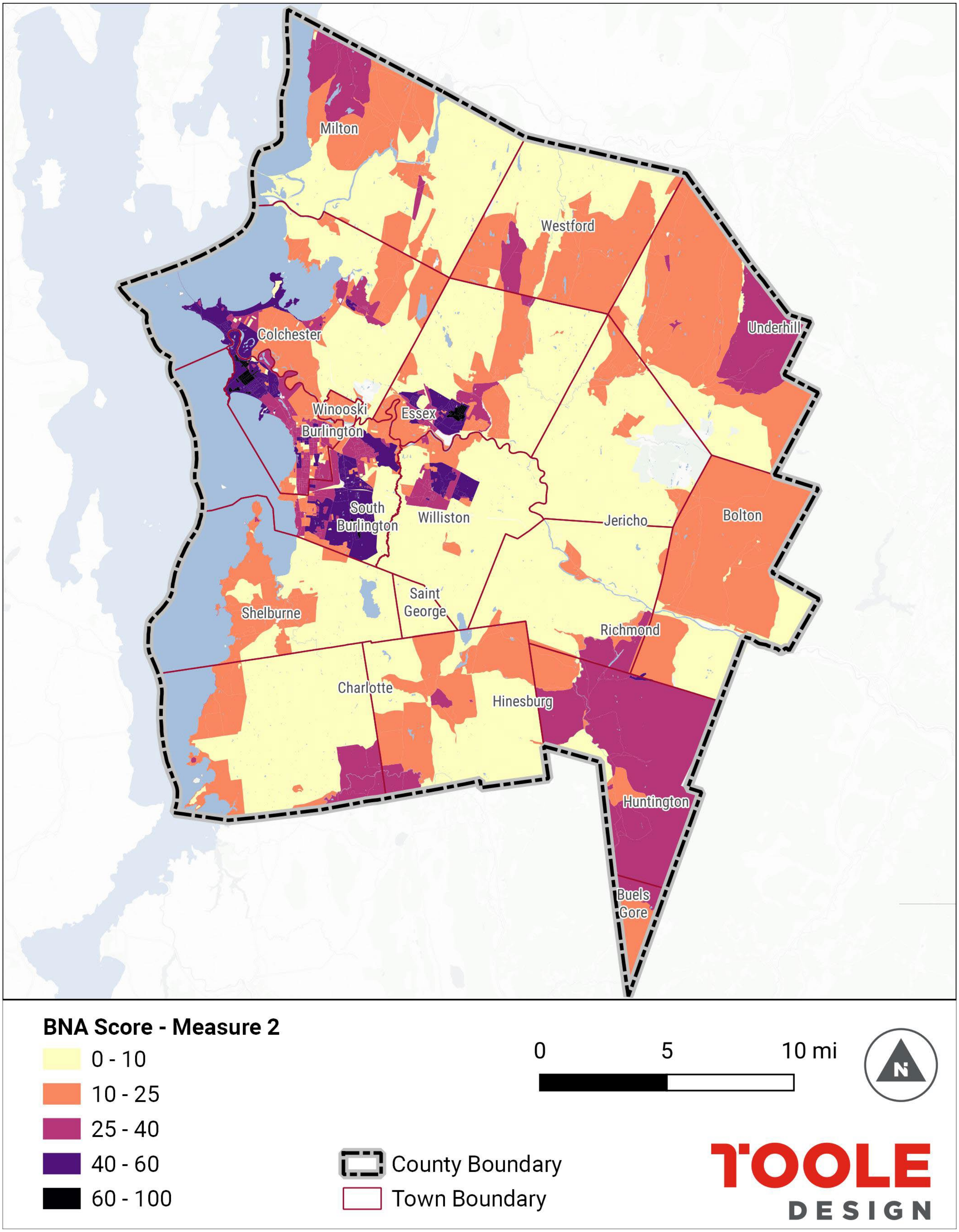
