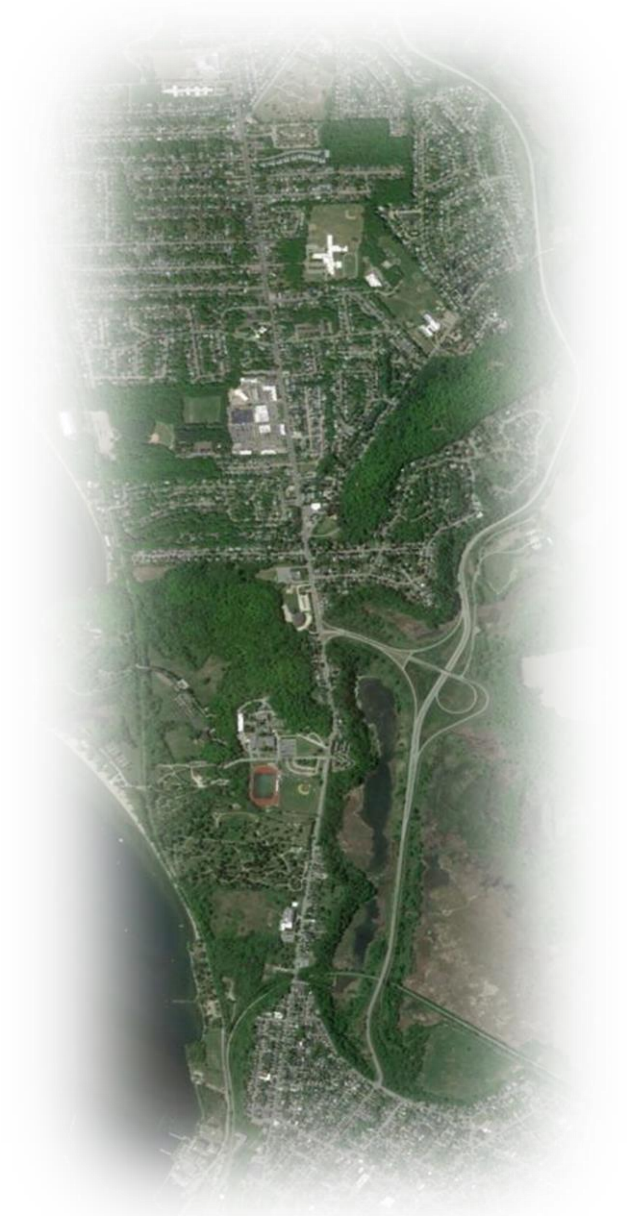

North Avenue Corridor Study

Final Report

October 2015

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Disclaimer:

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Chapter 1

Introduction & Overview

Background

North Avenue is the primary street linking the New North End neighborhoods with downtown Burlington. The street functions as a north-south minor urban arterial lined with residential, commercial, institutional, and recreational uses. Very few pass-through trips use North Avenue given the availability of VT 127, a parallel limited-access highway that provides a more direct route for trips that do not originate or end in the New North End. North Avenue thus functions as the New North End's "Main Street", providing access to adjacent land uses for local traffic consisting of pedestrians, cyclists, transit passengers, and motorists alike.

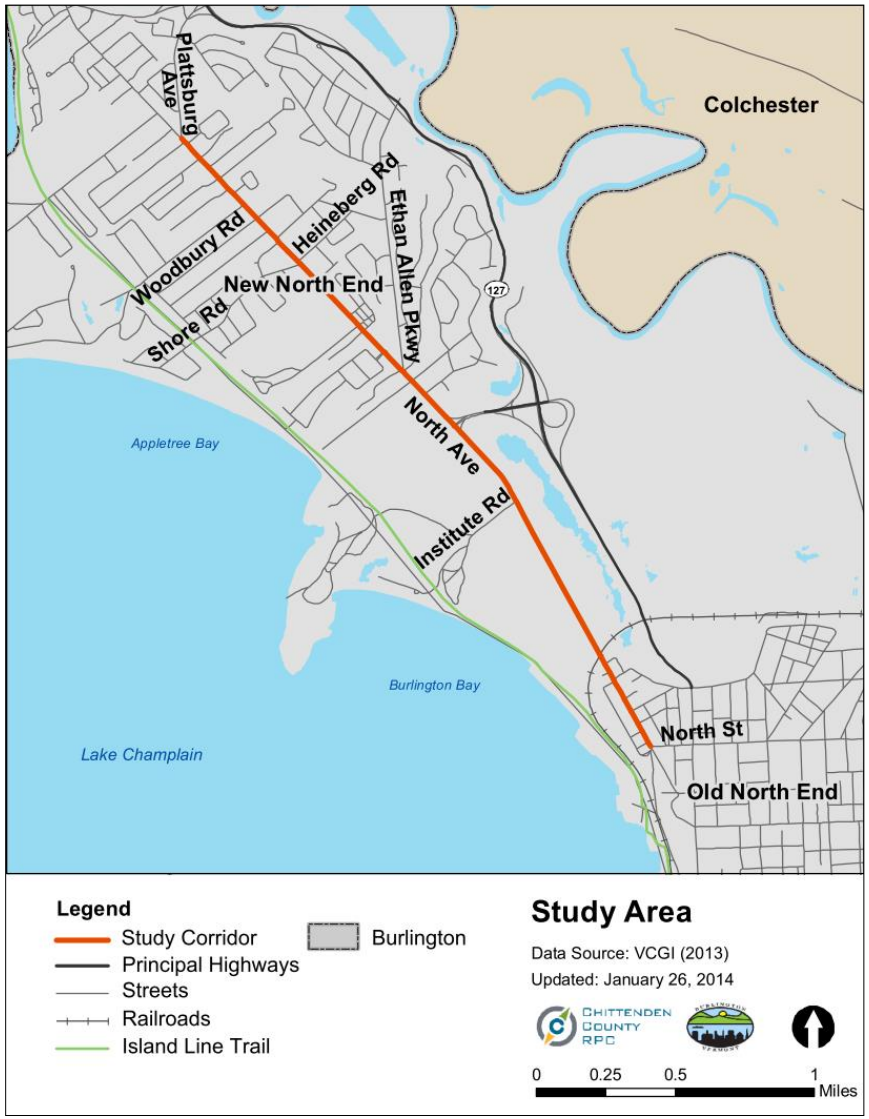
In 2013 the City of Burlington and the Chittenden County Regional Planning Commission (CCRPC), initiated a planning study to transform North Avenue into a complete streets corridor—one that safely accommodates all users regardless of age, ability, or modal preference as effectively as possible, preferably within the existing right-of-way.

The resulting *North Avenue Corridor Study* recommends complete streets improvements that meet the vision and goals for this 2.8-mile corridor based on evaluation of the existing and future transportation conditions. Figure 1 shows the study area, which is located between Plattsburg Avenue in the north and North Street in the south.

The complete streets vision for North Avenue, as well as other main streets within Burlington, was first presented in the City of Burlington Transportation Plan, *Moving Forward Together* (adopted in March 2011). Its vision stated that:

"…transportation functions as part of an interconnected system which offers a range of choices that are safe, affordable, efficient, and convenient for residents, employees, and visitors alike. As a result, rail,

Figure 1: North Avenue Corridor Study Area



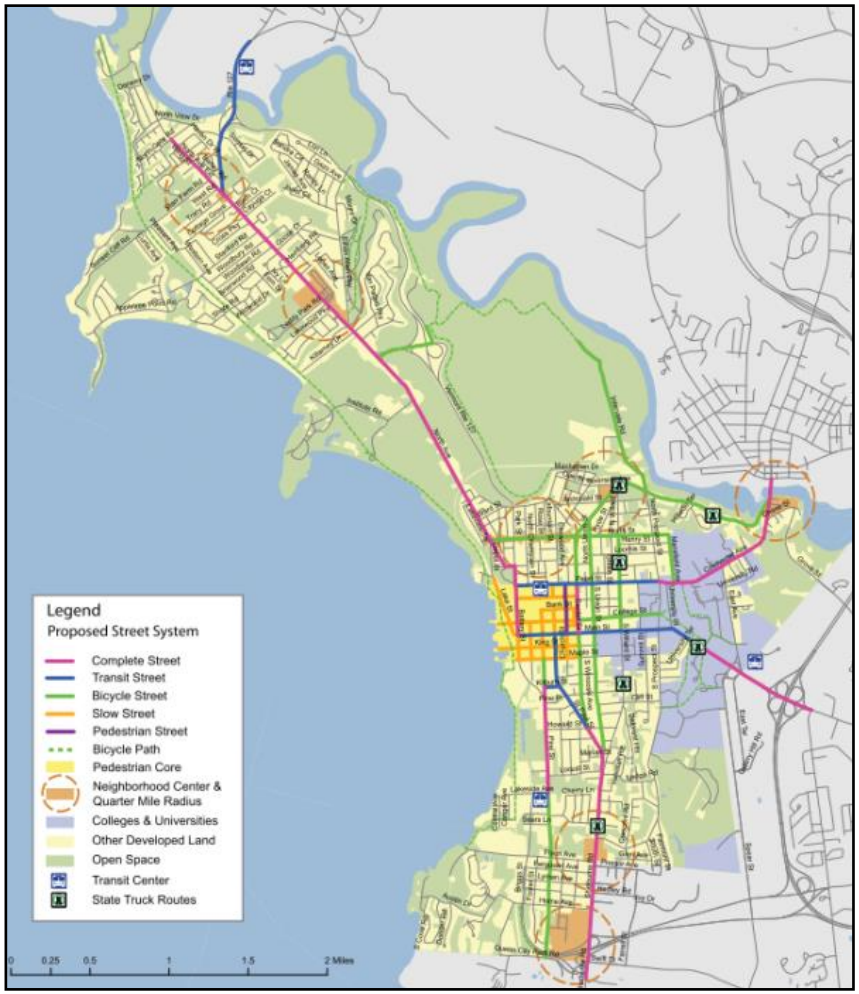
air, ferries, transit, cycling, and walking are successfully competing with the automobile for the dominant mode of choice. Local and regional multimodal corridors and centers are maximizing our use of existing infrastructure, while eliminating congestion, preserving air quality, and conserving energy. Commuters, families, and employers are benefiting from a diverse array of transportation demand management strategies such as car- and van-pools, flexible work schedules, and telecommuting. Land use and transportation decisions are considered together, significantly reducing the need for individual automobiles and large parking facilities. Greater use of rail for freight has been embraced as an effective means of removing trucks from neighborhood streets. City streets are attractive public spaces, and function as part of a system of interconnecting streets. Circulation within the downtown, waterfront, neighborhood activity centers, and institutional campuses is predominantly oriented to the pedestrian. A series of trails and paths provide access between neighborhoods and areas of protected open space."

The citywide plan proposed a street classification system—complete streets, transit streets, bicycle streets, slow streets, pedestrian streets—that designates modal priority within Burlington (

Figure 2). In addition to designating North Avenue as a complete street, the classification system included the following proposed elements relevant to the North Avenue corridor that are vital to realizing Burlington's transportation vision:

- Plattsburg Avenue, the study area's northern terminus, is proposed as a "transit street", designed to accommodate bus and other transit service efficiently, giving transit a "leg up" over the automobile.
- North Street and the VT 127 connector are proposed as "bicycle streets", designed to prioritize bicycles with treatments that enhance bicycle convenience and safety.
- Neighborhood Activity Centers, which are mixed-use centers designed to support multi-modality amongst surrounding neighborhoods, are identified at the Plattsburg Avenue and

Figure 2: City of Burlington Proposed Street System



Ethan Allen Shopping Center intersections near Leddy Park Road.

The *Street Design Guidelines*, included as an appendix to the Transportation Plan, detail the key elements, dimensions, and cross-sections for each street typology in the identified transportation strategy.

Study Process

The *North Avenue Corridor Study* is the second planning project to develop, analyze, evaluate, and recommend improvement concepts from a complete streets perspective in Burlington. Future improvements to North Avenue are intended to safely balance all modes of transportation and accommodate all users. The study process followed several steps:

1. Assessed Existing and Future Corridor Conditions: land uses, traffic operations, crash history, transit service, and pedestrian and bicycle accommodations for year 2013 and year 2035.
2. Developed Vision and Goals with the assistance of the public and the Advisory Committee.
3. Developed Multimodal Improvement Concepts for corridor-wide, intersection, and cross-section improvements.
4. Evaluated Multimodal Improvement Concepts against the corridor's vision and goals.
5. Created a draft Implementation Plan for the City Council's consideration through an Advisory Committee voting process that narrowed the universe of improvement concepts and prioritized project implementation.

Public and Stakeholder Input

The *North Avenue Corridor Study* was predicated on a public involvement and outreach campaign from start to finish. These stakeholders were instrumental in assisting with the creation, refinement, and, ultimately, selection of recommended intersection, cross section, and corridor-wide improvement concepts.

Advisory Committee

Working in tandem alongside the public involvement process, an Advisory Committee was formed to participate in developing the North Avenue corridor's vision, goals, and improvement concepts, and to communicate with and provide updates to the organizations or constituents that they represented on the committee. The committee represented a broad range of community organizations and interests including: Burlington City Council, Neighborhood Planning Assemblies for Wards 3, 4 and 7, Chittenden County Transportation Authority (CCTA), AARP Vermont, Burlington Partnership for Healthy Communities, Local Motion, and City Departments of Planning & Zoning, Community and Economic Development, and Public Works. The group met six times between June 2013 and July 2014.

Public Involvement

More than 160 people attended three public workshops between October 2013 and May 2014. Each interactive workshop solicited information and opinions from the public. At the first workshop, participants worked in small groups to identify existing issues throughout the corridor. Using this information, as well as other existing conditions data and analysis results, the second workshop presented initial improvement concepts. Participants were asked to provide comments and suggestions to further refine concepts. Finally, the third and last public workshop presented updated intersection and cross section concepts, followed by an open house format where participants discussed and commented on the concepts with the study team. Participants were asked to vote on their preferred concepts, but voting results proved inconclusive. Some trends were apparent, however, such as preferences for separated and protected cycling facilities as well as single-lane roundabouts.

The City augmented these public workshops with an online voting tool that allowed users to vote on preferred concepts, voice their support or concerns, and 'up vote' or 'down vote' other participants' comments. There was also outreach to two North End stakeholder groups: Heineburg Senior Center and the Flynn School Parent Teacher Organization.

The CCRPC hosted a project website that included all of the project materials and an online contact form to gather additional public feedback. The information and feedback gathered via the public involvement processes helped tailor improvement concepts to respond to community issues.

Appendix A documents the public engagement process and comments received for this study.

Figure 3: Final Public Workshop

Vision and Goals

The study team worked alongside the public and the Advisory Committee to craft the complete vision and goals for the North Avenue corridor. The vision provides an idealized picture of the corridor in the future. It generalizes how the corridor should function, look, and interact with the surrounding community. The goals will help achieve the future vision for the corridor over time.

Corridor Vision Statement

North Avenue will continue to serve as the primary transportation corridor connecting Burlington's New North End with the rest of the City. As the North End's "Main Street," North Avenue will provide for **safe, inviting, and convenient travel for all users of all ages and abilities** —including motorists, pedestrians, bicyclists, and public transportation riders. The **need to move people through the corridor will be balanced with the need to provide access to homes, businesses, and local institutions.** The corridor will develop into an **attractive public space** through creative streetscape, signage, and other site design features. The corridor will become more **livable** and **desirable by promoting social interaction, public health, economic development, and environmentally sustainable** initiatives.

Corridor Goals

Remake the North Ave corridor into a "Complete Street" that accommodates the safe and efficient travel for all users of all abilities and provides transportation choices.

- Achieve a world class transportation corridor that offers quality of service and highest safety for those who walk, bicycle, and travel by motor vehicle or transit.
- Identify near-term improvements that can be implemented now to improve the safe and convenient accommodation of all corridor users.
- Develop a longer-term plan for fully remaking the corridor according to "Complete Streets" principals.

Improve safety for all users.

- Pedestrians – improve condition of sidewalks and upgrade to meet current ADA standards; identify convenient/desirable crossing locations; and incorporate high visibility and driver awareness measures at crosswalks.
- Bicyclists – provide dedicated space and bicycle treatments to form a continuous, high quality bicycle corridor that facilitates travel in and out of the New North End.
- Design facilities with all users in mind including children and seniors.
- Address high crash locations and congested locations.
- Improve access management and left turn accommodations on the corridor to reduce conflicts.
- Calm traffic and moderate travel speeds.

Provide a range of convenient and efficient travel options and improve multimodal connections.

- Promote transportation options.
- Improve transit service in the corridor:
    - Reduce headways
    - Add shelters
    - Increase span of service during the day and weekend service
    - Ensure efficient flow of buses along the corridor
    - Improve access (sidewalks, bike access) to transit shelters/stops

- Improve pedestrian facilities.
- Develop a safe, efficient and continuous bicycle network.
- Promote Transportation Demand Management (TDM) initiatives in the corridor.

Develop strategies that support vibrant and livable neighborhoods in the New North End; enhance the quality of life of residents and visitors; and support sustainable economic growth.

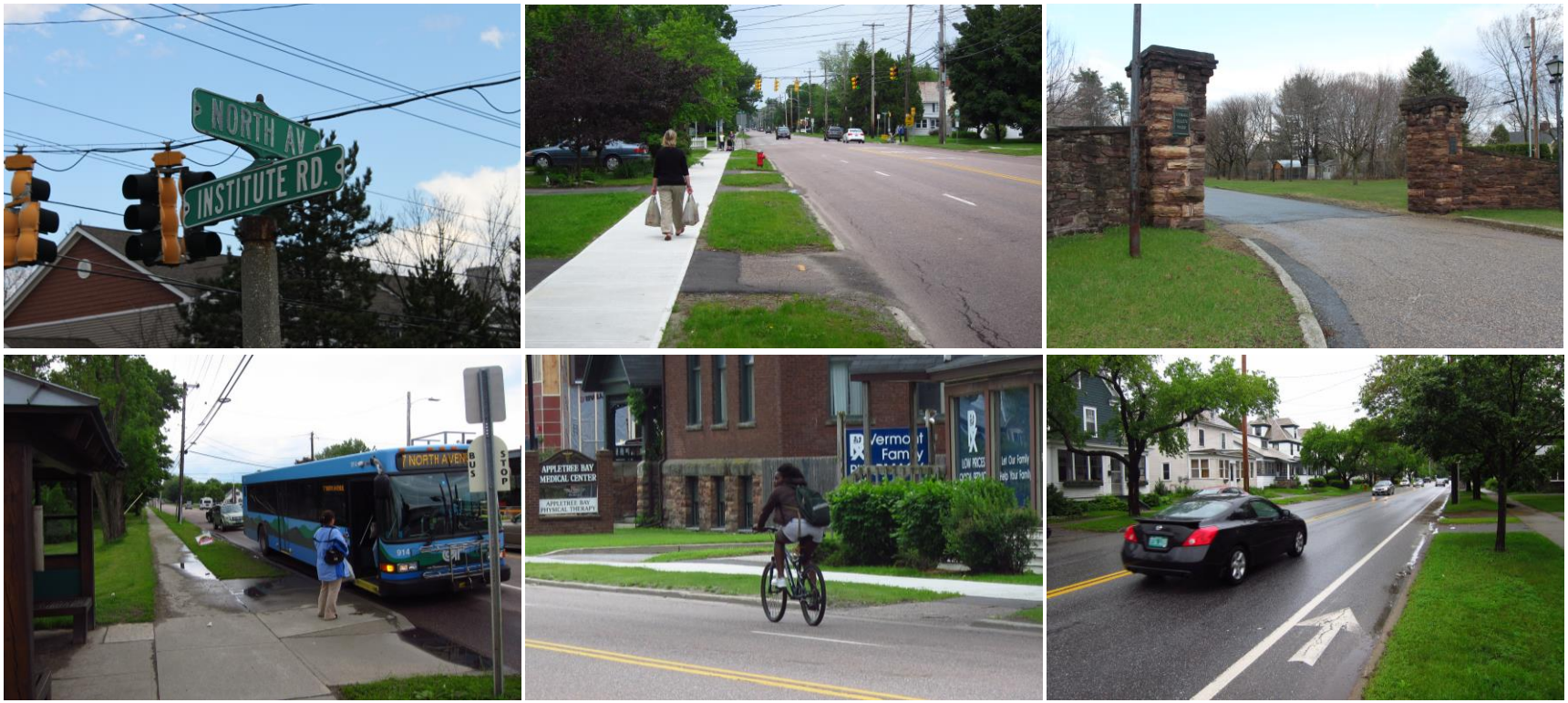
- Improve the visual character with streetscape treatments and other amenities that promote and enhance the pedestrian environment and public realm.
- Create attractive and inviting public spaces.
- Support economic development consistent with City planning objectives
- Enact supportive zoning/land use regulations including those that address building location and urban design specific to the corridor.
- Incorporate sustainable design practices.

Report Contents

The remainder of this final report provides a comprehensive summary of the assessment of existing and future conditions (Chapter 2), development and evaluation of multimodal improvement concepts (Chapter 3), and proposed Implementation Plan and City Council resolution (Chapter 4). Additional detail regarding the evaluation process, health impact assessment, and public involvement process is provided in the appendices.

Chapter 2

Existing and Future Corridor Conditions



CHAPTER 2: EXISTING AND FUTURE CORRIDOR CONDITIONS

This chapter describes issues and inventories existing corridor-wide transportation conditions and land uses along North Avenue as well as specific segment-by-segment details. This chapter also includes intersection traffic analyses for existing and estimated future traffic volumes (2035) and growth projections. The corridor has been divided into five segments to better present information/data. These segments are:

- Plattsburg Avenue to Shore Road
- Shore Road to VT 127 ramps
- VT 127 ramps to Institute Road
- Institute Road to Washington Street
- Washington Street to North Street

Corridor Issues

Members of the public and the Advisory Committee use North Avenue regularly and understand its multimodal transportation issues thoroughly, along with the impact these issues have on their community's livability. The study team reached out to all stakeholders early in the planning process to help identify these existing corridor-wide issues. The issues provided a starting point for the existing conditions analysis and a barometer for how well improvement concepts were responding to community needs. Identified issues included all modes, covering safety and operations:

- Few opportunities for pedestrians to safely cross North Avenue;
- Outdated curb ramps and poor sidewalk conditions;
- Missing pedestrian crossings at certain intersection approaches;
- Lack of audible countdown pedestrian signals;
- Frequent driveways along certain corridor segments;
- Several offset/skewed intersections (Ethan Allen Parkway, Shore/Heineberg, Plattsburg Ave), which are difficult to navigate as a pedestrian or cyclist;
- Missing/substandard bicycle facilities in certain corridor segments;
- Limited bus shelters;
- Limited weekend transit service, particularly on Sundays;
- Wide travel way from Plattsburg Ave to Shore Rd (unclear where on-street parking is allowed);
- Travel lanes are narrow and left turns block through lanes between Shore Road and the VT 127 ramps; and
- High vehicle speeds, particularly between Institute Road and Washington Street.

Subsequent sections of this chapter present detailed information and analyses of transportation and land use conditions along the North Avenue corridor.

Existing Land Uses

Existing development along North Avenue consists of a mix of residential, commercial and municipal uses. Residential uses dominate, and they typically consist of single family homes on moderately sized lots. More recently, several higher-density, multi-family infill residential developments have been constructed along the corridor. Farrington's Mobile Home Park is located on the east side of North Avenue, opposite the Ethan Allan Shopping Center, while a large public housing development is located east of North Avenue just south of Plattsburg Avenue. The Heineberg Senior Center and Thayer House are located directly off North Avenue, providing dedicated senior housing within walking distance of the Ethan Allen Shopping Center.

The major commercial travel generator along the corridor is the Ethan Allen Shopping Center, which is anchored by a Hannaford Supermarket & Pharmacy (Figure 4). Other commercial uses include several

convenience stores, food services, professional offices, banks, and gas stations located throughout the corridor.

Institutional uses along North Avenue include the Flynn Elementary School, located just north of the study corridor at Starr Farm Road; Burlington Fire Station located between Staniford Road and Woodbury Road; the Lyman Hunt Middle School and Miller Community Center at Woodbury Road; nearby Smith Elementary School accessed via Ethan Allen Parkway; the Post Office at Ethan Allen Shopping Center; the Burlington High School and Burlington Technical Center located at Institute Road.

North Avenue also provides access to several park and recreation areas, such as Ethan Allen Park and Leddy Park, located at and just north of the North Avenue/Ethan Allen Parkway intersection, respectively. The waterfront shared use path and Route 127 path run parallel to North Avenue, the former accessible via most streets west of the Avenue and the latter accessible from Ethan Allen Parkway.

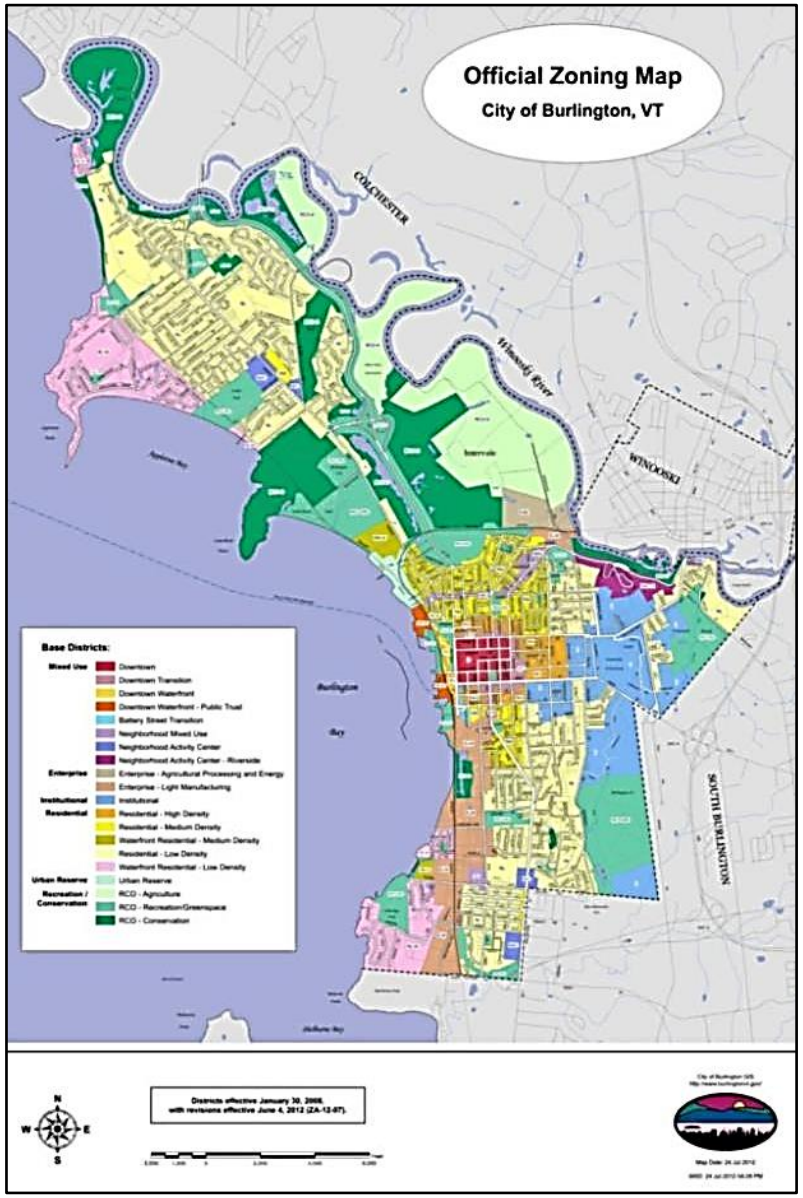
Other notable uses that are located on or accessed from North Avenue include major trip generators such as private schools and churches. From north to south, these include Saint Mark Church at Shore Road, Champlain Valley Baptist Church in the Ethan Allen Shopping Center, North Avenue Alliance Church at the intersection with the VT 127 ramps, Rock Point School and the Episcopal Diocese of Vermont located off Institute Road, and Burlington College located just south of the Lakeview Cemetery.

Figure 4: Major Trip Generators

Figure 5 illustrates the City of Burlington zoning districts, which largely reflect the existing land use patterns. Along North Avenue, the corridor is zoned Residential-Low Density from Plattsburg Avenue to just south of Shore Road. South of this location, the corridor is zoned Residential-Low Density and Residential-Medium Density to Ethan Allen Parkway, with Neighborhood Activity Center zones at the location of the Ethan Allen Shopping Center and the Rite Aid lot. From Ethan Allen Parkway to Burlington College, the corridor is surrounded by Residential-Low Density, Recreation/Greenspace, and Conservation zoning districts.

Further south in the Old North End the corridor is primarily surrounded by medium density residential zones. While the corridor is largely built out, infill development at higher intensity is possible in the areas that allow higher density, including the Old North End and near the Ethan Allen Shopping Center.

Figure 5: City of Burlington Zoning



Corridor-wide Transportation Characteristics

North Avenue is a minor arterial, ranging from a two- to four-lane cross section with 10' to 13' travel lanes. On-street parallel parking is provided on some segments of the corridor. The presence of conventional bicycle lanes varies by segment. The right-of-way is consistently 66', but the southernmost section is constrained by encroaching development. The total curb-to-curb roadway ranges from approximately 33' to 50+' wide. Continuous sidewalks are provided on both sides of North Avenue, located directly adjacent to the roadway in some locations and separated from the roadway by several feet of greenspace in other locations.

Traffic Control and Regulations

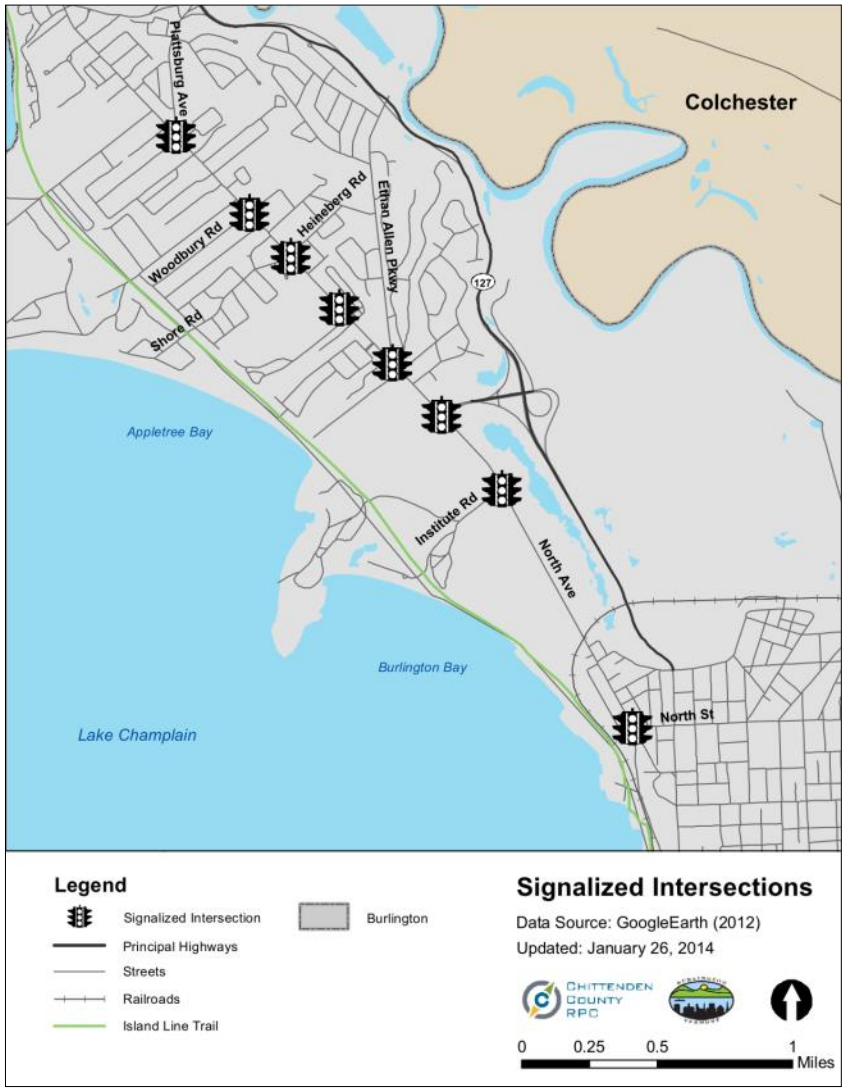
Traffic signals govern traffic movements at major intersections along North Avenue (Figure 6):

- Plattsburg Avenue
- Woodbury Road
- Shore Road/Heineberg Road
- Ethan Allen Shopping Center
- Ethan Allen Parkway
- VT 127 Connector
- Institute Road
- North Street

At the North Street/North Avenue intersection, traffic signals are installed on the street light posts. The other intersections have signal heads that hang from an overhead wire that runs diagonally across the intersection. These signals can be buffeted in windy conditions and are sometimes more difficult to see.

Connections to North Avenue from surrounding collector and local streets are stop-sign controlled. Numerous driveways with direct access to North Avenue are also present on the corridor, as many single- and multi-family residences line both sides of the street.

Figure 6: Location of Signalized Intersections



Current Traffic Volumes and Operating Conditions

Traffic Volumes

North Avenue between Ethan Allen Parkway and VT 127 is the busiest segment on the corridor, carrying some 19,100 vehicles per day (Figure 7). Volumes elsewhere on the corridor range from about 10,800 to 13,700 vehicles daily. The VT 127 connection carries about 7,700 vehicles daily, while Plattsburg Avenue to the north accommodates 6,600 vehicles (also connecting to VT 127).

As typical in urban areas, traffic peaks during the morning and afternoon commute. Because of the high prevalence of schools along the corridor, the morning peak is quite pronounced, and the afternoon peak extends from around 3:00 PM (end of school) to 5:00 PM.

Figure 8 shows the 24-hour distribution of traffic south of Institute Road, where both morning and afternoon traffic peaks at just over 1,000 vehicles per hour (total, both directions). The higher southbound volumes during the morning, and conversely higher northbound volumes during the afternoon, reflect commute trips into the downtown Burlington area. Figure 9 similarly shows the hourly distribution of traffic between 7:00 AM and 6:00 PM between Ethan Allen Parkway and VT 127. This location is less dominated by school trips; hence the afternoon peak is more spread out than the morning peak; commute, shopping and school trips tend to occur during the afternoon. Note that volumes for each signalized intersection are provided in the Segment Descriptions section later in this chapter.

Figure 7: Current Daily Traffic Volumes

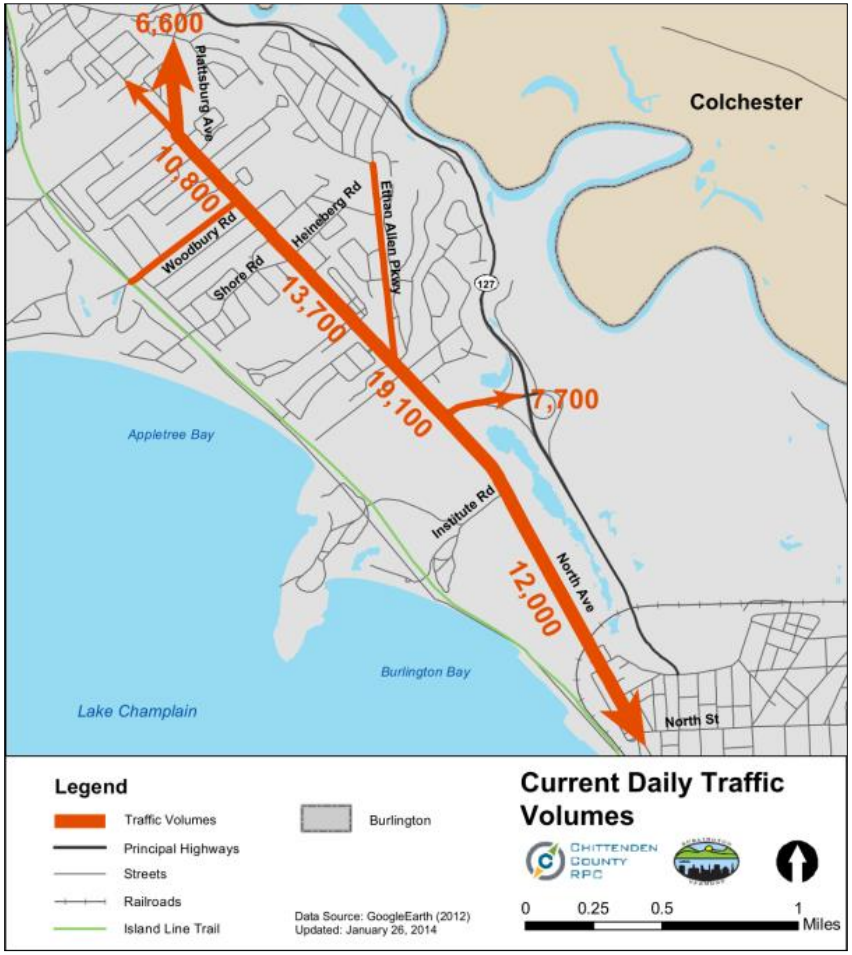


Figure 8: North Ave Hourly Traffic over a 24-Hour Period South of Institute Rd

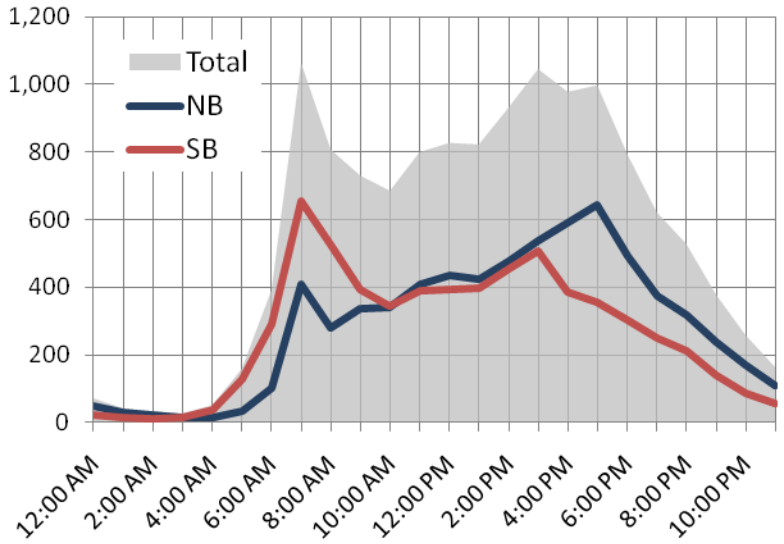
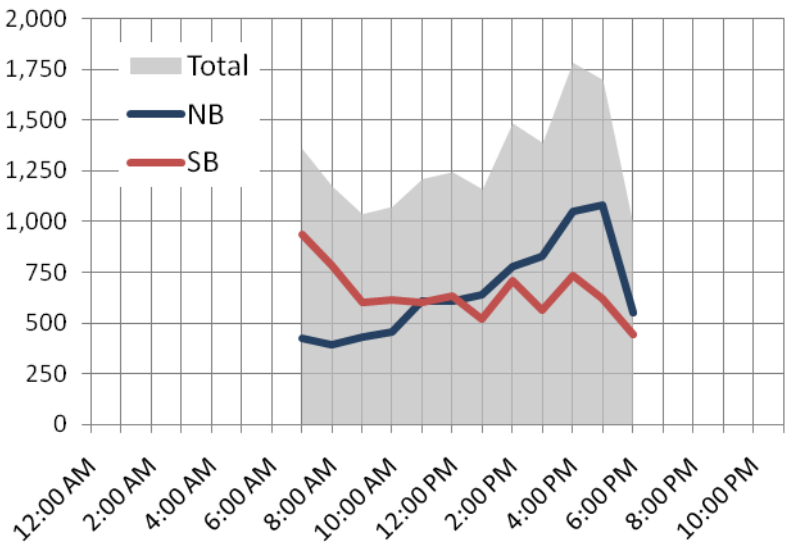


Figure 9: North Ave Hourly Traffic between 7:00 AM and 6:00 PM between Ethan Allen Pkwy and VT 127 Ramps



AM and PM Peak Hour Operating Conditions

Traffic operating conditions along North Avenue were evaluated using Synchro, a traffic analysis software package developed by Trafficware. Results are based on analytical methodologies detailed in the 2010 Highway Capacity Manual (HCM).

Results are presented in terms of Level of Service (LOS) using the ranges established by the 2010 HCM:

LOS A	Less than 10 seconds of delay per vehicle
LOS B	10 to < 20 seconds
LOS C	20 to < 35 seconds
LOS D	35 to < 55 seconds
LOS E	55 to < 80 seconds
LOS F	80 seconds or more delay per vehicle

Level of Service (LOS)

Level of Service, or LOS, is a standard measure of operational effectiveness for transportation facilities. LOS is defined by the Highway Capacity Manual, published by the Transportation Research Board (current edition: 2010). LOS is graded from LOS **A** (free flow conditions) to LOS **F** (congested conditions), and for signalized intersections is based on the estimated average vehicle delay for traffic at the intersection. LOS A represents little to no delay, or uncongested conditions, whereas LOS F indicates very congested conditions with long delays. In urbanized areas, such as the New North End of Burlington, LOS conditions of D or better are generally considered satisfactory during the peak hours. LOS E conditions indicate an intersection that is operating at or near peak capacity, while intersections operation at LOS F cannot effectively serve peak demand.

Table 1 shows intersection LOS for the AM and PM peak hours under existing conditions. Congestion is essentially limited to the VT 127 connection during the morning peak, and not significant at all during the PM peak. Isolated periods of congestion have also been observed prior to the start of school and immediately after school lets out, particularly at Institute Road.

Congestion at the connection to VT 127 during the AM commute is a result of a heavy southbound left turn from North Avenue onto VT 127, and a moderately heavy northbound through (straight) volume. These movements cannot occur at the same time, and therefore require exclusive green phases.

While the corridor is busy during the afternoon, heavy congestion does not typically form. Intersections operate at LOS A or B, with all approaches operating at LOS C or better, indicating busy, but not highly congested conditions.

Table 1: Existing AM and PM Peak Hour LOS and Average Queues (Number of Cars)

Intersection Location	Eastbound		Westbound		Northbound		Southbound		Intersection Overall
Plattsburg Ave			Plattsburg Ave		North Ave		North Ave		
AM Peak Hour	-	-	C	3	A	2	B	4	**B**
PM Peak Hour	-	-	C	5	A	3	B	3	**B**
Woodbury Rd	Woodbury Rd		School Driveway		North Ave		North Ave		
AM Peak Hour	B	1	C	2	A	2	A	1	**A**
PM Peak Hour	B	1	C	1	A	3	A	5	**A**
Shore Rd/Heineberg Rd	Shore Rd		Heineberg Rd		North Ave		North Ave		
AM Peak Hour	B	1	C	2	A	1	A	9	**A**
PM Peak Hour	B	1	C	1	A	5	A	6	**A**
Ethan Allen Shopping	Shopping Center		Farrington's Park		North Ave		North Ave		
AM Peak Hour	B	2	C	2	A	1	A	1	**A**
PM Peak Hour	C	5	C	1	A	4	B	4	**B**
Ethan Allen Pkwy	Little Eagle Bay		Ethan Allen Pkwy		North Ave		North Ave		
AM Peak Hour	A	0	C	3	C	6	C	14	**C**
PM Peak Hour	B	1	A	1	B	3	B	0	**B**
VT 127 Ramps	Alliance Church		VT 127 Ramps		North Ave		North Ave		
AM Peak Hour	A	1	C	4	C	8	C	16	**C**
PM Peak Hour	B	1	A	2	B	4	B	1	**B**
Institute Rd	Institute Rd		Condo Driveway		North Ave		North Ave		
AM Peak Hour	C	4	C	1	B	2	B	5	**B**
PM Peak Hour	C	1	C	1	A	5	A	3	**A**
North St			North St		North Ave		North Ave		
AM Peak Hour	-	-	B	1	A	2	B	7	**A**
PM Peak Hour	-	-	B	1	B	6	A	3	**B**

Forecast of Future Traffic Conditions (Year 2035)

The study team considered both historic growth patterns (population and traffic growth) as well as future growth forecasts from the CCRPC's regional travel demand model to develop growth projects through the year-2035. The CCRPC model estimates future year traffic volumes based on forecast changes in population and employment throughout the greater Burlington region. This process is further detailed in the technical memorandum, *Growth Summary for North Avenue Corridor (Appendix B).*

In general, both population and traffic in the study area has been fairly stable since 1990. Traffic volumes have increased modestly along the southern portions of the corridor, while decreasing modestly to the north.

The CCRPC travel demand model assumes that growth in occupied housing units will continue at a rate comparable to the historic average since 1990. By 2035, an addition of 848 housing units are expected in zones covering the study area. More residential growth is expected in the central and south portions of the study area than to the north (Table 2). No significant change in employment is presumed by the model.

Table 2: Projected Households by Subarea

Subarea	2010	2035	Increase	Average Annual Growth Rate
North	952	1,017	65	0.3%
Central	3,012	3,641	620	0.7%
South	1,115	1,278	163	0.5%
Total	**5,088**	**5,936**	**848**	**0.6%**

Source: CCRPC Travel Model (2013)

Other Future Growth Considerations

Institutional uses along the corridor, including the new Burlington College campus, could influence traffic volumes in the future. However, specific information regarding the scale and timing of proposed improvements at these uses is not presently available.

Year 2035 Growth Scenario

Households are expected to continue increasing at comparable rates to historic trends in the study area. Little (if any) additional commercial development is forecast, though institutional expansion is an unknown. In the absence of more specific information, it is reasonable to assume higher growth rates in the southern portion of the corridor given the potential for development at Burlington College and the historically higher growth rates in this portion of the corridor. The study therefore developed a 2035 traffic scenario that increased volumes relative to existing levels as follows:

- Plattsburgh Avenue: 5 percent increase through 2035 (equivalent to approximately 0.2 percent annually).
- North Avenue:
  - 5 percent increase north of Shore Road (equivalent to approximately 0.2 percent annually);
  - 10 percent increase between Shore Road and VT 127 (0.4 percent annually);
  - 15 percent between VT 127 and North St (0.6 percent annually).
- VT 127: 5 percent increase (0.2 percent annually).

Operational Assessment

Traffic analysis results (optimized signal operations), presented in Table 3 indicate some but no significant changes from overall current conditions.