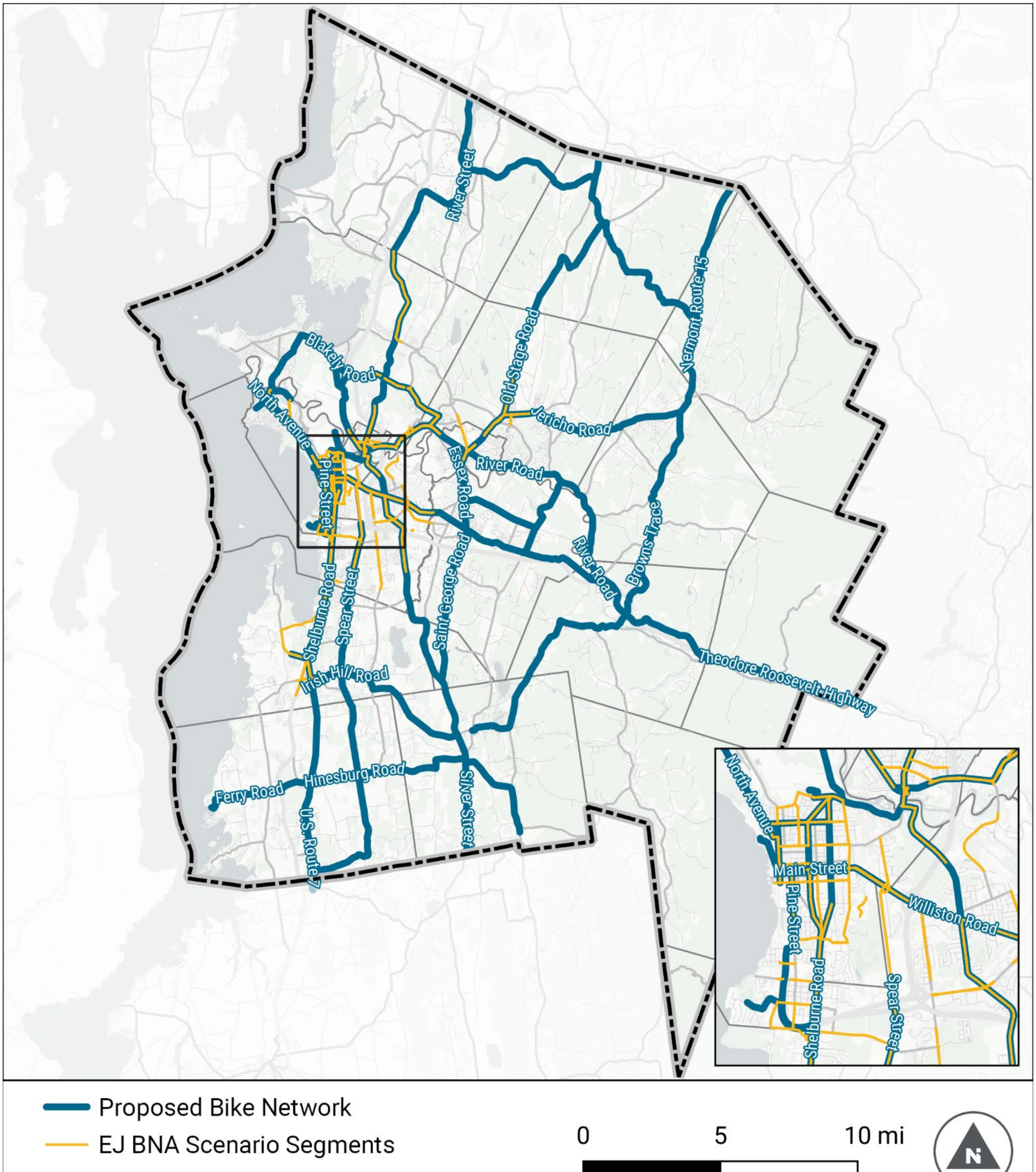