Table 3: Future Scenario (2035) AM and PM Peak Hour LOS and Average Queues (Number of Cars)

Intersection Location	Eastbound		Westbound		Northbound		Southbound		Intersection Overall
Plattsburg Ave			Plattsburg Ave		North Ave		North Ave		
AM Peak Hour	-	-	C	3	A	2	B	3	**B**
PM Peak Hour	-	-	B	5	A	3	A	2	**B**
Woodbury Rd	Woodbury Rd		School Driveway		North Ave		North Ave		
AM Peak Hour	B	1	C	2	A	1	A	9	**A**
PM Peak Hour	C	1	B	1	A	4	A	4	**A**
Shore Rd/Heineberg Rd	Shore Rd		Heineberg Rd		North Ave		North Ave		
AM Peak Hour	B	1	C	1	A	1	B	10	**A**
PM Peak Hour	B	1	C	1	A	3	A	3	**A**
Ethan Allen Shopping	Shopping Center		Farrington's Park		North Ave		North Ave		
AM Peak Hour	B	2	C	1	A	1	A	1	**A**
PM Peak Hour	C	5	C	1	A	1	A	3	**B**
Ethan Allen Pkwy	Little Eagle Bay		Ethan Allen Pkwy		North Ave		North Ave		
AM Peak Hour	A	0	D	7	A	1	A	8	**B**
PM Peak Hour	A	0	C	3	A	5	A	1	**A**
VT 127 Ramps	Alliance Church		VT 127 Ramps		North Ave		North Ave		
AM Peak Hour	A	0	C	3	F	9	C	15	**C**
PM Peak Hour	B	1	A	1	C	10	B	4	**B**
Institute Rd	Institute Rd		Condo Driveway		North Ave		North Ave		
AM Peak Hour	C	3	C	1	A	2	A	8	**A**
PM Peak Hour	B	1	C	1	A	6	A	3	**A**
North St			North St		North Ave		North Ave		
AM Peak Hour	-	-	B	1	A	2	A	6	**A**
PM Peak Hour	-	-	B	1	A	7	A	2	**A**

Corridor Crash History

High Crash Locations

The Vermont Agency of Transportation (VTrans) identifies high crash locations (HCLs) for intersections and segments statewide. In order to be designated a HCL segment or intersection, a location must have experienced five or more crashes over a five-year period, and crashes must occur at higher frequency than the average rate for similar roadways statewide.

During the 2006-2010 period, four segments on the study corridor were identified as HCLs (see Figure 10).

The Actual/Critical Ratio compares the crash rate for these locations to the average ratio for comparable facilities statewide. A ratio over 1.0 indicates higher than average frequency of crashes at all locations. The Severity Index, which is the average cost associated with crashes, indicates that the average severity of crashes is greatest between Lakewood Parkway and Ethan Allen Parkway; the Actual/Critical Ratio is highest here too. This segment is four-lanes, with frequent cross street and driveway connections. Crash records indicate high instances of at-angle crashes, typically associated with turning traffic.

Crashes Involving Pedestrians or Bicyclists

Six of the crashes occurring during the 2006-2010 period involved pedestrians. Two of these occurred near the Ethan Allen Shopping Center, indicating that specific attention may be necessary at this location. None of the crashes recorded over this period involved bicyclists. However, because of the relatively low sample size, it is not uncommon for pedestrian and bicycle crashes to exhibit patterns that do not lead to specific conclusions, requiring that these safety issues be analyzed proactively during design, rather than based on specific data analysis.

Other Potential Safety Issues

A number of potential safety concerns for pedestrians, bicyclists and motorists on the corridor were identified by staff review of the corridor and through the public outreach process:

- Excessive speeds, particularly where lanes are wide and on-street parking lanes are sparsely used.
- Considerable distance between crosswalks for pedestrians crossing North Avenue, and no accommodations to improve the convenience or safety of pedestrians crossing the street.
- Lack of pedestrian signals and poor visibility of traffic signal heads at many locations (pedestrians do not know who has the right-of-way).
- Narrow travel lanes in the four-lane segment.
- Lack of accommodations for bicyclists.
- Worn and missing pavement markings.
- Skewed intersection at Shore Road/Heineberg Road.
- High speed, heavy volume turns at the VT 127 connection, along with unclear geometry and allocation of pavement space.
- High speed, heavy volume right turns at Ethan Allen Parkway and Plattsburg Avenue, which conflict with pedestrians and bicyclists.
- Difficulty in making left turns at several critical locations.
- Presence of frequent residential and commercial driveways.
- Uncomfortable pedestrian environment along the rock bluff immediately adjacent to the sidewalk in the southbound direction between the VT 127 ramps and Institute Rd intersections.

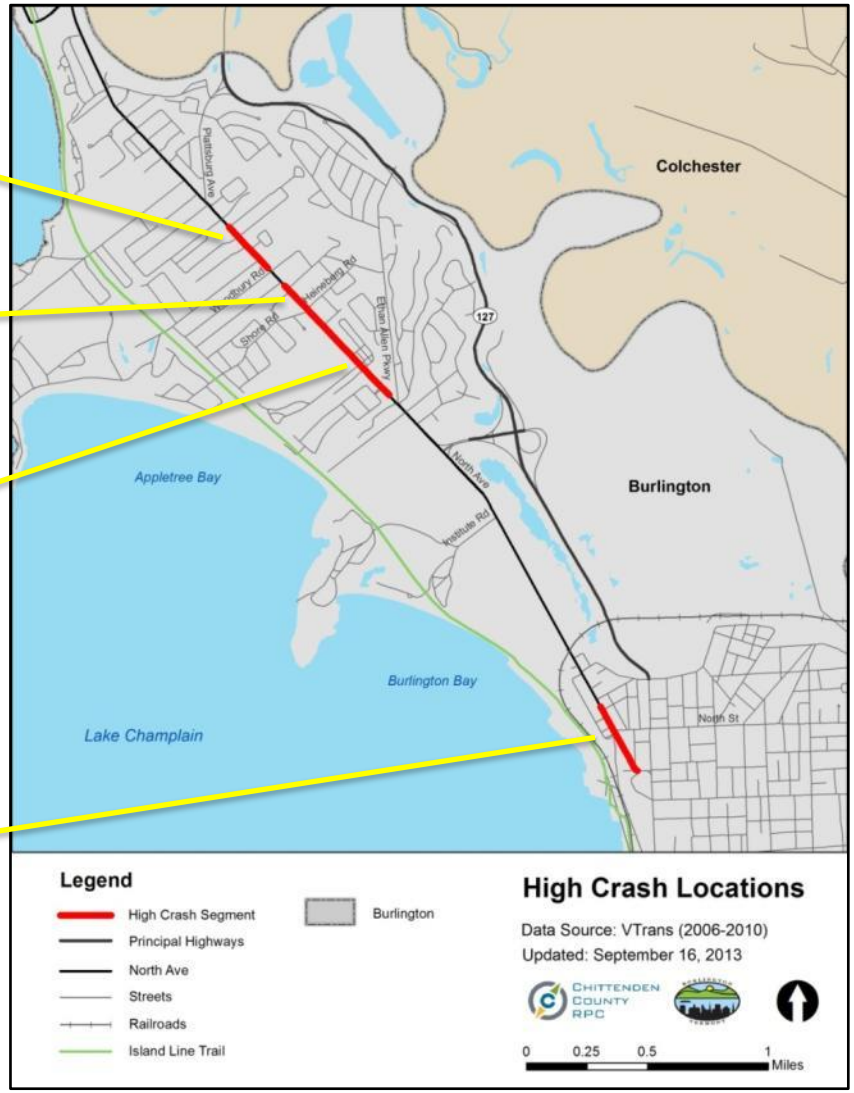
Birch Ct to Woodbury Rd
Crashes: 39
PDO: 33 (85%)
Crash Rate: 6.48 per MVM
Actual/Critical Ratio: 1.23
Severity Index: $21,677

Gosse Ct/Woodlawn Rd to Poirier Pl
Crashes: 46
PDO: 42 (91%)
Crash Rate: 6.18 per MVM
Actual/Critical Ratio: 1.22
Severity Index: $13,100

Lakewood Pkwy to Ethan Allen Pkwy
Crashes: 76
PDO: 60 (79%)
Crash Rate: 10.16 per MVM
Actual/Critical Ratio: 2.00
Severity Index: $41,204

Strong St/Ward St to Sherman St
Crashes: 58
PDO: 4 (93%)
Crash Rate: 9.51 per MVM
Actual/Critical Ratio: 1.81
Severity Index: $12,107

Figure 10: High Crash Locations (2003-2007)



Transit

North Avenue is served by CCTA Route 7 and Route 18 local bus service (Figure 11 and Figure 12). Route 7 is a fixed route local service that begins in Downtown Burlington at Cherry Street, and then travels via North Street to North Avenue, continuing along North Avenue to its terminus at Northgate Apartments. Service operates on weekdays from 5:40 AM to 10:15 PM and on Saturdays from 6:15 AM to 7:55 PM. On weekdays, service operates as frequently as every 30 to 35 minutes during the day. Following the PM peak, evening service frequency is less than one bus per hour. On Saturdays, service operates every 30 minutes during peak periods and every 60 minutes during off-peak periods. Weekday ridership on Route 7 averages 1,125 riders while Saturday ridership averages 602 riders (FY09 Average). The busiest stops are Cherry Street (369 boardings), Burlington High School (144 boardings), Ethan Allen Shopping Center (63 boardings), and Northgate Apartments (53 boardings).[1]

Route 18 operates as a fixed route local service in the late morning and afternoon hours and as a point deviation service in the early morning. The route begins in Downtown Burlington at Cherry Street, then travels south to Price Chopper via Pine Street, then travels north to UVM, then continues north via VT 127 to Plattsburg Avenue, then travels south along North Avenue towards Downtown. Service operates one day a week on Sundays from 8:25 AM to 5:20 PM. The late morning and afternoon service runs approximately every hour. Sunday ridership averages 124 riders (FY09 Average). The busiest stops are Cherry Street (33 boardings), Price Chopper (21 boardings), City Market (6 boardings), Northgate Apartments (6 boardings), and Ethan Allen Shopping Center (5 boardings).[1]

The fare for these services are in line with CCTA's local fare structure, with a single ride costing $1.25, ten-ride tickets costing $12.00, and a monthly pass costing $50.00. Children, seniors, and persons with disabilities ride at discounted rates.

[1] http://www.cctaride.org/pdf/Documents/AppendixB.pdf

Figure 11: CCTA Route 7

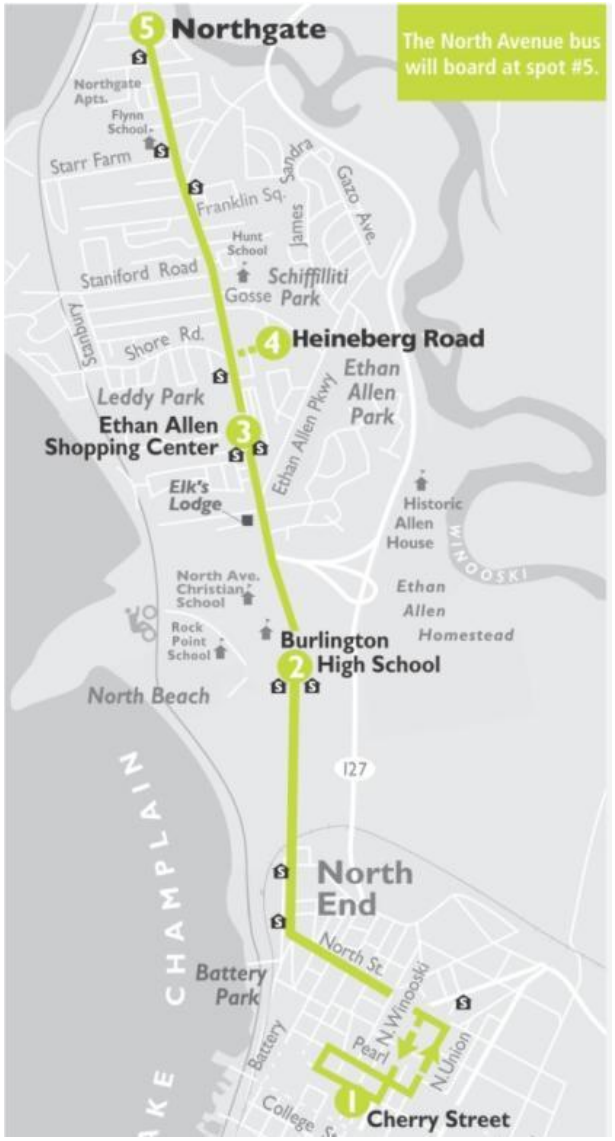


Figure 12: CCTA Route 18

Bus Stops

Within the study area, there are currently 23 bus stops in the southbound direction and 21 bus stops in the northbound direction. Bus pull-outs are not provided at the bus stops in most locations, and buses must typically stop in the right-most travel lane, creating potential conflicts between transit vehicles and general traffic. Table 4 indicates the location of each stop, along with whether a sign and/or shelter are present. Figure 13 illustrates bus stop locations along the corridor and the areas along the corridor that are located within ¼-mile (highlighted in blue) and ½-mile (highlighted in yellow) of a bus stop. The current stop locations provide good coverage of the corridor, as all uses abutting the corridor are within a ¼-mile walk of a bus stop, although the stop spacing is very close in certain cases. Several locations have offset stops or stops on only one side, making access difficult for pedestrians at Loaldo Drive, Green Acres Drive, Staniford Road, Gosse Court, Poirier Place, Lakewood Parkway, Killarney Drive, Saratoga Avenue, midblock north of Institute Road, Lakeview Cemetery, Burlington College, and Yankee Medical.

Table 4: Bus Stops on North Avenue

Cross Street	Southbound		Northbound	
	Location	Amenity	Location	Amenity
Plattsburg Ave	Near side	Sign		
Loaldo Dr	N/A	Sign	N/A	Sign/shelter
Birch Ct			N/A	Sign
Gr. Acres Dr	N/A	Sign	N/A	Sign
Cross Pkwy	N/A	Sign		
Edgemore Dr			N/A	Sign
Staniford Rd	N/A	Sign	N/A	Sign
Woodbury Rd	Near side	Sign		
Gosse Ct	N/A	Sign	N/A	Sign
Heineberg Rd	Near side	Sign	Near side	Sign
Poirier Pl	N/A	Shelter	N/A	Sign
EA Shopping	Far side	Sign/shelter	Near side	Sign/shelter
Lakewood Pkwy	N/A	Sign	N/A	Sign
Killarney Dr	N/A	Sign	N/A	Sign
Saratoga Ave	N/A	Sign	N/A	Sign
VT 127	Near side	Sign	Near side	Sign
Institute Rd (N)	N/A	Sign	N/A	Sign
Institute Rd	Far side	Sign/shelter	Near side	Shelter
Cemetery	N/A	Sign	N/A	Sign
Bur. College	N/A	Sign	N/A	Sign
Shell Station	N/A	Sign	N/A	Sign
Yankee Med.	N/A	Sign	NA	Sign
Berry St	N/A	Sign/shelter	N/A	Sign
Ward St	N/A	Sign		
Strong St			N/A	Sign
Canfield St	N/A	Sign/shelter		

Figure 13: North Avenue Corridor Bus Stops

Walking and Bicycling

Pedestrian Accommodations

Sidewalks are provided continuously along both sides of North Avenue within the study corridor and are a consistent 5' wide. Sidewalks along the corridor are generally separated from traffic by a planting strip that varies in width, except for two locations without a planting strip. The planting strip provides separation from traffic, particularly where on-street parking is not allowed, and provides for snow storage in the wintertime.

All intersections have curb ramps to accommodate wheelchair users and others with assistive devices; however, many ramps lack aprons on either side of the ramp or tactile indicators that alert visually-impaired pedestrian that they are standing at an intersection. Additionally, the orientation of curb ramps could be improved in some locations to improve pedestrian safety. For example, at the Plattsburg Avenue/North Avenue intersection, the orientation of the north side Plattsburg Avenue curb ramp leads pedestrians into a travel lane, as opposed to across the intersection.

Cross street intersections with North Avenue tend to have smaller turning radii. This is ideal for a complete street, as the smaller radii decreases the in-road distance pedestrians must cross. Curb cuts with larger turning radii are limited to locations where this design is necessary due to a larger design vehicle, such as at Ethan Allen Shopping Center where larger truck deliveries are commonplace.

Within the approximately 2.8-mile long corridor, 11 pedestrian crossing locations are provided:

- Plattsburg Avenue
- Woodbury Road
- Shore Road/Heineberg Road
- Ethan Allen Shopping Center
- Ethan Allen Parkway
- VT 127 Connector
- Institute Road
- Champlain Farms
- Washington Street/Berry Street
- Strong Street
- North Street

With the exception of the North Street intersection, only a single crosswalk of North Avenue is provided at each signalized intersection location. Additionally, the average distance between crosswalks is considerably greater than the maximum distance of 600' recommended in ITE's *Designing Walkable Urban Thoroughfares* handbook and 400' recommended in the Burlington *Street Design Guidelines*. The lack of pedestrian accommodations across North Avenue may pose a safety risk to pedestrians, particularly if pedestrians jaywalk in locations where convenient crosswalks are not provided. There is particular concern for dangerous jaywalking at locations where bus riders cannot easily access corresponding stops on the opposite side of the street for their return trip.

Bicycling Accommodations

On-street bicycle lanes are currently provided on North Avenue between North Street and VT 127 in the northbound direction, and between Institute Road and Berry Street in the southbound direction (Figure 14). A paved multi-use trail connects with North Avenue at Ethan Allan Parkway; however, this portion of the corridor does not have on-street bicycle facilities. An unpaved multi-use trail connects to the corridor just north of Institute Road; however, bike lanes are only present on the northbound side of the roadway at this location. Both the waterfront shared use path and Route 127 path parallel North Avenue but access is particularly limited for the Route 127 path. Neither path has dedicated bicycle facilities leading from North Avenue.

North of VT 127, the roadway configuration is not well suited to accommodate bicyclists, particularly given segments that have little to no shoulder and frequent turning vehicles throughout the corridor. Moreover, sidewalk bicycle riding is problematic due to potential conflicts between pedestrian and bicyclists, especially given the relatively narrow sidewalk width (5'). This poses a safety issue for bicyclists traveling on this segment of North Avenue to reach points beyond the corridor as well as for local trips that must travel via North Avenue due to a lack of connectivity in the local street grid on the east and west sides of the roadway.

Segment Descriptions

The remaining Chapter 2 sections provide more detailed descriptions of transportation conditions of the five North Avenue segments.

Table 5 on the following page summarizes the conditions along the corridor within these five segments.

Figure 14: North Avenue Corridor Area Bicycle Facilities

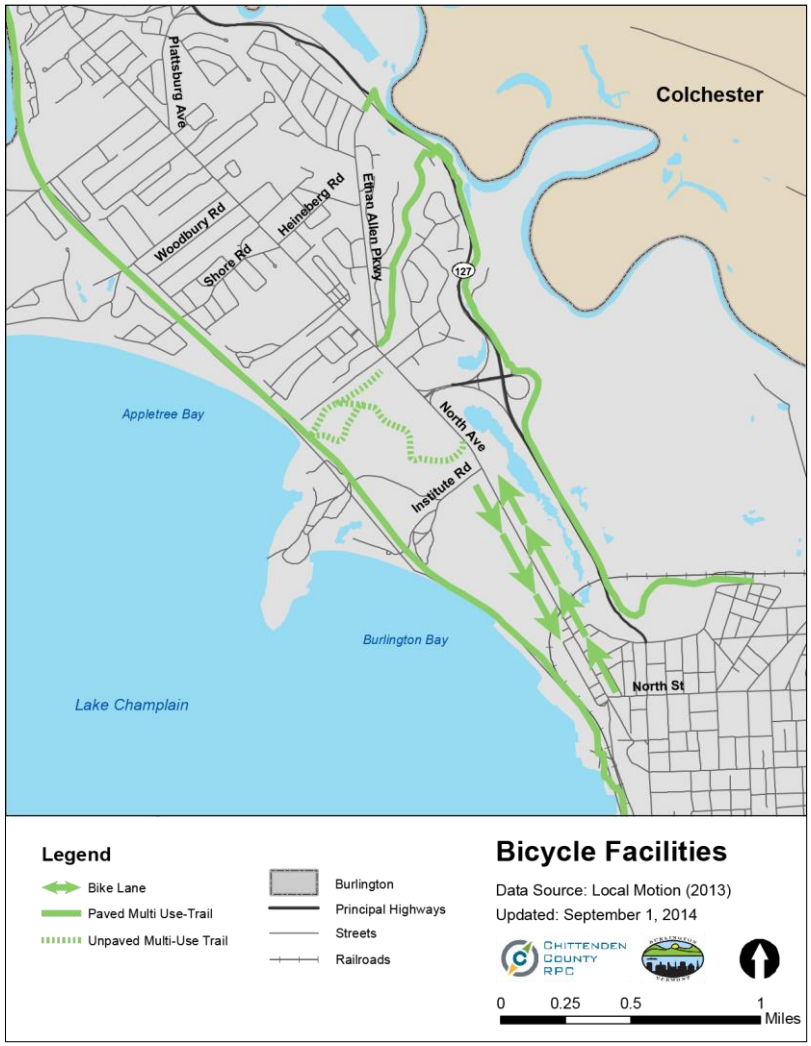


Table 5: Study Corridor Existing Conditions by Segment

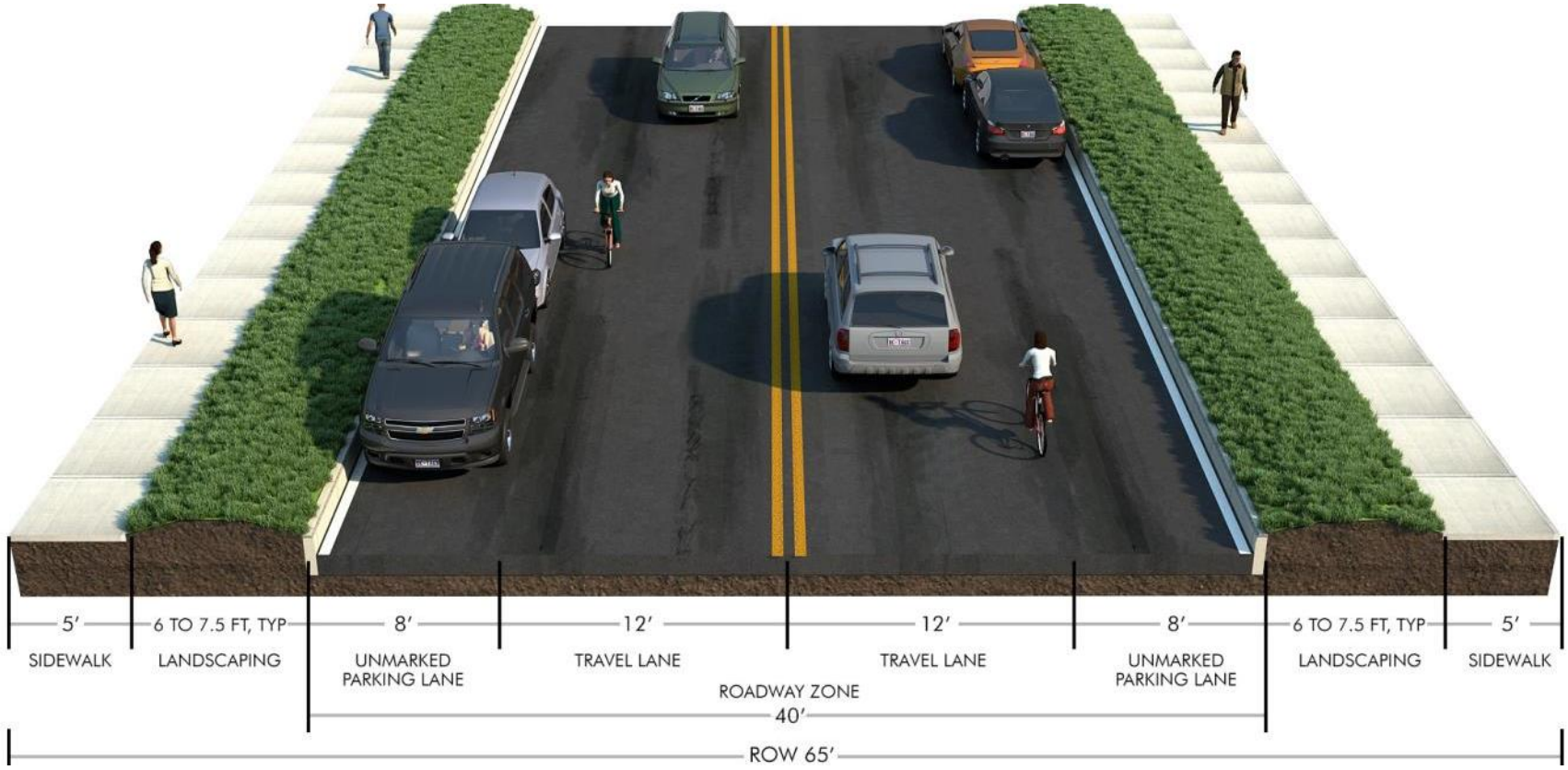
Characteristic	Plattsburg Ave to Shore Rd	Shore Rd to VT 127 Ramps	VT 127 Ramps to Institute Rd	Institute Rd to Washington St	Washington St to North St
Approximate Length	3,290 ft (0.62 miles)	4,240 ft (0.80 miles)	1,870 ft (0.35 miles)	3,870 ft (0.73 miles)	1,460 ft (0.28 miles)
Paved Width	40’	40’ – 43’	42’	35’	33’
ROW	65’	65’	65’	65’	65’
Travel Lanes	1 NB & 1 SB	2 NB & 2 SB	1 NB & 1 SB	1 NB & 1 SB	1 NB & 1 SB
Turn Lanes	None	• Shore Rd (NB left) • VT 127 (SB left)	Institute Rd (SB right)	Institute Rd (NB left)	North St (SB left)
Existing AADT	10,800	• 13,700 north of Ethan Allen Pkwy • 19,100 south of Ethan Allen Pkwy	12,000	12,000	12,000
Traffic Signals	• Plattsburg Ave • Woodbury Rd • Shore Rd	• Ethan Allen Shop. Ctr. • Ethan Allen Pkwy • VT 127 ramps	Institute Rd	None	North St
On-Street Parking	Both sides	None	NB and SB	None	SB only
Sidewalks	Both sides w/ greenscape zones	Both sides w/ greenscape zones	Both sides w/ some greenscape zones	Both sides w/ greenscape zones	Both sides w/ greenscape zones
Bicycle Lanes	None	None	None (NB pavement markings and sign only – no lane marking)	NB and SB	NB only
Land Use	Residential, retail, institutional	Residential, retail	Residential, institutional	Residential, institutional	Residential
Further Observations	• Walking schoolchildren • Wide travel way • Unclear where parking is allowed • Offset intersections	• Left turns block through lanes • Narrow lanes • Most retail in corridor • Ethan Allen Pkwy intersection difficult to negotiate • Busiest in corridor	• Unclear bicycle facilities	• Open space/low-intensity uses on west side • NB bike lane drops at Institute Rd • No on-street parking • Midblock crosswalk at Champlain Farms	• Narrow NB bike lane • Narrowest portion of corridor • Highest residential density in corridor w/ distinct feel • Development within the ROW

Plattsburg Avenue to Shore Road

Plattsburg Ave to Shore Rd is the northernmost segment within the study corridor and is notable for its many intersections, almost all unsignalized, and residential driveways. Its curb-to-curb width measures 40', accommodating two travel lanes and on-street parking. Because abutting homes include off-street parking, on-street parking remains underutilized, giving the impression that travel lanes are significantly wider than intended—signage within this segment reminds drivers to "Keep Single Lane". It is often ambiguous where on-street parking is permitted due to restrictions near intersections. There are sidewalks on both sides of the avenue but no bicycle facilities within this segment.

Traffic volumes here are the lowest within the study corridor with 10,800 vehicles per weekday. Conversely, pedestrian activity is high because of the adjacent Lyman C. Hunt Middle School, JJ Flynn Elementary School, and nearby CP Smith Elementary School.

Figure 15: Typical Cross Section between Plattsburg Ave and Shore Rd



Pedestrian Environment

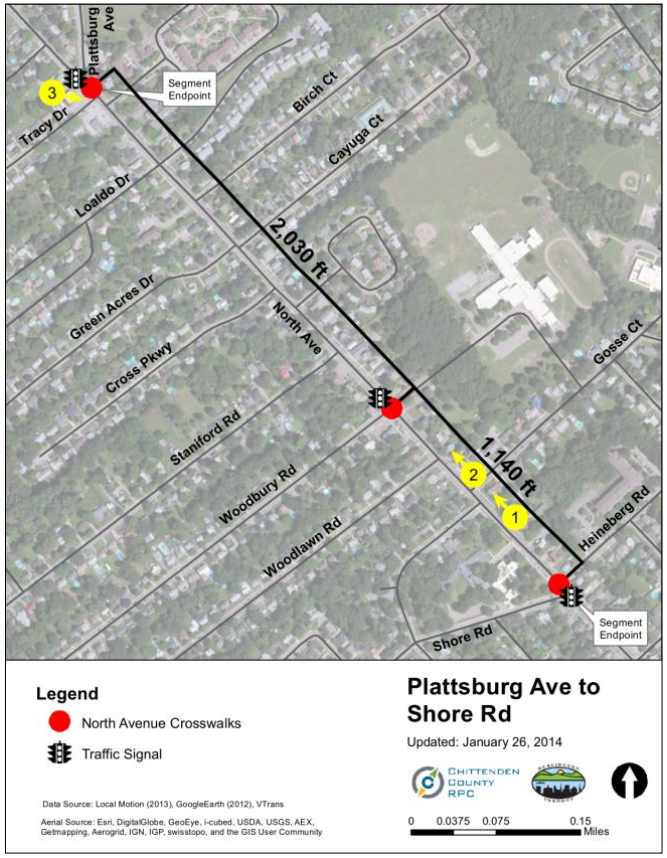
Public Schools are a major generator of pedestrian traffic within this segment. Sidewalks are generally in fair condition with some cracking that may be problematic for disabled pedestrians. Crosswalks—some with faded striping—with curb ramps are present at signalized intersections (but not all approaches), side streets, and major driveway crossings, though not all (e.g. at the fire station's large curb cut). However, like the rest of the corridor, curb ramps are outdated and prone to water ponding.

North Avenue crosswalks are located at signalized intersections only (Shore Road/Heineberg Road, Woodbury Road, and Plattsburg Avenue), which are between 1,140' and 2,030' apart. Concrete sidewalks continue uninterrupted across residential and commercial driveways, giving pedestrians priority at these conflict zones.

Sidewalks with landscaped buffer zones are found on both sides of North Avenue. Where present, these landscaped buffers house bus shelters, trees, fire hydrants, and utility poles that support streetlights.

Figure 16: Crosswalks and Sidewalks between Plattsburg Ave and Shore Rd

Figure 17: Pedestrian Environment between Plattsburg Ave and Shore Rd

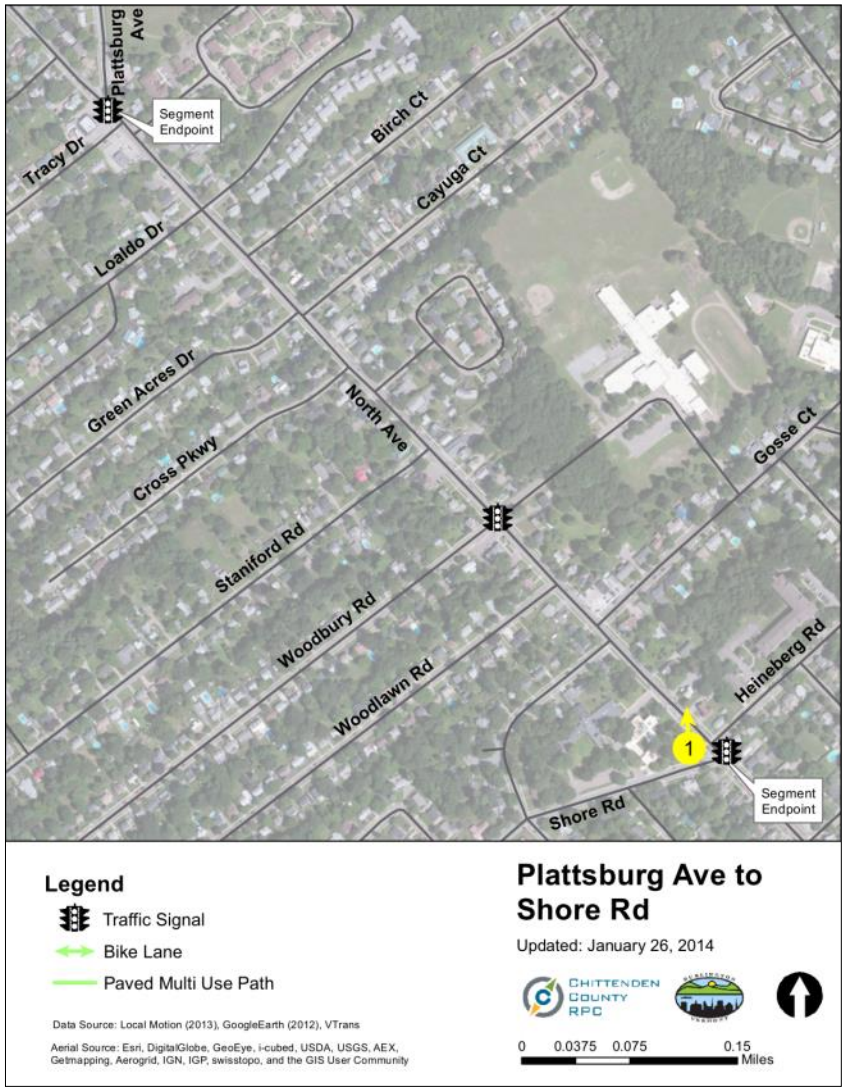


Bicycle Environment

There are no dedicated bicycle facilities between Plattsburg Avenue and Shore Road/Heineberg Road. Bicyclists were observed riding on the sidewalks and in travel lanes within this segment.

Figure 18: Cyclist North of the Shore Rd/Heineberg Rd Intersection

Figure 19: Bicycle Environment between Plattsburg Ave and Shore Rd



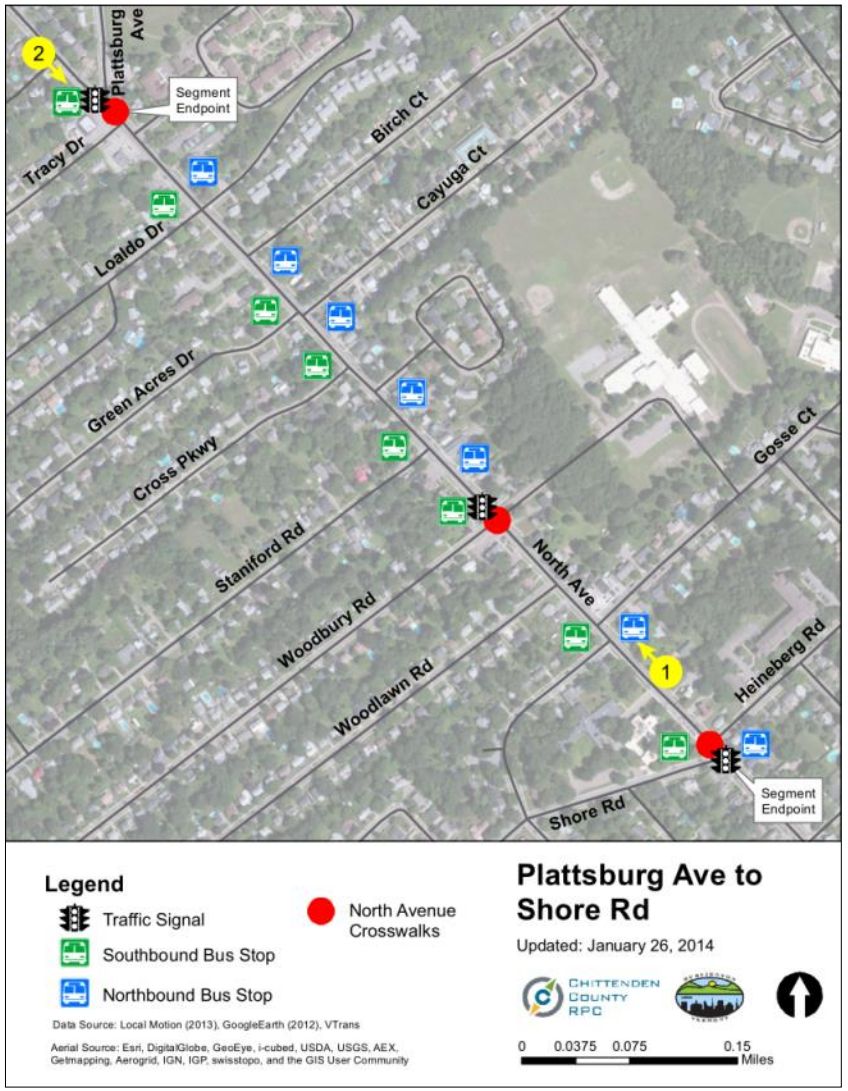
Transit Environment

Many northbound and southbound bus stops are located within this segment, as shown in Figure 21. Stops are aligned with cross streets and not necessarily in northbound/southbound pairs. There are no crosswalks on North Avenue to serve bus stops that are not located near signalized intersections.

One shelter is located at the northbound stop between Fairmont Place and Franklin Square, just south of the Plattsburg Avenue intersection. The shelter includes a bench and is adjacent to a concrete pad that connects the sidewalk to the curb for easier boarding. The southbound stop at Plattsburg Avenue includes a concrete pad as well. All other stops are marked by signs only and lack passenger amenities. Grass within the landscaped buffer has disappeared at several stops within this segment, the result of frequent use by passengers entering and exiting the bus at these locations.

Figure 20: Views of Bus Stops between Plattsburg Ave and Shore Rd

Figure 21: Bus Stop Locations between Plattsburg Ave and Shore Rd



Signalized Intersections

Two traffic signals are located within this segment: Woodbury Road and Plattsburg Avenue.

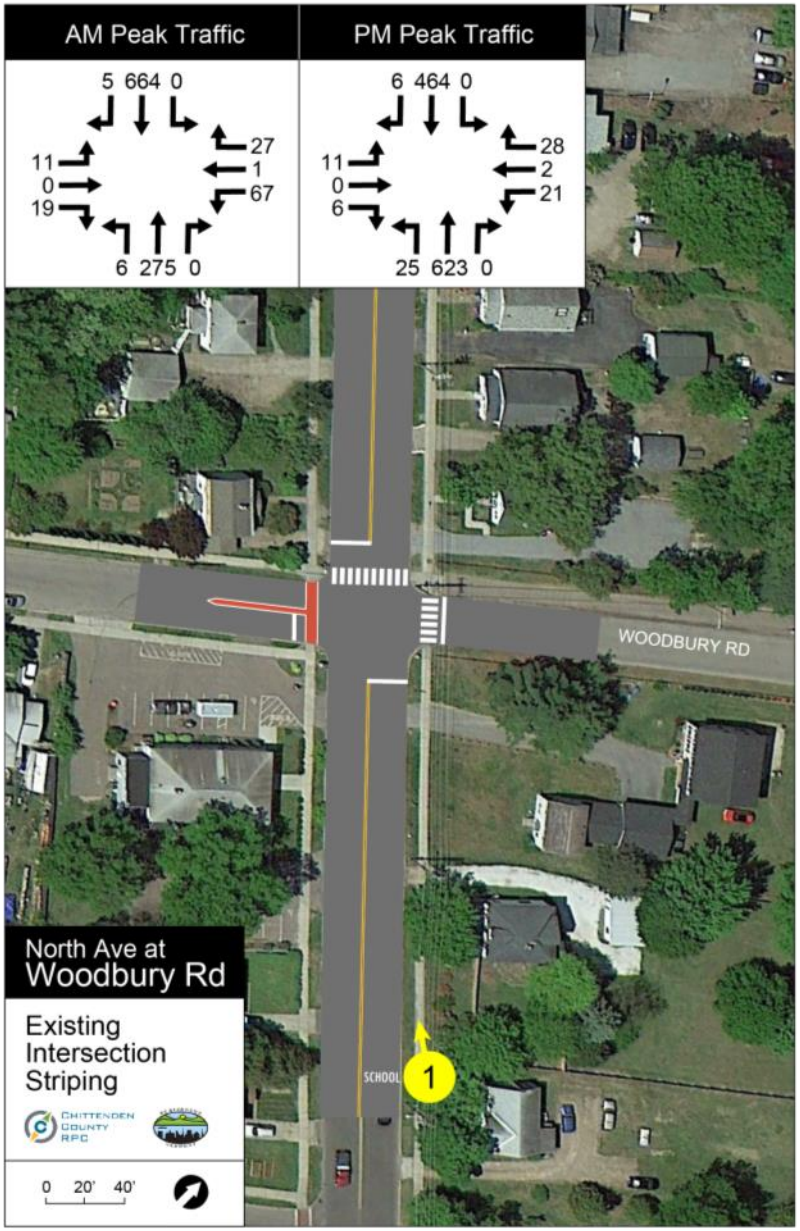
The Woodbury Road intersection serves as the primary access point to Lyman C. Hunt Middle School, located 500' northeast of North Avenue. Woodbury Road is one-way (westbound) east of North Avenue, accommodating traffic exiting the school. All approaches to this intersection are simple two-lane cross sections without dedicated left- or right-turn lanes. The school zone on North Avenue extends from Heineberg Road to Staniford Road. School zone signage is static and does not incorporate flashing beacons during school hours.

Three of the four approaches are marked with crosswalks, as shown in Figure 23, marked with red paint (over Woodbury Road) or white continental striping (over North Avenue and the school driveway). Many students were observed utilizing these crosswalks as they walked to and from Lyman C. Hunt Middle School. While each crosswalk also includes curb ramps, only the North Avenue crosswalk includes a push-button-activated walk signal.

This intersection presently operates at LOS A during the morning and afternoon peaks.

Figure 22: View of North Ave at Woodbury Rd Intersection

Figure 23: North Ave at Woodbury Rd Intersection



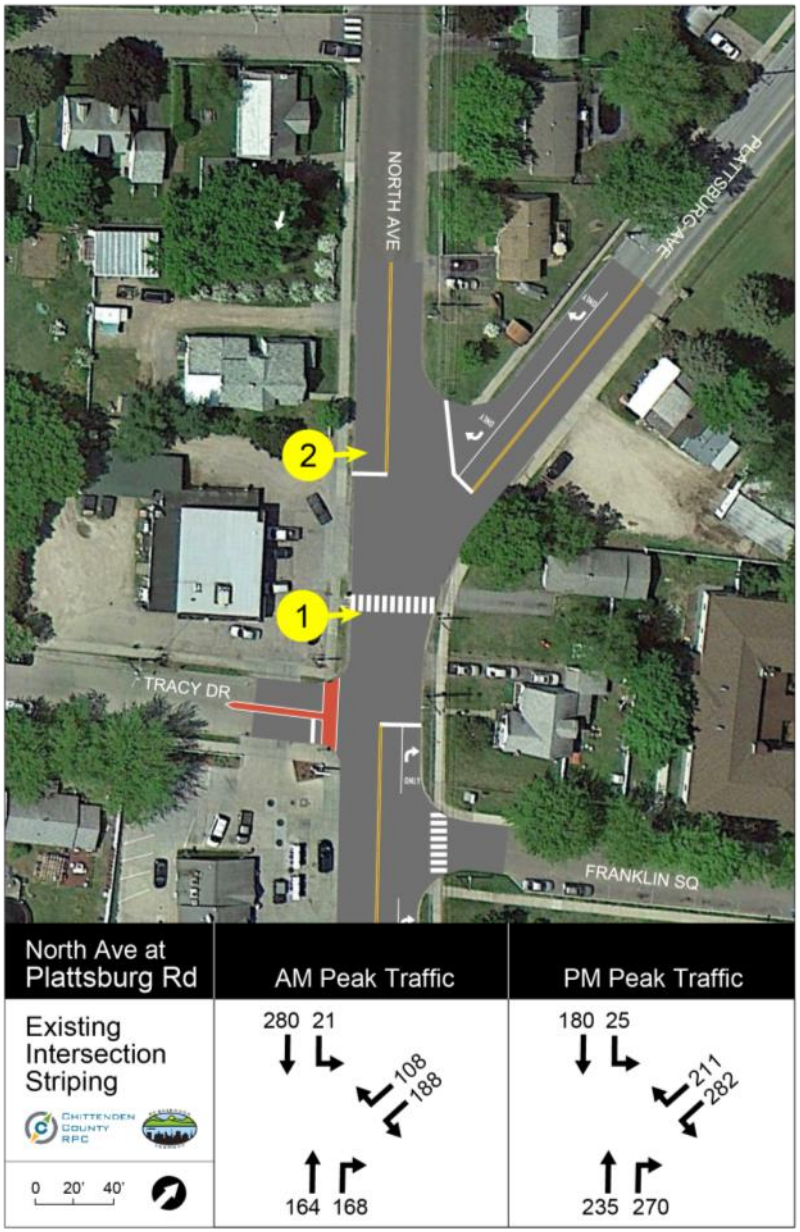
The Plattsburg Avenue intersection is located at the northern end of the study corridor. The angle at which Plattsburg Avenue intersects North Avenue allows for high-speed right turns from North Avenue, putting pedestrians at risk, particularly because there is no crosswalk or walk signal at Plattsburg Avenue. This intersection is complicated by Tracy Drive, a stop-controlled side-street located partially within the signalized intersection, and the Merola's Market driveway that is within the intersection. Drivers exiting Tracy Drive and the market must gauge which opposing movements have green signal indications and watch for acceptable gaps when pulling out into traffic, which is particularly difficult for left-turning vehicles.

The intersection provides a single crosswalk with white continental striping on North Avenue directly within the middle of the intersection. This crosswalk includes a push-button-activated walk signal as well as curb ramps of varying quality, one of which is a residential driveway's crumbling asphalt apron. Near the intersection to the south is a solid red crosswalk at Tracy Drive, which includes curb ramps but no walk signal (as this approach does not operate as part of the signal).

This intersection presently operates at LOS B during the morning and afternoon peaks.