Figure 4: EJ Scenario Network Overlap



Public Input, Existing Bicycle Facilities, TIP, MTP, and Other Destinations

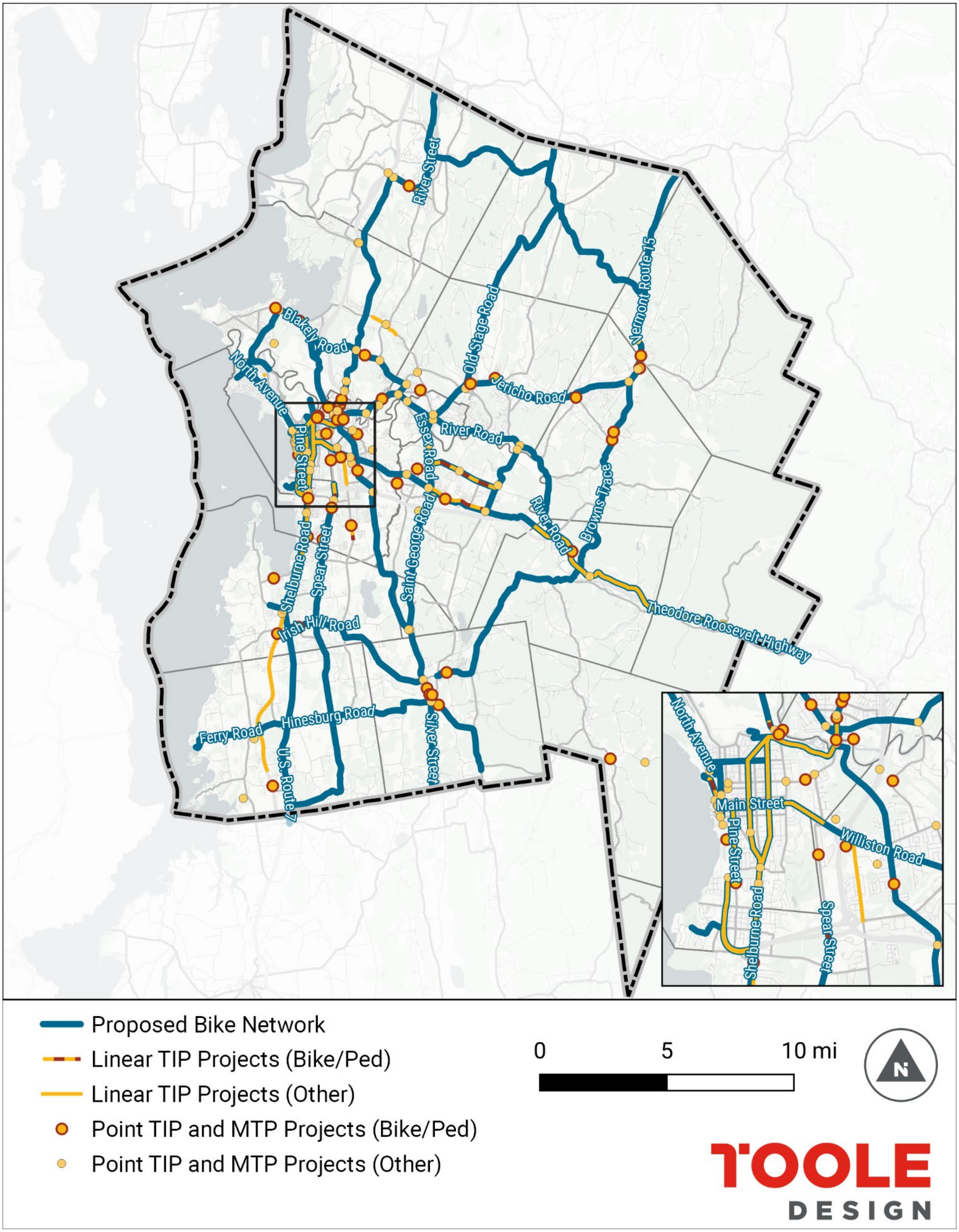
The project team refined bicycle network recommendations by examining desired and actual connections to other planned or existing facilities. Network recommendations connect to existing trails to ensure the recommendations lead to a connected network of comfortable facilities. For example, approximately half a mile of Harbor Road in Shelburne was added to the network to provide a connection between Shelburne Road and the Ti-Haul Trail. Other recommendations end at existing trails, such as the northern terminus of the Spear Street recommendation in South Burlington and the West Lakeshore Drive and Prim Road recommendations in Colchester.

Public feedback indicated desires for connections to facilities like the Waterfront Park in Burlington, which are also included at multiple points. This feedback also indicated desires for connectivity over the interstates separating Burlington from South Burlington, so multiple connections are included in the network.

Many of the network recommendations are located in areas with projects planned in the TIP and MTP. Please refer to Task 1 Materials Review memo for a list of these projects. While some of these are already planned as bike/ped projects, like the path along Williston Road in Williston and the path on Spear Street crossing I-189 in South Burlington, most of these projects are highway-related. These projects present opportunities to incorporate high-comfort bicycle and pedestrian facilities where they coincide with network recommendations. In addition to routes connecting more rural towns with Burlington, such as the TIP project along Shelburne Road through Shelburne and South Burlington, many of these TIP projects make up the core network in Burlington itself where the demand for bicycle facilities is highest. The TIP and MTP projects are shown alongside the bicycle network recommendations in Figure 5.