Figure 24: Views of North Ave at Plattsburg Ave Intersection

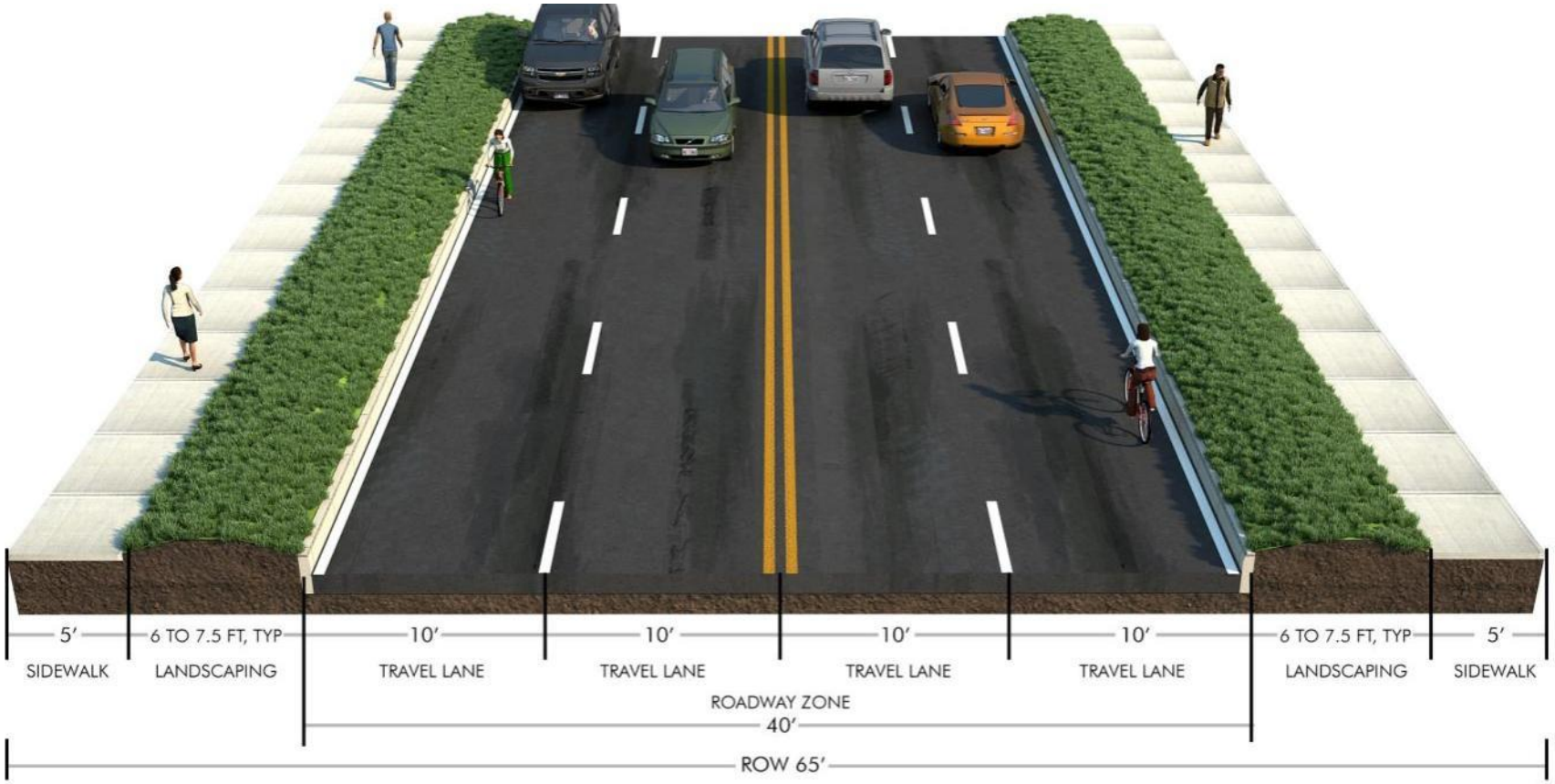
Figure 25: North Ave at Plattsburg Ave Intersection



Shore Road to VT 127 Ramps

The longest and widest segment in the study corridor, Shore Rd to the VT 127 ramps has a curb-to-curb width ranging from 40' to 43'. This segment includes four travel lanes, no bicycle facilities, and sidewalks on both sides of the Avenue. Travel lanes are relatively narrow and on-street parking is prohibited. This segment is notable for its many intersections, almost all unsignalized. This segment is adjacent to the Ethan Allen Shopping Center, the commercial center of the study corridor, and the high-density residential development Thayer Commons. It provides access to a large portion of the study corridor's residential development, particularly via the intersection of Ethan Allen Parkway north of the VT 127 ramps. With traffic volumes totaling 13,700 to 19,100 per weekday, it is the busiest segment of the study corridor.

Figure 26: Typical Cross Section between Shore Rd and VT 127 Ramps

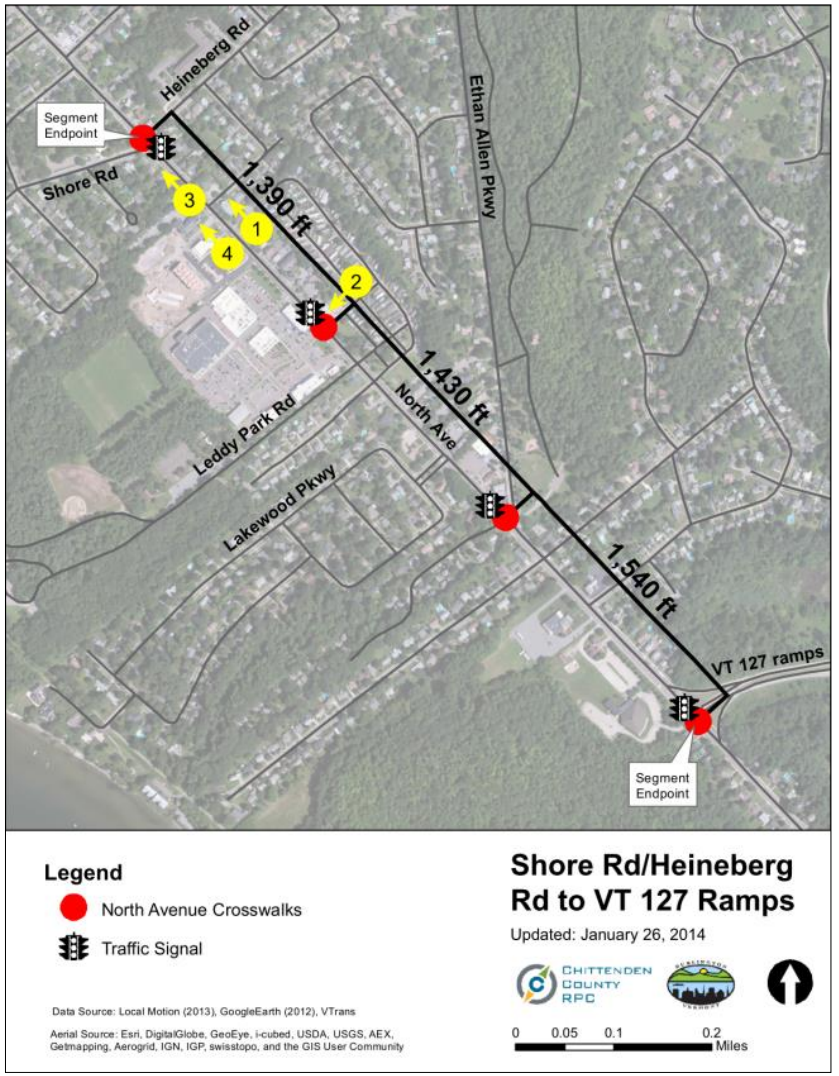


Pedestrian Environment

Sidewalks with landscaped buffer zones are found on both sides of North Avenue. Where present, these landscaped buffers house bus shelters, trees, fire hydrants, and utility poles that support streetlights. Sidewalks are generally in fair condition with some cracking that may be problematic for disabled pedestrians. A portion of the sidewalk north of the VT 127 ramps intersection lacks a landscaped buffer, creating an uncomfortable environment by locating pedestrians directly adjacent to moving traffic. Water ponding was observed at curb cuts, driveway entrances, and at curb ramps throughout this segment. Crosswalks—often with faded striping—with curb ramps are present at signalized intersections and side streets. Crosswalks over North Avenue are located at the signalized intersections 1,390' to 1,540' apart. Concrete sidewalks generally continue uninterrupted across most driveways, giving pedestrians priority at these conflict zones.

Figure 27: Crosswalks and Sidewalks between Shore Rd and VT 127 Ramps

Figure 28: Pedestrian Environment between Shore Rd and VT 127 Ramps



Bicycle Environment

There are no designated bicycle facilities between Shore Road/ Heineberg Road and the VT 127 ramps. As a result, many bicyclists prefer to ride on the sidewalk in this segment, though some bicyclists were observed in the travel lanes. Signage alerting drivers to share the road is present.

Figure 29: Bicyclists between Shore Rd and VT 127 Ramps

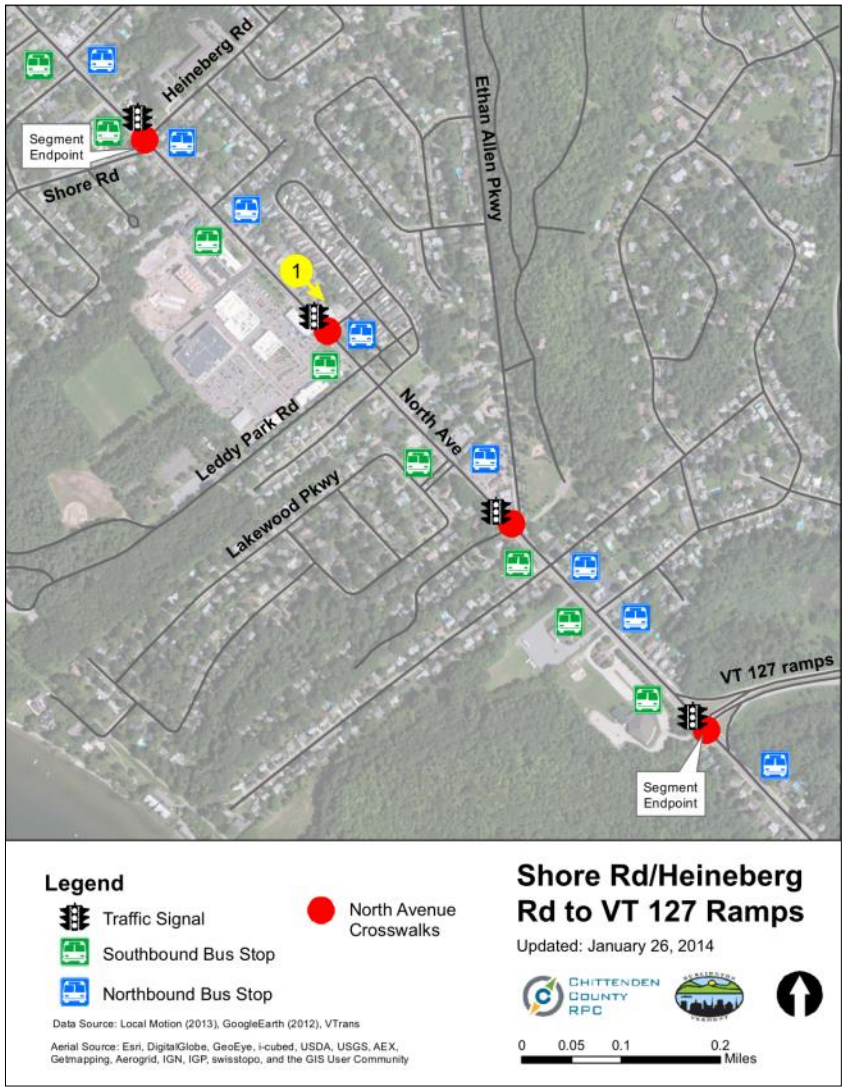
Figure 30: Bicycle Environment between Shore Rd and VT 127 Ramps

Transit Environment

Six northbound/southbound bus stop pairs are located within this segment, as shown in Figure 32. Shelters are located at two southbound stops (Thayer Commons and Ethan Allen Shopping Center) and one northbound stop (Ethan Allen Shopping Center). Shelters include a bench and are adjacent to a concrete pad that connects the sidewalk to the curb for easier boarding. All other stops are marked by signs only and lack passenger amenities. There are no crosswalks on North Avenue to serve bus stops that are not located at signalized intersections.

Figure 31: Northbound Bus Stop at Ethan Allen Shopping Center

Figure 32: Bus Stop Locations between Shore Rd and VT 127 Ramps



Signalized Intersections

Three traffic signals are located within this segment: Ethan Allen Parkway, Ethan Allen Shopping Center, and Shore Road/Heineberg Road.

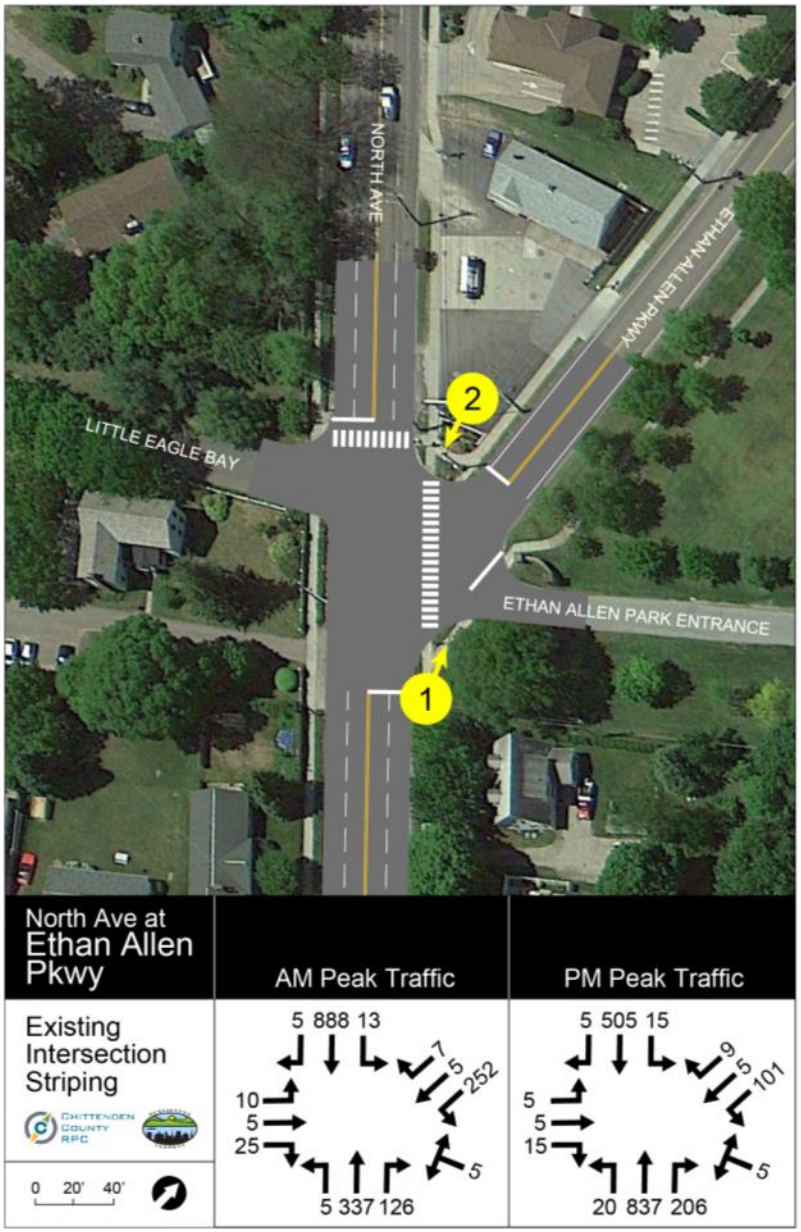
The Ethan Allen Parkway intersection is difficult to negotiate because of its skewed geometry. The angle at which Ethan Allen Parkway intersects North Avenue allows for high-speed right turns from North Avenue, putting pedestrians at risk. The angle also results in a long crosswalk for pedestrians. When the Ethan Allen Parkway pedestrian signal is activated, the northbound right turn signal for North Avenue presents an unexpected stop and no right turn on red for the right travel lane on North Avenue.

Only two approaches are marked with crosswalks, as shown in Figure 34. Curb ramps and push-button-activated walk signals accompany both crosswalks, but sidewalk condition and geometry are poor.

This intersection presently operates at LOS B during the morning peak and LOS A during the afternoon peak.

Figure 33: Views of North Ave at Ethan Allen Pkwy Intersection

Figure 34: North Ave at Ethan Allen Pkwy Intersection



There is a time-of-day activated northbound left turn arrow but no dedicated left turn lanes on North Avenue at the Ethan Allen Shopping Center intersection. While congestion is light to moderate, without dedicated left-turn lanes, turning vehicles block through traffic and adversely affect safety. The intersection is complicated by the extensive curb cuts at the Bamboo Hut restaurant in the north corner. Nearly the entire street frontage of this parking lot is a curb cut, allowing drivers to enter and exit almost anywhere. As a result, the sidewalk along Bamboo Hut needs repair and is subject to considerable water ponding during and after a rain storm.

Only two approaches are marked with crosswalks, as shown in Figure 36. The crosswalk over the shopping center entrance is painted solid red, while the North Avenue crosswalk features white continental stripes. Both sidewalks have curb ramps and push-button-activated walk signals. Crosswalk paint is considerably faded in spots.

This intersection presently operates at LOS A during the morning peak and LOS B during the afternoon peak.

Figure 35: Views of North Ave at Ethan Allen Shopping Center Intersection

Figure 36: North Ave at Ethan Allen Shopping Center Intersection

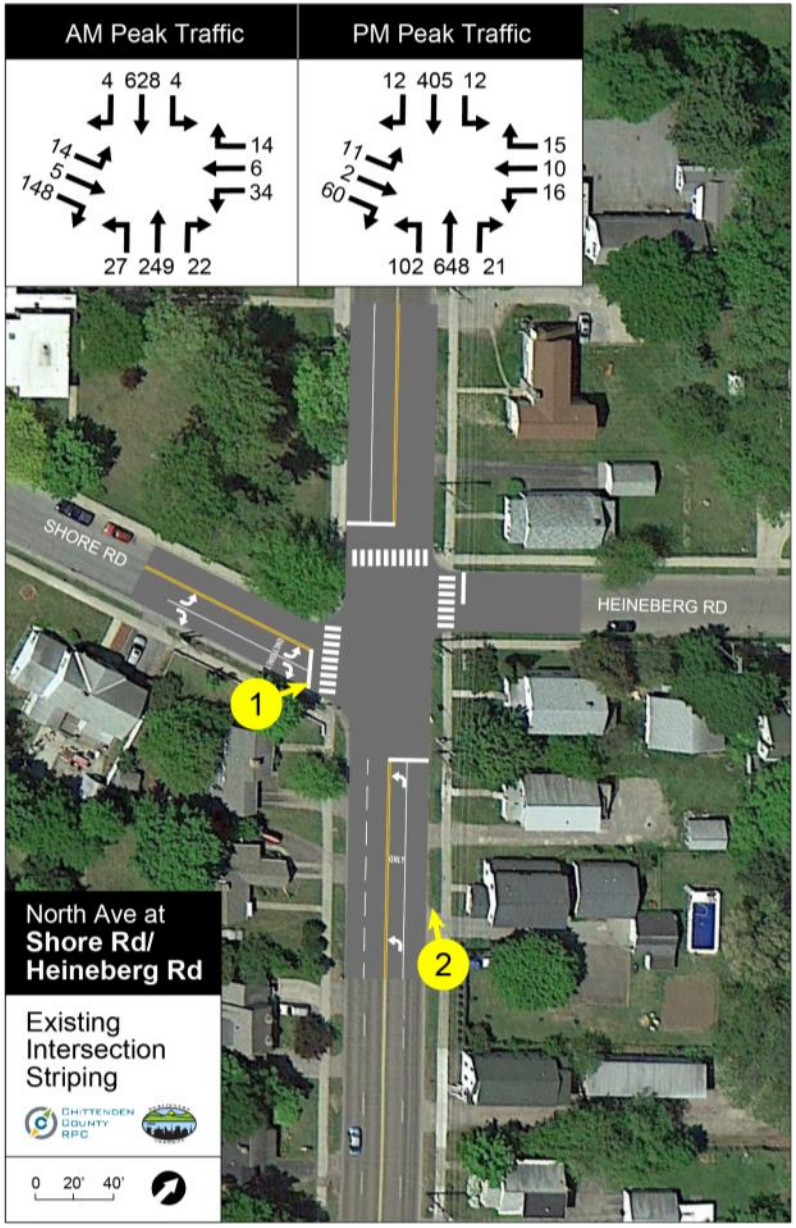
The North Avenue and Shore Road/Heineberg Road intersection marks a transition between North Avenue's two- and four-lane cross sections. North Avenue's second northbound lane transitions to a dedicated left-turn movement to westbound Shore Road; North Avenue's second southbound lane is striped south of Shore Road with the removal of on-street parking. The left-most northbound lane can be a lane trap for unfamiliar drivers who expect to continue northbound, but find themselves in a left turn lane. Shore Road and Heineberg Road have a green light concurrently, which is problematic given the overlapping left turns and the skewed geometry.

Three approaches are marked with crosswalks, as shown in Figure 38, and all feature white continental striping patterns. Curb ramps and push-button-activated walk signals accompany these crosswalks. Crosswalk paint is considerably faded in spots.

This intersection presently operates at LOS A during the morning and afternoon peaks.

Figure 37: Views of North Ave at Shore Rd/Heineberg Rd Intersection

Figure 38: North Ave at Shore Rd/Heineberg Rd Intersection

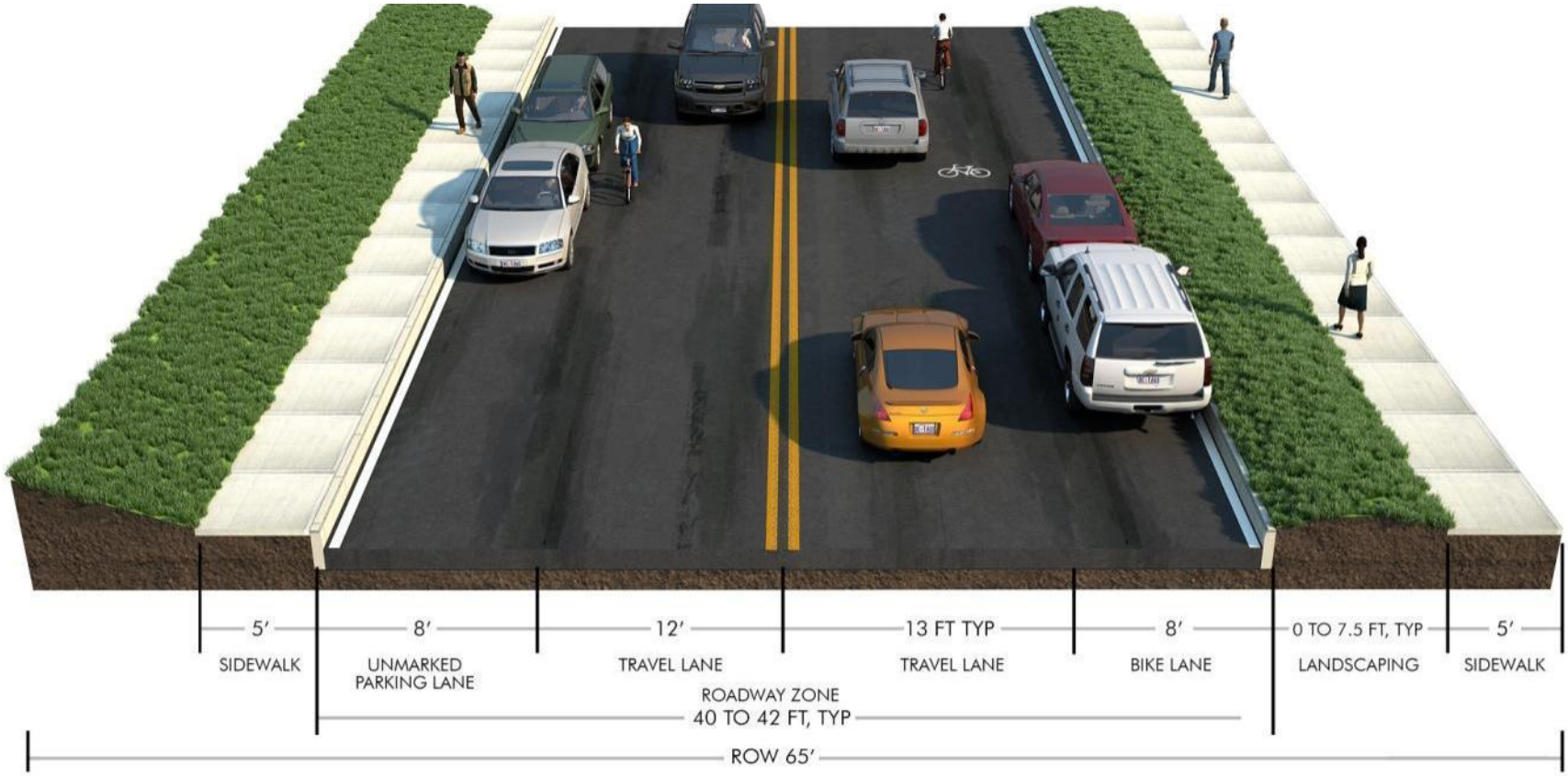


VT 127 Ramps to Institute Road

The shortest segment in the study corridor, VT 127 Ramps to Institute Road has a curb-to-curb width of 40' to 42'. There are sidewalks on both sides of the avenue and no dedicated bicycle facilities. This segment is primarily lined with single-family homes, though some multi-family residential is located near Institute Road. On-street parking is permitted in both directions. Because houses along this street have dedicated off-street parking, on-street parking remains underutilized, underutilized which makes travel lanes feel significantly wider and encourages speeding.

This segment marks the transition from narrower landscaped buffers to the north and wider landscaped buffers to the south. Where present, these landscaped buffers house fire hydrants and utility poles. Utilities are buried where the landscaped buffers are absent.

Figure 39: Typical Cross Section VT 127 Ramps and Institute Rd



Pedestrian Environment

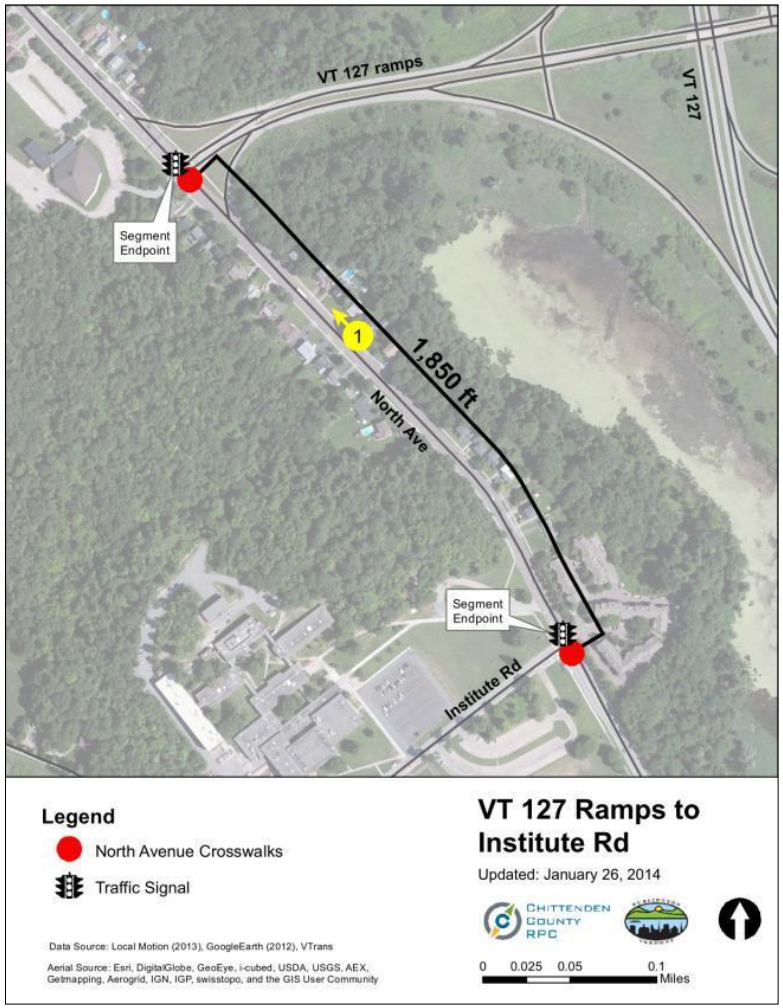
Sidewalks are available on both sides of North Avenue. Sidewalks are generally in fair condition with some cracking that may be problematic for disabled pedestrians. The pedestrian environment suffers from long stretches without a landscaped buffer, locating pedestrians adjacent to moving traffic. This is an issue north of Institute Road in the southbound direction where the sidewalk abuts a large rock wall, leaving little room to walk comfortably. In addition, the southbound sidewalk approaching Institute Road is misaligned.

At the VT 127 intersection, crosswalks are missing at the northwest leg and the Alliance Church driveway. Drivers have a free right-turn movement from North Avenue onto VT 127 ramps. While the crosswalk here is accompanied by a small yield-to-pedestrians sign, this vehicle movement poses a danger to pedestrians because it accommodates high-speed turns.

North Avenue crosswalks in this segment are located at the signalized intersections at the VT 127 ramps (white continental striping) and Institute Road (solid red paint and white continental striping), which are 1,850' apart. Vehicles have worn crosswalk striping in areas. Concrete sidewalks continue across all other driveways uninterrupted, giving pedestrians priority at these conflict zones. All crosswalks include curb ramps for enhanced accessibility. Like other segments, water ponding is an issue at curb ramps during and after rain storms.

Figure 40: Missing Landscaped Buffer between VT 127 Ramps and Institute Rd

Figure 41: Pedestrian Environment between VT 127 Ramps and Institute Rd

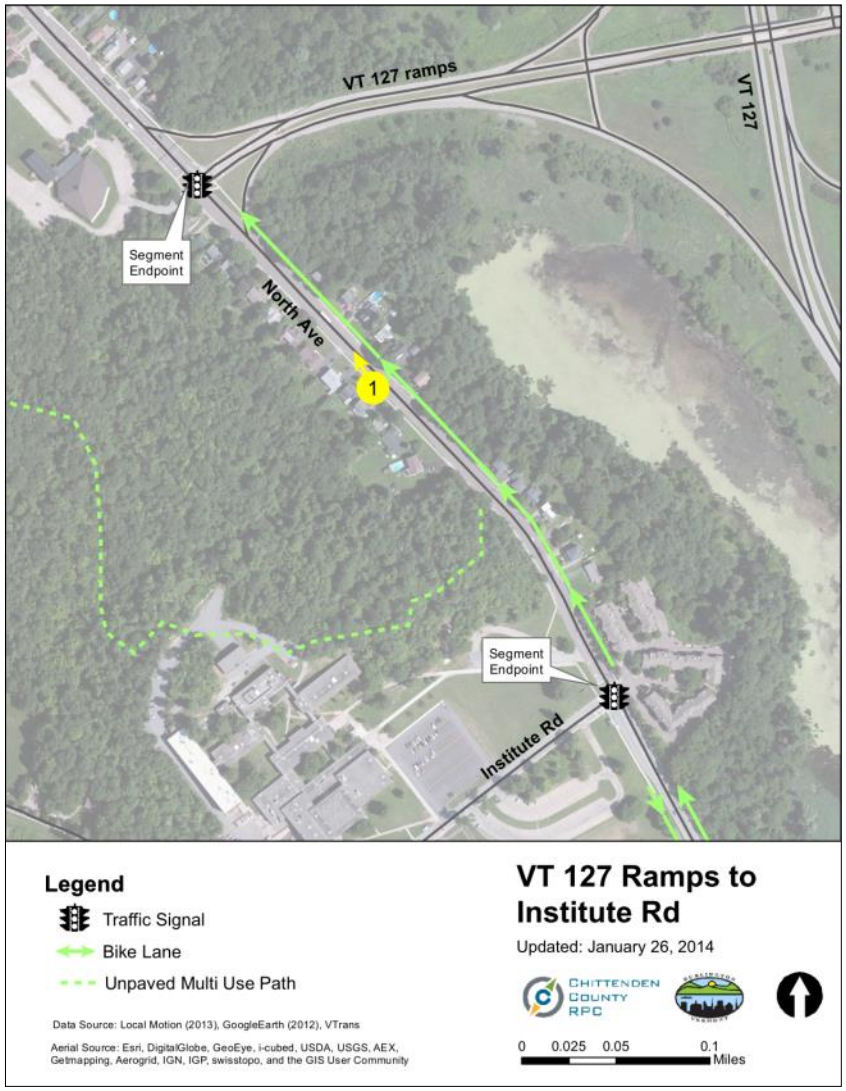


Bicycle Environment

There are no marked bicycle lanes between VT 127 and Institute Road. However, bicycle stenciling and signage is present. The approach to the intersection with the VT 127 ramps has been noted as being particularly difficult for bicyclists because of the presence of a high-speed right-turn ramp and difficulty merging immediately north of the intersection. Observations revealed that some bicyclists prefer riding on the sidewalks.

Figure 42: Faded Northbound Bicycle Markings between VT 127 Ramps and Institute Rd

Figure 43: Bicycle Environment between VT 127 Ramps and Institute Rd

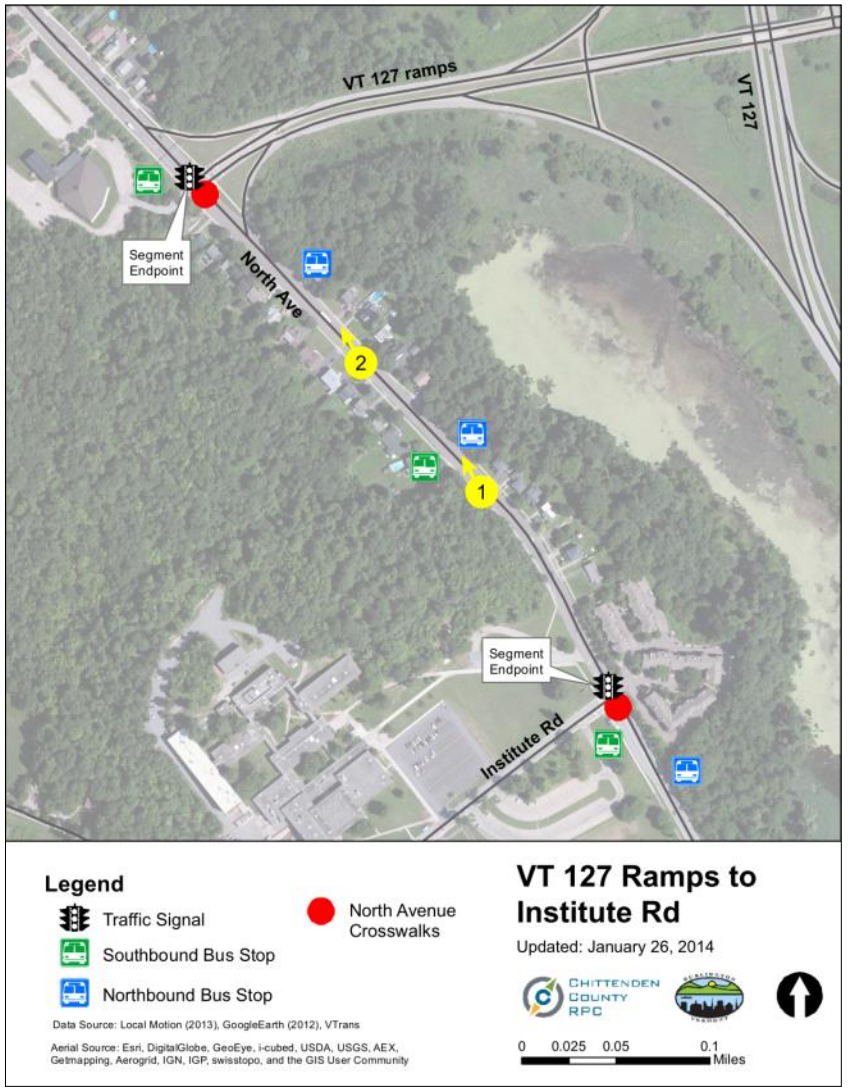


Transit Environment

A few northbound/southbound bus stop pairs are located within this segment, as shown in Figure 45. These stops are marked by signs only and lack any passenger amenities. Passengers have little space between themselves and moving traffic to wait comfortably, as the landscaped buffer found throughout the study corridor is often missing within this segment. There are no midblock crosswalks to serve bus stops in the center of this segment.

Figure 44: Views of Bus Stops between VT 127 Ramps and Institute Rd

Figure 45: Bus Stop Locations between VT 127 Ramps and Institute Rd



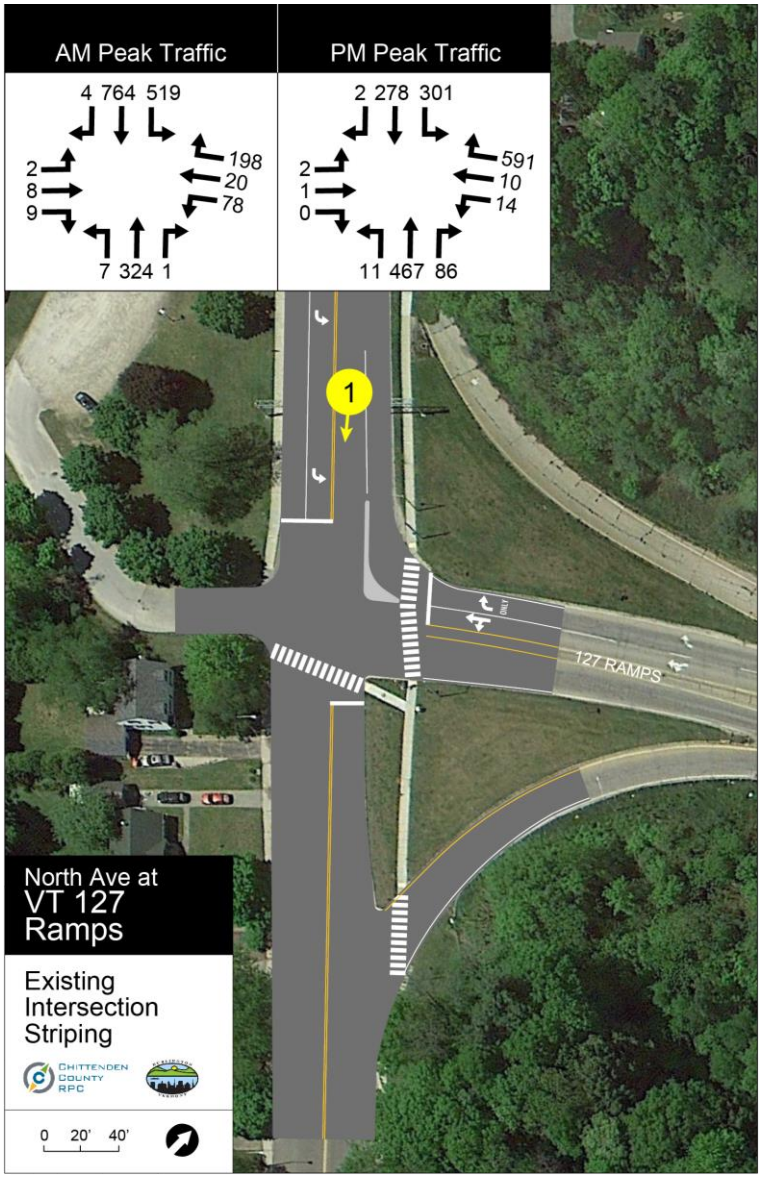
Signalized Intersections

The VT 127 ramps intersection is the busiest intersection within the study corridor. This intersection marks a transition from two to four travel lanes on North Avenue: the second southbound travel lane becomes a dedicated left-turn lane onto VT 127, while the westbound right-turn lane from VT 127 becomes the second northbound travel lane (note that this right-turn lane replaced the abandoned right-turn slip lane onto northbound North Avenue visible in Figure 47). A large right-turn slip lane from North Avenue onto VT 127 is located south of the intersection as well. Drivers must yield to pedestrians at this slip lane, but its design accommodates high-speed turns, the yield sign is small, and pedestrians and bicyclists do not feel safe here.

Only two approaches are marked with crosswalks, as shown in the plan view. Curb ramps are located at the ends of each crosswalk. All crosswalks at the intersection, with the exception of the right-turn slip lane, also include push-button-activated walk signals.

Figure 46: View of North Ave at VT 127 Ramps Intersection

Figure 47: North Ave at VT 127 Ramps Intersection



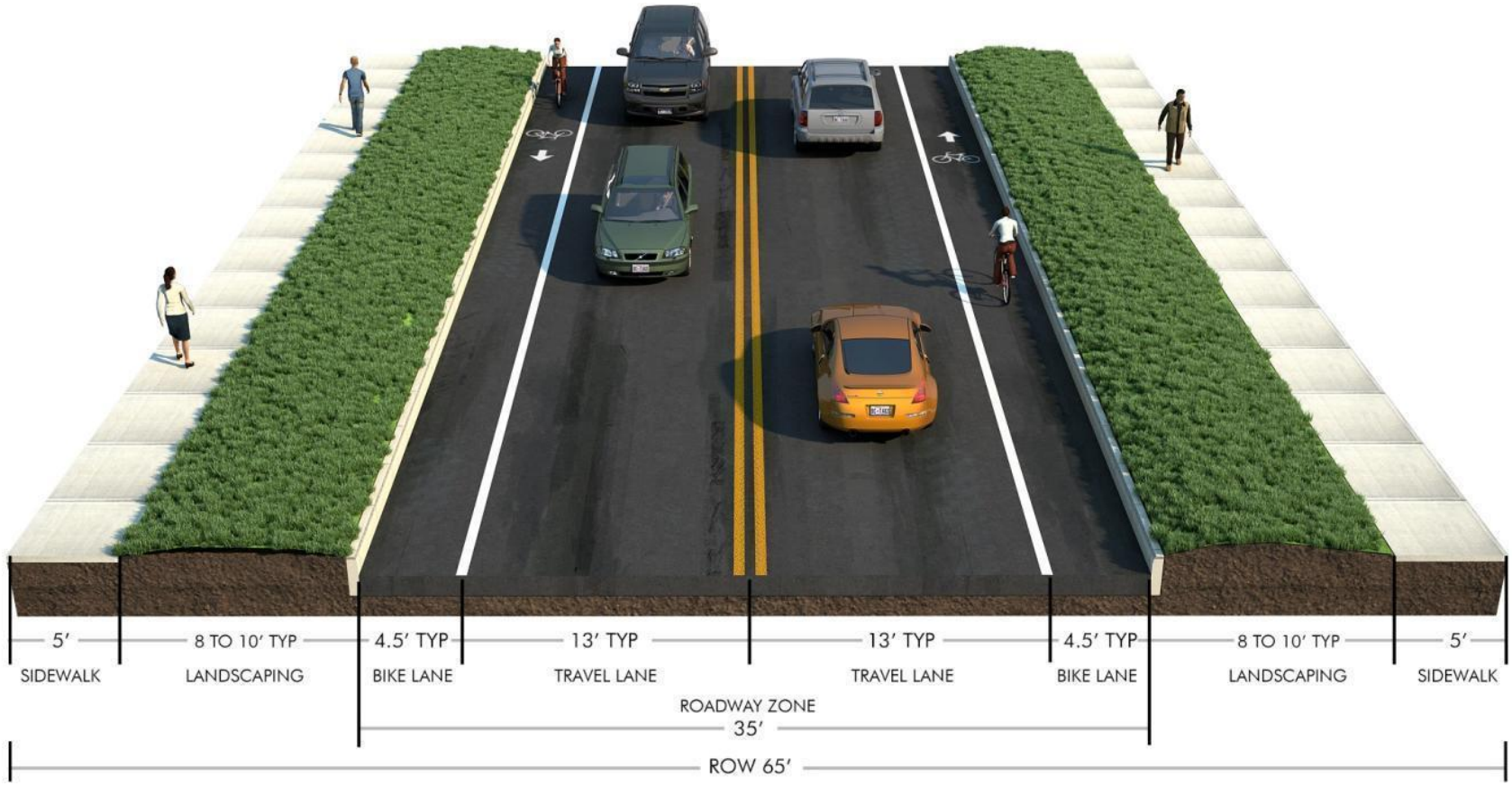
Institute Road to Washington Street

With a curb-to-curb width of 35', the segment between Institute Rd and Washington St/Berry St is relatively narrow for the study corridor. On-street parking is not permitted, as bicycle lanes are present in the northbound and southbound directions. Houses, businesses, and other land uses have dedicated off-street parking. Travel lanes are wide and bicycle lanes are somewhat narrow.

The remainder of the ROW is dedicated to sidewalks with generous landscaped buffers. These landscaped buffers house bus shelters, mature trees, fire hydrants, and utility poles that support streetlights.

This segment acts as a transition between more densely developed ends of the study corridor. Low-intensity land uses line the west side of North Avenue, while open space and single and multi-family residential define the street's east side. Schools located in this stretch are major generators of pedestrian traffic.

Figure 48: Typical Cross Section between Institute Rd and Washington St



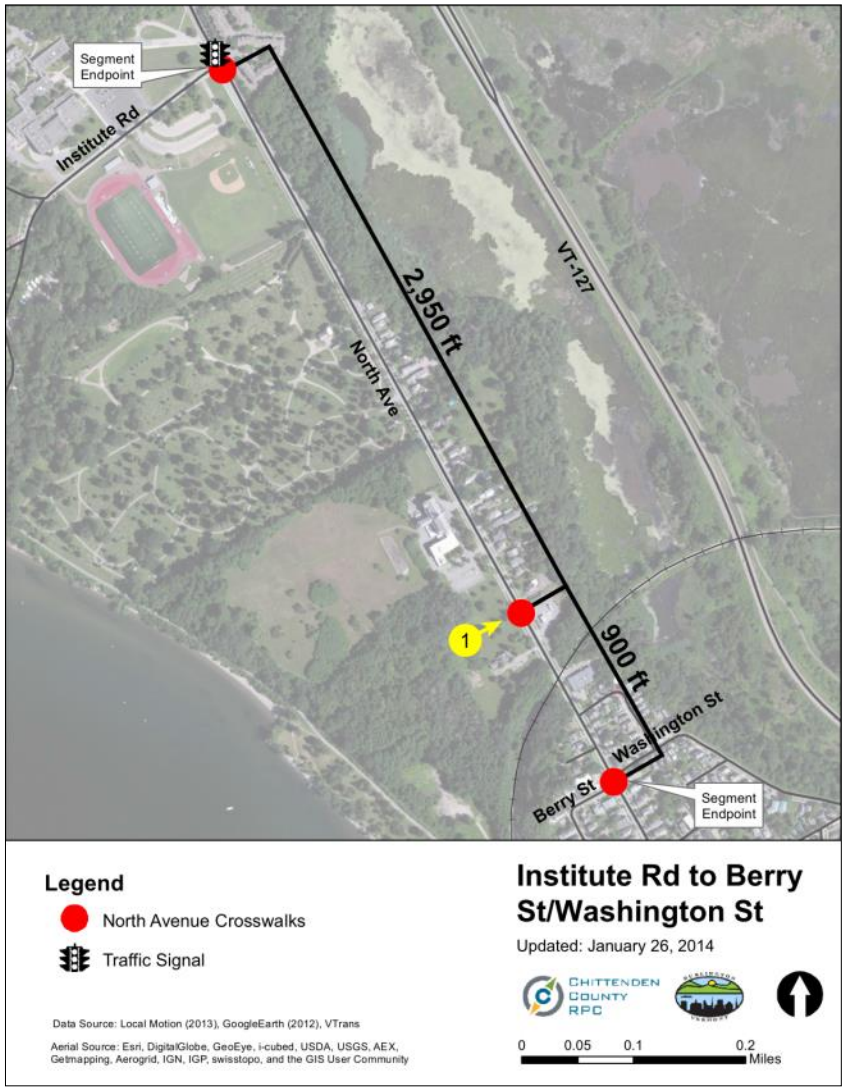
Pedestrian Environment

Sidewalks are generally in fair condition with some cracking that may be problematic for disabled pedestrians. North Avenue crosswalks are limited to three locations in this segment: Washington Street/Berry Street, midblock at Champlain Farms, and at Institute Road. Distances between these crosswalks range from 900' to 2,950'. Pedestrians have precedence when crossing residential and commercial driveways, as the concrete sidewalk material continues across driveways uninterrupted.

All but the North Avenue crosswalk at Institute Road, which is painted red, exhibit white continental striping. While crosswalks are visible, vehicles have worn away some portions that are now faded. All crosswalks include curb ramps for enhanced accessibility. Like other segments, water ponding is an issue at curb ramps during and after rain storms.

Figure 49: Midblock Crosswalk at Champlain Farms

Figure 50: Pedestrian Environment between Institute Rd and Washington St



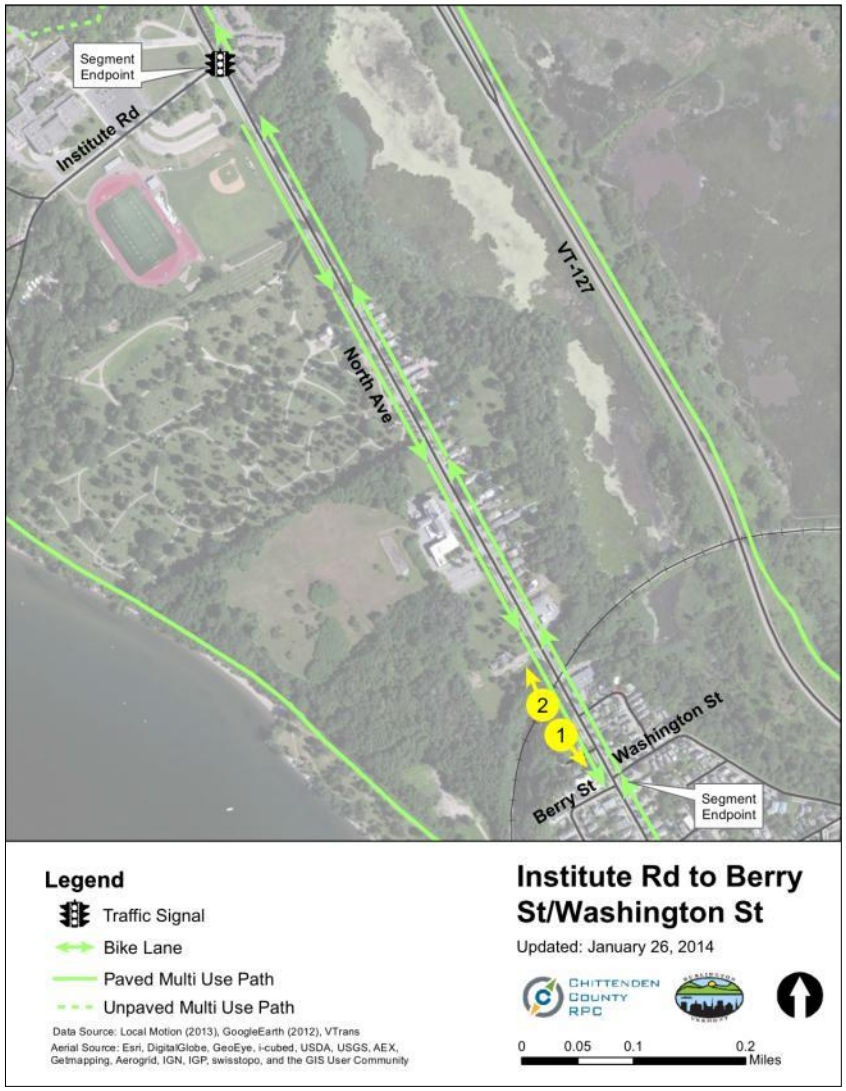
Bicycle Environment

This segment has narrow (4.5' wide) bicycle lanes in both the northbound and southbound directions. However, both lanes are eliminated 230' south of Institute Road to accommodate a left-turn lane for vehicles without further offsetting the oncoming through lanes. These bicycle lanes are in direct conflict with buses, which much temporarily pull into bicycle lanes to serve bus stops.

Observations revealed vehicles parked in the bicycle lanes. Stormwater grates, which are located in the bicycle lane and are thus a nuisance to bicyclists, do not entirely eliminate water ponding in the bicycle lane. As a result, bicyclists must ride closer to moving traffic or entirely within the travel lanes to avoid puddles and grates. Some bicyclists were observed riding on the sidewalks.

Figure 51: Views of Bicycle Lanes between Institute Rd and Washington St

Figure 52: Bicycle Environment between Institute Rd and Washington St

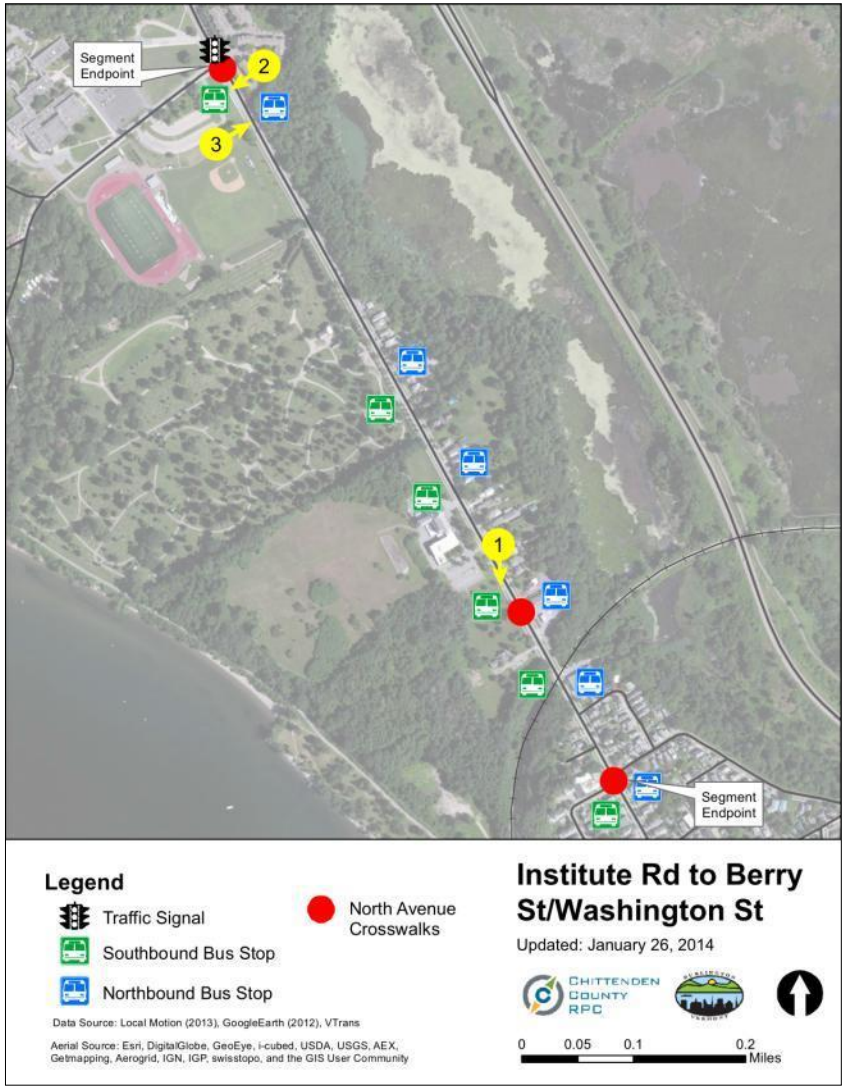


Transit Environment

Several northbound/southbound bus stop pairs are located within this segment, as shown in Figure 54. Stops are more closely spaced in the southern portion of the segment, between Lakeview Cemetery and Washington Street/Berry Street. Northbound and southbound shelters are present at the Institute Road stop only, which serves Burlington High School. Both shelters are adjacent to a concrete pad that connects the sidewalk to the curb for easier boarding. Bus riders often overfill the shelters, and pedestrians often jaywalk to the offset northbound shelter. The southbound stop at the midblock crossing adjacent to Champlain Farms includes a bench without a shelter or concrete boarding pad. All other stops in this segment are marked by signs only and have no other passenger amenities.

Figure 53: Views of Bus Stops between Institute Rd and Washington St

Figure 54: Bus Stop Locations between Institute Rd and Washington St



Signalized Intersections

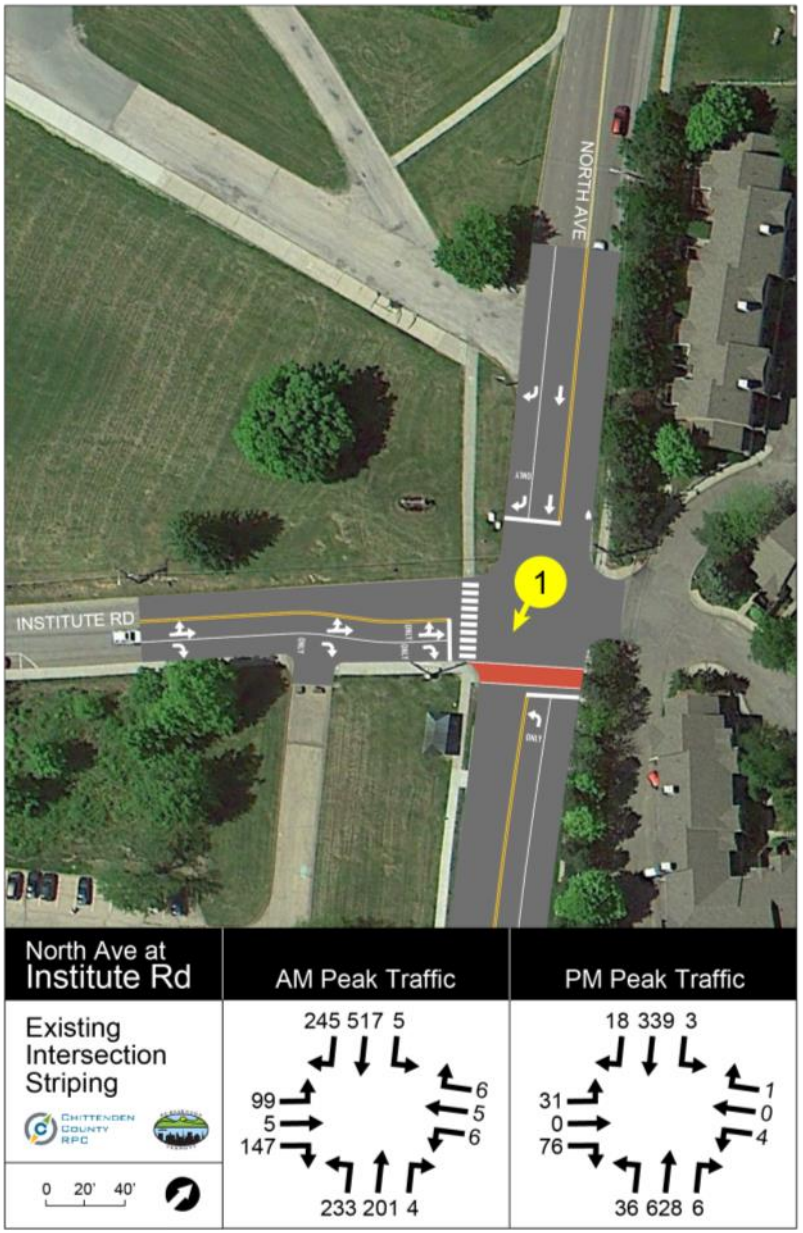
The only traffic signal within this segment is located at the Institute Road intersection, which provides access to Burlington High School and North Beach Park. The northbound centerline is slightly offset into the southbound through lane. In the southbound direction at the far-side bus stop, the roadway zone is slightly wider than the typical cross section to allow vehicles to pass buses serving the Institute Road stop. Immediately north of the intersection is an access driveway for buses going to Burlington High School; this driveway is located in such close proximity that vehicle queues at the intersection interfere with entering and exiting vehicles.

Only two approaches are marked with crosswalks, as shown in Figure 56. While each corner includes curb ramps to some degree, only the southwest corner's curb ramp is in good enough condition to be considered ADA accessible. The red North Avenue crosswalk includes push-button-activated walk signal, while pedestrians crossing the Institute Road crosswalk do not have a walk signal.

This intersection presently operates at LOS B in the morning peak and LOS A in the afternoon peak.

Figure 55: View of North Ave at Institute Rd Intersection

Figure 56: North Ave at Institute Rd Intersection

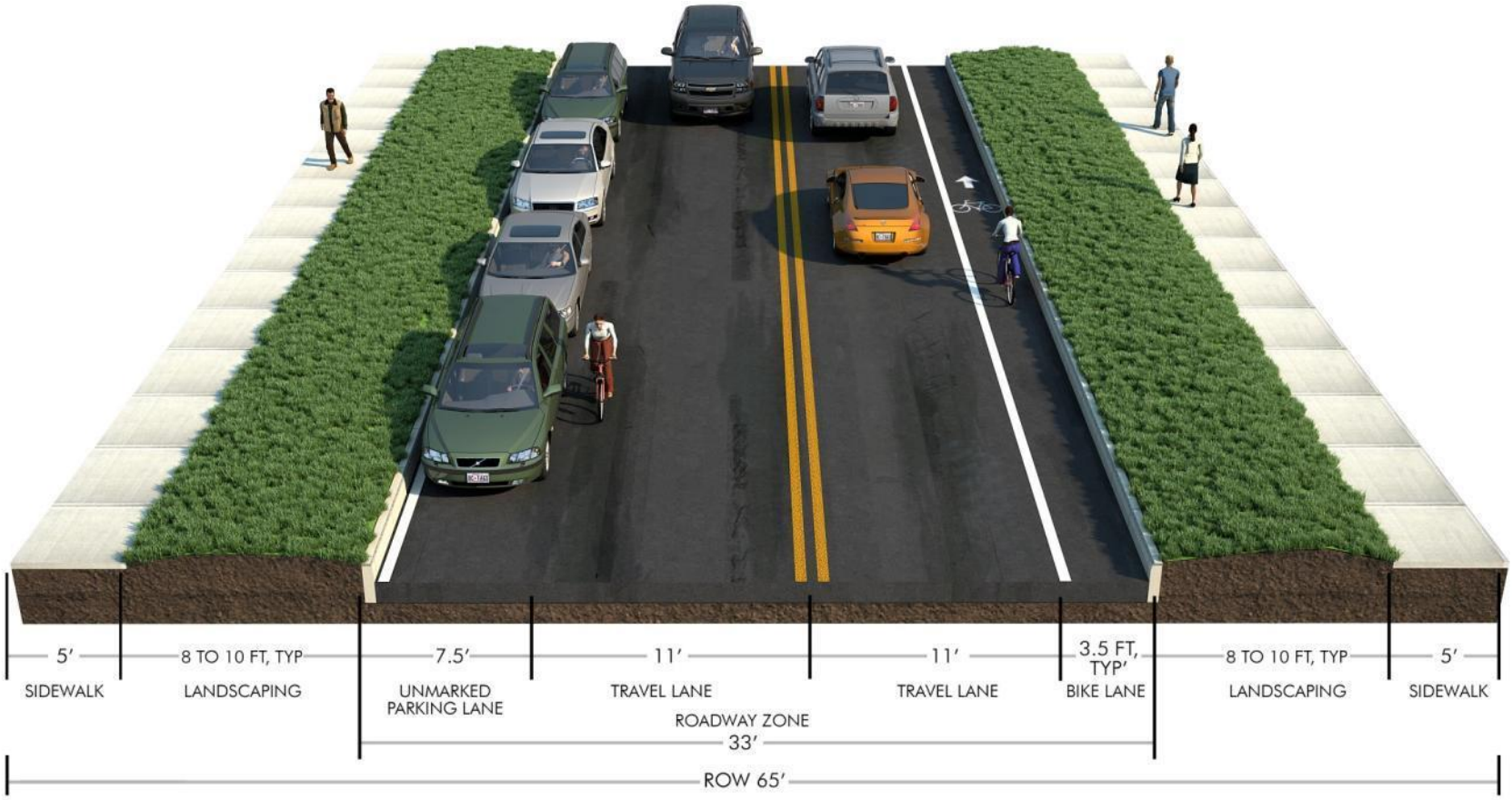


Washington Street to North Street

The narrowest segment within the corridor—between Washington St/Berry St and North St—features a curb-to-curb width of 33'. On-street parking is permitted in the southbound direction only, and the only bicycle facility is a narrow northbound bicycle lane. The remainder of the ROW is dedicated to sidewalks with generous landscaped buffers. These landscaped buffers house bus shelters, mature trees, fire hydrants, and utility poles that support streetlights.

This segment feels the most distinct within the study corridor, as it located in Old North End and was developed before other segments, which are in the New North End. Its residential density is notable, and its homes are closer to the street and on smaller lots.

Figure 57: Typical Cross Section between Washington St and North St



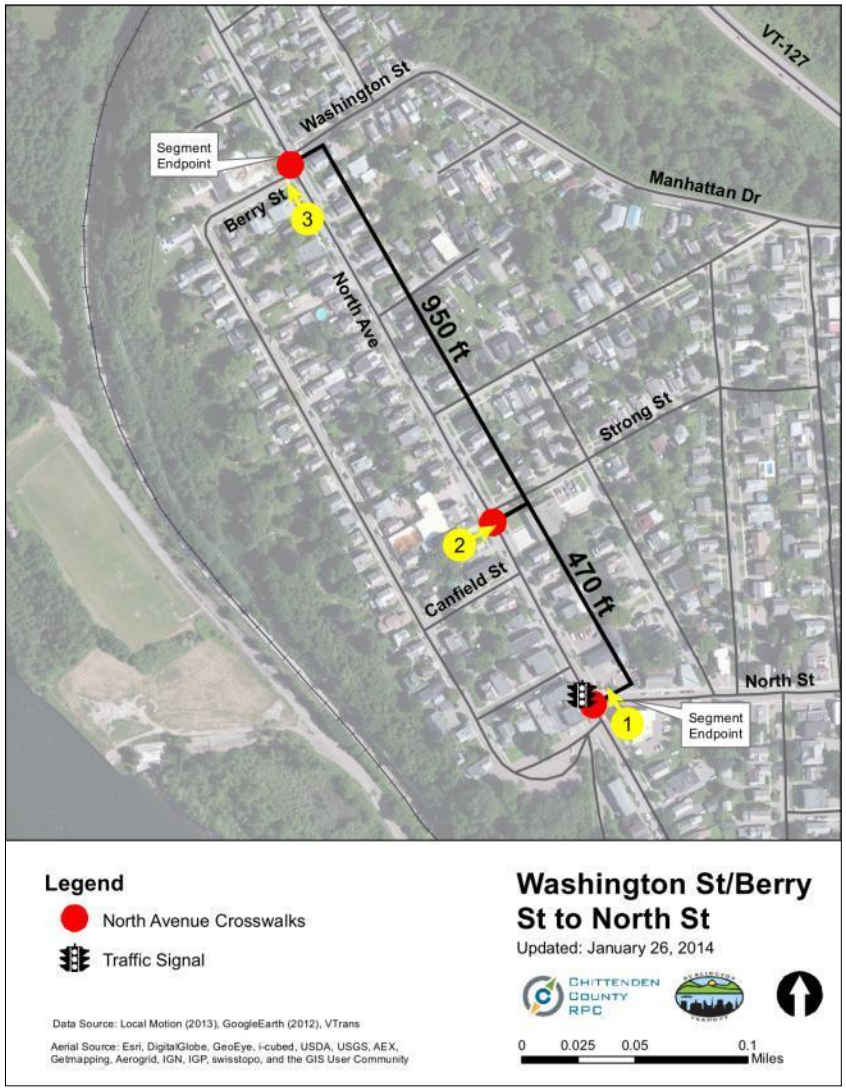
Pedestrian Environment

Sidewalks are generally in fair condition with some cracking that may be problematic for disabled pedestrians. North Avenue crosswalks are found in three locations within this segment: North Street, Strong Street, and Washington Street/Berry Street. Distances between these crosswalks range from 470' to 950'. In addition, all side street crossings have crosswalks.

Most crosswalks exhibit white continental striping, though a few, notably the entire North Street intersection, use solid red paint. While crosswalks are visible, vehicles have worn away some portions that are now faded. All crosswalks include curb ramps for enhanced accessibility. Water ponding is an issue at these ramps during and after rain storms.

Figure 58: Views of Crosswalks between Washington St and North St

Figure 59: Pedestrian Environment between Washington St and North St



Bicycle Environment

This segment has no dedicated bicycle facility in the southbound direction. At 3.5' wide, the northbound bicycle lane is narrow and does not meet current guidelines. This bicycle lane is in direct conflict with buses, which must temporarily pull into the bicycle lane to serve bus stops.

Observations revealed some vehicles parked in the bicycle lane. Stormwater grates, which are located in the bicycle lane and are thus a nuisance to bicyclists, do not entirely eliminate water ponding in the bicycle lane. As a result, bicyclists must ride closer to moving traffic or entirely within the northbound travel lane to avoid puddles and grates. Some bicyclists were observed riding on the sidewalks.

Figure 60: Views of Northbound Bicycle Lane between Washington St and North St

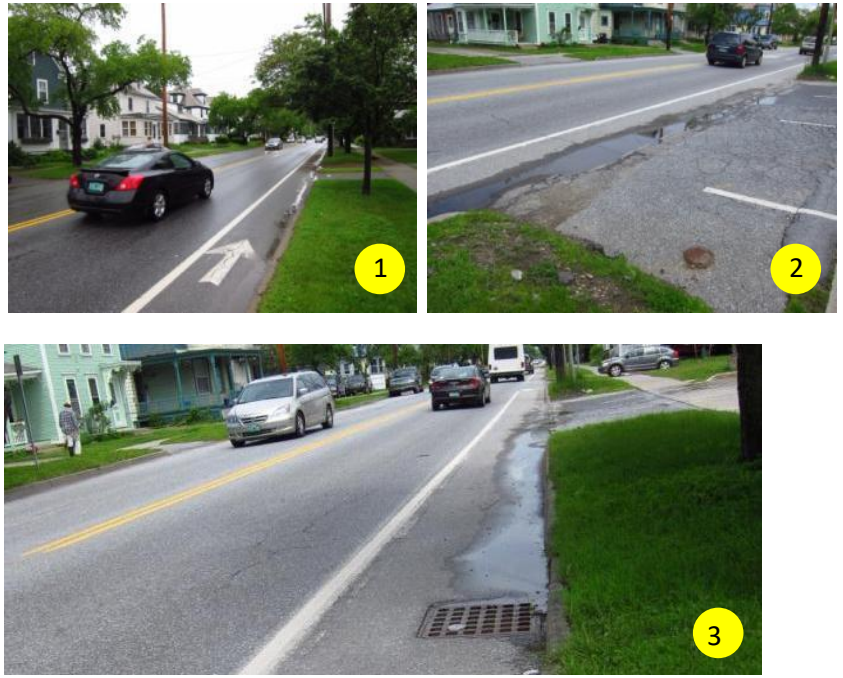


Figure 61: Bicycle Environment between Washington St and North St

Transit Environment

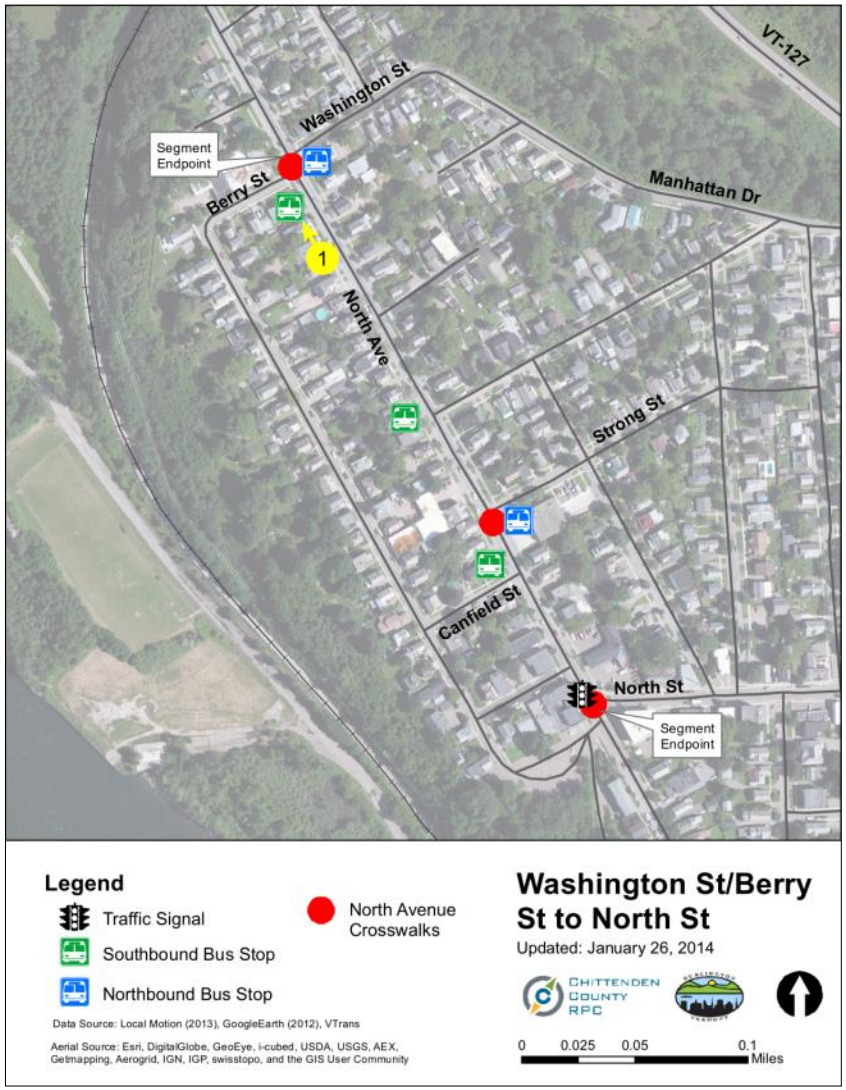
Two northbound/southbound bus stop pairs are located within this segment: Berry Street/Washington Street and Canfield Street/Strong Street. Shelters are included at these stops in the southbound direction only, reflecting that these stops primarily serve waiting passengers traveling to downtown. Both bus stop pairs are served by a North Avenue crosswalk.

Shelters include a bench, are oriented toward the sidewalk, and are adjacent to a concrete pad that connects the sidewalk to the curb for easier boarding. These pads, however, are constructed as ramps, and slope down toward street level, which makes it more difficult for disabled or elderly passengers to board.

An additional southbound-only stop is located at Ward Street. This stop, which is only 350' north of the Canfield Street stop, does not have a shelter and has no connecting crosswalk over North Avenue.

Figure 62: Shelter at Berry St Southbound Bus Stop

Figure 63: Bus Stop Locations between Washington St and North St



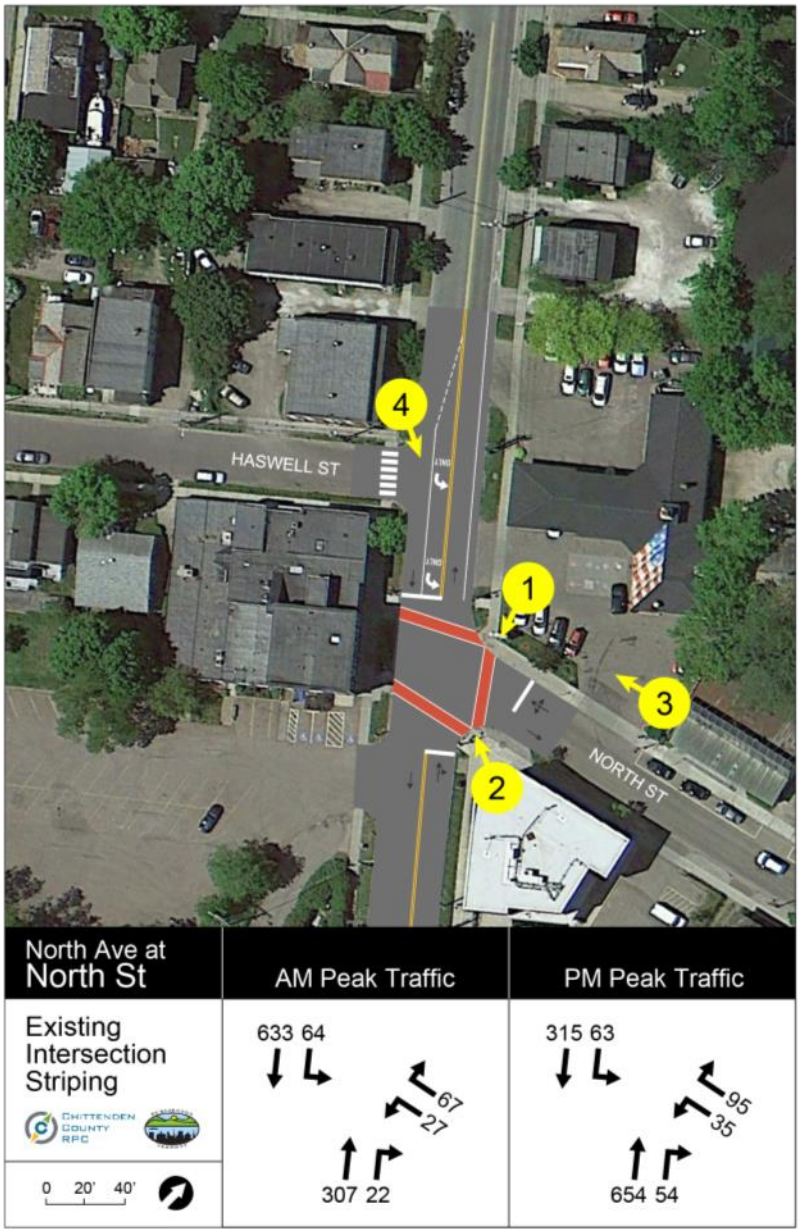
Signalized Intersections

The only traffic signal within this segment is located at the North Street intersection. Southbound parking is restricted north of this intersection to accommodate a southbound left-turn lane. Faded red crosswalks, each with ADA-compliant curb ramps, and push-button-activated walk signals are provided at each approach. The crosswalks and pushbuttons are offset from the sidewalks leading into the intersection.

This intersection presently operates at LOS A in the morning peak and LOS B in the afternoon peak.

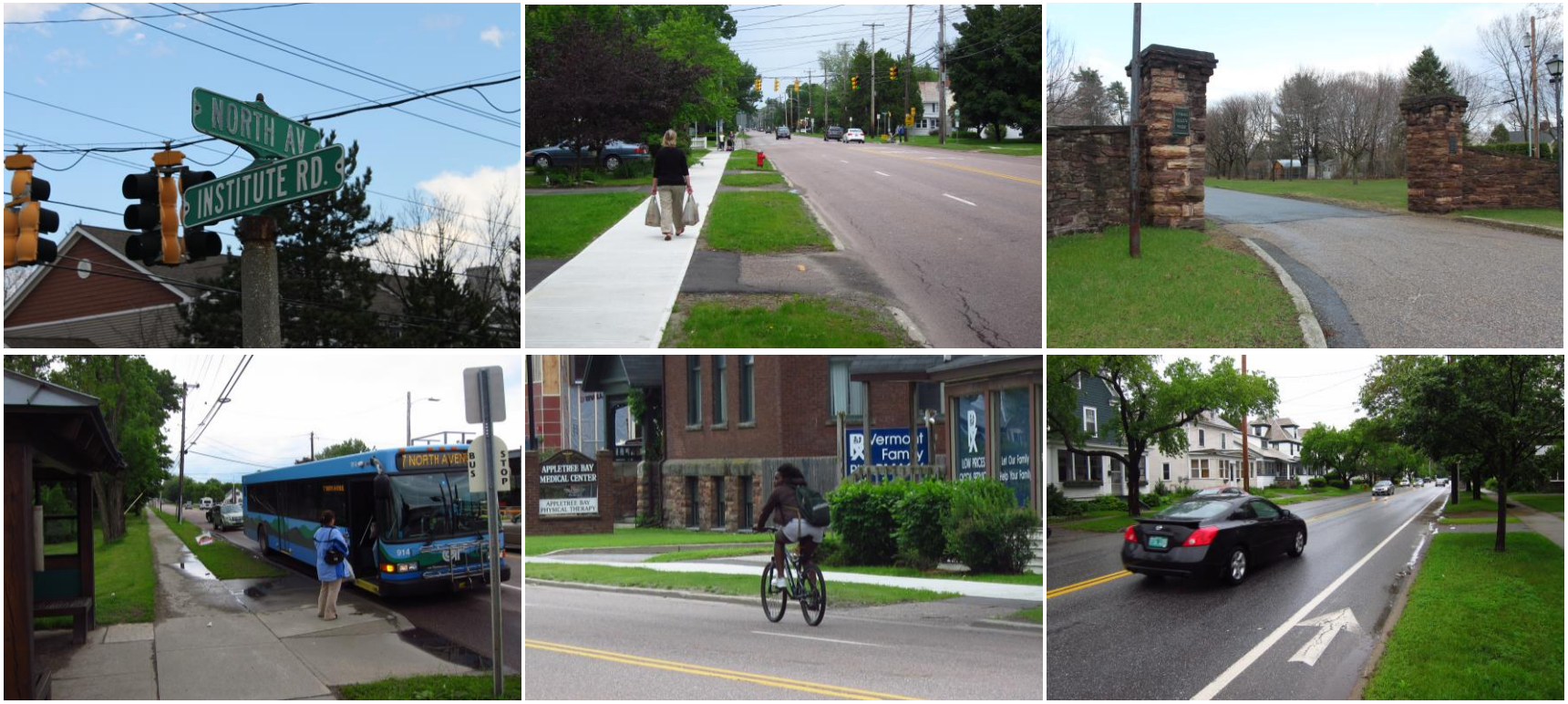
Figure 64: Views of North Ave at North St Intersection

Figure 65: North Ave at North St Intersection



Chapter 3

Improvement Concepts



This chapter describes the development and evaluation of corridor-wide, cross-section, and intersection improvement concepts for North Avenue. The improvement concepts presented in this chapter represent a comprehensive history of all concepts considered, including the ones removed along the way.

Complete Street Design Principles

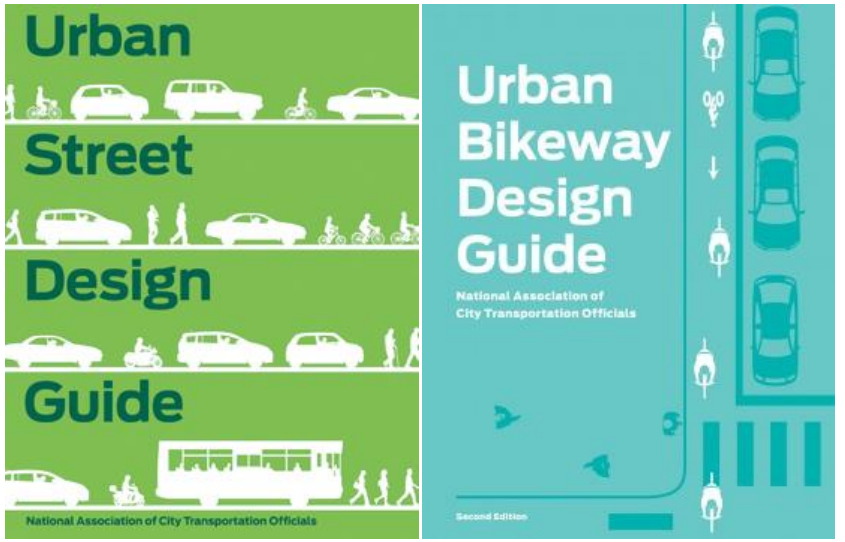
The multimodal concepts developed and evaluated for the North Avenue Corridor adhere to the complete streets principles and they strive to enhance safety for everyone, balance mobility and access, enhance the streetscape, promote public health, and foster social interaction. These principles, include:

- Design for all modes of travel;
- 25 mph speed limit, reinforced with traffic calming elements;
- 10 to 15 mph motor vehicle turning speeds, reinforced by compact intersections;
- Consistent transportation facilities along the corridor;
- Safe and accessible pedestrian facilities (e.g., crosswalks, curb ramps, pedestrian signals) on all intersection approaches; and
- Continuous bicycle facilities through intersections.

These complete street design principles draw upon best practices from national and local complete street guidelines.

The National Association of City Transportation Officials (NACTO) publishes two design guides—*Urban Street Design Guide* and *Urban Bikeway Design Guide*—to advance sustainable, multimodal street design through cooperation among member cities (Burlington is an affiliate member of NACTO). These guides describe appropriate design elements, strategies, and controls (e.g., design speed, design motor vehicle, design hour, etc.) for urban streets. Many state Departments of Transportation and cities throughout the country have officially endorsed both publications.

Figure 66: NACTO Guidance Documents



The Burlington Department of Public Works (DPW) created the Burlington *Street Design Guidelines* to ensure that transportation projects comply with the City's complete streets requirements as well as its 2011 transportation plan, *Moving Forward Together*. The document provides project reporting forms outlining potential complete street treatments that should be considered. These treatments are consistent with design elements identified in both NACTO publications.

Complete Streets Toolbox

The study team outlined a complete streets toolbox consistent with these complete street design principles. The toolbox is a list of specific complete streets design elements available for consideration when developing improvement concepts throughout the North Avenue corridor. These design elements are intended to make North Avenue safer and more convenient for everyone.

Because pedestrian safety greatly correlates with lower motor vehicle speed, much of the toolbox consists of traffic calming elements designed to support a 25-mph speed limit. A driver's peripheral vision

narrows and motor vehicle stopping distances are greater at higher speeds. Subsequently, a pedestrian's fatality risk significantly increases when struck by a motor vehicle traveling faster than 25 mph (Figure 67 and Figure 68).

Figure 67: Motor Vehicle Speed and Pedestrian Safety

Source: NACTO

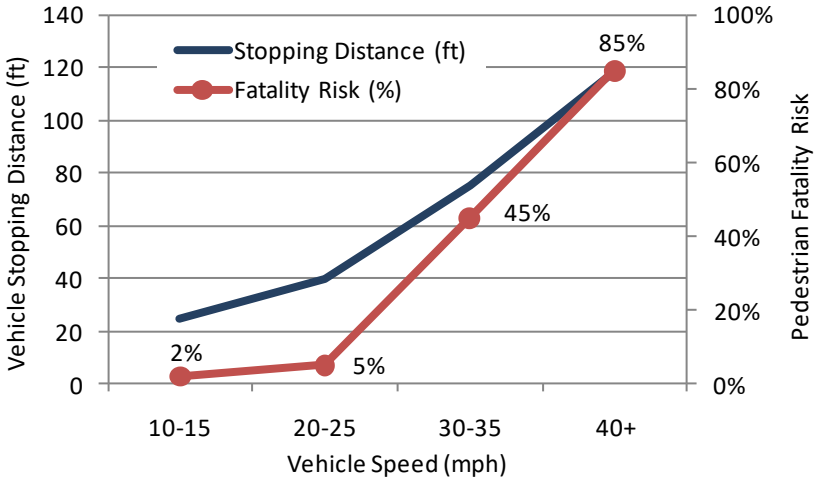


Figure 68: Motor Vehicle Speed and Field of Vision

Source: NACTO

Table 6: Complete Streets Toolbox - Corridor Wide

ID*	Design Element	Benefits
N/A	Consistent 10.5' travel lane width	10'-11' lanes are appropriate for urban settings to control speeds (wider lanes correlate with faster speeds). A 0.5' shoulder provides buses additional space in constrained areas (along curbs or parking).
1	Curb extensions/ chokers	Narrows street to reduce motor vehicle speeds at mid-block crossings or intersections and to shorten pedestrian crossing distances.
2	Mid-block crossings	Provides safe crossing location between intersections. May be paired with pedestrian refuge islands and/or actuated pedestrian beacons.
N/A	Striped on-street parallel parking	Reduces motor vehicle speeds by activating the curb. Provides buffer between pedestrians and moving traffic.
3	Parking chicane	Alternates parking from one side of the street to the other; slows motor vehicle traffic.
4	Bus bulbs	Curb extension with a bus stop. Provides additional space for transit amenities and waiting passengers. Allows buses to stay in travel lane while at the stop.
5	Colored pavement	Green pavement alerts of the presence of a bicycle facility or a bicycle crossing, often where motor vehicle and bicycle movements conflict. Red pavement is often used in Burlington for pedestrian crossings.
N/A	Bicycle-friendly drainage grates	Prevents bicycle tires from getting caught in the grate.

**Design element IDs correspond to images in Figure 69*

Figure 69: Complete Streets Toolbox - Corridor Wide

Source: NACTO

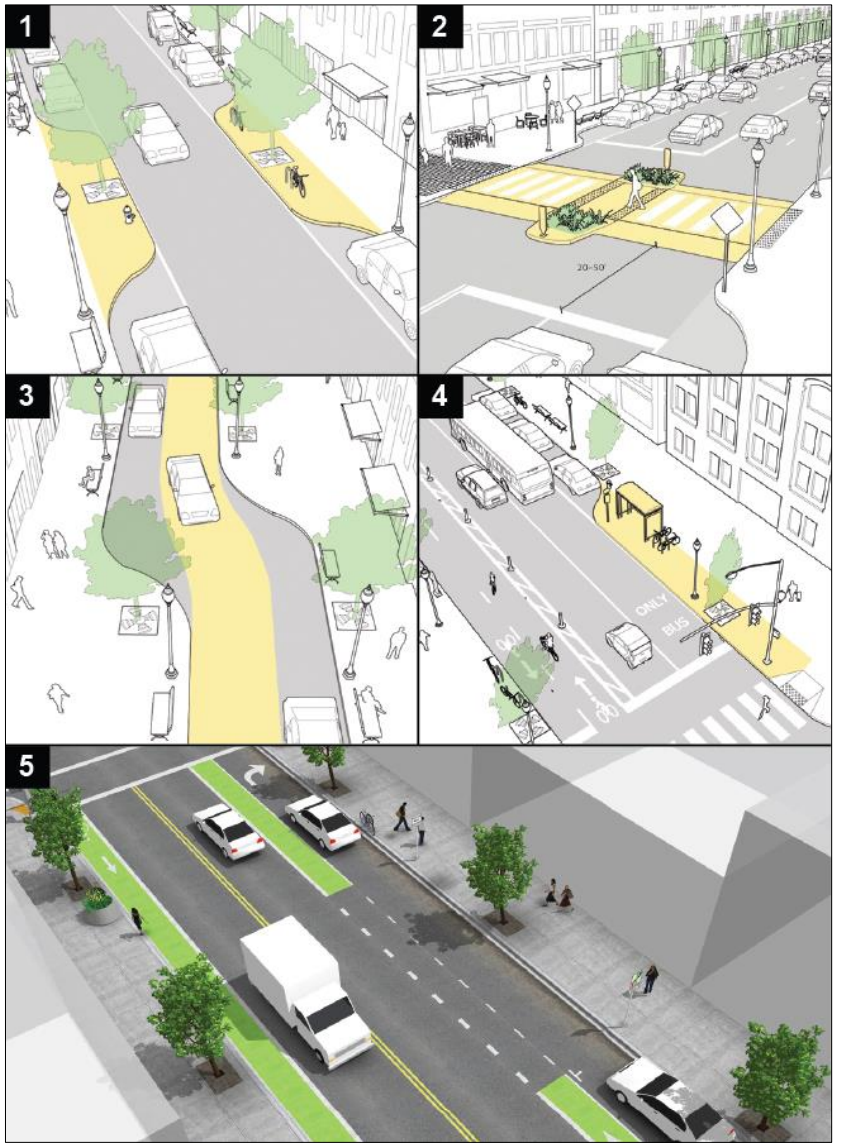


Table 7: Complete Streets Toolbox - Intersections

ID*	Design Element	Benefits
1	Tightened actual and effective corner radii (10'-15')	Requires lower motor vehicle speeds to safely navigate the turn. Effective corner radius can be reduced with curb extensions.
2	Pedestrian crossings on all approaches	Expands pedestrian network, improves convenience, and provides safe crossing facilities in areas where pedestrians are likely to cross.
3	Leading pedestrian intervals	Gives pedestrians a 5-second head start at signalized intersections, providing temporal separation from motor vehicles.
4	Raised intersections	Lowers motor vehicle speeds for safer pedestrian crossings by raising the entire intersection to curb level.
5	Roundabouts: full (shown) or mini	Lowers motor vehicle speeds for through movements. Provides a greater opportunity for gateway treatments compared to standard intersections.
6	Gateway treatments	Slows drivers by providing a visual cue that they are transitioning into a distinct or special area. Common gateway treatments include raised crossings, raised intersections, special signage, colored pavement, or enhanced landscaping.