Finally, the network is designed to accommodate connections to important destinations, particularly schools and future growth centers. For example, connections to the existing network near the University of Vermont are included along Main Street in Burlington and via Spear Street. Since the catchment area for Richmond schools include children in Jericho and Underhill, Browns Trace is included in the network to connect these towns. Similarly, since Hinesburg schools include students living in Shelburne, it was important to include the Shelburne Falls Road/Dorset Street/Irish Hill Road connection in the network in addition to connections to Charlotte, St. George, and Williston that were included as part of the Trip Potential process. The future “growth center” identified in the CCRPC Future Land Use Plan in Colchester is connected to nearby schools, residential areas, and commercial areas with network connections on Roosevelt Highway and Severance/Blakely Roads.

Figure 5: Bicycle Network Recommendations with TIP and MTP Project Locations



Project Level Recommendations

Project Identification

Longer corridors in the network were split into 106 distinct projects that will be individually prioritized as part of Task 5: Project Prioritization. The project team divided these segments based on road characteristics, existing bicycle facility limits, planned TIP project limits, and municipal boundaries.

Changes in the travel and built environments also dictated where corridors were split into different projects. At locations where road characteristics, such as number of travel lanes, the urban context, or the type of existing bicycle facility, changes, proposed routes were split into separate projects. For example, where Roosevelt Highway expands from two to four lanes in Colchester north of Rathe Road, projects are split into #13 to the north and #18 to the south, and where a sidepath along College Parkway/Pearl Street in Colchester and Essex was constructed, project #28 is distinct from #19 to the east and #78 to the west. Often, bridges over key barriers have distinct roadway characteristics from streets on either side, and in these cases are identified as separate projects. For example, project #39 on Colchester Avenue/Main Street where it crosses the Winooski River, #75 on East Allen Street in Winooski where it crosses I-89, and #68 on Hinesburg Road in South Burlington where it crosses I-89.

Similarly, where a section of the network is identified as part of a TIP project, that area is identified as a distinct project, such as project #62 on Williston Road and #72 on Dorset Street in South Burlington, or #85 on Mountain View Road in Williston. In many cases, municipal boundaries were also used as a project limit. In some cases, like where the context changes shortly after a municipal boundary or where a segment crosses multiple municipal boundaries in a short distance, projects span across multiple municipalities. A list of projects can be found in Appendix A.