**Design element IDs correspond to images in Figure 70*

Figure 70: Complete Streets Toolbox - Intersections

Source: NACTO (1-4, 6) and WSDOT (5)

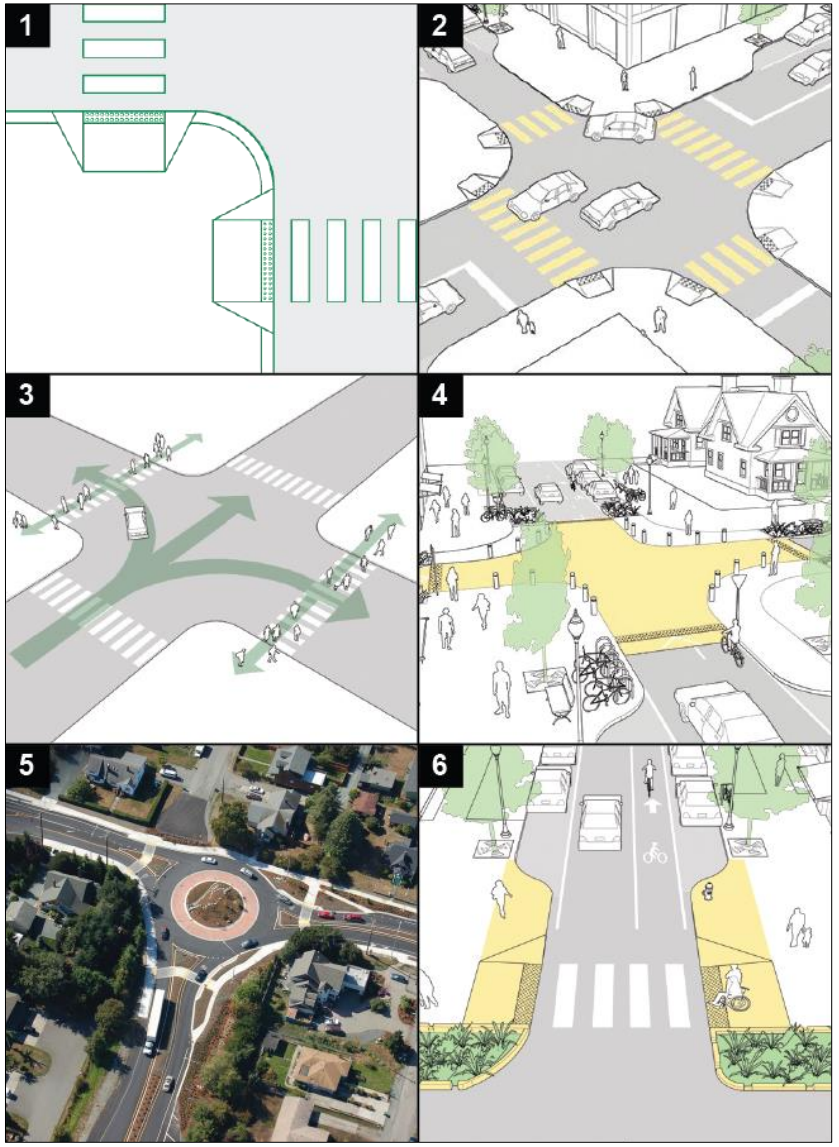


Table 8: Complete Streets Toolbox - Bicycle Facilities

ID*	Design Element	Benefits
1	Conventional bike lanes (5' lane next to curb, 6' lane next to parallel parking)	Dedicated space for cyclists delineated from adjacent travel and parking lanes with white stripes. (Motor vehicle doors obstruct bike lanes when opened.)
2	Buffered bike lanes (5' lane + 2' buffer)	Similar to a conventional bike lane, except one or both sides incorporate wider delineation. Buffer provides additional space for cyclists to reduce dooring risk.
3	On-street one-way protected bike lanes (5' lane + 2' to 3' buffer)	Street-level bike lane protected from motor vehicles by a raised or other types of solid buffers.
4	Raised one-way protected bike lanes (6.5' lane + buffer)	Bike lane raised to sidewalk level, protected from motor vehicles and pedestrians by raised buffers. Wide enough to pass other cyclists. (Buffer in example image is not landscaped.)
5	On-street two-way protected bike lane (9' – 12' path + 3' buffer)	Street-level two-way bicycle lane protected from motor vehicles by a raised buffer.
6	Raised two-way protected bike lane (12' path + buffer)	Two-way bicycle path raised to sidewalk level, protected from motor vehicles and pedestrians by raised buffers. (Buffer in example image is not landscaped.)

**Design element IDs correspond to images in Figure 71*

Figure 71: Complete Streets Toolbox - Bicycle Facilities

Source: NACTO

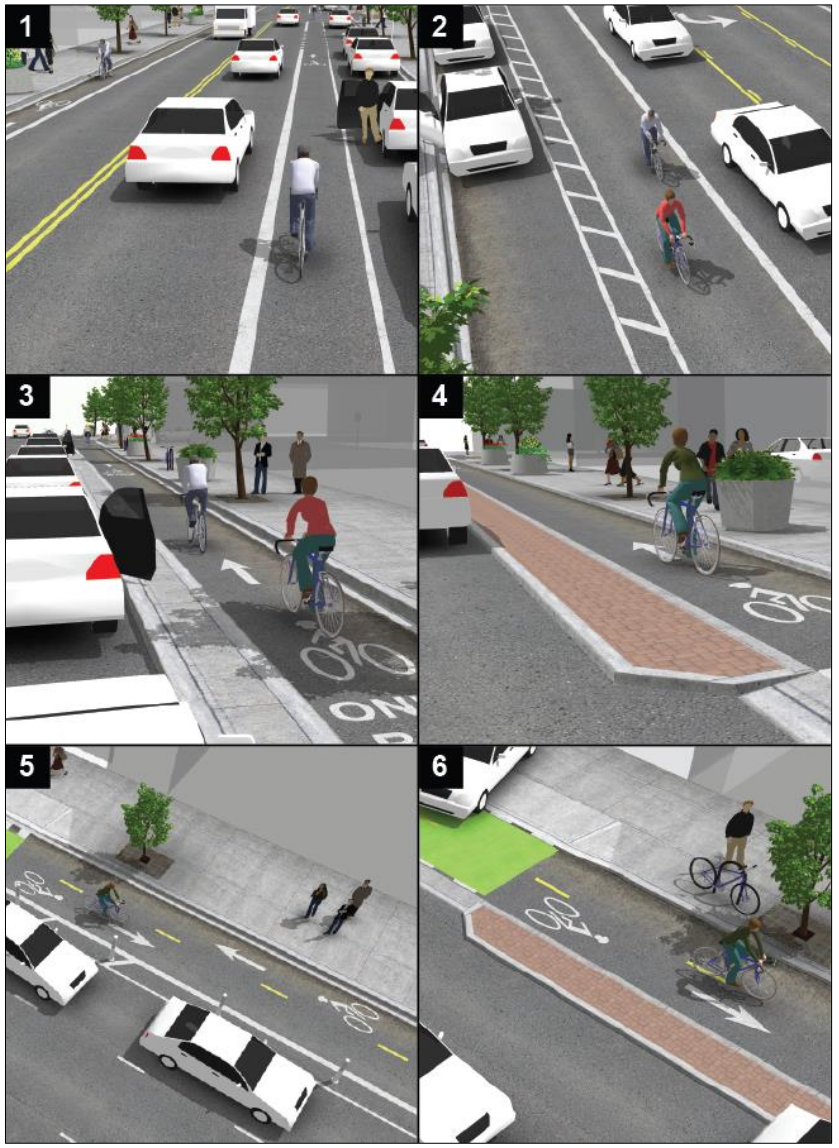


Table 9: Complete Streets Toolbox - Bicycle Facilities at Intersections

ID*	Design Element	About
1	Intersection crossing markings	Provides a marked path through an intersection, like a crosswalk for cyclists. (For signalized or unsignalized intersections)
2	Bike boxes	Provides queuing space for cyclists in front of motor vehicles, increasing the visibility of cyclists to minimize right hook crashes. (For signalized intersections only)
3	Two-stage left-turn boxes	Facilitates safe left turns at intersections, requiring two signal phases to complete the turn. (For signalized or unsignalized intersections)
4	Bike signals	Gives cyclists a 5-second head start at signalized intersections, providing temporal separation from motor vehicles. (For signalized intersections only)
5	Shared right-turn lanes	Continues a bike lane's presence through a right-turn lane with sharrow pavement markings. Only recommended in constrained areas. (For signalized or unsignalized intersections)

**Design element IDs correspond to images in Figure 72*

Figure 72: Complete Streets Toolbox - Bicycle Facilities at Intersections

Source: NACTO

Universe of Concepts

There is only so much public right-of-way on North Avenue and safely accommodating all users regardless of age and ability requires trade-offs regarding which transportation facilities can be incorporated into the limited right-of-way. This study acknowledged these trade-offs by asking several fundamental questions to drive the process of defining all planning-level improvement concepts for North Avenue:

- **How many travel lanes are needed?** Is a road diet feasible between Shore Road and the VT 127 ramps intersection?
- **How will bicycles be accommodated?** Conventional bike lanes, buffered bike lanes, on-street cycle tracks, raised cycle tracks, one-way cycle tracks, or a two-way cycle track?
- **What should intersections look like?** Are additional travel lanes needed at some intersections? Are certain intersections more appropriate as roundabouts? How can high-speed turning movements be slowed to enhance pedestrian safety?
- **How should on-street parallel parking be configured?** Both sides of the avenue or on one side only? No parking? Selective provision at certain locations only or consistently throughout the corridor?

Essentially, these questions speak to the consistency of transportation facilities on North Avenue, a noted issue. Today the street has two different speed limits (25 mph and 30 mph), discontinuous bicycle lanes, inconsistent on-street parking, and between two and four travel lanes. Improvement concepts, therefore, are primarily concerned with creating a well-ordered, balanced, and consistent corridor within the limited right-of-way that serves everyone. Various combinations of facilities comprise the universe of concepts presented in this report. Most of these concepts were later evaluated based on how well they meet the corridor vision and goals, but some concepts were dropped before full evaluation based on feedback provided by the advisory committee and the public.

The universe of improvement concepts is organized as follows:

- **Corridor-wide** concepts include complete street design elements that are not tied to specific intersection or cross-section concepts.
- **Intersection** concepts include complete street design elements applied specifically to major intersections.
- **Cross-section** concepts include complete street design elements relating to the width of the street between major intersections. Cross-section concepts are primarily focused on the proposed cycling facilities because the width and configuration of these facilities was the differentiating factor (additional design elements are included, but are often the same amongst different concepts and thus do not provide a basis for differentiation).

Short-, medium- and long-term concepts were developed to address corridor issues and meet the vision and goals.

Corridor-wide Improvements

Corridor-wide improvements are complete street design elements that apply to multiple locations (e.g., bicycle-friendly drainage grates) or specific locations along North Avenue (e.g., new greenscape zone adjacent to rock outcrop north of Institute Road). These improvements are the basic implementation of complete street design principles and are thus intended for incorporation into all intersection and cross-section concepts to the extent feasible. The final quantity and location of these elements will be determined at a later scoping and design phase following the conclusion of this study.

Pedestrian Treatments

Mid-block Crossings

Pedestrian crossings are few and far between along North Avenue, averaging one crossing every 1,470'. Additional crossings are needed to provide safe access to bus stops and to achieve the shorter average spacing suggested in the *Burlington Street Design Guidelines*. More pedestrian crossings will expand connectivity of the existing pedestrian network, more closely link the east and west sides of North Avenue, and increase accessibility to neighborhood destinations. Pedestrian crossings also calm traffic, particularly when paired with refuge islands and/or actuated pedestrian beacons.

Figure 73 highlights 13 proposed pedestrian crossings at unsignalized intersections or mid-block locations. If all 13 are implemented, average spacing between pedestrian crossings would decrease to 640', a 56-percent reduction over existing conditions.

Crossings at Signalized Intersections

All approaches at signalized intersections are proposed to include crosswalks, accessible curb ramps for the disabled, and audible pedestrian countdown timers with five-second (minimum) push-button Leading Pedestrian Intervals (LPIs). LPIs give pedestrians a 5-second head start at signalized intersections, providing temporal separation from motor vehicles. These treatments will make crossing at major intersections safer and more convenient for all users.

Figure 73: Proposed Pedestrian Crossing Locations

Bicycle Treatments

Lanes

Bicycle lanes may be striped, buffered with paint, or protected with a barrier. Protected bike lanes may be one-way or two-way facilities. The various types are discussed in detail as specific cross-section concepts.

Bicycles at Intersections

North Avenue's existing bike lanes terminate before reaching major intersections at North Street and Institute Road. Cyclists, however, are vulnerable at major intersections because of motor vehicle turning movements. Continuous bicycle treatments at intersections will raise drivers' awareness of cyclists' presence and to provide cyclists clear paths through intersections for through and turning movements. Green paint can help mark points of conflict to further increase visibility of cyclists.

Bicycle treatments for intersections throughout the corridor are listed in Table 9, but specific locations for these intersection treatments will be identified later during the design phase.

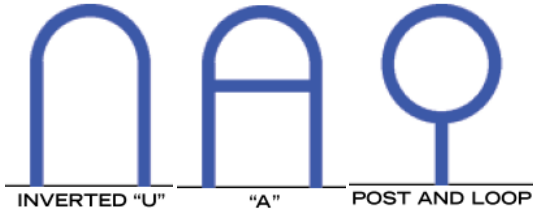
Bicycle Parking

Needs for bike parking within the North Avenue right-of-way are limited because it is primarily a residential street. Destinations along the corridor—Ethan Allen Shopping Center, schools, parks, and churches—are set back from the street, so it is likely that any bike parking at these locations will be on private property outside of the North Avenue right-of-way. However, new bike parking may be added adjacent to bus stops, smaller businesses (e.g., Merola's Market, Bessery's Quality Market), or at regular intervals along the corridor to serve both residents and visitors. Specific locations for bike parking will be identified later during the design phase.

The *Burlington Bicycle Parking Ordinance* requires that all bicycle parking is in accordance with the Association of Pedestrian and Bicycle Professionals *Bicycle Parking Guidelines*, which recommends inverted "U", "A", and post and loop racks to provide upright support for bicycles (Figure 74).

Figure 74: Recommended Bike Parking Designs

Source: Association of Pedestrian and Bicycle Professionals



Drainage Grates

Existing stormwater grates on North Avenue include crosshatch designs and are located within bike lanes, where present. While bicycle tires are unlikely to become stuck with this design (reducing the potential for serious crashes), the relatively widely spaced grate openings create an unnecessarily bumpy ride for cyclists. Cyclists are likely to swerve away from these grates altogether, creating potential conflicts with motor vehicles. Some grates are also surrounded by a lip

to the pavement level, the result of multiple paving cycles since the grate's installation. These barriers reduce the convenience of the bicycle lane and are potential hazards.

In the short-term, existing grates could be replaced with bicycle-friendly designs without altering the catch basins. Longer-term solutions may reconstruct catch basins entirely, presenting an opportunity to remove grates from bicycle facilities altogether, as shown in Figure 75.

Figure 75: Example Bicycle-Friendly Drainage Grates

Source: Mark Wagenbuur (left), Northeastern University (right)

Transit

Improvements to existing CCTA service and shelters have been consistently identified by the public as a critical issue for the North Avenue corridor. Pending funding availability, potential corridor-wide transit improvements include:

- Additional bus shelters at high-usage stops (specific locations determined later during the design phase) and larger shelters at Burlington High School;
- Fifteen-minute peak period weekday headways for Route 7; and
- Increased weekend services.

Parking

The study proposes limiting on-street parking, where available, to one side of the street only or eliminating it altogether in certain corridor segments. Demand for parking appears sparse north of Washington Street (New North End), while parking demand south of Washington Street (Old North End) is high. Several factors likely contribute to low parking demand along most of North Avenue: relatively high motor vehicle speeds, frequent nearby side streets with lower traffic volumes, lack of parking pavement markings, and availability of off-street parking at residences, commercial properties, and other destinations. A formal evaluation of parking demand was not completed for this study.

Greenscape Zone

Most of the North Avenue corridor incorporates a vegetated buffer between the street and the sidewalk—a greenscape zone—to enhance the pedestrian experience. Some locations, however, lack this feature because of commercial driveways, widened curb-to-curb street width, or topographical issues.

For example, a nearly 500' stretch of sidewalk north of Institute Road lacks a greenscape zone because an adjacent rock outcrop limits the buildable width of the right-of-way. As a result, the sidewalk is sandwiched between a rock wall and North Avenue without a buffer. Members of the public noted that this sidewalk is uncomfortable for walking because of a lack of a greenscape buffer, and potentially dangerous in the winter from snow and ice. Corridor reconstruction presents an opportunity to reconnect these disconnected greenscape zones.

Stormwater Treatments

North Avenue is relatively flat, and as a result drainage is a noted issue, particularly water ponding within bike lanes and at curb ramps. Enhanced stormwater treatments such as rain gardens and stormwater planters could help reduce ponding (Figure 76 and Figure 77). These features provide similar benefits—collect, absorb, and treat runoff on-site—but stormwater planters include additional features such as structural walls for support and underdrains/drainage pipes to handle excess runoff. Rain gardens are simpler, relying more on porous soils in a recessed bed. In the winter these treatments winter double as snow storage.

North Avenue contains many opportunities for stormwater treatment within linear greenscape zones and in parking lanes. Proposed site-specific curb extensions and intersection gateway treatments also provide an excellent opportunity to integrate these design elements. These treatments also provide landscaping opportunities to integrate native trees, shrubs, and grasses. Low-maintenance vegetation is preferred in order to reduce maintenance costs.

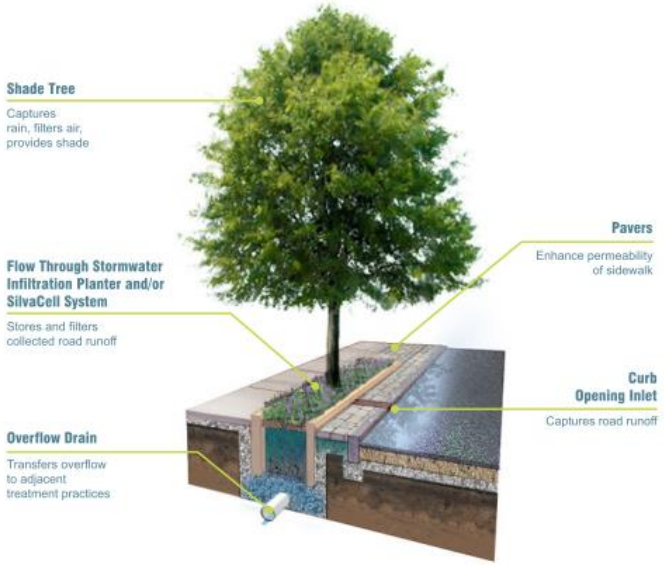
Corridor reconstruction presents the opportunity to implement enhanced stormwater treatments. Additional treatments, such as raised pedestrian crossings at side streets, would further reduce water ponding at curb ramps. The quantity and location of specific stormwater treatments will be determined at a later design phase.

Figure 76: Rain Garden

Source: *Burlington Street Design Guidelines*

Figure 77: Stormwater Planer

Source: *Burlington Downtown & Waterfront planBTV*



Intersection Concepts

Intersection concepts include complete street design elements applied specifically to the North Avenue corridor's major signalized and unsignalized intersections (Figure 78).

Each intersection concept includes a basic set of corridor-wide improvements in addition to concept-specific design elements. All intersection concepts include:

- Crosswalks on all approaches;
- Accessible curb ramps for the disabled and visually impaired on all approaches;
- Continuous bicycle treatments at intersections to raise drivers' awareness of cyclists' presence and to provide cyclists clear paths through intersections for through and turning movements; and
- Audible pedestrian countdown timers with five-second (minimum) push-button Leading Pedestrian Intervals (LPIs) (Note that this does not apply to roundabout concepts).

As noted above, LPIs give pedestrians a 5-second head start at signalized intersections, providing for safer and more convenient crossing, particularly for seniors, the disabled, or pedestrians with visual or hearing impairments. This is especially relevant near the Ethan Allen Shopping Center, described as the most challenging route for seniors and pedestrians with visual and hearing impairments.

The study conducted traffic analyses for all signalized intersections between Shore Road and VT 127 ramps for two different roadway cross-sections:

- A concept that maintains the existing four-lane North Avenue cross section between Shore Road and VT 127 ramps; and
- A concept that converts this segment to a three-lane cross section (i.e., one northbound, one southbound, and a two-way left-turn lane).

Figure 78: Location of Intersection Concepts

Plattsburg Avenue

The study team developed three concepts for the Plattsburg Avenue signalized intersection. Each concept includes a large curb extension at the intersection's eastern corner, creating a more standardized T intersection and thereby removing the ability for drivers to make the right turn from North Avenue northbound to Plattsburg Avenue eastbound at high speeds. This curb extension is larger in Concepts 2 and 3. The curb extension provides an opportunity to minimize the intersection area by moving the northbound crosswalk and stop bar farther north, more clearly delineating Tracy Drive as a separate unsignalized intersection and leaving more space for pedestrian and bicycle treatments. Plattsburg Avenue's role as the corridor's northern gateway is enhanced in all concepts through the use of gateway treatments on all four corners, which may include special streetscaping, pavement, stormwater treatments, or signage.

Concepts 1 and 2 maintain the traffic signal and include similar design elements, but Concept 2 removes the dedicated northbound right-turn lane in favor of additional space for bicycle facilities or gateway treatments. Concept 1's south crosswalk is protected by an exclusive pedestrian phase because the dominant traffic movement conflicts with the crossing. Concept 2, however, does not include this exclusive pedestrian phase because an LPI provides enough temporal separation for pedestrians when the distance is shorter.

Concept 3 is a mini-roundabout (i.e. a roundabout that fits within the intersection's existing curbs) with no flared entry on the approaches. Eliminating flare on median islands provides drivers greater visibility of pedestrians, cyclists, and other motor vehicles, and slows motor vehicle turns. Traffic analysis results are listed in Table 10.

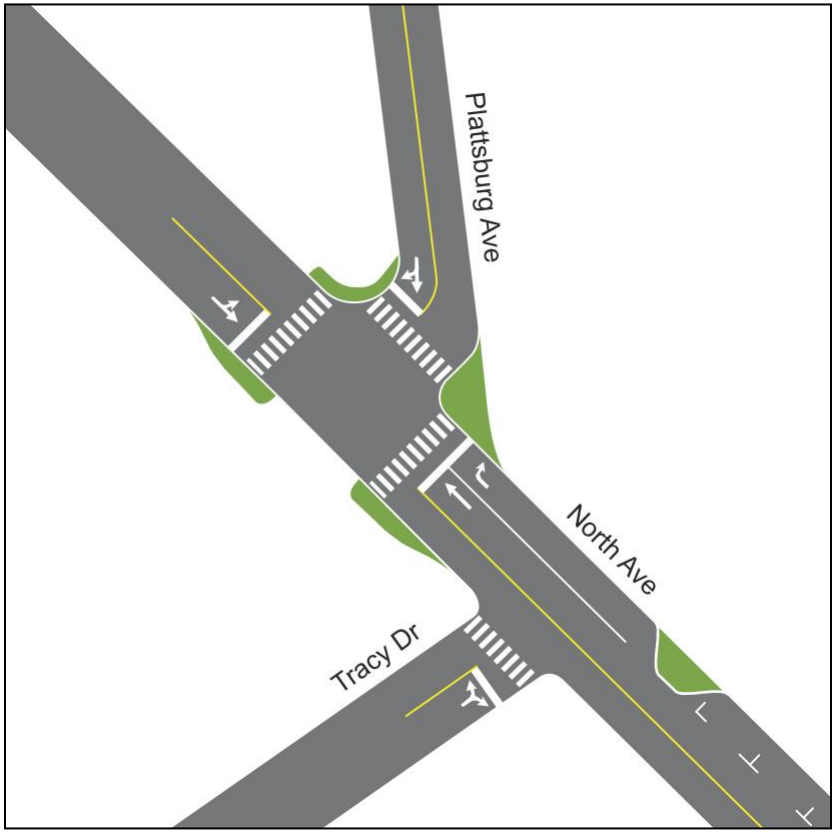
Table 10: Plattsburg Ave 2035 AM and PM Peak Hour LOS and Average Queues (Number of Cars)

Concept	Period	Eastbound (N/A)		Westbound (Plattsburg Ave)		Northbound (North Ave)		Southbound (North Ave)		Intersection Overall
Exist. Config.	AM Peak Hour	-	-	C	3	A	2	B	3	**B**
	PM Peak Hour	-	-	B	5	A	3	A	2	**B**
1	AM Peak Hour	-	-	C	3	B	2	C	3	**B**
	PM Peak Hour	-	-	C	6	B	3	C	3	**B**
2	AM Peak Hour	-	-	B	3	C	5	C	5	**B**
	PM Peak Hour	-	-	C	9	C	11	B	4	**C**
3	AM Peak Hour	-	-	B	1	C	2	D	2	**C**
	PM Peak Hour	-	-	C	4	D	4	C	3	**D**

Concept 1

- Slow high-speed NB right turns with curb extension
- Resolve Tracy Dr turns and access to Merola's Market
- Exclusive pedestrian phase at south crosswalk
- Gateway treatments (north entrance to corridor)

Figure 79: Plattsburg Avenue Concept 1

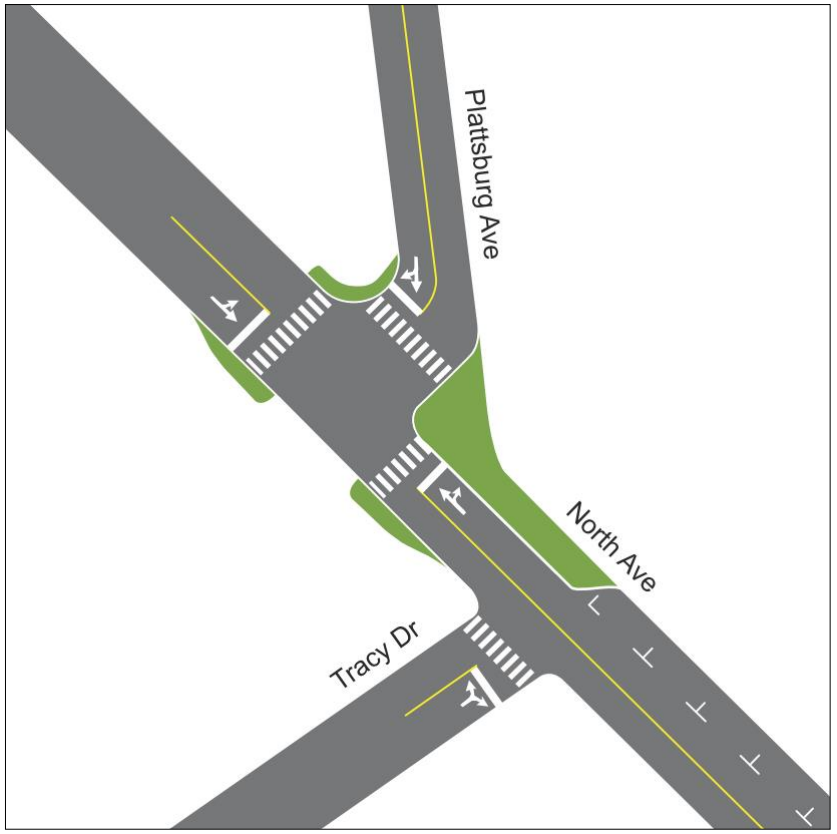


Note: not an engineering drawing to scale; bicycle facilities not shown

Concept 2

- Slow high-speed NB right turns with curb extension and removal of the NB right-turn lane
- Resolve Tracy Dr turns and access to Merola's Market
- Gateway treatments (north entrance to corridor)

Figure 80: Plattsburg Ave Concept 2

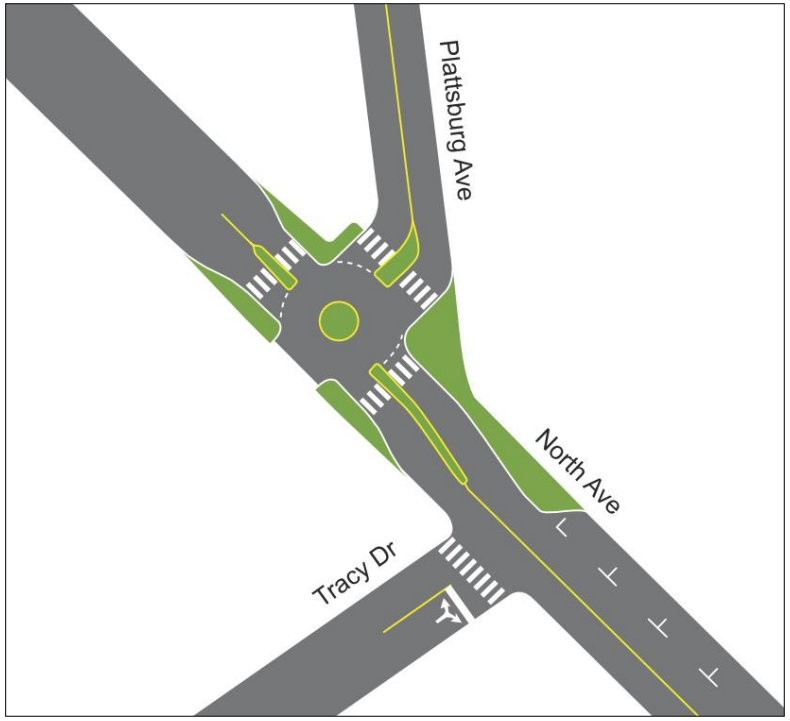


Note: not an engineering drawing to scale; bicycle facilities not shown

Concept 3

- Mini-roundabout with no flared entry (increases visibility of pedestrians and cyclists to drivers, and slows motor vehicle turns)
- Separated protected bike lane around roundabout (not shown)
- Slow high-speed NB right turns with curb extension and removal of the NB right-turn lane
- Resolve Tracy Dr turns and access to Merola's Market
- Additional gateway treatments (north entrance to corridor)

Figure 81: Plattsburg Ave Concept 3



Note: not an engineering drawing to scale; bicycle facilities not shown

Shore Road/Heineberg Road

The study team developed two concepts for the Shore Road/ Heineberg Road signalized intersection. Both concepts increase pedestrian crossing times and prohibit right turns on red to better serve nearby seniors accessing Ethan Allen Shopping Center.

Concepts 1 and 2 differ in how the traffic signals operate because of the skewed intersection. Concept 1 proposes no modifications to the intersection geometry, instead relying on split phasing of the traffic signal (i.e. Shore Road and Heineberg Road receive separate signal phases) to eliminate confusion and reduce the risk of left-turn collisions. Concept 2 proposes a relocation of Shore Road to better align with Heineberg Road. In this configuration, split phasing can be eliminated. The former Shore Road right-of-way could then be dedicated to a large curb extension or other community purposes. Concept 2 relies on a right-of-way donation from St. Mark Church, whose property would be impacted.

The study analyzed two versions of Concepts 1 and 2: one that maintains the four-lane North Avenue cross section south of Shore Road and one that converts North Avenue to a three-lane cross section south of Shore Road (one northbound, one southbound, and one left-turn lane). Traffic analysis results are listed in Table 11.

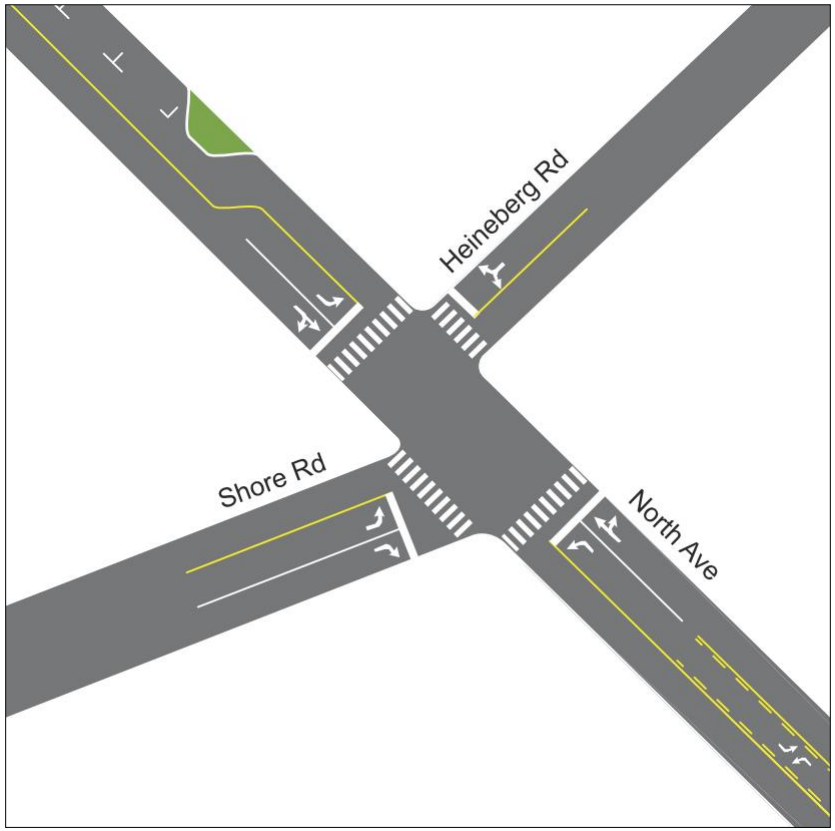
Table 11: Shore Rd/Heineberg Rd 2035 AM and PM Peak Hour LOS and Average Queues (Number of Cars)

Concept	Period	Eastbound (Shore Rd)		Westbound (Heineberg Rd)		Northbound (North Ave)		Southbound (North Ave)		Intersection Overall
Exist. Config.	AM Peak Hour	B	1	C	1	A	1	A	10	**A**
	PM Peak Hour	B	1	C	1	A	3	A	3	**A**
1: 3 lanes	AM Peak Hour	D	5	D	2	C	1	C	14	**C**
	PM Peak Hour	D	2	D	2	B	5	B	7	**B**
1: 4 lanes	AM Peak Hour	D	5	D	2	C	4	C	14	**C**
	PM Peak Hour	D	2	D	2	C	8	B	7	**C**
2: 3 lanes	AM Peak Hour	C	4	C	2	B	4	C	13	**C**
	PM Peak Hour	C	2	C	1	A	6	A	3	**B**
2: 4 lanes	AM Peak Hour	C	4	C	2	B	5	C	13	**C**
	PM Peak Hour	C	2	C	1	A	6	A	3	**B**

Concept 1

- Increase pedestrian crossing times for seniors
- Pedestrian-activated no right turn on red
- Split phasing for Shore Road and Heineberg Road approaches

Figure 82: Shore Road/Heineberg Road Concept 1 (Three Lanes)

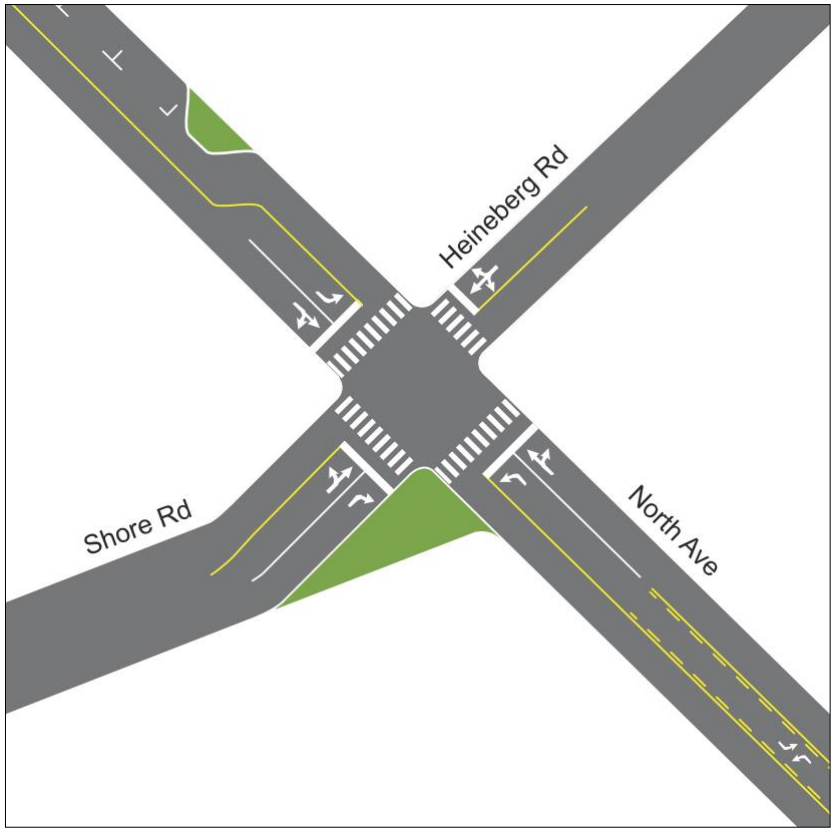


Note: not an engineering drawing to scale; bicycle facilities not shown

Concept 2

- Increase pedestrian crossing times for seniors
- Pedestrian-activated no right turn on red
- Realign Shore Road (contingent upon St. Mark Church right-of-way donation)

Figure 83: Shore Road/Heineberg Road Concept 2 (Three Lanes)



Note: not an engineering drawing to scale; bicycle facilities not shown

Ethan Allen Shopping Center

The study team developed two concepts for the Ethan Allen Shopping Center signalized intersection. Both concepts increase pedestrian crossing times and prohibit right turns on red to better serve nearby seniors accessing the shopping center.

Concept 2, however, would reconstruct the eastern side of the intersection, including the Farrington's Mobile Home Park entrance and the curb cuts and sidewalk along the Bamboo Hut property. This intersection is the main entrance to the mobile home park, but the small street more closely resembles a driveway because it lacks curbs, a crosswalk, pedestrian signals, a center line, and other pavement markings. The adjacent Bamboo Hut property fronts a large curb cut on North Avenue, allowing drivers to cut through to avoid the traffic signal. Sidewalk conditions at this location suffer and need reconstruction. New sidewalk, curbing, and a greenscape zone along the Bamboo Hut would improve the quality of the pedestrian experience.

The study analyzed two versions of Concepts 1 and 2: one that maintains the four-lane North Avenue cross section and one converting North Avenue to a three-lane cross section (one northbound, one southbound, and one left-turn lane). Traffic analysis results are listed in Table 12.

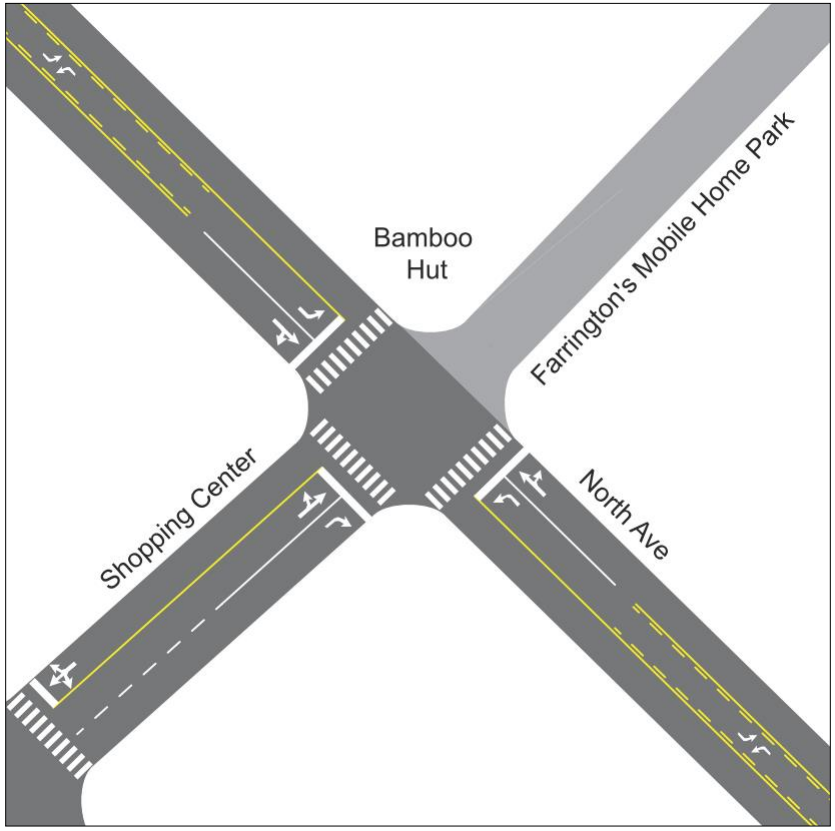
Table 12: Ethan Allen Shopping Center 2035 AM and PM Peak Hour LOS and Average Queues (Number of Cars)

Concept	Period	Eastbound (Ethan Allen Shopping Center)		Westbound (Farrington's Mobile Home Park)		Northbound (North Ave)		Southbound (North Ave)		Intersection Overall
Exist. Config.	AM Peak Hour	B	2	C	1	A	1	A	1	**A**
	PM Peak Hour	C	5	C	1	A	1	A	3	**B**
1: 3 lanes	AM Peak Hour	D	2	D	1	B	8	C	14	**C**
	PM Peak Hour	D	7	D	1	C	17	C	7	**C**
1: 4 lanes	AM Peak Hour	D	2	D	1	B	3	C	5	**C**
	PM Peak Hour	D	7	D	1	B	5	C	3	**C**
2: 3 lanes	AM Peak Hour	D	2	D	1	B	8	C	14	**C**
	PM Peak Hour	D	7	D	1	C	17	C	7	**C**
2: 4 lanes	AM Peak Hour	D	2	D	1	B	3	C	5	**C**
	PM Peak Hour	D	7	D	1	B	5	C	3	**C**

Concept 1

- Increase pedestrian crossing times for seniors
- Pedestrian-activated no right turn on red

Figure 84: Ethan Allen Shopping Center Concept 1 (Three Lanes)

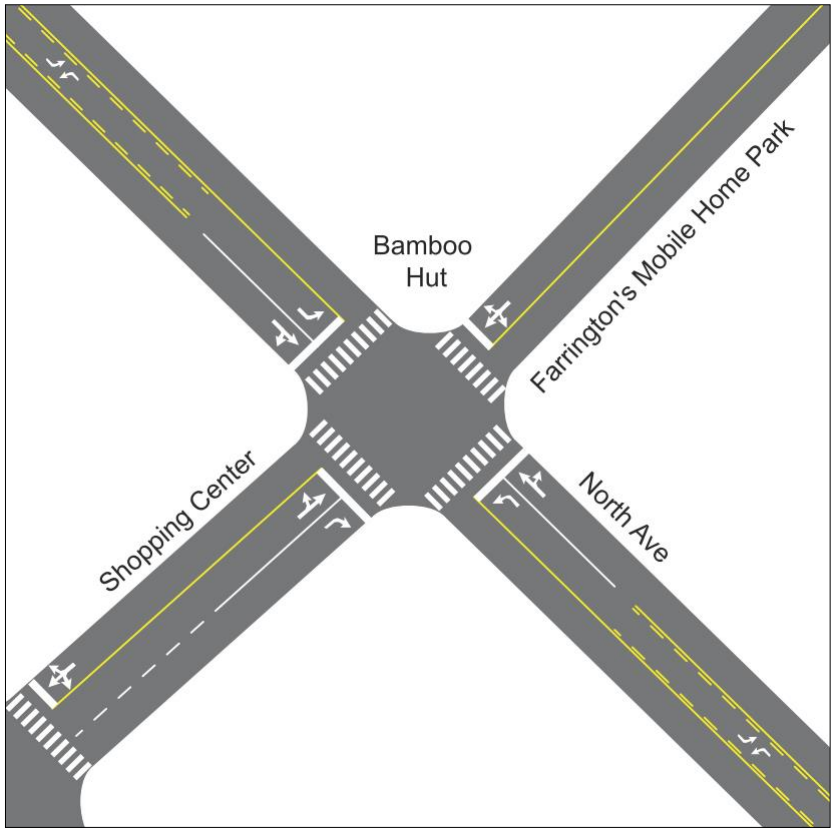


Note: not an engineering drawing to scale; bicycle facilities not shown

Concept 2

- Maintain Concept 1 improvements
- Reconstruct Farrington's Mobile Home Park entrance
- Reconstruct Bamboo Hut sidewalk and curb cuts

Figure 85: Ethan Allen Shopping Center Concept 2 (Three Lanes)



Note: not an engineering drawing to scale; bicycle facilities not shown

Ethan Allen Parkway

The study team developed two concepts for the Ethan Allen Parkway signalized intersection. Both concepts propose relocating the motor vehicle entrance to Ethan Allen Park away from the intersection to simplify operations. The study proposes maintaining the existing stone entryway for pedestrians and bicycles only.

Concept 1 maintains the signalized intersection, adding Little Eagle Bay to the signal and removing Ethan Allen Park entrance from the signal. Like Plattsburg Avenue, Concept 1 includes a large curb extension at the intersection's eastern corner, creating a more standardized T intersection and thereby removing the ability for northbound drivers to make this right turn at high speeds.

Concept 2 reconfigures the intersection as a full roundabout with no flared entry on the approaches. Eliminating flare on median islands provides drivers greater visibility of pedestrians, cyclists, and other motor vehicles, and slows motor vehicle turns. The roundabout includes two approach lanes in both the northbound and southbound directions. The outer northbound approach lane is right turn only onto Ethan Allen Parkway. A cycle track would encircle the roundabout to separate and protect cyclists, regardless of which type of bicycle facility is recommended for the rest of the corridor. Additional right-of-way from adjacent properties would be needed to construct this concept, though no surveying or design work has been performed at this point for this analysis. The study analyzed two versions of Concepts 1 and 2: one that maintains the four-lane North Avenue cross section and one converting North Avenue to a three-lane cross section (one northbound, one southbound, and one left-turn lane). Traffic analysis results are listed in Table 13. The study team also considered concepts that maintained the Ethan Allen Park motor vehicle entrance at its current location, but these concepts were not advanced to the evaluation process due to impacts on future traffic performance.