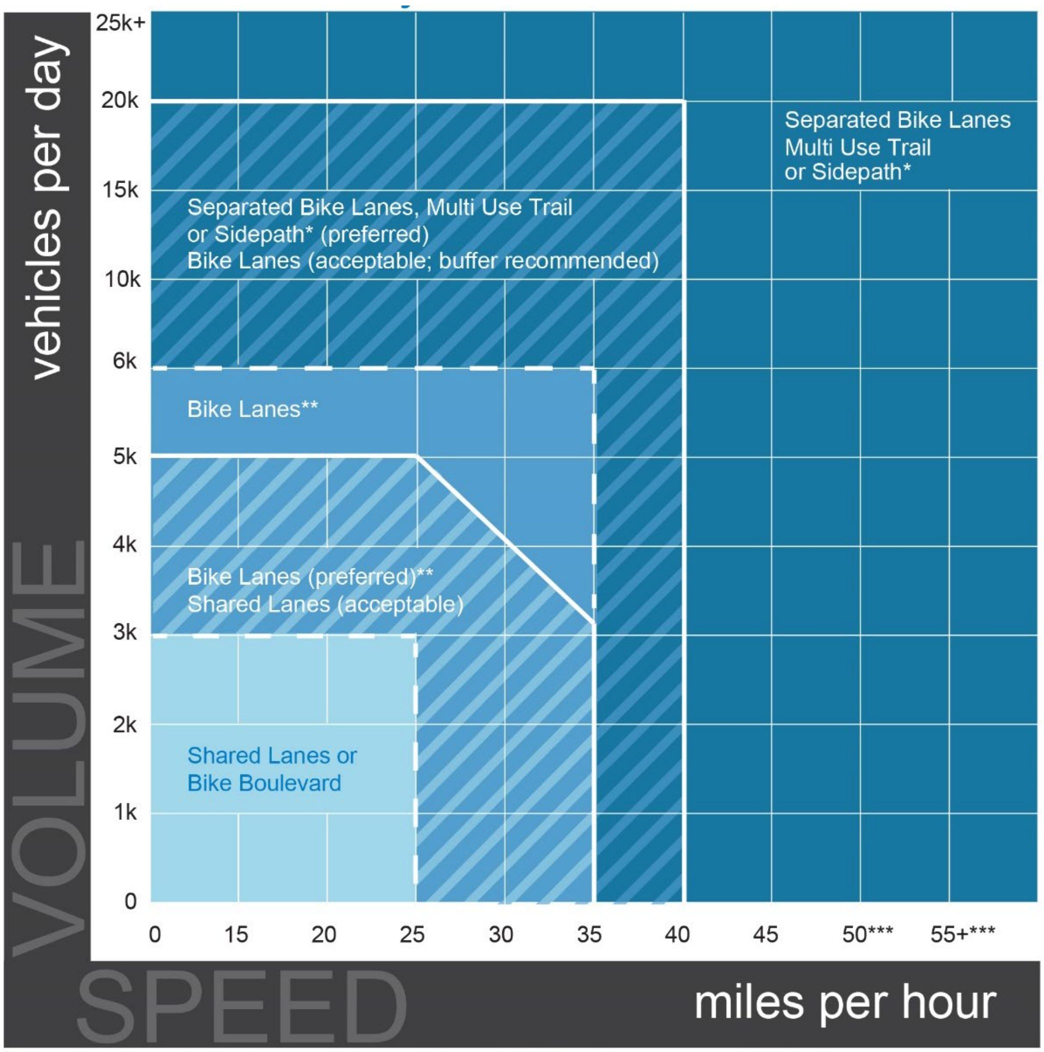
Facility Selection

Bicycle networks should be continuous, connect seamlessly across jurisdictional boundaries, and provide access to destinations. Anywhere a person would want to drive to for utilitarian purposes, such as commuting or running errands, is a potential destination for bicycling. As such, planning connected low-stress bicycle networks is not achieved by simply avoiding motor vehicle traffic. Rather, planners should identify solutions for lowering stress along higher traffic corridors so that bicycling can be a viable transportation option for the majority of the population.

Various methodologies can be used to select the appropriate bicycle facility based on roadway width, traffic volumes, speeds, and other considerations. Figures 6 and 7 provide some guidance on how to select the appropriate facilities based on traffic volume and speed (AADT and speed limits are provided for project segments in Appendix A). These matrices include preferred and acceptable values for each facility type. Designers should utilize forecast traffic volumes if available. Additionally, designers should default to selecting the preferred facility when possible. For more information, refer to the FHWA's Bikeway Selection Guide.

While we are providing resources and data for facility selection, it is beyond the scope of this plan to undertake comprehensive facility selection, which should instead be done as part of individual project scoping and development during plan implementation, in coordination with local agencies and project stakeholders.