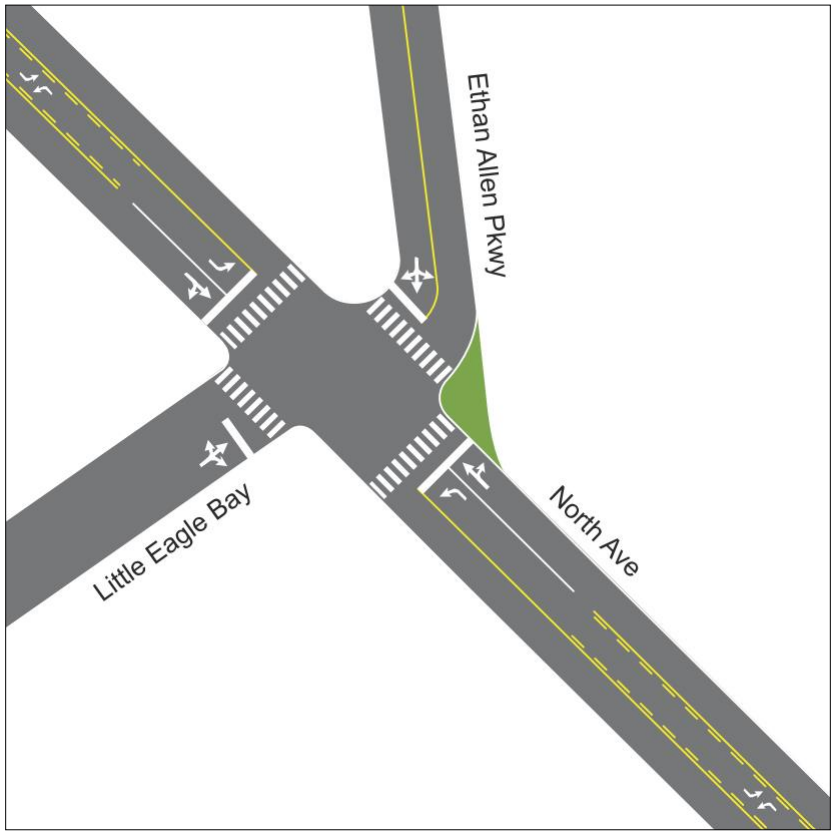
Table 13: Ethan Allen Parkway 2035 AM and PM Peak Hour LOS and Average Queues (Number of Cars)

Concept	Period	Eastbound (Little Eagle Bay)		Westbound (Ethan Allen Pkwy)		Northbound (North Ave)		Southbound (North Ave)		Intersection Overall
Exist. Config.	AM Peak Hour	A	0	D	7	A	1	A	8	**B**
	PM Peak Hour	A	0	C	3	A	5	A	1	**A**
1: 3 lanes	AM Peak Hour	B	1	E	8	B	10	D	22	**D**
	PM Peak Hour	B	1	D	4	C	36	A	3	**B**
1: 4 lanes	AM Peak Hour	A	1	D	6	A	3	B	8	**B**
	PM Peak Hour	B	1	C	3	A	6	A	3	**A**
2: 3 lanes	AM Peak Hour	D	1	D	1	C	1	E	1	**D**
	PM Peak Hour	B	1	E	1	E	1	D	1	**C**
2: 4 lanes	AM Peak Hour	B	1	E	1	A	1	D	1	**D**
	PM Peak Hour	E	1	A	1	C	3	C	1	**D**

Concept 1

- Incorporate Little Eagle Bay into signal
- Slow high-speed NB right turns with curb extension
- Relocate motor vehicle entrance to Ethan Allen Park
- Opposing NB/SB left-turn lanes (three-lane conversion only)

Figure 86: Ethan Allen Parkway Concept 1 (Three Lanes)

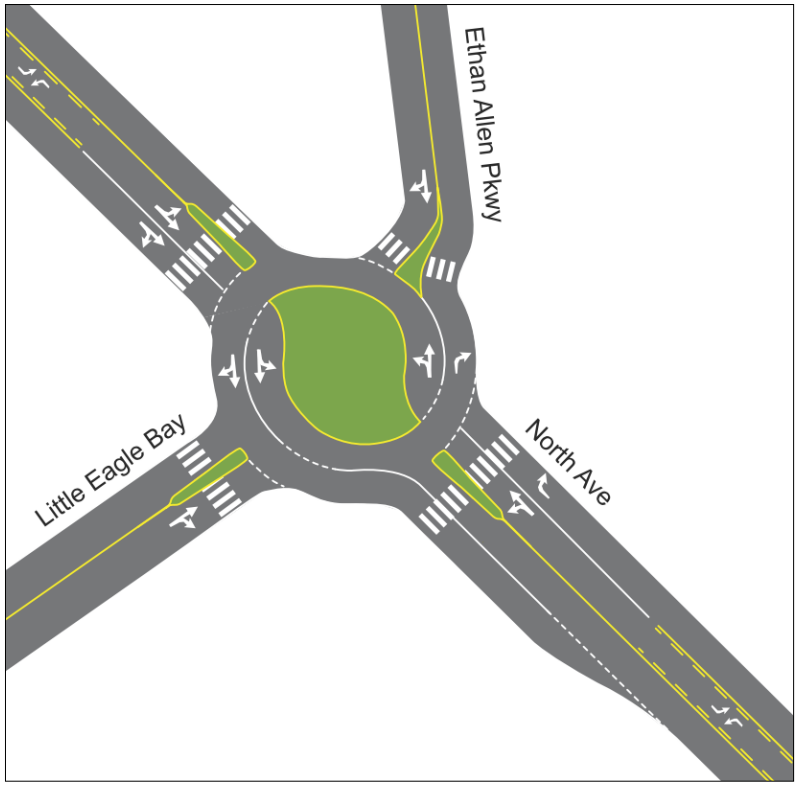


Note: not an engineering drawing to scale; bicycle facilities not shown

Concept 2

- Roundabout with dual NB/SB approach lanes (NB right-turn bypass lane) and no flared entry (increases visibility of pedestrians and cyclists to drivers, and slows motor vehicle turns)
- Separated cycle track around roundabout (not shown)
- Relocate motor vehicle entrance to Ethan Allen Park
- Resolve driveway access on west side of intersection

Figure 87: Ethan Allen Parkway Concept 2 (Three Lanes)



Note: not an engineering drawing to scale; bicycle facilities not shown

VT 127 Ramps

The study team developed three concepts for the VT 127 ramps signalized intersection. All concepts close the northbound on-ramp. Concepts 1 and 2 maintain the traffic signal and include similar design elements: adding a northbound left-turn lane, removing the free-flow westbound right-turn lane, removing the gantry on North Avenue, and recognizing the intersection's role as a gateway between high-speed (VT 127) and low-speed (North Avenue) corridors. Gateway treatments may include special streetscaping, pavement, stormwater treatments, or signage. Concept 2 also adds a second southbound left turn lane and a corresponding pedestrian refuge island on the south crosswalk.

Concept 3 reconfigures the intersection as a full roundabout with no flared entry on the approaches. The roundabout includes two southbound approach lanes and a westbound right-turn bypass lane. A cycle track would encircle the roundabout to separate and protect cyclists. New right-of-way is not expected to be needed given the space currently occupied by the existing ramps.

The study analyzed two versions of each concept: one that maintains the four-lane North Avenue cross section north of the intersection and one converting North Avenue to a three-lane cross section (one northbound, one southbound, and one left-turn lane) north of the intersection. Traffic analysis results are listed in Table 14.

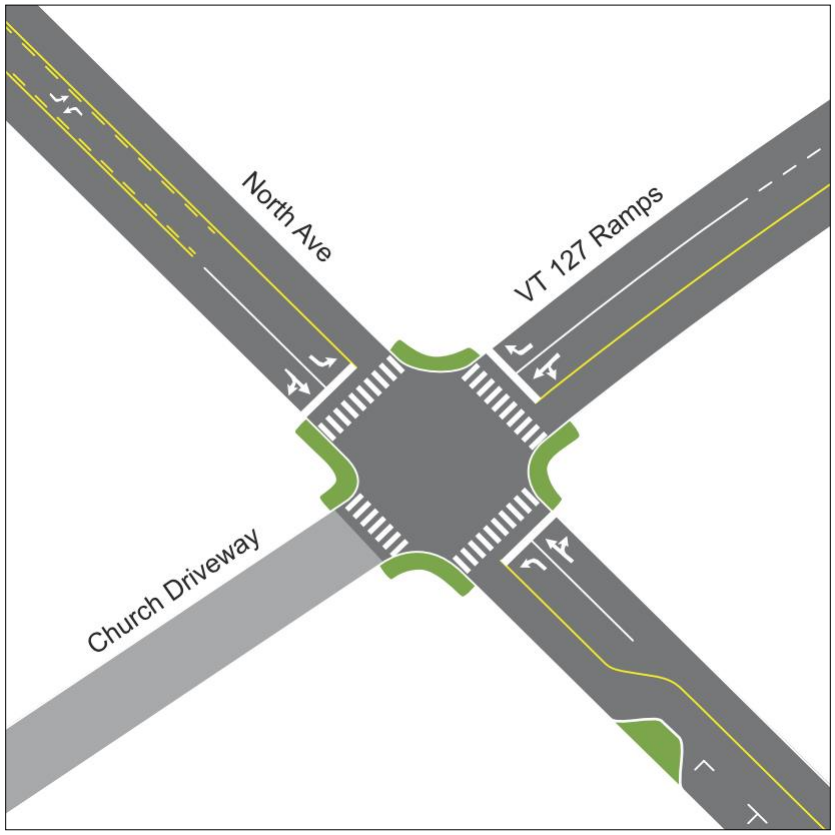
Table 14: VT 127 Ramps 2035 AM and PM Peak Hour LOS and Average Queues (Number of Cars)

Concept	Period	Eastbound (Alliance Church)		Westbound (VT 127 ramps)		Northbound (North Ave)		Southbound (North Ave)		Intersection Overall
Exist. Config.	AM Peak Hour	A	0	C	3	F	9	C	15	**C**
	PM Peak Hour	B	1	A	1	C	10	B	4	**B**
1: 3 lanes	AM Peak Hour	C	1	C	3	C	7	B	12	**B**
	PM Peak Hour	C	1	C	4	D	21	C	7	**C**
1: 4 lanes	AM Peak Hour	C	1	C	3	C	6	B	12	**B**
	PM Peak Hour	C	1	C	6	C	19	C	6	**C**
2: 3 lanes	AM Peak Hour	C	1	C	3	B	7	A	7	**B**
	PM Peak Hour	C	1	C	8	C	14	B	5	**C**
2: 4 lanes	AM Peak Hour	C	1	C	3	B	6	B	7	**B**
	PM Peak Hour	C	1	C	9	C	14	B	3	**C**
3: 3 lanes	AM Peak Hour	C	1	B	1	A	1	D	2	**C**
	PM Peak Hour	A	1	E	2	B	1	B	1	**C**
3: 4 lanes	AM Peak Hour	D	1	A	1	C	1	C	1	**C**
	PM Peak Hour	A	1	A	1	C	1	A	1	**A**

Concept 1

- Close high-speed NB on ramp
- Remove free flow WB right-turn
- Remove gantry from North Avenue
- Gateway treatments (highway transition)

Figure 88: VT 127 Ramps Concept 1 (Three Lanes)

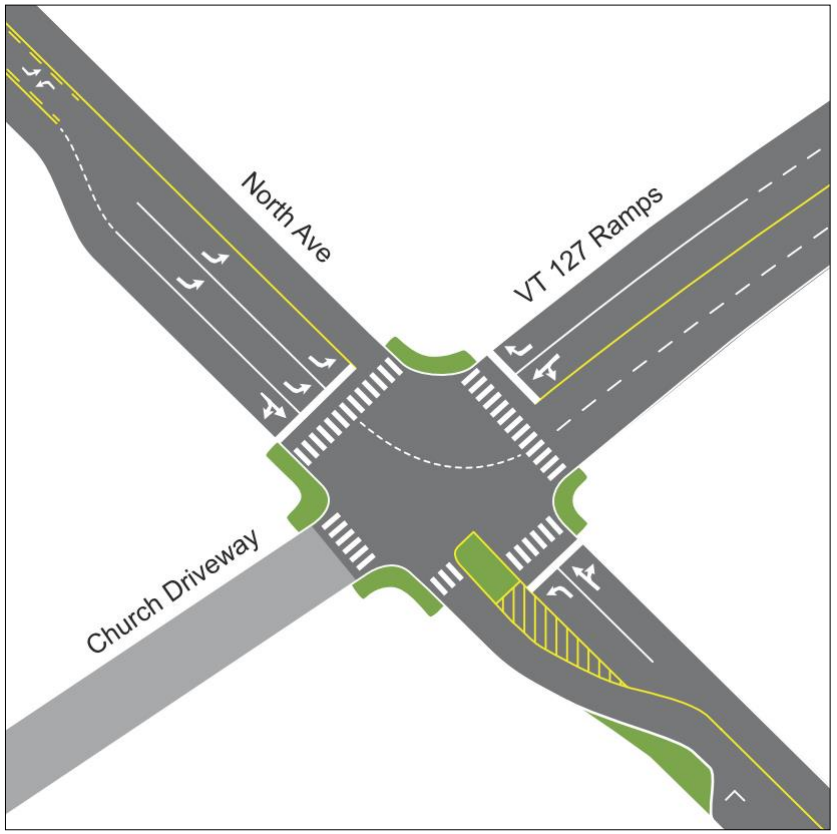


Note: not an engineering drawing to scale; bicycle facilities not shown

Concept 2 (Three Lanes)

- Maintain Concept 1 improvements
- Dual SB left-turn lanes
- South crosswalk pedestrian refuge
- Gateway treatments (highway transition)

Figure 89: VT 127 Ramps Concept 2 (Three Lanes)

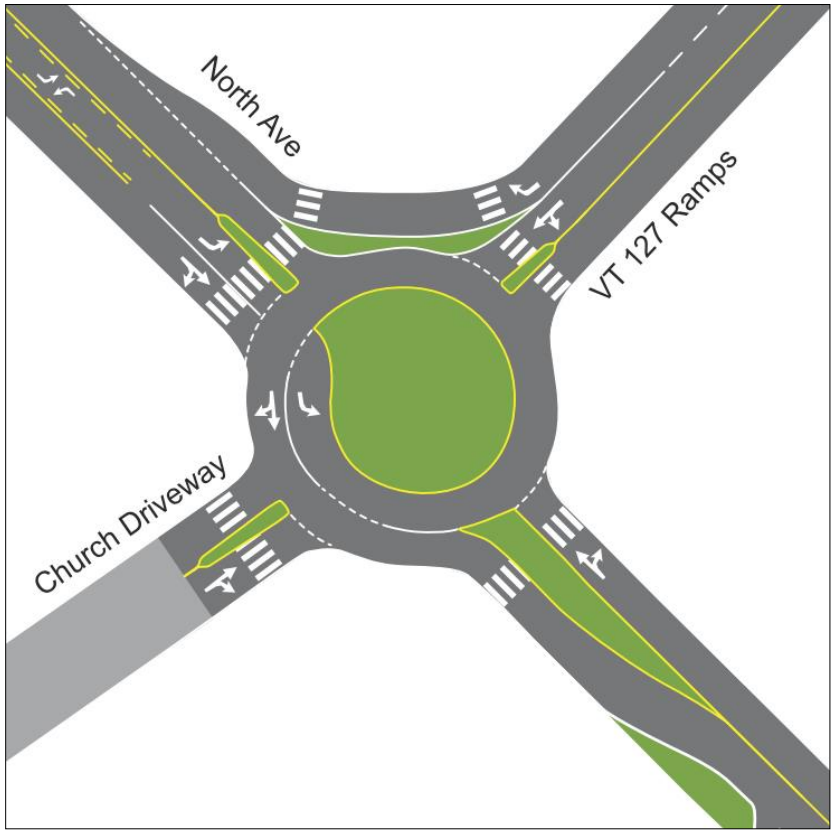


Note: not an engineering drawing to scale; bicycle facilities not shown

Concept 3

- Roundabout with dual SB approach lanes, WB right-turn bypass lane, and no flared entry (increases visibility of pedestrians and cyclists to drivers, and slows motor vehicle turns)
- Separated cycle track around roundabout (not shown)
- Remove unused ramp pavement
- Gateway treatments (highway transition)

Figure 90: VT 127 Ramps Concept 3 (Three Lanes)



Note: not an engineering drawing to scale; bicycle facilities not shown

Institute Road

The study team developed two concepts for the Institute Road signalized intersection. Both concepts would address access to the school bus driveway located just north of Institute Road, which will require further coordination with the Burlington School District during the design phase.

Concept 1 maintains the signalized intersection and fixes the motor vehicle detection, reduces the intersection footprint with pavement markings, and relocates the northbound bus stop to the far side of the intersection. This concept also prohibits right turns on red because of limited sight distance over the hill. Concept 1 will identify a solution to the conflict between southbound through cyclists and southbound right-turning motor vehicles during the design phase. Possibilities include a shared right-turn lane, a through bike lane, or even physical separation (e.g., protected bike lane or cycle track) and/or temporal separation (e.g., bike signals) at the intersection.

Concept 2 reconfigures the intersection as a full roundabout with no flared entry on the approaches. Eliminating flare on median islands provides drivers greater visibility of pedestrians, cyclists, and other motor vehicles, and slows motor vehicle turns. The roundabout includes a southbound right-turn bypass lane. A cycle track would encircle the roundabout to separate and protect cyclists, regardless of which type of bicycle facility is recommended for the rest of the corridor. Additional right-of-way from the Burlington School District would be needed to construct this concept, though no surveying or design work has been performed at this point in the analysis. Traffic analysis results are listed in Table 15.

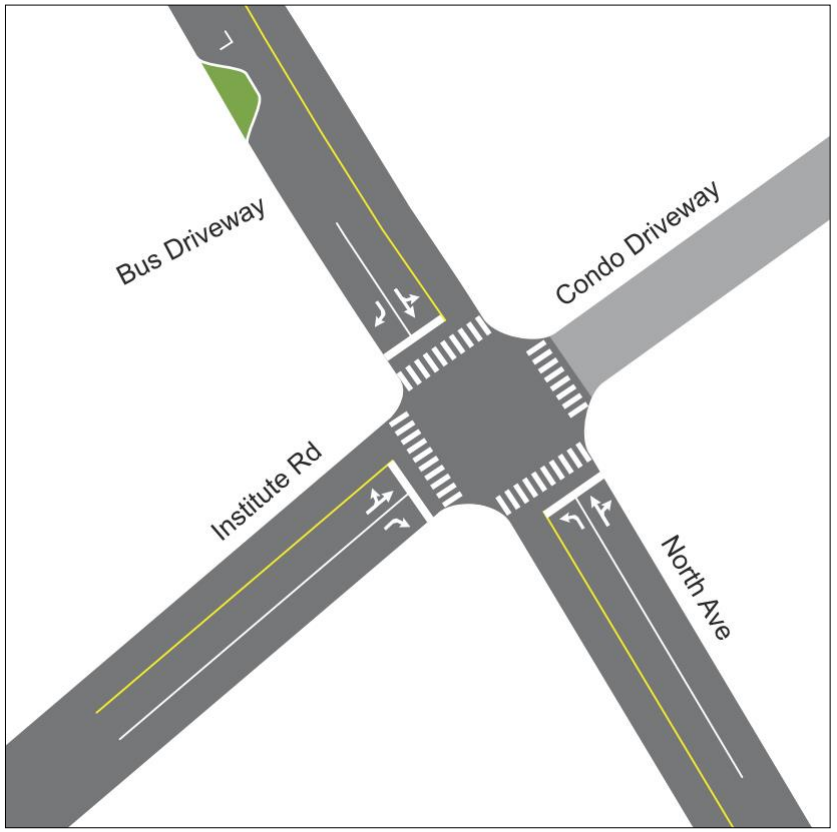
Table 15: Institute Road 2035 AM and PM Peak Hour LOS and Average Queues (Number of Cars)

Concept	Period	Eastbound (Institute Road)		Westbound (Condo Driveway)		Northbound (North Ave)		Southbound (North Ave)		Intersection Overall
Exist. Config.	AM Peak Hour	C	3	C	1	A	2	A	8	**A**
	PM Peak Hour	B	1	C	1	A	6	A	3	**A**
1	AM Peak Hour	D	5	C	1	B	2	C	13	**C**
	PM Peak Hour	D	2	C	1	A	7	C	8	**B**
2	AM Peak Hour	A	1	A	1	B	1	B	1	**C**
	PM Peak Hour	A	1	A	1	A	1	B	2	**A**

Concept 1

- Fix motor vehicle detection
- Pedestrian activated no right turn on red
- Address conflict between SB through cyclists and right-turning motor vehicles
- Reduce intersection footprint (markings in short-term)
- Relocate NB bus stop to far side
- Resolve bus driveway access

Figure 91: Institute Road Concept 1

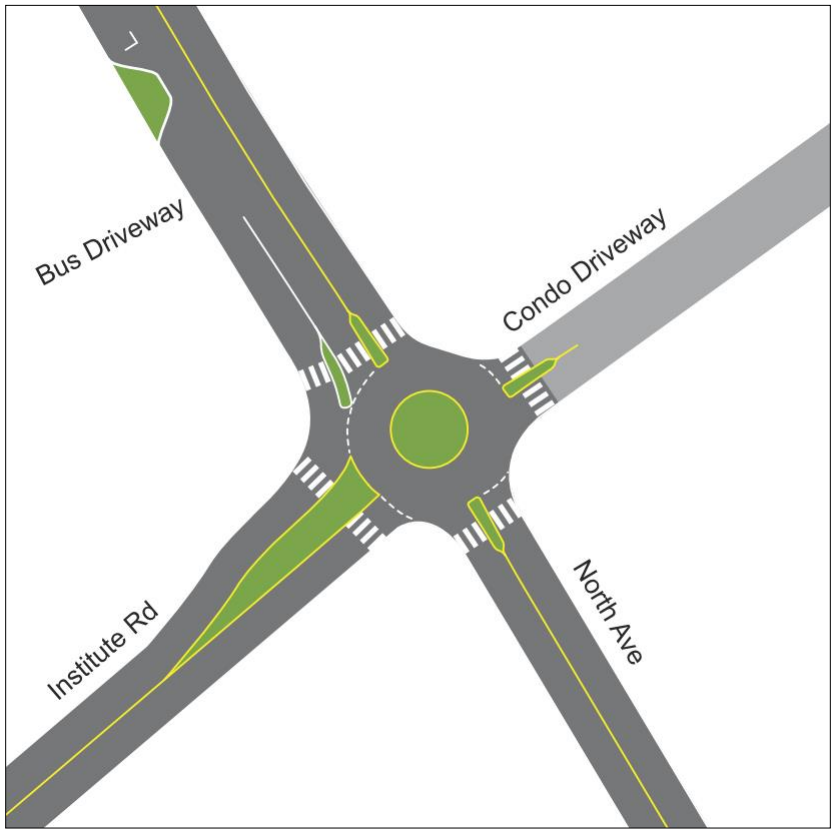


Note: not an engineering drawing to scale; bicycle facilities not shown

Concept 2

- Roundabout with SB right-turn bypass lane and no flared entry (increases visibility of pedestrians and cyclists to drivers, and slows motor vehicle turns)
- Separated cycle track around roundabout (not shown)
- Resolve bus driveway access

Figure 92: Institute Road Concept 2



Note: not an engineering drawing to scale; bicycle facilities not shown

Washington Street

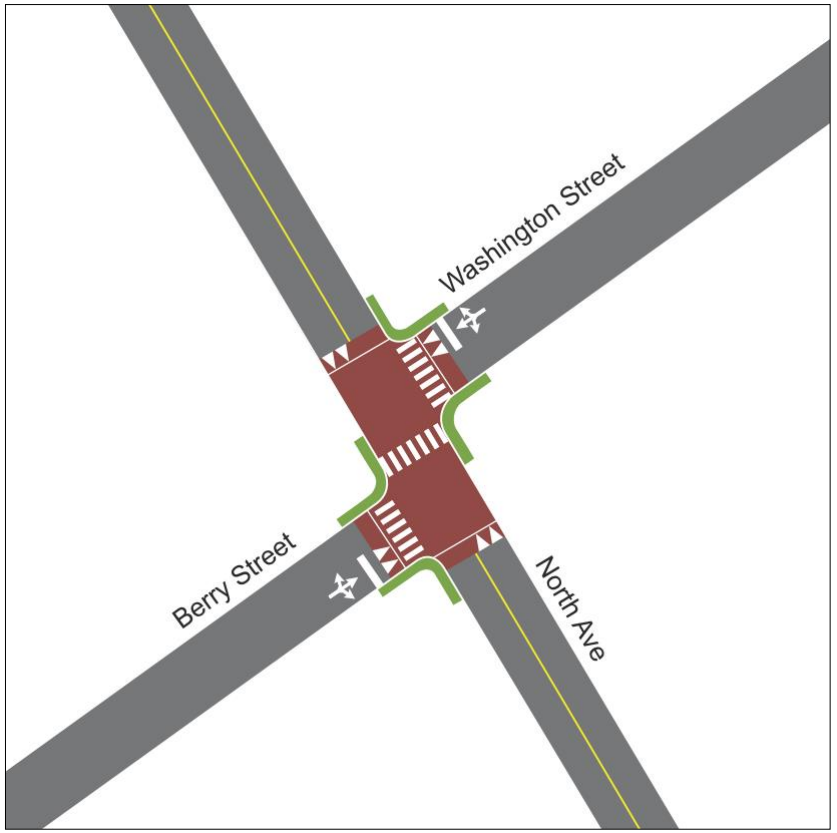
The study team developed one concept for the Washington Street unsignalized intersection. Concept 1 focuses on improving pedestrian safety and calming traffic.

Crossing North Avenue at Washington Street is difficult as a pedestrian. Drivers rarely yield to waiting pedestrians and traffic begins to pick up speed as it exits the Old North End heading northbound. Concept 1 proposes a pedestrian-actuated rapid flash beacon for this crosswalk to better alert drivers of a pedestrian's presence. This intersection's role as the transition between the Old North End and New North End is enhanced in Concept 1 through the use of gateway treatments on all four corners, which may include special streetscaping, pavement, stormwater treatments, or signage. Concept 1 also proposes raising the intersection to sidewalk level to further calm traffic and remind drivers that a pedestrian crossing is nearby. Raised intersections also benefit pedestrians by eliminating the vertical distance between the sidewalk and street level at crosswalks, which also eliminates water ponding since there are no curb ramps.

Concept 1

- Pedestrian-actuated rapid flash beacon for crosswalk
- Raised intersection
- Gateway treatments (Old North End and New North End transition)

Figure 93: Washington Street Concept 1



Note: not an engineering drawing to scale; bicycle facilities not shown

North Street

The study team developed one concept for the North Street signalized intersection. Concept 1 focuses on improving pedestrian safety and calming traffic. This concept prohibits right turns on red because of relatively high pedestrian volumes compared to the rest of the corridor, realigns the south crosswalk to reduce the crossing distance, and realigns the north crosswalk to align with the existing pedestrian phase push-button. Members of the public noted that drivers sometimes continue southbound through the intersection from the left-turn lane. Concept 1 would eliminate this unsafe behavior by adding a pedestrian refuge island to the south crosswalk.

Concept 1 proposes closing the parking lot access directly from North Avenue or a reconfiguration to a right-in, right-out operation only. (Parking access would remain via Haswell Street.) If closed, bicycle access to Depot Street would remain at this location (Depot Street provides direct access to the Island Line Trail and the lakefront from the Old North End).

This intersection's role as the southern entrance to the North Avenue corridor and the entrance to the North Street Historic District is enhanced through the use of gateway treatments on all four corners, which may include special streetscaping, pavement, stormwater treatments, or signage.

Concept 1's traffic signal operates with protected/permitted left turns. Traffic analysis results are listed in Table 16.

The study team initially considered a separate North Street intersection concept with split phasing, but this concept was not advanced to the evaluation process based on Advisory Committee and public feedback.

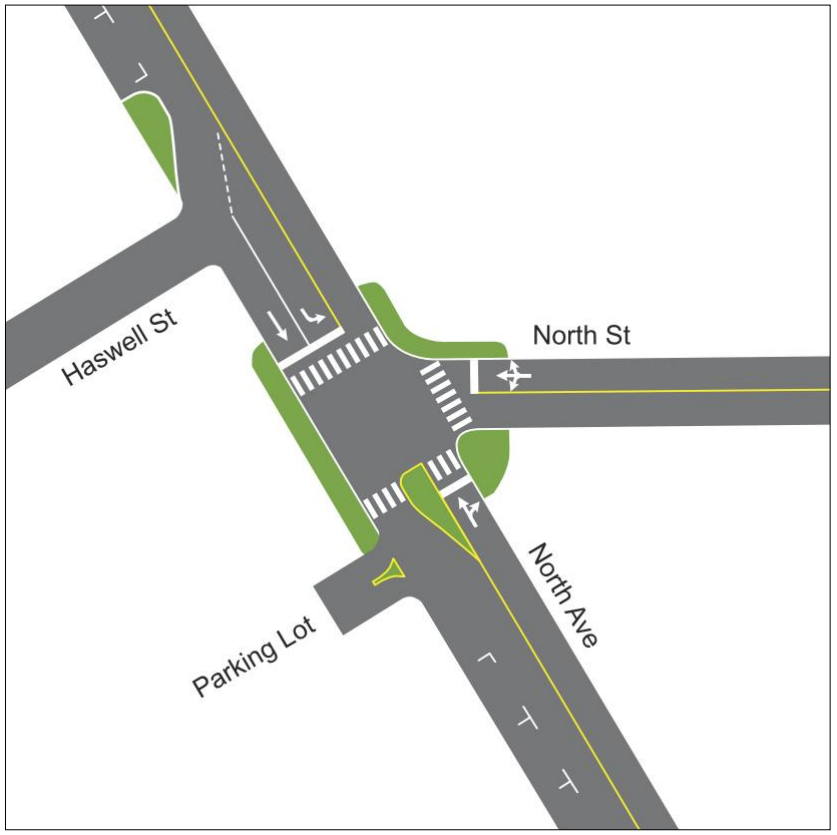
Table 16: North Street 2035 AM and PM Peak Hour LOS and Average Queues (Number of Cars)

Concept	Period	Eastbound (N/A)		Westbound (North Street)		Northbound (North Ave)		Southbound (North Ave)		Intersection Overall
Exist. Config.	AM Peak Hour	-	-	B	1	A	2	A	6	**A**
	PM Peak Hour	-	-	B	1	A	7	A	2	**A**
1	AM Peak Hour	-	-	C	2	B	5	B	7	**B**
	PM Peak Hour	-	-	C	3	C	15	A	3	**C**

Concept 1

- Pedestrian activated no right turn on red
- Right-in, right-out or curb cut removal at parking lot access
- Realign south crosswalk and add pedestrian refuge
- Realign north crosswalk to align with push button
- Protected/permitted SB left turns
- Gateway treatments (southern entrance to corridor and entrance to North Street Historic District)

Figure 94: North Street Concept 1



Note: not an engineering drawing to scale; bicycle facilities not shown

Cross Section Concepts

Cross-section concepts include complete street design elements relating to the width of the street. As noted previously, cross-section concepts are named in terms of their proposed cycling facilities because the width and configuration of these facilities was the differentiating factor (additional design elements are included, but are often the same amongst different concepts and thus do not provide a basis for differentiation). Please refer to Table 8 for general descriptions of bicycle facility options.

Visuals presented in this section are of typical cross sections between major intersections; some modifications to each cross section at major intersections (e.g., turn lanes, curb extensions, etc.) are generalized in the *Intersection Concepts* section, but specific changes to typical cross sections will be determined at a later scoping and design phase after this planning study.

Because the transportation facilities, context of the street, and curb-to-curb width vary along the entire 2.8-mile North Avenue corridor, the corridor was divided into five separate segments (defined in Figure 95), with the concepts depicted separately within each segment. Each cross-section concept includes a basic set of corridor-wide improvements in addition to concept-specific design elements. All cross-section concepts include:

- Consistent transportation facilities for all users;
- Traffic calming elements;
- Marked 8' parking lane (when present), on one side only; and
- 10.5' travel lanes, with an additional 0.5' shoulder when adjacent to on-street parking or curb, to accommodate buses.

This study's complete street design principles and toolbox support a 25-mph speed limit. All North Avenue cross-section concepts therefore propose a 25-mph speed limit north of Shore Road because traffic calming treatments are incorporated into the design (the existing speed limit is 30 mph north of Shore Road).

Figure 95: Segments for Cross Section Concepts

However, some concepts maintain the existing four-lane cross section between Shore Road and the VT 127 ramps, precluding the ability to incorporate many complete street design elements necessary to enable a lower 25 mph speed limit. Those concepts that maintain this four-lane cross section also maintain the existing 30 mph speed limit.

Complete street design elements are precluded in the four-lane cross section because of a lack of space and safety concerns. For example, curb extensions and bus bulbs cannot be implemented in this cross section because it lacks parallel parking, a necessary component. Left-turn lanes are similarly excluded from a four-lane North Avenue because of a lack of space. A raised two-way cycle track is not recommended with the four-lane cross section either; there would be unsafe conflicts between transit passengers and two-way bicycle traffic without a greenscape zone to provide separation and house the bus stops/shelters. Finally, unsignalized/mid-block crossings are not recommended in locations with more than one travel lane in each direction, as adjacent motor vehicles traveling in the same direction can obscure views of pedestrians crossing the street (so-called "double jeopardy").

A three-lane cross section—one southbound lane, one northbound lane, and one two-way left-turn lane in the center—simplifies traffic operations and eliminates the ability to pass. It provides dedicated queuing space for left turns at both signalized and unsignalized intersections. By reducing the number of lanes that must be crossed when turning left, turning movements are safer and visibility of pedestrians and cyclists to drivers is improved.

To provide a thorough evaluation, the *North Avenue Corridor Study* developed and evaluated cross-concepts that either:

- Maintain the existing four-lane cross section and the 30-mph speed limit between Shore Road and the VT 127 ramps, or
- Convert the existing four-lane cross section to a three-lane cross section and lower the speed limit to 25 mph.

All cross-section concepts that move curbs impact the existing greenscape zone to some extent. However, almost all concepts maintain some greenscape zone, many of which equal or exceed the 5' minimum width established in the Burlington *Street Design Guidelines*. Greenscape zones contain trees of varying age and size as well as utilities. The extent to which these features are affected will be determined at a later scoping and design phase following completion of this planning study.

Concept A1: Within Existing Curbs (Four Lanes)

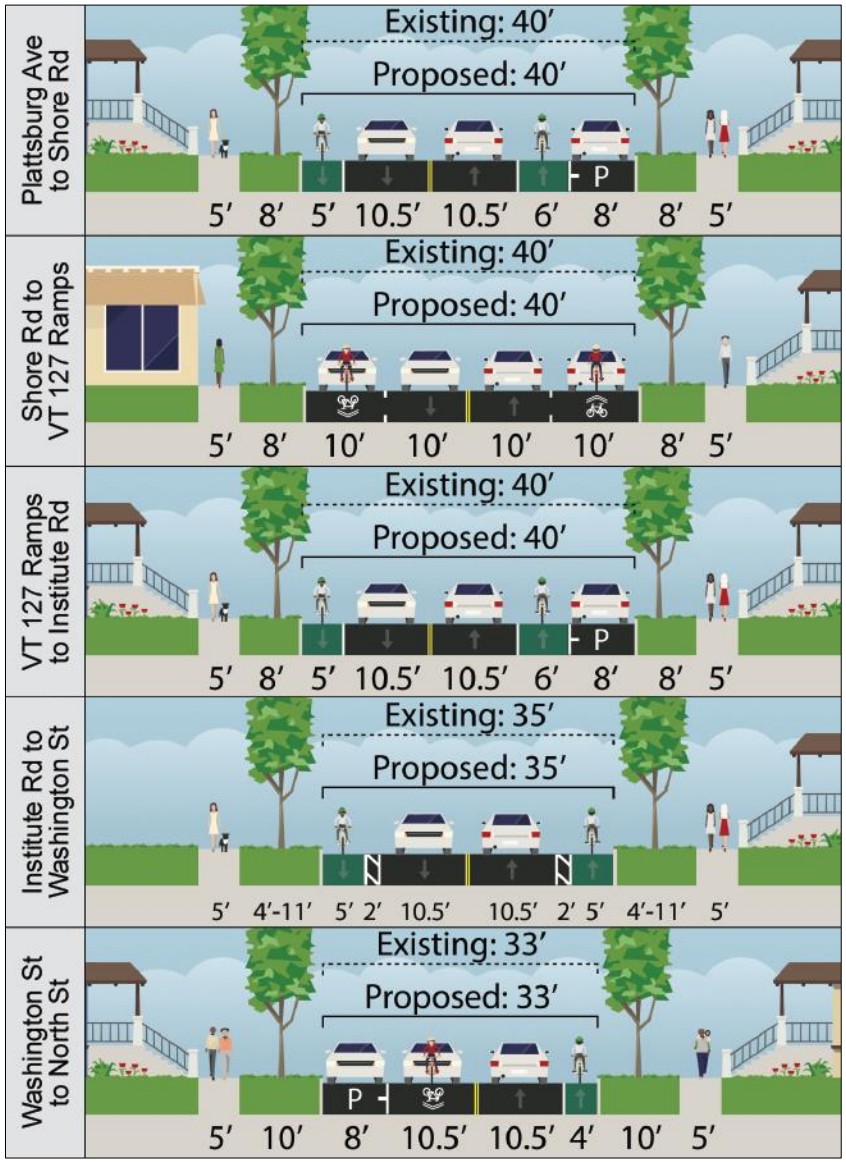
Concept A1 proposes low-cost cycling facilities within existing curbs, leaving sidewalks and greenscape zones undisturbed (Figure 96). The existing number of lanes remains in this concept, including the four-lane cross section between Shore Road and the VT 127 ramps.

Cycling facilities range from sharrows, to conventional bike lanes, to buffered bike lanes, depending on the space available. Concept A1 creates space for these cycling facilities by narrowing wide travel lanes to 10.5' and consolidating on-street parallel parking to one side of the street (on-street parking is not proposed where presently absent). Sharrows are provided in constrained locations only. Proposed bike lanes are 4' to 5' wide against curbs, and 6' wide against parallel parking to reduce the likelihood of cyclists colliding with motor vehicle doors. Proposed buffered bike lanes are 5' wide with 2' buffers, increasing the separation between cyclists and motor vehicles.

The combined width of the sidewalk and greenscape zone leaves ample room for additional CCTA bus shelters. CCTA buses would stop in bike lanes to serve passengers at the curb in Concept A1.

Concept A1 would be created with new striping and pavement markings only. Permanent design elements (e.g., curb extensions, mid-block pedestrian refuges) are not proposed for this concept.

Figure 96: Concept A1 Cross Sections



Note: not an engineering drawing to scale; the location of on-street parking is illustrative only and not finalized.

Concept A2: Within Existing Curbs (Three Lanes)

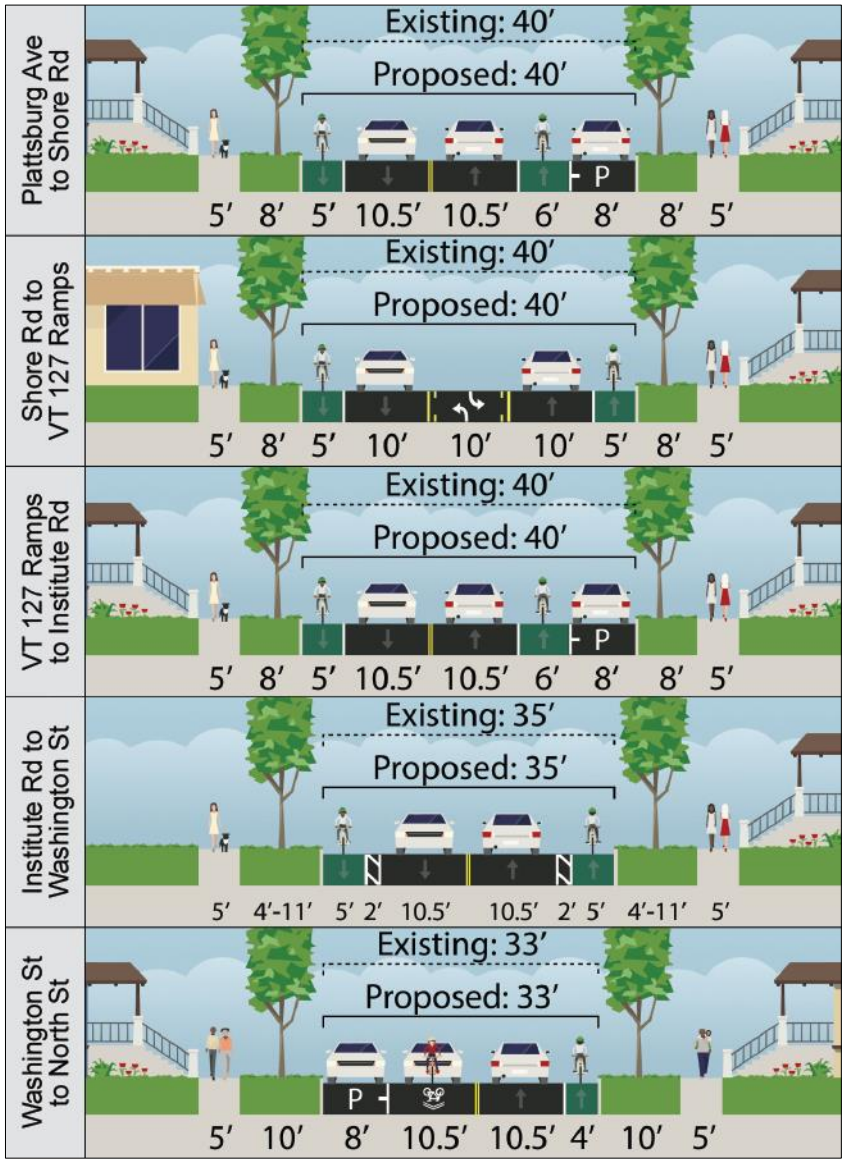
Concept A2 proposes a three-lane conversion of the existing four-lane cross section as well as low-cost cycling facilities within existing curbs, leaving sidewalks and greenscape zones undisturbed (Figure 97). In this concept, the segment between Shore Road and the VT 127 ramps is converted to a three-lane cross section.

Cycling facilities range from sharrows, to conventional bike lanes, to buffered bike lanes, depending on the space available. Concept A2 creates space for these cycling facilities by narrowing wide travel lanes to 10.5' and consolidating on-street parallel parking to one side of the street (on-street parking is not proposed where presently absent). Southbound sharrows are provided south of Washington Street only, because of the constrained curb-to-curb street width. Proposed bike lanes are 4' to 5' wide against curbs, and 6' wide against parallel parking to reduce the likelihood of cyclists colliding with motor vehicle doors. Proposed buffered bike lanes are 5' wide with 2' buffers, increasing the separation between cyclists and motor vehicles.

The combined width of the sidewalk and greenscape zone leaves ample room for additional CCTA bus shelters. CCTA buses would stop in bike lanes to serve passengers at the curb in Concept A2.

Concept A2 would be created with new striping and pavement markings only. Permanent design elements (e.g., curb extensions, mid-block pedestrian refuges) are not proposed for this concept.

Figure 97: Concept A2 Cross Sections



Note: not an engineering drawing to scale; the location of on-street parking is illustrative only and not finalized.

Concept A3: Within Existing Curbs (Three Lanes)

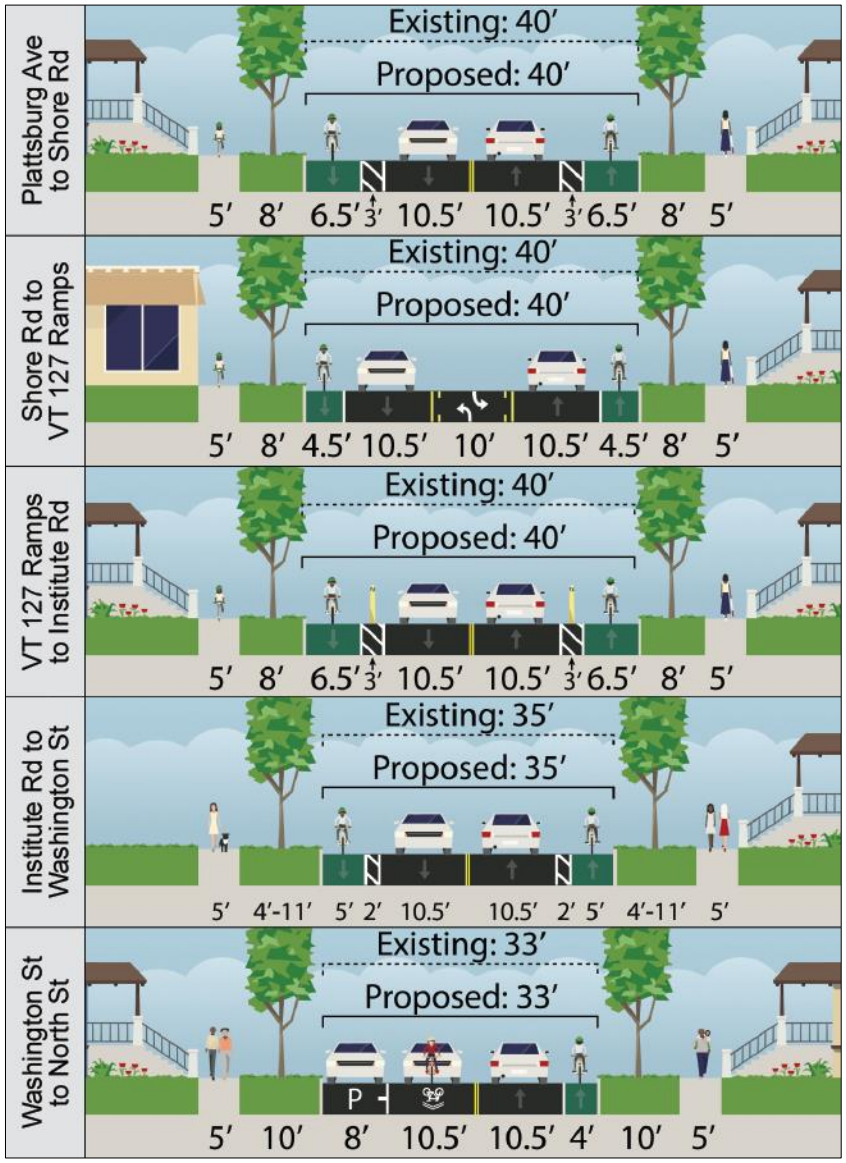
The Advisory Committee proposed Concept A3, which eliminates on-street parking north of Institute Road to provide additional space for buffered and protected cycling facilities within existing curbs (Figure 98). Concept A3 also proposes a three-lane conversion of the existing four-lane cross section between Shore Road and the VT 127 ramps. By not altering curbs Concept A3 leaves sidewalks and greenscape zones undisturbed.