Figure 6: Urban Bicycle Facility Selection Matrix

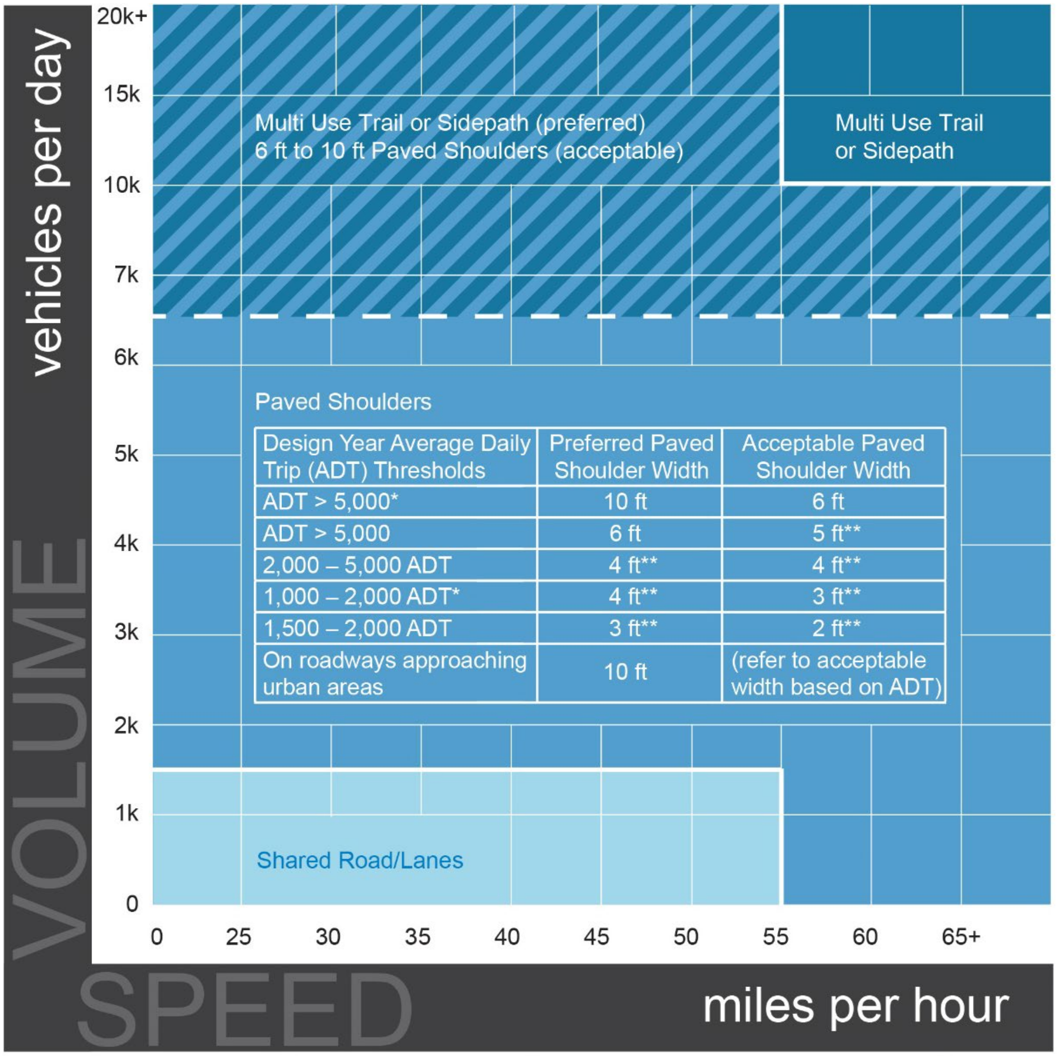


*To determine whether to provide a multi use trail/sidepath or separated bike lane, consider pedestrian and bicycle volumes or, in the absence of volume, consider land use.

**Advisory bike lanes may be an option where traffic volume < 4,000 ADT

***Speeds 50 mph or greater in urban areas are typically found in urban/rural transition areas.

Figure 7: Rural Bicycle Facility Selection Matrix



Design Year Average Daily Trip (ADT) Thresholds	Preferred Paved Shoulder Width	Acceptable Paved Shoulder Width
ADT > 5,000*	10 ft	6 ft
ADT > 5,000	6 ft	5 ft**
2,000 – 5,000 ADT	4 ft**	4 ft**
1,000 – 2,000 ADT*	4 ft**	3 ft**
1,500 – 2,000 ADT	3 ft**	2 ft**
On roadways approaching urban areas	10 ft	(refer to acceptable width based on ADT)

*On roadways where a higher level of bicycle traffic is expected (e.g., bike routes identified by cities, counties, RPAs, and MPOs, as well as official US Bicycle Routes and national trails).
**Paved width exclusive of rumble strips.

Appendix A: Project Segments[1]

Project ID	Street Name(s)	Route #	Functional Class(es)	Speed Limit	AADT	Municipality(ies)	Length (Miles)
1	US 7	US 7	primary	50	8351	Milton	2.8
2	Main Street		tertiary	30	4937	Milton	0.6
3	Westford Road		tertiary	30	2559	Milton	3.0
4	River Street	US 7	primary	35	10847	Milton	1.1
5	U.S. Route 7 South	US 7	primary	50	16506	Milton	3.9
6	Browns River Road, Vermont Route 128	VT 128	secondary	50	4000	Westford	3.2
7	Westford-Milton Road		tertiary	40	2175	Westford	1.8
8	Brookside Road		tertiary	30		Westford	2.1
9	Maple Tree Lane, Woods Hollow Road		tertiary	35		Westford	2.1
10	Machia Hill Road, Osgood Hill Road, Repa Road		residential	25	500	Underhill, Westford	5.3
11	Vermont Route 15	VT 15	primary	50	5771	Underhill, Westford	7.0
12	Vermont Route 15	VT 15	primary	35	7911	Underhill	0.8
13	Roosevelt Highway, U.S. Route 7	US 2;US 7,US 7	primary	50	14772	Colchester	6.1
14	Blakely Road, Severance Road, West Lakeshore Drive	VT 127	secondary	30	13785	Colchester	5.7
15	Heineburg Drive, Prim Road	VT 127	secondary	30	11973	Colchester	2.0
16	Malletts Bay Avenue		tertiary	30	3902	Colchester, Winooski	3.1
17	Lavigne Road		tertiary	25		Colchester	0.6
18	Roosevelt Highway	US 2;US 7	primary	40	30524	Colchester	0.9

[1] Following conversations with CCRPC staff, the project team removed proposed network segments along areas with existing facilities, resulting in certain project numbers being skipped. While the highest project number is 110, there are only 106 total projects.