Cycling facilities range from sharrows, conventional bike lanes, buffered bike lanes, and protected bike lanes, depending on the space available. Concept A3 creates space for these cycling facilities by narrowing wide travel lanes to 10.5’ and eliminating on-street parking north of Washington Street. Southbound sharrows are provided south of Washington Street only, because of the constrained curb-to-curb street width. Proposed bike lanes are 4’ to 5’ wide against curbs. Proposed buffered bike lanes are 5’ to 6.5’ wide with 2’ to 3’ buffers, increasing the separation between cyclists and motor vehicles. Proposed protected bike lanes between the VT 127 ramps and Institute Road incorporate plastic flexible posts (i.e., flexposts) into the 3’ buffer for additional safety.

The combined width of the sidewalk and greenscape zone leaves ample room for additional CCTA bus shelters. CCTA buses would stop in bike lanes to serve passengers at the curb in Concept A3. Flexpost spacing would take into consideration requirements for bus pull-in space at bus stop locations.

Concept A3 would be created with new striping and pavement markings only. Permanent design elements (e.g., curb extensions, mid-block pedestrian refuges) are not proposed for this concept.

Figure 98: Concept A3 Cross Sections



Note: not an engineering drawing to scale; the location of on-street parking is illustrative only and not finalized.

Concept B: 5' Minimum Bike Lanes

Concept B proposes continuous 5' minimum bike lanes along the entire corridor, requiring movement of some existing curbs and modification to some greenscape zones. This concept includes two scenarios for the segment between Shore Road and the VT 127 ramps intersection: a three-lane conversion scenario (Figure 99) and a scenario that maintains the four-lane cross section (Figure 100).

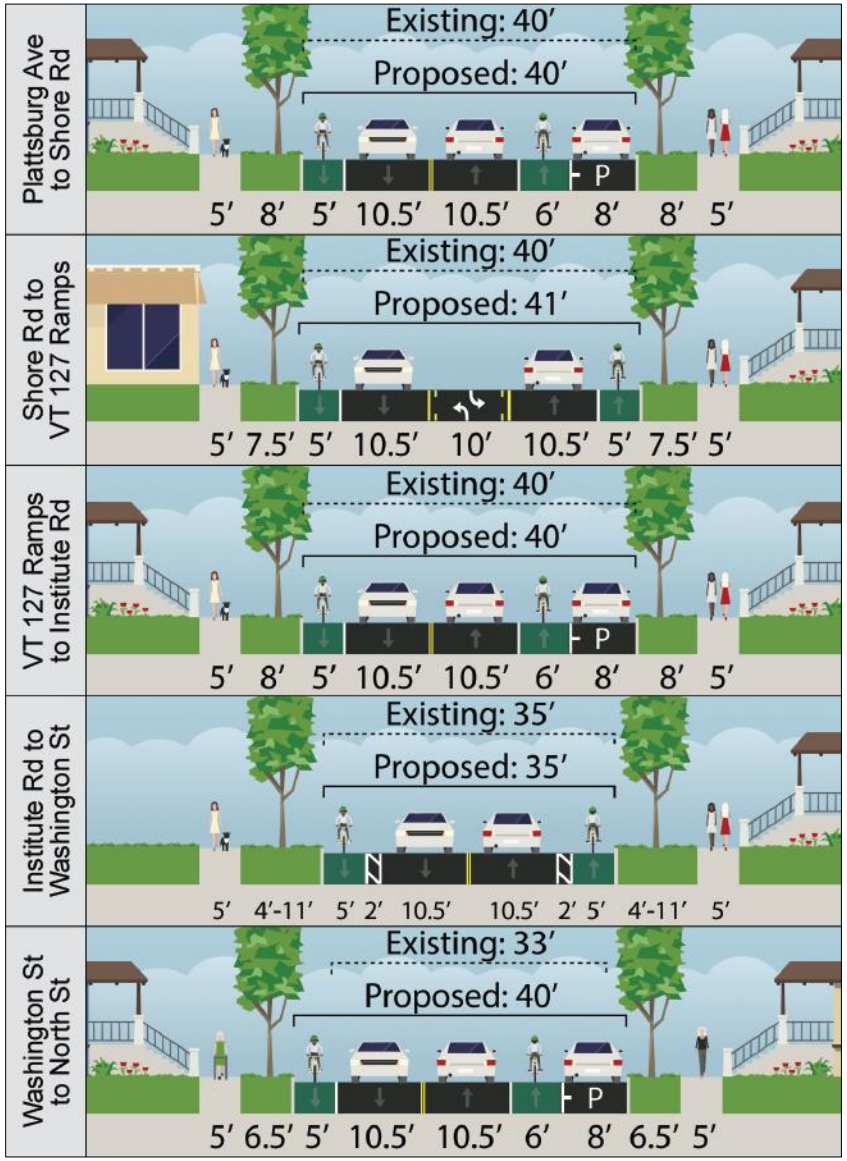
Concept B creates space for bike lanes by narrowing wide travel lanes to 10.5' and consolidating on-street parallel parking to one side of the street (on-street parking is not proposed where presently absent). Proposed bike lanes are 5' wide against curbs, and 6' wide against parallel parking to reduce the likelihood of cyclists colliding with motor vehicle doors.

The existing curbs and greenscape zones between Plattsburg Avenue and Shore Road, and between the VT 127 ramps and Institute Road would remain untouched because the curb-to-curb width can accommodate the proposed improvements.

Concept B would require reconstruction work along most of the corridor, opening the opportunity for permanent design elements that go beyond striping and pavement markings. Segments with on-street parking can accommodate curb extensions, mid-block pedestrian refuges, bus bulbs, or other complete streets design elements, depending on final details of design. Such facilities would replace one or two parking spaces where implemented. Pedestrian refuge islands are also feasible between Shore Road and the VT 127 ramps with the introduction of the two-way left-turn lane. However, the four-lane cross section precludes the application of many complete streets design elements because of space limitations and safety concerns.

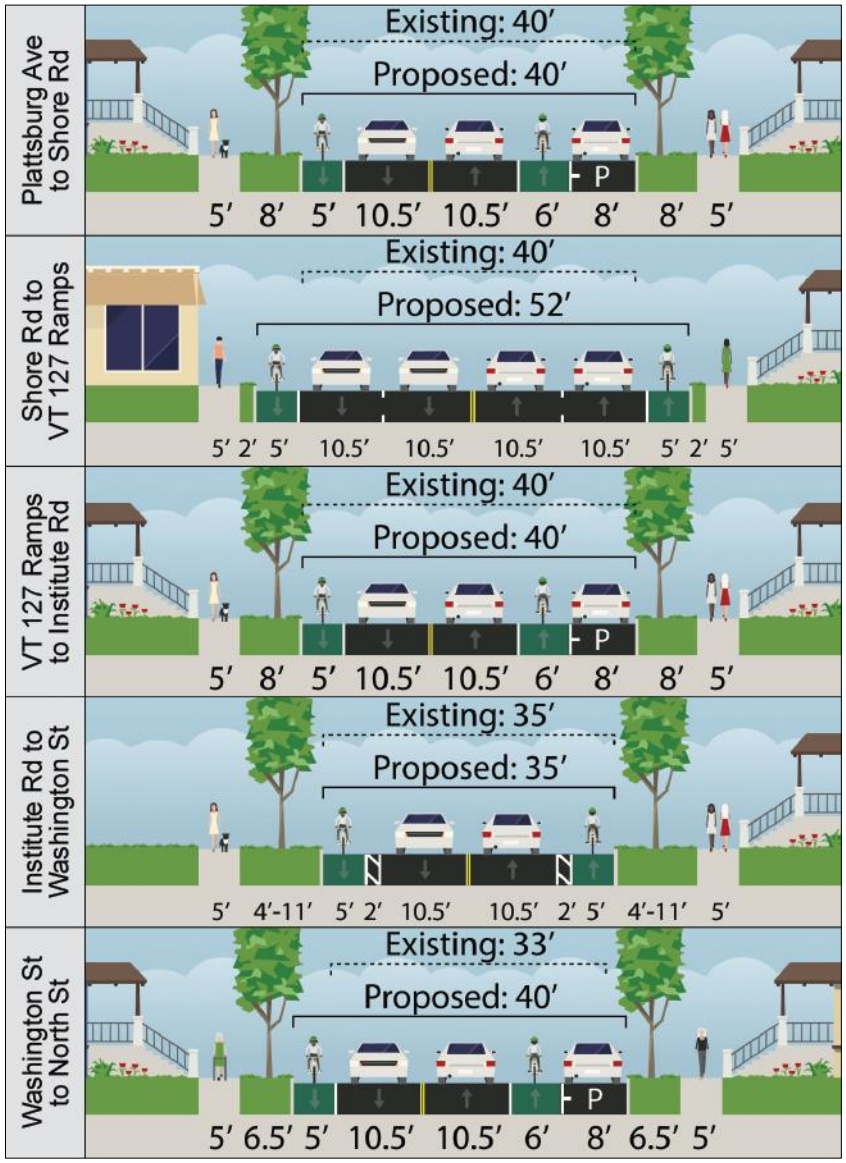
The combined width of the sidewalk and greenscape zone leaves room for additional CCTA bus shelters in many segments. The exception is the four-lane cross section between Shore Road and the VT 127 ramps. The addition of bike lanes nearly eliminates the greenscape zone, leaving just 2'. Any additional shelters in this segment would be located on adjacent private property, requiring easements. CCTA buses would stop in bike lanes to serve passengers at the curb in Concept B.

Figure 99: Concept B Cross Sections (Three Lane Conversion)



Note: not an engineering drawing to scale; the location of on-street parking is illustrative only and not finalized.

Figure 100: Concept B Cross Sections (Maintain Four Lanes)



Note: not an engineering drawing to scale; the location of on-street parking is illustrative only and not finalized.

Concept C: Buffered Bike Lanes

Concept C proposes continuous buffered bike lanes along the entire corridor, requiring movement of all curbs and modification to all greenscape zones. This concept includes two scenarios for the segment between Shore Road and the VT 127 ramps intersection: a three-lane conversion scenario (Figure 101) and a scenario that maintains the four-lane cross section (Figure 102).

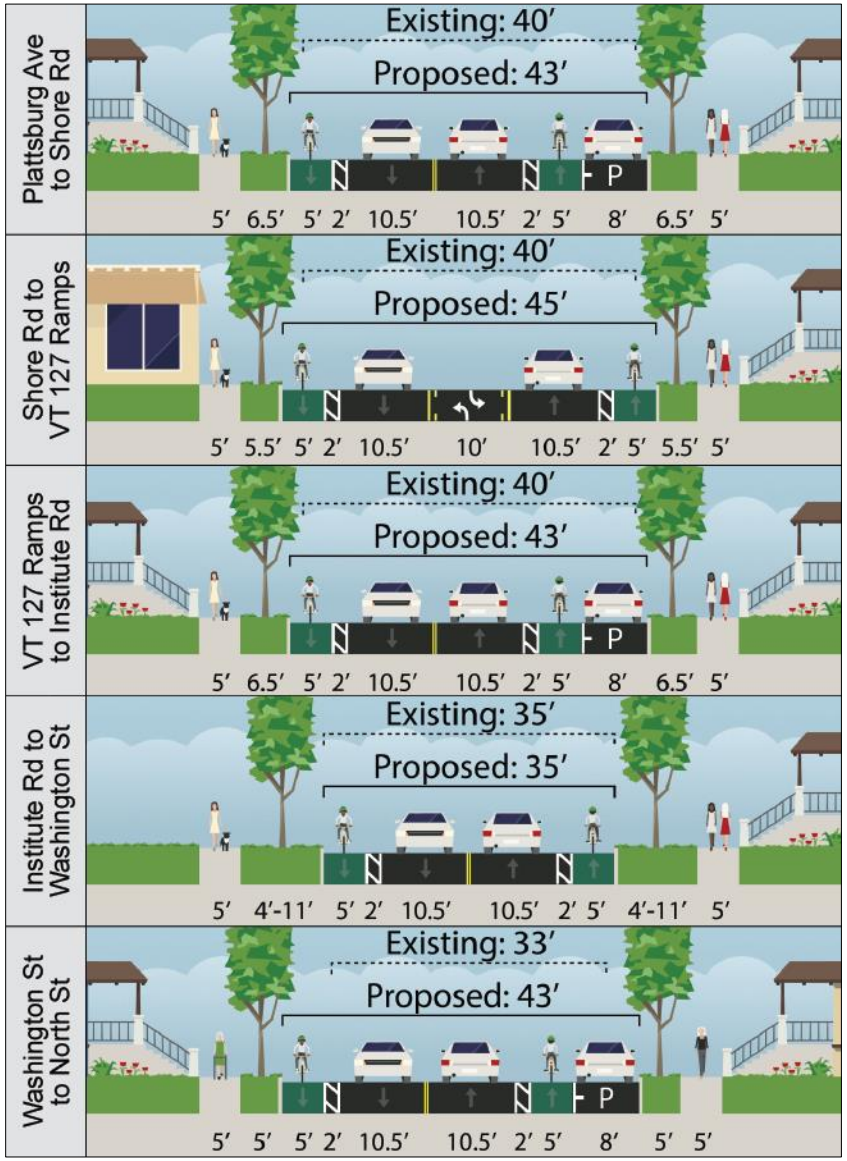
Concept C creates space for buffered bike lanes by narrowing travel lanes to 10.5’ and consolidating on-street parallel parking to one side of the street (on-street parking is not proposed where presently absent). Proposed buffered bike lanes are 5’ wide with 2’ buffers, increasing the separation between cyclists and motor vehicles.

Concept C would require complete reconstruction of the entire corridor, opening the opportunity for permanent design elements that go beyond striping and pavement markings. Segments with on-street parking can accommodate curb extensions, mid-block pedestrian refuges, bus bulbs, or other complete streets design elements, depending on final details of design. Such facilities would replace one or two parking spaces where implemented.

Pedestrian refuge islands are also feasible between Shore Road and the VT 127 ramps with the introduction of the two-way left-turn lane. However, the four-lane cross section precludes the application of many complete streets design elements because of space limitations and safety concerns.

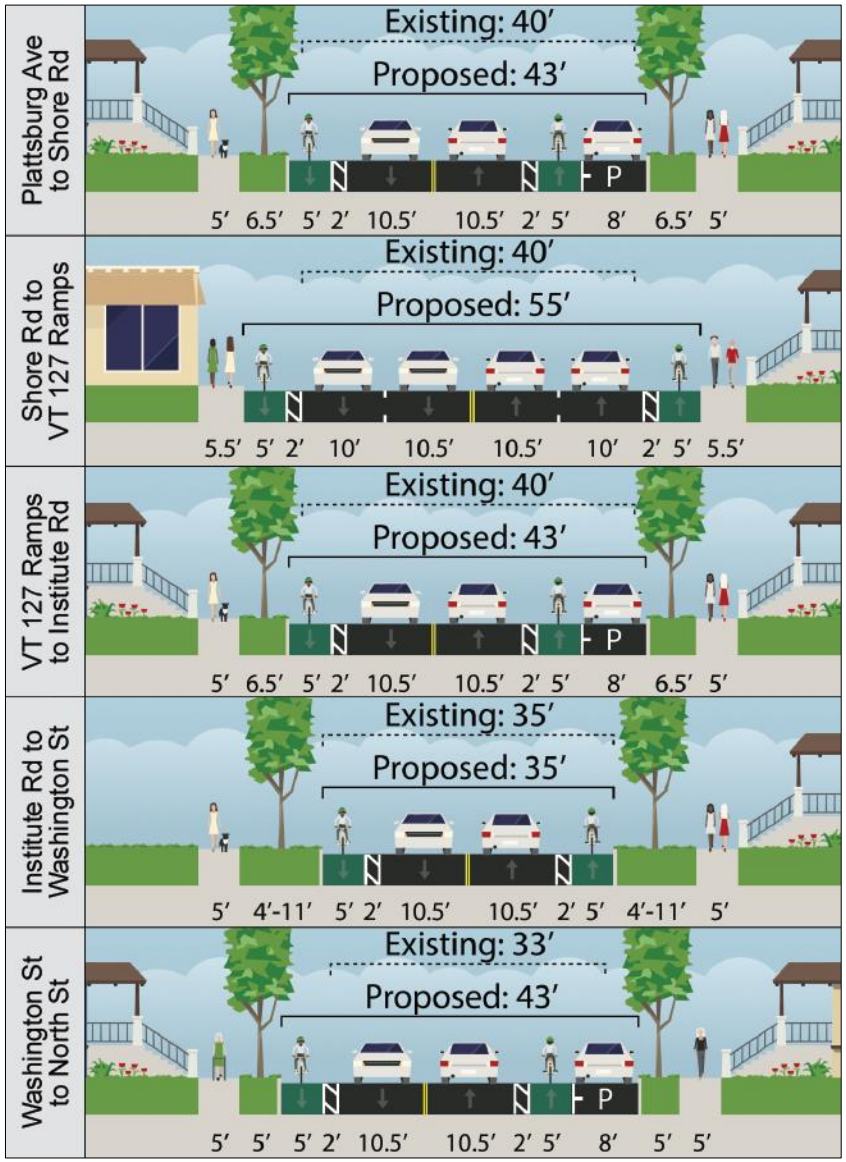
Almost all remaining greenscape zones would be 5’ wide or greater. The combined width of the sidewalk and remaining greenscape zone leaves room for additional CCTA bus shelters in many segments. The exception is the four-lane cross section between Shore Road and the VT 127 ramps. The addition of buffered bike lanes completely eliminates the greenscape zone. Any additional shelters in this segment would be located on adjacent private property, requiring easements. CCTA buses would stop in buffered bike lanes to serve passengers at the curb in Concept C.

Figure 101: Concept C Cross Sections (Three Lane Conversion)



Note: not an engineering drawing to scale; the location of on-street parking is illustrative only and not finalized.

Figure 102: Concept C Cross Sections (Maintain Four Lanes)



Note: not an engineering drawing to scale; the location of on-street parking is illustrative only and not finalized.

Concept D: On-Street One-Way Protected Bike Lanes

Concept D proposes continuous on-street one-way protected bike lanes along the entire corridor, requiring movement of all curbs and modification to all greenscape zones. This concept includes two scenarios for the segment between Shore Road and the VT 127 ramps intersection: a three-lane conversion scenario (Figure 104) and a scenario that maintains the four-lane cross section (Figure 105).

Concept D creates space for protected bike lanes by narrowing wide travel lanes and consolidating on-street parallel parking to one side of the street (on-street parking is not proposed where presently absent). Note that travel lanes adjacent to parking are 11' and the combined width of the travel lanes and shoulders adjacent to curbs are 11' to provide enough space for buses. Proposed protected bike lanes are 5' to 7' wide with 2' to 3' raised concrete buffers, fully separating cyclists and motor vehicles.

Concept D would require complete reconstruction of the entire corridor, opening the opportunity for permanent design elements that go beyond striping and pavement markings. Segments with on-street parking can accommodate curb extensions, mid-block pedestrian refuges, bus bulbs, or other complete streets design elements, depending on final details of design. Such facilities would replace one or two parking spaces where implemented.

Pedestrian refuge islands are also feasible between Shore Road and the VT 127 ramps with the introduction of the two-way left-turn lane. However, the four-lane cross section precludes the application of many complete streets design elements because of space limitations and safety concerns.

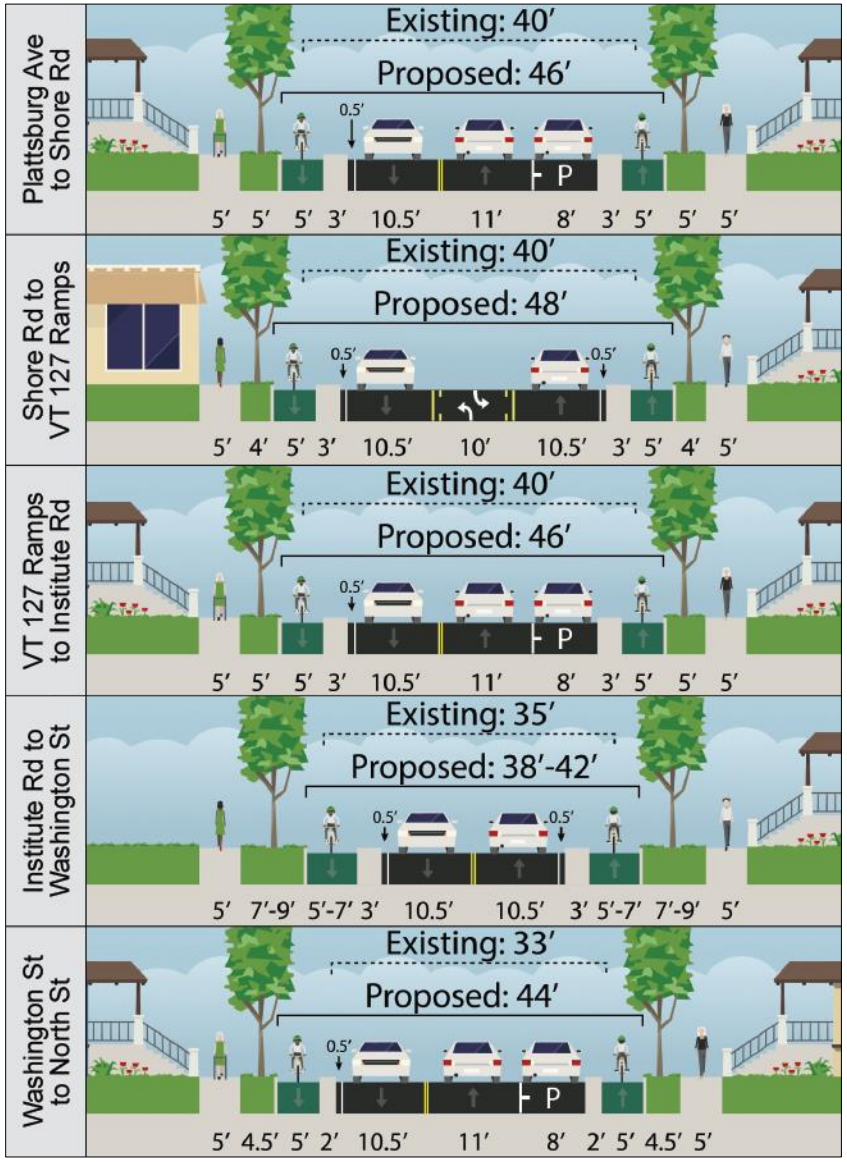
Most of the remaining greenscape zones would be 5' wide or greater. The combined width of the sidewalk and remaining greenscape zone leaves room for additional CCTA bus shelters in many segments. The exception is the four-lane cross section between Shore Road and the VT 127 ramps. The addition of protected bike lanes completely eliminates the greenscape zone. Any additional shelters in this segment would be located on adjacent private property, requiring easements.

All CCTA bus stops would be reconstructed with protected bike lanes routed behind bus bulbs (Figure 103), potentially as raised cycle tracks at sidewalk level. Bus shelters would be located on the bus bulbs. In this configuration buses, do not pull into the bicycle facility, eliminating most conflicts between buses and cyclists. However, pedestrians must cross the cycle tracks when traveling between bus stops/shelters and sidewalks.

Figure 103: Eliminating Conflicts between Buses and Cyclists at Stops

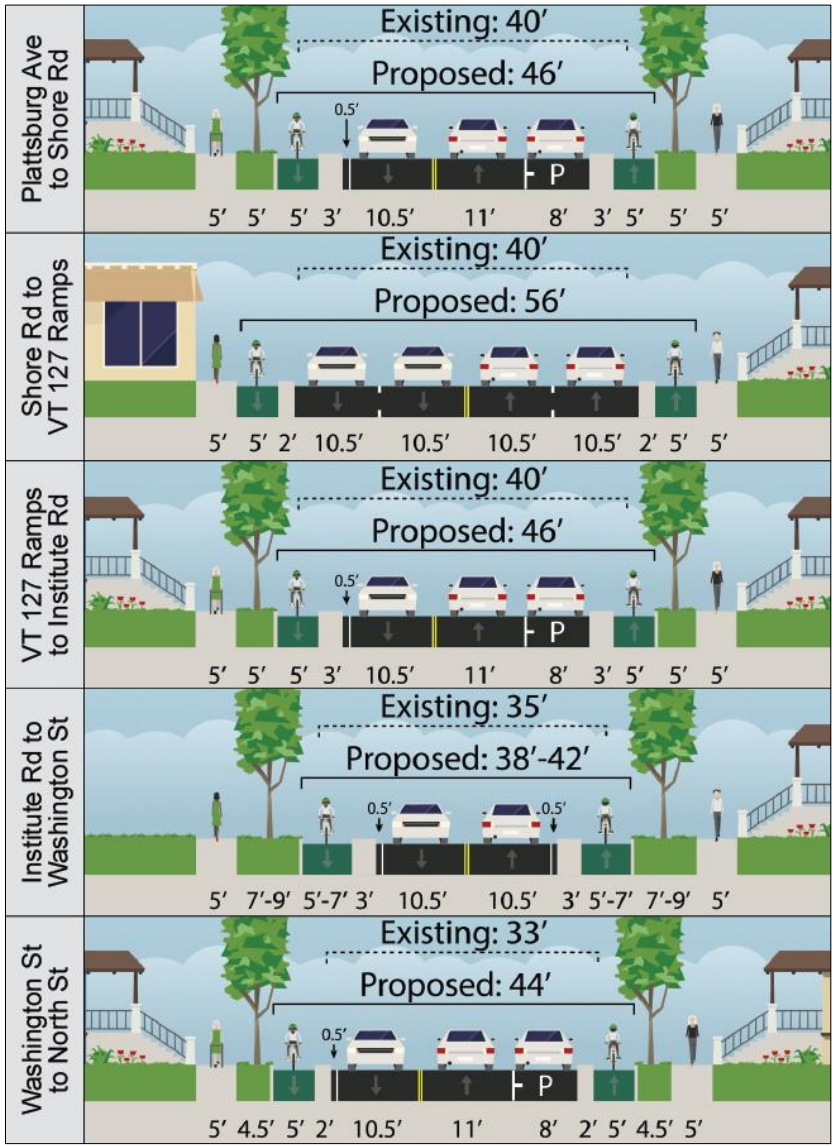
Source: NACTO

Figure 104: Concept D Cross Sections (Three Lane Conversion)



Note: not an engineering drawing to scale; the location of on-street parking is illustrative only and not finalized.

Figure 105: Concept D Cross Sections (Maintain Four Lanes)



Note: not an engineering drawing to scale; the location of on-street parking is illustrative only and not finalized.

Concept E: Raised One-Way Cycle Tracks

Concept E proposes continuous raised one-way cycle tracks along the entire corridor, requiring movement of all curbs and modification to all greenscape zones. This concept includes two scenarios for the segment between Shore Road and the VT 127 ramps intersection: a three-lane conversion scenario (Figure 106) and a scenario that maintains the four-lane cross section (Figure 107).

Concept E creates space for raised one-way cycle tracks by narrowing wide travel lanes and consolidating on-street parallel parking to one side of the street (on-street parking is not proposed where presently absent). Note that travel lanes adjacent to parking are 11' and the combined width of the travel lanes and shoulders adjacent to curbs are 11' to provide enough space for buses.

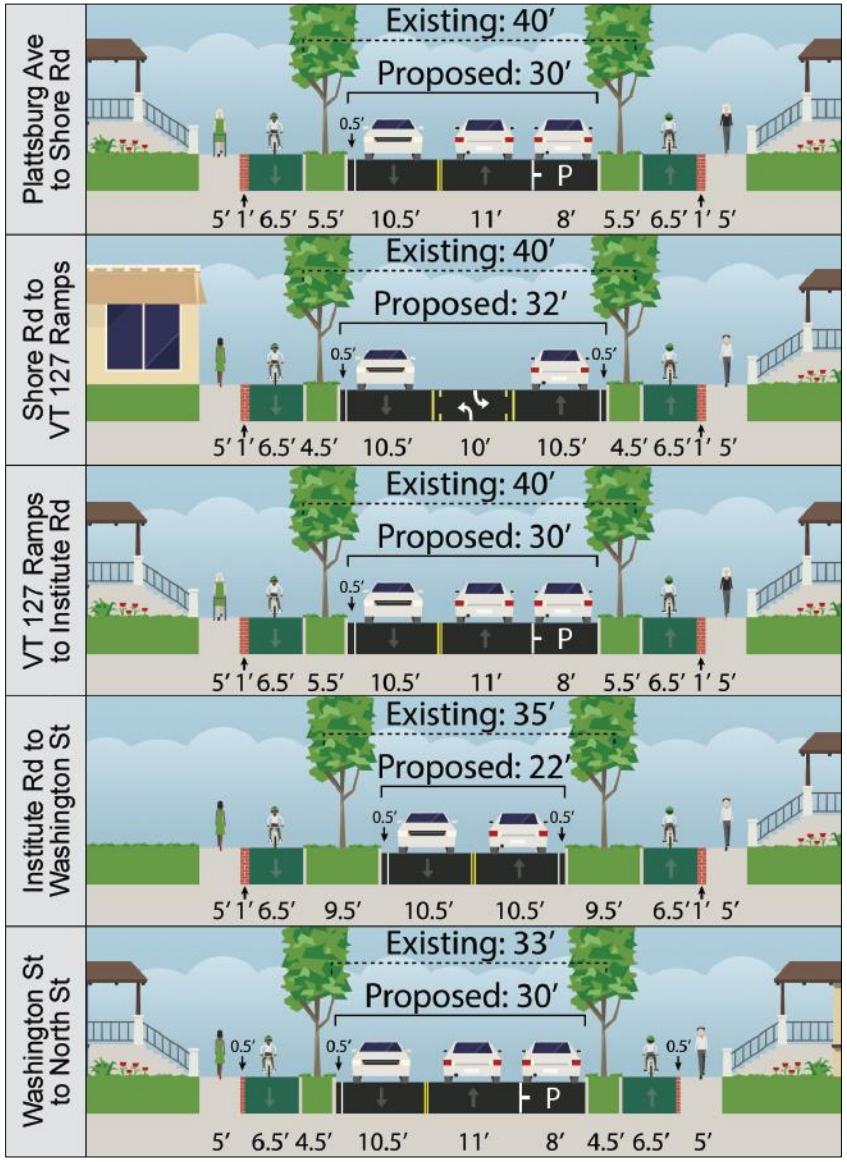
Raised cycle tracks are at sidewalk level for increased protection from motor vehicles. They drop to street level at major intersections, but remain at sidewalk level through minor side street intersections, through the creation of raised crossings. These crossings also benefit pedestrians by providing a surface flush with the sidewalk that eliminates curb ramps. Proposed raised one-way cycle tracks are 5' to 6.5' wide with a 0.5' to 1' wide paved delineation providing a clear separation from the sidewalk. Greenscape zones serve as generous buffers between the raised cycle tracks and the adjacent travel lanes, fully separating cyclists and motor vehicles (note that the greenscape zone is removed in the four-lane segment due to space constraints.) The result is a curb-to-curb street width that is narrower than existing conditions, where trees are closer to the roadway and create a sense of enclosure for additional traffic calming effect.

Concept E would require complete reconstruction of the entire corridor, opening the opportunity for permanent design elements that go beyond striping and pavement markings. Segments with on-street parking can accommodate curb extensions, mid-block pedestrian refuges, bus bulbs, or other complete streets design elements, depending on final details of design. Such facilities would replace one or two parking spaces where implemented.

Most of the remaining greenscape zones would be 5' wide or greater. The width of the remaining greenscape zones leaves room for additional CCTA bus shelters in many segments, provided that the cycle tracks are constrained to 5' wide at these locations. The exception is the four-lane cross section between Shore Road and the VT 127 ramps. The addition of raised cycle tracks completely eliminates the greenscape zone, leaving a 1' raised concrete buffer. Any additional shelters in this segment would be located on adjacent private property, requiring easements.

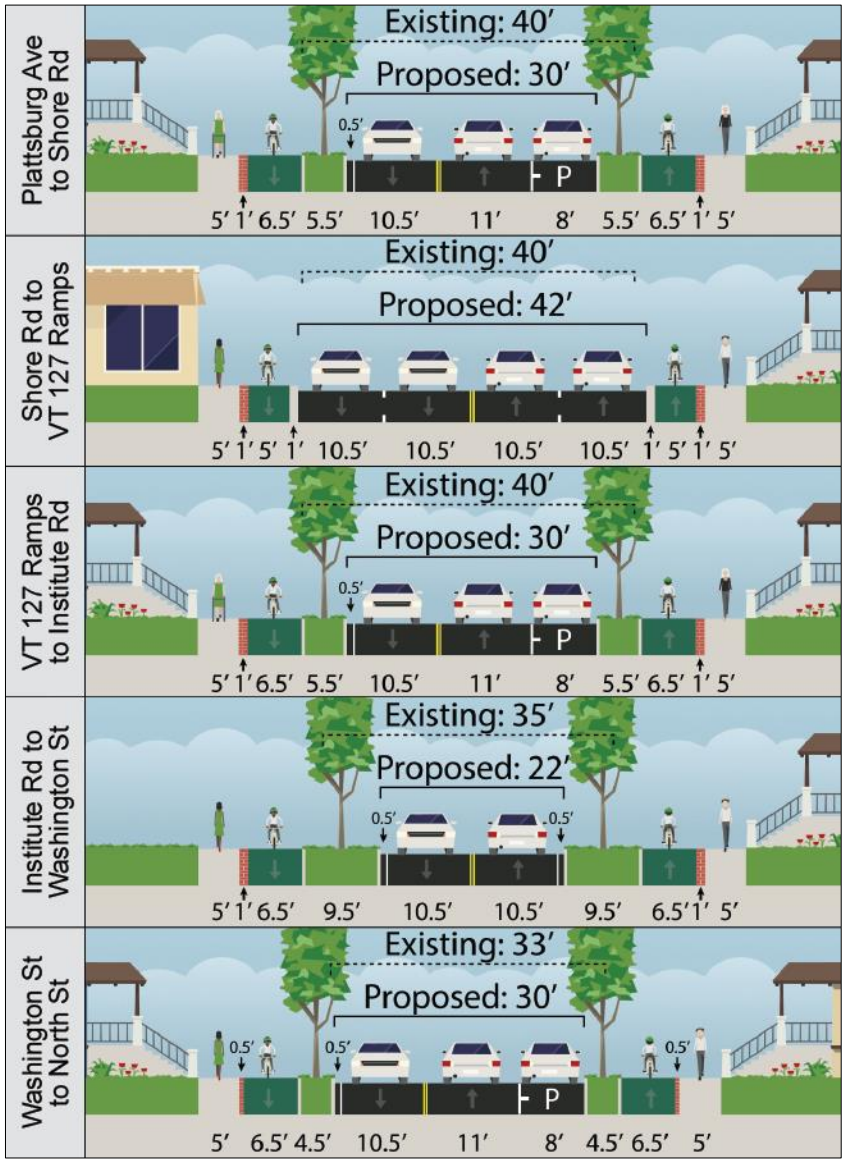
All CCTA bus stops would be reconstructed with raised cycle tracks routed behind bus shelters located in the greenscape zone. In this configuration buses, do not pull into the bicycle facility, eliminating most conflicts between buses and cyclists. However, pedestrians must cross the cycle tracks when traveling between bus stops/shelters and sidewalks (Figure 103).

Figure 106: Concept E Cross Sections (Three Lane Conversion)



Note: not an engineering drawing to scale; the location of on-street parking is illustrative only and not finalized.

Figure 107: Concept E Cross Sections (Maintain Four Lanes)



Note: not an engineering drawing to scale; the location of on-street parking is illustrative only and not finalized.

Concept F1: Raised Two-Way Cycle Track (West Side)

Concept F1 proposes a continuous raised two-way cycle track along the west side of the entire corridor (Figure 108), requiring movement of all curbs and modification to all greenscape zones. A west-side cycle track avoids conflicts with dominant flow from/to the east (e.g., Plattsburg Avenue, Ethan Allen Parkway, VT 127 ramps, and North Street) and enhances accessibility to destinations to the west (Island Line Trail, Burlington High School, North Beach Park, Leddy Park, and Ethan Allen Shopping Center, etc.) compared to a similar facility on the east side of North Avenue.

The raised two-way cycle track is at sidewalk level for increased protection from motor vehicles. It drops to street level at major intersections, but remains at sidewalk level through minor side street intersections through the creation of raised crossings. These crossings also benefit pedestrians by providing a surface flush with the sidewalk that eliminates curb ramps. The proposed raised two-way cycle track is 12’ wide with a 1’ to 2’ wide paved delineation providing a clear separation from the sidewalk.

Concept F1 would require complete reconstruction of the entire corridor, opening the opportunity for permanent design elements that go beyond striping and pavement markings. It creates space for a raised two-way cycle track by narrowing wide travel lanes and consolidating on-street parallel parking to one side of the street (on-street parking is not proposed where presently absent). Note that travel lanes adjacent to parking are 11’ and the combined width of the travel lanes and shoulders adjacent to curbs are 11’ to provide enough space for buses.

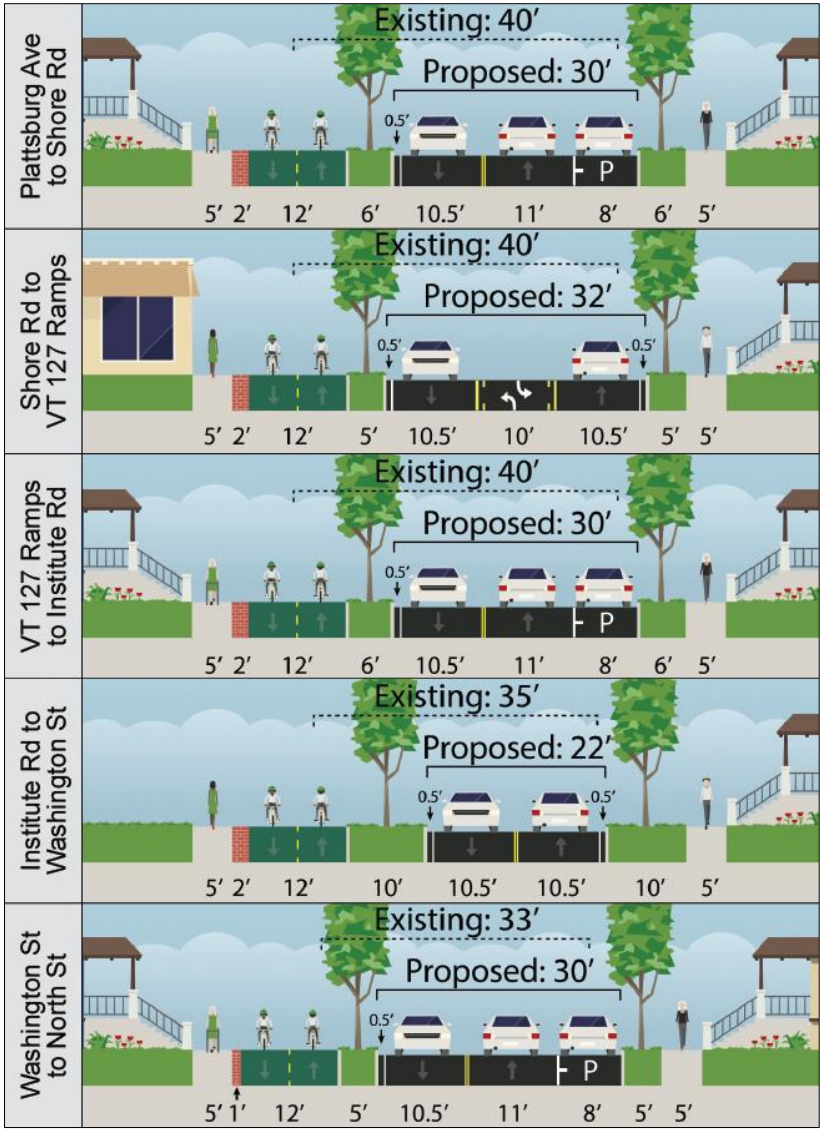
Greenscape zones serve as generous buffers between the raised cycle track and the adjacent travel lanes, fully separating cyclists and motor vehicles. The result is a curb-to-curb street width that is narrower than existing conditions, where trees are closer to the roadway and create a sense of enclosure for additional traffic calming effect. All greenscape zones would be 5’ wide or greater. The width of the greenscape zones leaves room for additional CCTA bus shelters in many segments, provided that the cycle track is constrained to 10’ wide at these locations.

Segments with on-street parking can accommodate curb extensions, mid-block pedestrian refuges, bus bulbs, or other complete streets design elements, depending on final details of design. Such facilities would replace one or two parking spaces where implemented. Pedestrian refuge islands are also feasible between Shore Road and the VT 127 ramps with the introduction of the two-way left-turn lane.

All southbound CCTA bus stops would be reconstructed with the raised two-way cycle track routed behind bus shelters located in the greenscape zone. In this configuration buses, do not pull into the bicycle facility, eliminating most conflicts between buses and cyclists. However, pedestrians must cross the cycle track when traveling between bus stops/shelters and sidewalks (Figure 103).

Concept F1 does not include a scenario that maintains the four-lane segment. There would be unsafe conflicts between transit passengers and two-way bicycle traffic without a greenscape zone to provide separation and house the bus stops/shelters.

Figure 108: Concept F1 Cross Sections



Note: not an engineering drawing to scale; the location of on-street parking is illustrative only and not finalized.

Concept F2: On-Street Two-Way Cycle Track (West Side)

Concept F2 proposes a continuous on-street two-way cycle track along the west side of the entire corridor (Figure 109), requiring movement of all curbs and modification to all greenscape zones. A west-side cycle track avoids conflicts with dominant traffic flows to the east (e.g., Plattsburg Avenue, Ethan Allen Parkway, VT 127 ramps, and North Street) and enhances accessibility to destinations to the west (e.g., Island Line Trail, Burlington High School, North Beach Park, Leddy Park, and Ethan Allen Shopping Center) compared to a similar facility on the east side of North Avenue.

Concept F2 creates space for an on-street two-way cycle track by narrowing wide travel lanes and consolidating on-street parallel parking to one side of the street (on-street parking is not proposed where presently absent). Note that travel lanes adjacent to parking are 11’ and the combined width of the travel lanes and shoulders adjacent to curbs are 11’ to provide enough space for buses.

The proposed on-street two-way cycle track is 9’ to 12’ wide with a 3’ wide raised concrete buffer, fully separating cyclists and motor vehicles. This two-way cycle track is narrower than the raised two-way cycle track because the greenscape zone does not double as the buffer.

Concept F2 would require complete reconstruction of the entire corridor, opening the opportunity for permanent design elements that go beyond striping and pavement markings. Segments with on-street parking can accommodate curb extensions, mid-block pedestrian refuges, bus bulbs, or other complete streets design elements, depending on final details of design. Such facilities would replace one or two parking spaces where implemented. Pedestrian refuge islands are also feasible between Shore Road and the VT 127 ramps with the introduction of the two-way left-turn lane.

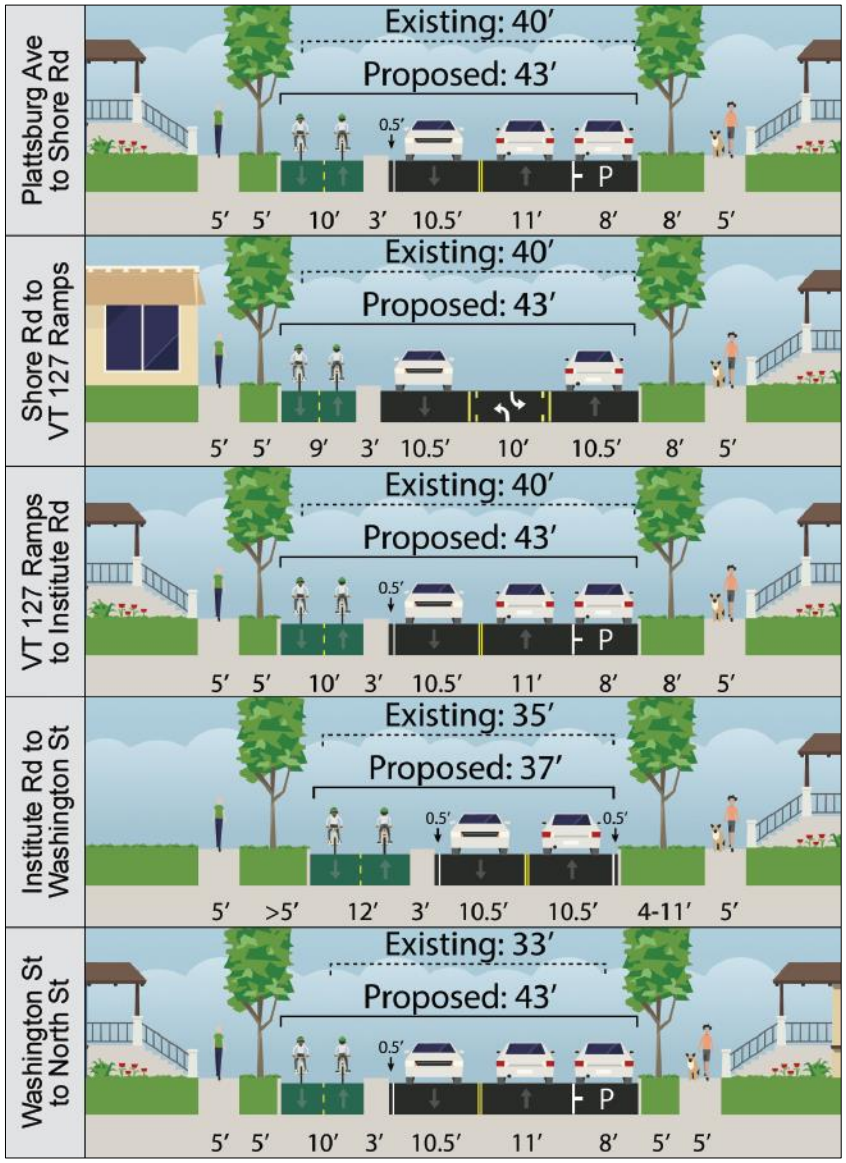
All of the remaining greenscape zones would be 5’ wide or greater. The combined width of the greenscape zones and the 3’ buffer leaves room

for additional CCTA bus shelters in many segments, provided that the cycle track is constrained (minimum of 8') at these locations.