Project ID	Street Name(s)	Route #	Functional Class(es)	Speed Limit	AADT	Municipality(ies)	Length (Miles)
19	College Parkway	VT 15	primary	35	23633		0.0
20	Old Stage Road		tertiary	40	3061	Essex, Westford	4.6
21	Jericho Road	VT 15	primary	50	13256	Essex	2.8
22	Center Road, Main Street, Upper Main Street	VT 15	primary	40	27393	Essex	2.3
23	Maple Street, River Road	VT 117	primary	40	6706	Essex, Essex Junction	1.1
24	River Road	VT 117	primary	40	8195	Essex	1.0
25	River Road	VT 117	primary	50	9271	Essex	2.0
26	Kellogg Road		secondary,secondary_link	40	10505	Essex	0.6
27	Susie Wilson Road		primary	35	21189	Essex	0.5
29	Vermont Route 15	VT 15	primary	35	7911	Jericho	0.5
30	Vermont Route 15	VT 15	primary	50	11092	Jericho	3.2
31	Browns Trace, Jericho Center Circle		secondary,tertiary	35	4103	Jericho	6.0
32	River Road, Vermont Route 117	VT 117	primary	50	4912	Jericho, Richmond	3.6
33	Burlington Beltline, Heineburg Drive	VT 127	primary			Burlington, Colchester	1.1
34	Plattsburg Avenue		primary_link,secondary	30	8851	Burlington	0.8
35	Starr Farm Road		residential	25	500	Burlington	0.5
36	North Avenue, Sherman Street		secondary,tertiary	30	16338	Burlington	3.2
37	Intervale Road		unclassified	25	500	Burlington	0.9
38	Intervale Avenue, Manhattan Drive, Riverside Avenue	US 7 Alternate	residential,secondary,tertiary	25	9911	Burlington	0.4
39	Colchester Avenue, Main Street	US 2;US 7	primary	25	25096	Burlington, Winooski	0.1
41	Colchester Avenue		secondary	25	12444	Burlington	0.6
42	Barrett Street, Chase Street, Grove Street		tertiary	25	6227	Burlington	0.7
43	North Winooski Avenue, Saint Paul Street, Shelburne Road, Shelburne Street, South Winooski Avenue	US 7,US 7 Alternate	primary,secondary,tertiary	30	17427	Burlington	2.0

Project ID	Street Name(s)	Route #	Functional Class(es)	Speed Limit	AADT	Municipality(ies)	Length (Miles)
44	North Willard Street, Shelburne Road, South Willard Street	US 2;US 7,US 7	primary	30	6969	Burlington	1.9
45	North Prospect Street		tertiary	25	3975	Burlington	0.6
46	North Street		tertiary	25	5602	Burlington	0.8
47	Battery Street, Maple Street, Park Street	VT 127	primary,tertiary	25	15892	Burlington	0.8
48	Colchester Avenue		secondary	25	13976	Burlington	0.4
49	East Avenue		primary,primary_link,secondary	35	14139	Burlington	0.9
50	Colchester Avenue, Pearl Street		primary,secondary,tertiary	25	11192	Burlington	0.9
51	College Street, Lake Street, Penny Lane		residential,tertiary	25	4405	Burlington	0.5
52	Ledge Road, South Prospect Street		tertiary	25	11193	Burlington	1.7
53	Main Street	US 2	primary	25	30363	Burlington	0.9
54	Main Street, Williston Road	US 2	primary	25	44556	Burlington	1.1
55	Pine Street		secondary	25	10216	Burlington	1.1
56	Shelburne Road, Shelburne Street	US 7	primary,trunk	30	32502	Burlington	1.2
57	Champlain Parkway					Burlington	2.0
58	Austin Drive, Home Avenue		residential,tertiary	25	500	Burlington	0.5
59	Patchen Road		tertiary	25	6784	South Burlington	1.1
60	Spear Street		primary,secondary	25	4840	South Burlington	0.6
61	Williston Road	US 2	primary	35	44556	South Burlington	0.6
62	Williston Road	US 2	primary	35	30032	South Burlington	0.4
63	Williston Road	US 2	primary	35	15538	South Burlington, Williston	2.0
64	Hinesburg Road	VT 116	primary	35	9679	South Burlington	1.5
66	Spear Street		secondary	35	6290	South Burlington	0.7
68	Hinesburg Road	VT 116	primary	40	5869	South Burlington	0.2
69	Hinesburg Road	VT 116	primary	50	5869	South Burlington	2.6
70	Shelburne Road	US 7	trunk	40	38277	Shelburne, South Burlington	7.6
71	Spear Street		secondary	35	6290	South Burlington	1.9
72	Dorset Street		tertiary	40	5816	South Burlington	0.6

Project ID	Street Name(s)	Route #	Functional Class(es)	Speed Limit	AADT	Municipality(ies)	Length (Miles)
73	Main Street	US 2;US 7	primary	25	17126	Winooski	0.7
74	Malletts Bay Avenue		tertiary	25	3902	Winooski	0.5
75	East Allen Street	VT 15	primary	35	23633	Winooski	0.4
76	East Allen Street	VT 15	primary	25	18789	Winooski	0.6
77	East Allen Street, Main Street, West Allen Street, West Center Street	US 2;US 7,VT 15	primary,primary_link,tertiary	25	15160	Winooski	0.7
78	Pearl Street	VT 15	primary,primary_link	25	19683	Essex, Essex Junction	1.1
79	Main Street, Park Street	VT 15,VT 2A	primary	35	16960	Essex Junction	1.7
80	Pearl Street	VT 15	primary	35	13975	Essex Junction	1.1
81	Maple Street	VT 117	primary	25	7466	Essex Junction	0.9
82	Essex Road	VT 2A	primary	25	16960		0.1
83	North Williston Road		tertiary	40	6399	Essex, Williston	3.1
84	Essex Road	VT 2A	primary	40	16380	Williston	0.9
85	Mountain View Road		tertiary	40	5378	Williston	2.9
86	Williston Road	US 2	primary	40	13768	Williston	1.3
87	Williston Road	US 2	primary	40	10929	Williston	4.1
88	Saint George Road	VT 2A	primary	35	19721	Williston	0.8
89	Saint George Road, Vermont Route 2A	VT 2A	primary,primary_link	50	10671	Saint George, Williston	5.0
90	Theodore Roosevelt Highway	US 2	primary	50	5579	Bolton	5.6
91	Dorset Street		secondary,tertiary	40	5816	Shelburne, South Burlington	3.9
92	Spear Street		secondary	35	6290	Shelburne	3.0
93	Vermont Route 116	VT 116	primary	50	10671	Saint George, Shelburne, Williston	3.5
94	Falls Road, Harbor Road		tertiary	35	5253	Shelburne	1.3
95	Falls Road, Irish Hill Road		secondary	35	5829	Shelburne	2.2

Project ID	Street Name(s)	Route #	Functional Class(es)	Speed Limit	AADT	Municipality(ies)	Length (Miles)
96	Jericho Road		tertiary	45	3546	Jericho, Richmond	2.3
97	West Main Street	US 2	primary	50	12022	Richmond	1.2
98	West Main Street	US 2	primary	40	8330	Richmond	1.5
99	East Main Street	US 2	primary	50	4120	Richmond	3.7
100	Bridge Street		tertiary	25	6736	Richmond	0.6
101	Hinesburg Road, Huntington Road		tertiary	45	4048	Richmond	4.5
102	Vermont Route 116	VT 116	primary	50	10671	Hinesburg, Saint George	2.6
103	Shelburne Falls Road, Shelburne Hinesburg Road		secondary	45	5329	Hinesburg, Shelburne	3.9
104	Richmond Road		tertiary	35	2805	Hinesburg, Richmond	3.6
105	Vermont Route 116	VT 116	primary	30	12326	Hinesburg	0.8
106	Charlotte Road, Church Hill Road, Ferry Road, Hinesburg Road	VT F-5	secondary,tertiary	50	3073	Charlotte, Hinesburg	10.1
107	Silver Street		tertiary	40	4620	Hinesburg	3.4
108	Vermont Route 116	VT 116	primary	50	3794	Hinesburg	4.1
109	Mount Philo Road		tertiary	45	1822	Charlotte, Shelburne	7.4
110	Spear Street		tertiary	45	1712	Charlotte, Shelburne	9.1