All southbound CCTA bus stops would be reconstructed with the raised two-way cycle track routed behind bus shelters located in the greenscape zone. In this configuration buses, do not pull into the bicycle facility, eliminating most conflicts between buses and cyclists. However, pedestrians must cross the cycle track when traveling between bus stops/shelters and sidewalks (Figure 103).

Concept F2 does not include a scenario that maintains the four-lane segment. There would be unsafe conflicts between transit passengers and two-way bicycle traffic without a greenscape zone to provide separation and house the bus stops/shelter.

Figure 109: Concept F2 Cross Sections



Note: not an engineering drawing to scale; the location of on-street parking is illustrative only and not finalized.

Cost Estimates

Table 17 summarizes planning-level cost estimates for cross-section concepts. Cost categories considered include:

- Light resurfacing;
- Lane marking removal/repainting;
- Curb reset;
- Sidewalk and greenscape, including trees;
- Bicycle facilities (sharrows, lanes, protected lanes, raised cycle tracks); and
- Underground utilities.

Cross section concepts that move curbs have higher cost estimates. It was conservatively assumed that utilities would be impacted wherever curbs were reconstructed.

Cost estimates are based on planning-level concepts. More detailed costs will be refined as projects are developed for design.

Table 17: Planning-Level Cost Estimates

Concept	Description	Cost Estimate ($1,000s)
A1	Work Within Existing Curbs (Maintain Four Lanes)	$169,000
A2*	Work Within Existing Curbs (Three Lane Conversion)	$269,000
A3*	Work Within Existing Curbs (Advisory Committee Proposal)	$290,000
B	5' Minimum Bike Lanes	$2,973,000
C	Buffered Bike Lanes	$5,568,000
D	On-Street One-Way Protected Bike Lanes	$7,787,000
E	Raised One-Way Cycle Tracks	$12,945,000
F1	Raised Two-Way Cycle Track (West Side)	$12,945,000
F2	On-Street Two-Way Cycle Track (West Side)	$4,307,000

** Concept A2 and A3 received more detailed cost estimates performed by the Department of Public Works. These estimates include intersection improvements and enhanced pedestrian crossings, which are not included in cost estimates for other cross-section concepts.*

Evaluation of Concepts

The study developed a robust process to evaluate intersection and cross-section concepts against the study's six goals, which support the overall vision for North Avenue:

- Improve safety for all users
- Balance transportation choices
- Improve multimodal connectivity
- Provide consistent facilities throughout the corridor
- Support vibrant and livable community
- Support sustainable economic growth

The process consisted of identifying evaluation criteria within each goal, developing a scoring system, performing the required analyses (depending on the criteria), and presenting the results to the Advisory Committee for consideration when deliberating and selecting concepts to the City Council's approval. Detailed information regarding the evaluation process, including criteria, analyses, and results, are provided in the *Appendix C*.

Criteria

Improvement concepts can be evaluated against many criteria, but the criteria must illuminate the differences between concepts for a meaningful evaluation process. This was especially true when defining evaluation criteria for this study because all concepts were developed using the same complete street design principles and elements from the complete street toolbox. The study team first separated goals that were diagnostic (i.e., that would help in determining meaningful differences between concepts) from goals that were would not provide differentiation between concepts. The team decided that improving safety for all users, balancing transportation choices, and improving multimodal connectivity provided a foundation for identifying specific criteria, while the other goals either represented design criteria—which should be accomplish to the greatest extent possible by all concepts—or more overarching community goals—which did not provide significant differentiation between concepts.

The resulting criteria consisted of familiar transportation evaluation measures (e.g., level of service, motor vehicle queues, etc.) as well as many quantitative and qualitative measures reflecting the complete streets nature of this study:

- **Improves safety for all users**:
  - Consistency with Burlington *Street Design Guidelines*
  - Pedestrian experience
  - Level of traffic stress
  - Bicycle conflicts with turning motor vehicles at signalized and unsignalized intersections
  - Bicycle conflicts with buses
  - Opportunities to improve accessibility
  - Traffic calming treatments
- **Balances transportation choices**:
  - Level of service
  - Average motor vehicle queue length
- **Improves multimodal connectivity**:
  - Bus stop and crosswalk pairing
  - Opportunities for bus bulbs and bus stop amenities
  - Access to major destinations for cyclists

Additional criteria were added to better understand how concepts would impact right-of-way and maintainability:

- **Right-of-way impacts**:
  - New right-of-way needs
  - Greenscape zone impacts
- **Maintainability**:
  - Snow plowing and storage
  - Drainage

Scoring System

The results of the intersection and cross-section analyses were translated into a point-based scoring system to provide a quick comparison between concepts. Each criterion was rated against existing conditions on a relative 1- to 5-point scale where 3 points represented baseline conditions:

- **1 point**: Much worse than existing conditions
- **2 points**: Worse than existing conditions
- **3 points**: About the same as existing conditions
- **4 points**: Better than existing conditions
- **5 points**: Much better than existing conditions

Results

Total scores were averaged across all criteria. However, Table 19 and Table 20 simplify the presentation of scores by grouping criteria within overall evaluation categories that correspond to project goals. Detailed scoring information is provided in Appendix D. Concepts with the highest scores were not necessarily recommended by the Advisory Committee. The results of the evaluation process were intended to inform the Advisory Committee only, as one source of information on which to base their recommendations regarding improvement strategies/implementation plan.

Intersection and cross-section concepts that converted the four-lane cross-section between Shore Road and the VT 127 ramps into a three-lane cross section were favored by the evaluation process. The three-lane cross section provides more opportunities for complete streets design elements that improve the safety of all users, including drivers. Intersection concepts with smaller overall footprints scored well for the same reason.

There was a general correlation between higher scores for cross section concepts as the level of separation and protection for cyclists increased. Cross-section concepts that provided buffers from adjacent traffic also scored well because additional space was available for other complete street treatments.

All of these evaluation outcomes are consistent with North Avenue's Vision and Goals.

Health Impact Assessment

The Burlington District Office of the Health Department was asked by the Advisory Committee to conduct and submit a desktop Health Impact Assessment (HIA) as part of the *North Avenue Corridor Study*. This type of HIA draws from existing data such as local reports, public meetings, and published literature about similar scenarios. Consideration of the public's health in the planning process ensures that the potential impacts on the physical and mental well-being of residents is evaluated and addressed.

The strategies for making the North Avenue corridor provide safe, inviting, and convenient travel for all users of all ages and abilities overlap with those that promote health by increasing prospects for safer physical activity and by improving access to services and opportunities for users of all transportation modes.

Table 18 shows that residents of approximately 45 percent of New North End households could walk or bike to Hannaford, the only full service supermarket within the study area, if safe, inviting infrastructure is in place (for healthy adults, destinations within one-half mile are considered walkable, and destinations less than one mile are considered bikeable). The HIA analyzed supermarket access for low-income and senior populations as well, finding that the Avenue Apartments (33 affordable units), Thayer House (36 units for the elderly), and Heineberg Senior Housing (82 units for the elderly) are within walking distance to Hannaford. While Franklin Square (60 affordable units) is within biking distance, the remaining subsidized housing in the study area (336 affordable units at Northgate and six units for disabled residents at Pennington House) are more than one mile away. The analysis revealed that many New North End residents cannot be reasonably expected to walk or bike to access healthy foods,

and that efficient public transportation and driving options are needed for these residents. Additional detail, including maps of this analysis, is provided in the complete HIA in Appendix E.

Table 18: Access to Full Service Supermarkets within the Study Area

Distance from Hannaford (miles)	New North End Households within Specified Range	
	Number	Percent
< 0.25	99	2.5%
0.25 to 0.5	421	10.7%
0.5 to 1	1,280	32.5%
> 1	2,137	54.3%
All	3,937	100.0%

After reviewing the proposed concepts for each segment of the corridor, the Burlington District Office of the Health Department formulated the following conclusions:

- Continuous, protected bike facilities, particularly those physically separated from the roadway, (proposed Options D, E and F) would allow a larger number of inexperienced bicyclists to travel North Avenue. These configurations allow for safer travel and may lead to an increase in the number of people making the choice to walk or bicycle. The corollary to this increase is potential improvement in the health of residents.
- Care should be taken in the design of facilities, particularly at intersections, driveways, crossings, and transit stops to reduce any potential for increased crashes. Additionally, an array of traffic calming strategies can help reduce the severity of injuries. Both intersection design and traffic calming features may increase residents' perception of safety and result in a concomitant increase in the number of people willing to bike and walk along the corridor.
- The three-lane conversion between Shore Road and the VT 127 ramps can make roadway conditions safer—both for motorists and other users of the roadways—by limiting excessive speed and providing protected center turn lanes.
- Pedestrian-scale details like street trees, green space, and lighting, can contribute to a sense of mental well-being, safety, and connectedness among residents in addition to amplifying the traffic calming effect.
- Providing multimodal transportation options increases access and the potential for children, seniors, people with disabilities, recent immigrants, or those with limited financial resources to access a range of essential opportunities and services such as grocery stores, pharmacies, parks, and places of employment.

The greatest gains in public health, through improvements in physical activity, social connectivity, and equitable access to services and opportunities will be attained through a truly complete street that accommodates people of all ages and abilities.

Table 19: Evaluation Results: Intersection Concepts

Intersection	Concept	Evaluation Category			Final Score (Highest scoring concepts per intersection highlighted)
		Balances Transportation Choices	Improves safety for all users	Right-of-way impacts	
Plattsburg Ave	1	3.0	4.0	3.0	**3.5**
	2	3.0	4.5	4.0	**4.0**
	3	2.0	4.0	4.0	**3.5**
Shore Rd/ Heineberg Rd	1 (3 lane)	2.0	4.0	3.0	**3.3**
	1 (4 lane)	2.0	3.8	2.5	**3.0**
	2 (3 lane)	3.0	4.5	3.0	**3.8**
	2 (4 lane)	3.0	4.3	2.5	**3.5**
Ethan Allen Shopping Center	1 (3 lane)	2.0	4.0	2.5	**3.1**
	1 (4 lane)	2.0	3.3	2.0	**2.6**
	2 (3 lane)	2.0	4.3	3.0	**3.4**
	2 (4 lane)	2.0	3.5	2.0	**2.8**
Ethan Allen Pkwy	1 (3 lane)	2.0	4.0	2.0	**3.0**
	1 (4 lane)	3.0	3.3	2.0	**2.9**
	2 (3 lane)	1.0	2.3	3.0	**2.1**
	2 (4 lane)	1.5	2.3	2.5	**2.1**
VT 127 ramps	1 (3 lane)	2.5	4.5	3.5	**3.8**
	1 (4 lane)	3.0	4.0	3.0	**3.5**
	2 (3 lane)	3.0	4.0	3.0	**3.5**
	2 (4 lane)	3.0	3.8	2.5	**3.3**
	3 (3 lane)	1.5	2.3	4.0	**2.5**
	3 (4 lane)	2.5	2.3	3.5	**2.6**
Institute Rd	1	2.0	4.0	3.5	**3.4**
	2	3.0	3.8	3.0	**3.4**
North St	1	3.0	3.8	2.5	**3.3**

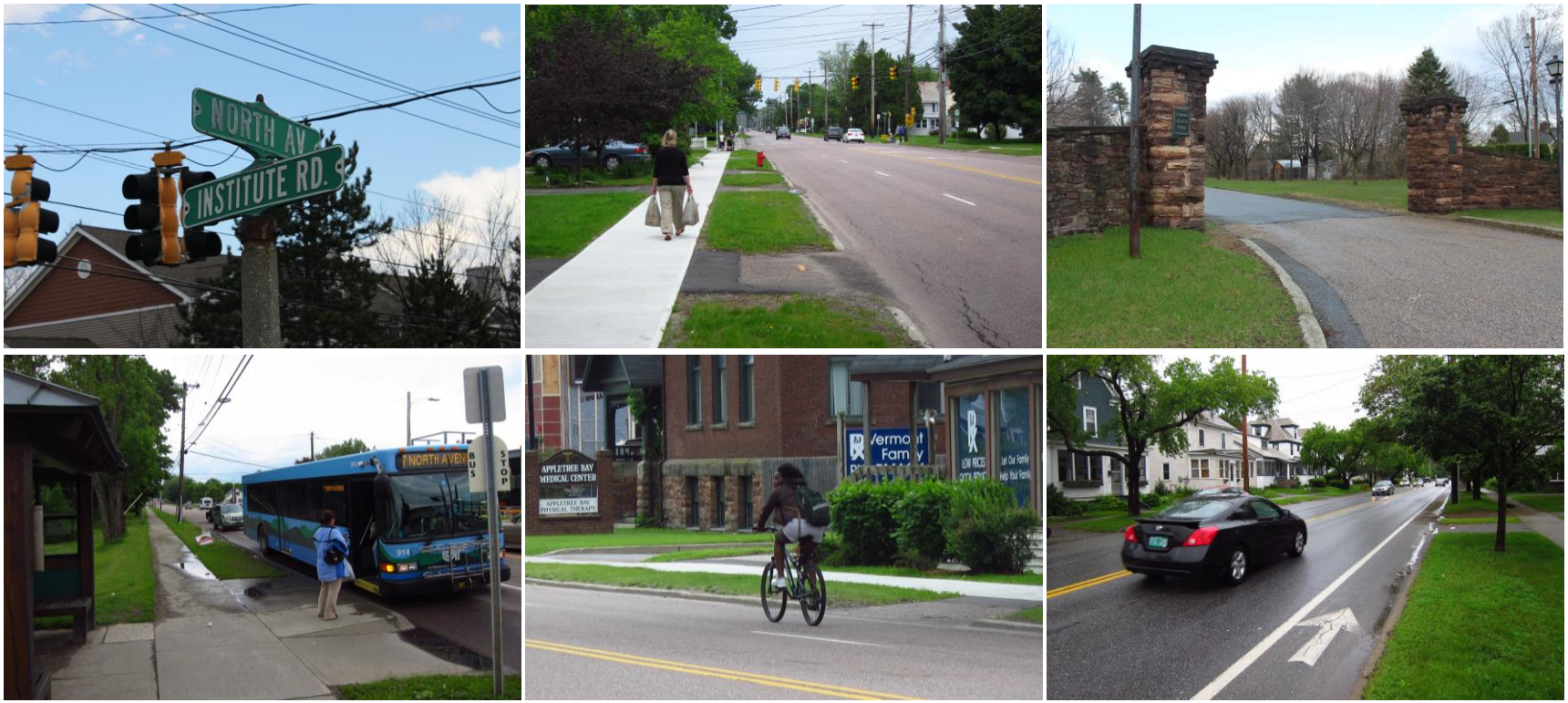
Table 20: Evaluation Results: Cross-Section Concepts

Cross-Section Concept		Config.	Evaluation Category					Final Score (Highest scoring cross-section concept highlighted)
			Consistency w/ Burl. CS Guidance	Improves Safety for All Users	Improves Multi-modal Connectivity	Right-of-Way Impacts	Maintain-ability	
A1	Work Within Existing Curbs	4 Lanes	4	3.3	4.0	3.0	3.0	**3.4**
A2	Work Within Existing Curbs	3 Lanes	5	4.2	4.3	3.0	3.0	**3.9**
A3	Work Within Existing Curbs (AC Proposal)	3 Lanes	*	*	*	*	*	*
B	5' Minimum Bike Lanes	3 Lanes	5	4.2	4.3	2.5	3.5	**3.9**
		4 Lanes	5	3.5	3.7	2.0	3.0	**3.4**
C	Buffered Bike Lanes	3 Lanes	5	4.3	4.3	2.5	3.5	**4.0**
		4 Lanes	5	3.5	3.7	2.0	2.5	**3.3**
D	On-Street One-Way Protected Bike Lanes	3 Lanes	5	4.8	4.3	2.5	4.0	**4.3**
		4 Lanes	5	4.0	3.7	2.0	3.0	**3.6**
E	Raised One-Way Cycle Tracks	3 Lanes	5	5.0	4.3	2.5	4.5	**4.4**
		4 Lanes	5	4.2	3.7	2.0	3.0	**3.6**
F1	Raised Two-Way Cycle Track (West Side)	3 Lanes	5	5.0	4.7	2.5	4.5	**4.5**
F2	On-Street Two-Way Cycle Track (West Side)	3 Lanes	5	5.0	4.7	2.5	4.0	**4.4**

** Concept A3 was created by the Advisory Committee late in the planning process. It was therefore not formally evaluated.*

Chapter 4

Recommendations and Implementation Plan



Chapter 4 describes the short-, medium- and long-term multimodal concepts endorsed by the North Avenue Advisory Committee and the final concepts approved by the Burlington City Council. As described in previous chapters, these improvement concepts were developed and refined through an extensive public process and committee input and were evaluated for their ability to meet the corridor's vision and goals. A detailed description of all concepts is provided in Chapter 3.

Designs of long-term intersection and cross-section concepts presented in this report are conceptual. Further analyses (scoping) and detailed design is required for these concepts to move towards implementation. Some improvement concept descriptions note important details for the future scoping/design phases because these specific details are critical to the safety of all users, particularly the most vulnerable users such as pedestrians and cyclists.

All recommended improvement concepts are presented in the *Implementation Matrix* section within this chapter.

Implementation Timeframes

All improvement concepts were organized into three implementation periods:

- Short term (less than three years)
- Medium term (three to seven years)
- Long term (more than seven years)

These timeframes help differentiate between concepts that could be implemented relatively quickly versus concepts that require additional time to develop. Improvement concepts were placed into each implementation period based on several factors, including project complexity (i.e., the extent of evaluation, scoping, and design required), length of the public process, construction costs, and feasibility of obtaining funding.

Short Term

Short-term projects could be implemented in less than three years because there are minimal evaluation/design requirements and no major reconstruction of the roadway. Examples of short-term projects include new striping (e.g., bike lanes, narrowed lanes, on-street parking), traffic signal optimization, ADA improvements, high-priority new pedestrian crossings, high-priority and minor intersection construction, and new transit shelters. Some short-term projects will require additional public process for regulatory changes, some will benefit from additional public engagement, but the most basic short-term projects will advance without any additional review (e.g. signal optimization, pedestrian countdown signals, and ADA improvements).

Medium Term

Medium-term projects could be implemented within three to seven years. These projects require a more detailed design process because of more complex construction, which may include curb relocations at some locations. Examples of medium-term projects include gateway treatments (i.e., curb extensions, special pavement), minor intersection construction, and more complex striping patterns. These projects require a greater degree of public input and additional time may be needed to seek funding from multiple sources.

Long Term

Long-term projects represent the most significant investments in the North Avenue Corridor, and may take more than seven years to fully implement. Long-term projects require full evaluation, scoping, and design, as well as a robust public involvement process throughout all phases of the project, including construction. Examples of long-term projects include full curb and planting strip reconstruction, low-stress cycling facilities (e.g., protected bike lanes), utility burial or relocation, more complex intersection reconstruction, and stormwater treatments. Long-term projects also take more time to implement due to their high costs (could exceed several millions of dollars) which

makes securing a variety of funding sources critical to their implementation.

Voting for Preferred Concepts

At their last meeting on July 1, 2014, the Advisory Committee voted for their preferred cross-sections, intersections, crosswalks, and corridor-wide concepts by timeframe. Concepts that received a simple majority were advanced as Advisory Committee recommendations for the Transportation, Energy, and Utility Committee's (TEUC) consideration. The final Implementation Plan was selected by the City Council during their October 6, 2014 meeting.

The study team (staff from DPW, CCRPC, and Parsons Brinckerhoff) had concerns on the ability to implement some of the concepts endorsed by the Advisory Committee within the recommended timeframes.

The organizations represented on the Advisory Committee are:

- American Association of Retired Persons (AARP)
- Burlington Partnership for a Healthy Community (BPHC)
- Chittenden County Transportation Authority (CCTA)
- City Council
- Burlington Department of Public Works (DPW)
- Local Motion
- Burlington Department of Planning and Zoning
- Burlington Department of Community and Economic Development
- Neighborhood Planning Assembly (NPA) Representatives from Wards 3, 4, and 7
- Burlington School District
- Vermont Agency of Transportation (VTrans)

Each organization represented on the Advisory Committee received a single vote, although not every organization participated in the voting process.

Short-Term Concepts

Cross-Sections

The Advisory Committee voted (8 to 2) in favor of a short-term pilot project (Concept A3) with the following elements:

- Three-lane configuration between Shore Rd and VT 127 with 10.5' travel lanes and 4.5' bike lanes
- 25 mph throughout the corridor
- All parking eliminated north of Institute Road
- Bike lanes, enhanced/buffered where space allows
- Protected bike lanes (with flexposts) from VT 127 ramps to Institute Road
- Replacement of existing drainage grates with bicycle-friendly grates

At their September 10, 2014 meeting, the TEUC voted to approve short-term cross section Concept A3, excluding 25 mph throughout the corridor, and advance this recommendation to the full City Council for consideration.

Long-Term Concepts

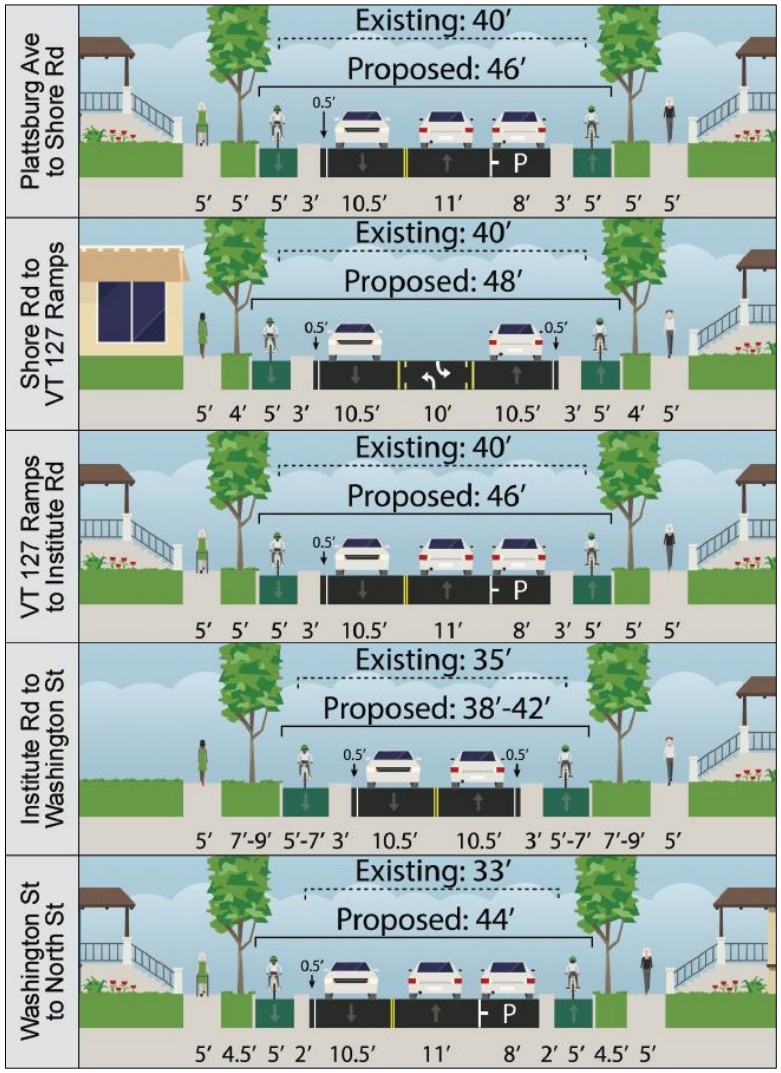
Cross-Sections

The Advisory Committee voted (6 to 4) in favor of Concept D (On-Street One-Way Protected Bike Lanes, see Figure 110) as the long-term cross-section for North Avenue. With this full redesign, on-street parking could be reevaluated and the full North Avenue corridor will be designed for a consistent 25 mph speed limit. In addition, improvements should be coordinated with the Department of Parks and Recreation to incorporate clear, safe, and inviting pedestrian and bicycle connections to pathways and parkland.

At their September 10, 2014 meeting the TEUC also voted to approve long-term cross section Concept D and advance this recommendation to the full City Council for consideration.

The committee also paid particular attention to the interaction between protected bike lanes (the preferred long-term cross-section for North Avenue) and bus stops. Bus stops and conventional bike lanes typically conflict with one another because buses must pull into the bike lane to reach the curb. This creates an unsafe interaction on the street between buses and cyclists. Protected bike lanes are designed to travel behind bus stops—in effect creating a floating bus bulb—removing direct conflicts between buses and cyclists (see Figure 103). The conflict between buses and cyclists was a vital consideration and topic of much discussion, particularly when weighing advantages and disadvantages between one-way or two-way protected bike lanes. As a result, the committee noted that future scoping, evaluation, and design of cross-section Concept D should incorporate safe and proven designs at bus stop locations.

Figure 110: Long-term Cross-section Concept D: On-Street One-Way Protected Bike Lanes



Note: not an engineering drawing to scale; the location of on-street parking is illustrative only and not finalized.

Unsignalized/Mid-Block Pedestrian Crossings

A list of nine candidate locations for new unsignalized/mid-block pedestrian crossings was developed based on comments received from the public via the online voting tool and public meetings. Advisory Committee members were asked to vote for three to five preferred locations. The five locations with the most votes were assigned to the short-term timeframe, and the remaining four were assigned to the medium term (Table 21 and Figure 111).

Table 21: Implementation Timeframes for Unsignalized/Mid-Block Pedestrian Crossings

Proposed Pedestrian Crossing Location (Listed North to South)	Timeframe
Loaldo Drive/Fairmont Place	Medium
Green Acres Drive/Cayuga Court	Short
Staniford Road	Long
Gosse Court	Short
Poirier Place	Medium
Lakewood Parkway	Medium
Killarney Drive/Village Green Drive	Short
Saratoga Avenue	Medium
Mid-block at bus stop pair south of VT 127 ramps	Long
Burlington College	Short
Convent Square	Long
Ward Street	Short
Canfield Street	Long

Based on additional comments received through the online input tool and public meetings, the study team also assigned four additional pedestrian crossings to the long-term timeframe, which are intended to provide safer crossing opportunities for bus passengers at stops along North Avenue. All unsignalized/mid-block crossing locations will be evaluated for the most appropriate crosswalk design features, which may include high-visibility treatments, lighting, and alignment.

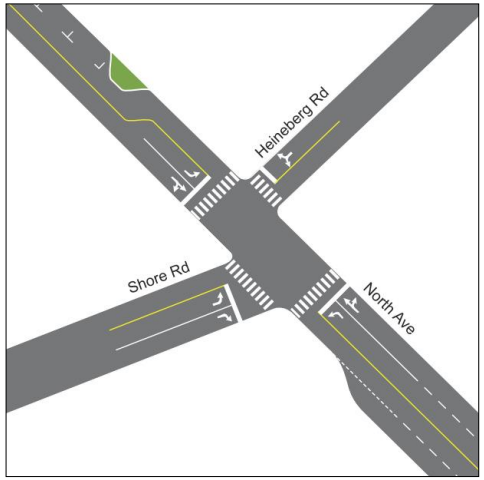
Figure 111: Implementation Timeframe for Unsignalized/Mid-Block Pedestrian Crossings

Intersection Concepts

The Advisory Committee was asked to vote on preferred short-, medium-, and long-term concepts for all signalized intersections in the corridor and the unsignalized Washington Street intersection. The committee unanimously supported all corridor-wide short-term intersection improvements:

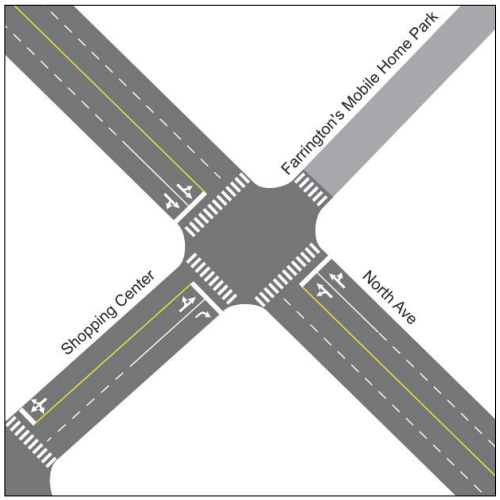
- Crosswalks on all approaches at signalized intersections;
- Accessible curb ramps for the disabled and visually impaired on all approaches;
- Audible pedestrian countdown timers with five-second (minimum) push-button LPIs (Note that this does not apply to roundabout concepts); and
- Where present in advance of intersections, continuous bicycle treatments through intersections to raise drivers' awareness of cyclists' presence and to provide cyclists clear paths through intersections for through and turning movements.

Preferred Short-Term Intersection Concepts



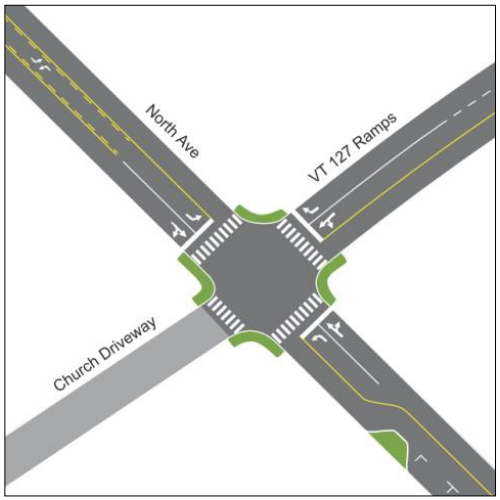
Shore Rd Concept 1:

- Increase pedestrian crossing times for seniors
- Pedestrian-activated no right turn on red
- Split phasing for Shore Road and Heineberg Road approaches



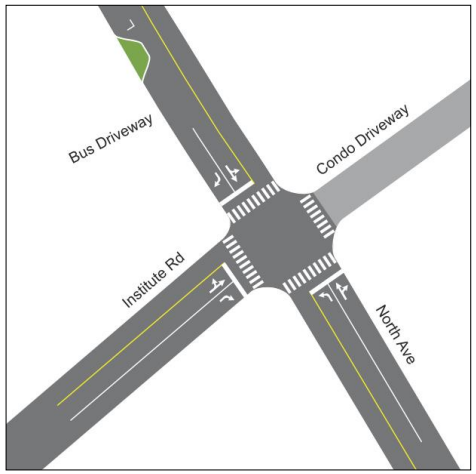
Ethan Allen Shopping Center Concept 1:

- Increase pedestrian crossing times for seniors
- Pedestrian-activated no right turn on red



VT 127 Ramps Concept 1:

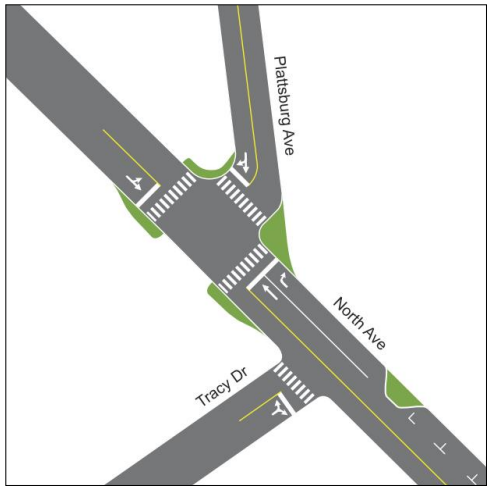
- Optimize signal timing
- Close high-speed NB on- ramp
- Remove free flow WB right turn
- Remove gantry from North Avenue
- Gateway treatments (highway transition)



Institute Rd Concept 1:

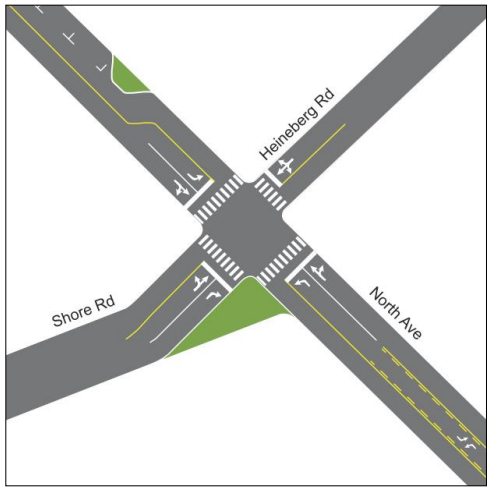
- Fix motor vehicle detection
- Pedestrian-activated no right-turn on red
- Address conflict between SB through cyclists and right-turning motor vehicles
- Reduce intersection footprint (paint in short term)
- Relocate NB bus stop to far side

Preferred Medium-Term Intersection Concepts



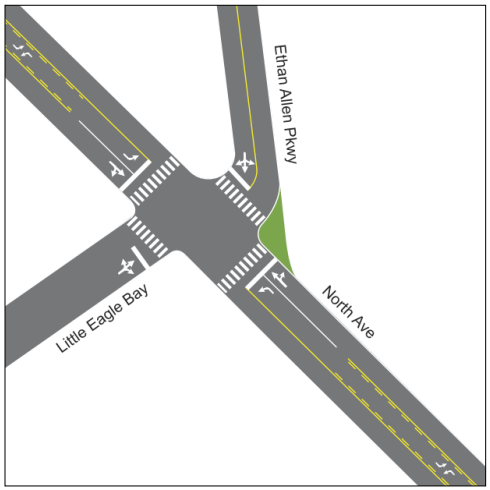
Plattsburg Avenue Concept 1:

- Slow high-speed NB right turns with curb extension and signal relocation
- Resolve Tracy Dr turns and access to Merola's Market
- Exclusive pedestrian phase at south crosswalk
- Gateway treatments (north entrance to corridor)



Shore Rd Concept 2:

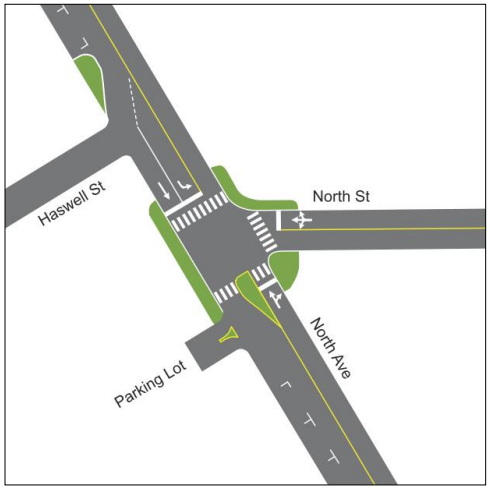
- Maintain increased pedestrian crossing times and pedestrian-activated no right turn on red from Concept 1
- Realign Shore Road (contingent upon St. Mark Church right-of-way donation)



Ethan Allen Parkway Concept 1:

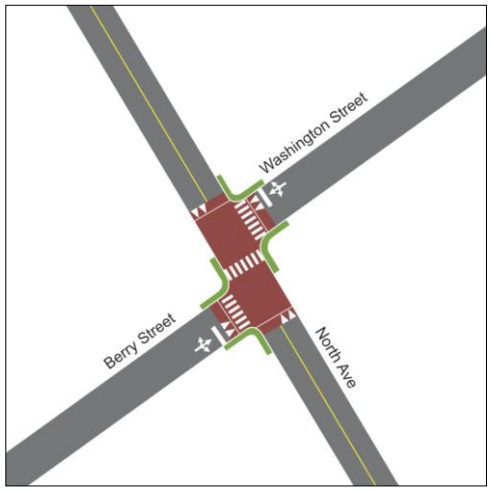
Scoping study to include:

- Little Eagle Bay into signal, slow high-speed NB right turns with curb extension, relocate motor vehicle entrance to Ethan Allen Park



North Street Concept 1:

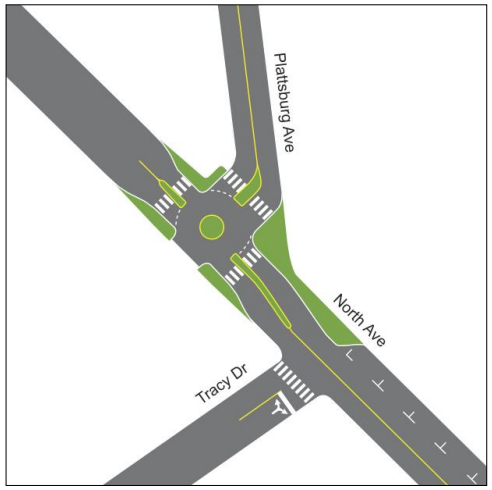
- Pedestrian-activated no right-turn on red
- Right-in, right-out or curb cut removal at parking lot access
- Realign south crosswalk and add pedestrian refuge
- Realign north crosswalk to align with push button
- Protected/permitted SB left turns
- Gateway treatments



Washington Street

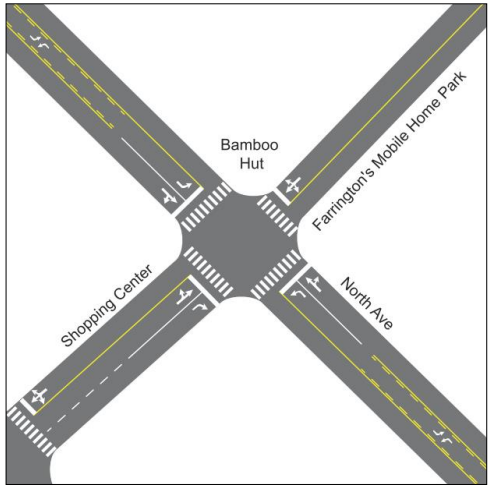
- Raised intersection
- Pedestrian-actuated rapid flash beacon
- Gateway treatments

Preferred Long-Term Intersection Concepts



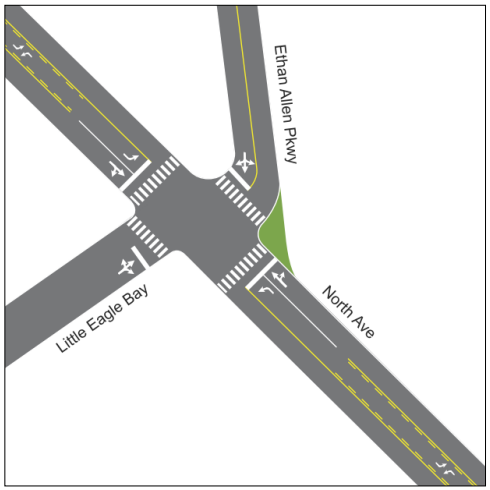
Plattsburg Avenue Concept 3:

- Scoping for single-lane mini-roundabout or other alternatives



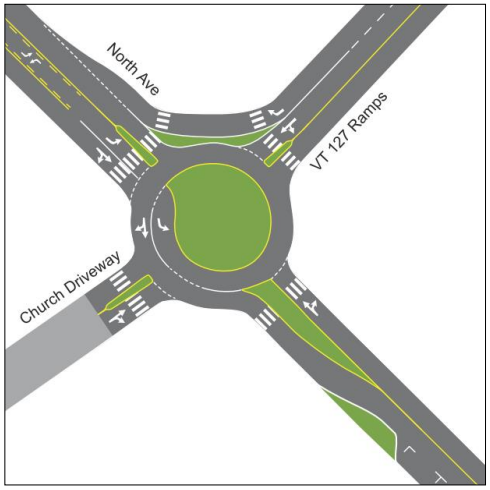
Ethan Allen Shopping Center Concept 2:

- Maintain increased pedestrian crossing times and pedestrian-activated no right turn on red from Concept 1
- Reconstruct Farrington's Mobile Home Park entrance
- Reconstruct Bamboo Hut sidewalk and curb cuts



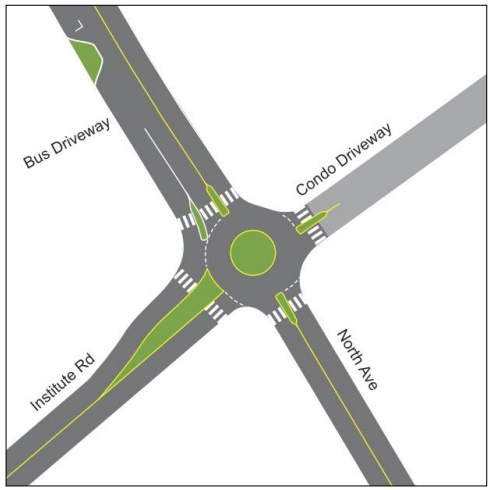
Ethan Allen Parkway Concept 1:

- Implement scoping study recommendation



VT 127 Ramps Concept 3:

- Scoping for roundabout or other alternatives



Institute Rd Concept 2:

- Scoping for roundabout or other alternatives
- Resolution of the bus driveway

Transit Concepts

Even though there is currently transit service on North Avenue provided by CCTA, improvements to the routes and shelters have been consistently identified by the public as a critical issue for this corridor.

The following transit improvements for the North Avenue corridor were supported by the Advisory Committee and CCTA, pending funding availability:

- Additional bus shelters at high-usage stops (CCTA supports up to three new shelters in the short term) and larger shelters at Burlington High School;
- Fifteen-minute peak period weekday headways for Route 7 in the medium-term; and
- Increased weekend services.

Implementation Matrix

The Implementation Matrix provides a summary of the Advisory Committee's preferred Implementation Plan for short-, medium- and long-term multimodal improvement concepts.

Implementation Matrix by Timeframe

The Implementation Matrix describes important aspects associated with each recommendation, including:

- **Details**: An overview of the elements and design features.
- **Leader(s)**: Those agencies expected to take the lead for implementation of a project.
- **Direct Partners**: Those agencies expected to have direct involvement to support the implementation of a project.
- **Next Steps/Comments**: Summary of important notes and next steps to advance the recommendation.

Table 22: Implementation Matrix: Short-Term Recommendations

Recommendation	Details	Leaders	Direct Partners	Next Steps/Comments

Cross-section Concept A3: Corridor-wide on-road improvements	• 3-lane cross section between Shore Rd and VT 127 ramps
	• Bicycle facilities:
	  ○ Plattsburg to Shore: buffered bike lanes
	  ○ Shore to VT 127 ramps: conventional bike lanes
	  ○ VT 127 ramps to Institute: protected bike lanes (flexposts)
	  ○ Institute to Washington: buffered bike lanes
	  ○ Washington to Institute: conventional bike lane (NB), sharrows (SB)
	• 10.5' travel lanes
	• All parking eliminated north of Washington St
	• Replace existing drainage grates with bicycle-friendly grates
		DPW	CCRPC, Public Works Commission, Public	• Initiate planning and design for pilot project, including 90-second cycle lengths and signal coordination.
				• Initiate public involvement process.
				• Identify duration of the pilot.
				• Define measurable multimodal metrics, both quantitative (e.g. crashes, number of cyclists, vehicle delay, etc.) and qualitative (e.g. survey responses), to track before and after performance and assess effectiveness.
				• Identify funding source(s).

High priority pedestrian crossings at unsignalized intersections or mid-block locations	• Green Acres Dr/Cayuga Ct • Gosse Ct • Killarney Dr/Village Green Dr* • Burlington College • Ward St	DPW	Public Works Commission, Public, CCTA	• Identify the highest priority pedestrian improvement projects • Initiate public involvement process. • Assess the need for flashing beacons and/or refuge islands at unsignalized/mid-block crossings. • Coordinate with CCTA regarding bus stop location near proposed crossings (relocate stops if necessary). • Investigate drainage issues at ADA ramps for long-term solutions (e.g. raised crossings at side streets).
Pedestrian crossings on all approaches of all signalized intersections	• High visibility continental or solid (red) crosswalks • American with Disabilities (ADA) compliant curb ramps with detectable warning surfaces	DPW		

Recommendation	Details	Leaders	Direct Partners	Next Steps/Comments
LPIs on all approaches of all signalized intersections	• Minimum 5-second length • Audible, pedestrian countdown timers • Push-button activation			• Identify funding source(s). • *Note:* Killarney Dr/Village Green Dr crossing only compatible with a three-lane conversion.
Bicycle facilities (where provided) maintained through all intersections	• Crossbike markings • Bike boxes • Two-stage left-turn boxes	DPW		• Initiate public involvement process. • Coordinate with and implement alongside Concept A3, as well as short-term intersection concepts at Shore, Ethan Allen Shopping Center, VT 127 ramps, and Institute Rd.
Shore Rd/Heineberg Rd Intersection: Concept 1	• Increase pedestrian crossing times for seniors • Pedestrian-activated no right turn on red • Split phasing for Shore Rd and Heineberg Rd approaches	DPW		• Identify funding source(s). • Initiate public involvement and outreach.
Ethan Allen Shopping Center: Intersection Concept 1	• Increase pedestrian crossing times for seniors • Pedestrian-activated no right turn on red			• Identify funding source(s).
VT 127 Ramps: Intersection Concept 1	• Optimize signal timing • Close high-speed NB on-ramp • Remove free flow WB right-turn • Remove gantry • Gateway treatments (highway transition)		VTrans, City, CCRPC, Public, BCA	• Initiate planning and design. • Initiate public involvement process. • Initiate public outreach process and educational campaign of proposed changes. • Identify funding source(s).
Institute Rd: Intersection Concept 1	• Fix motor vehicle detection • Pedestrian-activated no right turn on red • Address conflict between SB cyclists and right-turning motor vehicles • Reduce intersection footprint (paint in the short-term) • Relocate NB bus stop to far side		City, VTrans, CCRPC, CCTA, BSD	• Initiate planning and design. • Initiate public involvement process. • Coordinate with CCTA to relocate the NB bus stop. • Identify funding source(s).

Recommendation	Details	Leaders	Direct Partners	Next Steps/Comments
Transit: New bus shelters	• Additional shelters at high ridership stops (up to three shelters in the short term, pending funding) • Larger shelters at Burlington High School	CCTA	City, BSD	• Initiate public involvement process. • Investigate high ridership stops for candidate shelter locations. • Assess site restrictions and land availability. • Coordinate with Burlington School Department regarding shelter sizes at Burlington High School. • Identify funding source(s).

Table 23: Implementation Matrix Medium-Term Recommendations

Project	Project Details	Leaders	Direct Partners	Next Steps/Comments
Additional pedestrian crossings at unsignalized intersections or mid-block locations	• Loaldo Dr • Poirier Pl* • Lakewood Pkwy* • Saratoga Ave*	DPW	Public Works Commission, Public	• Initiate public involvement process. • Assess the need for flashing beacons or refuge islands are warranted for unsignalized/mid-block crossings. • Coordinate with CCTA regarding bus stop location near proposed crossings (relocate stops if necessary). • Identify funding sources. • *Note:* Poirier Pl, Lakewood Pkwy, and Saratoga Ave crossings only compatible with a three-lane conversion. • Identify funding source(s).
Plattsburg Ave Intersection: Concept 1	• Slow high-speed NB right turns with curb extension and signal relocation • Resolve Tracy Dr turns and access to Merola's Market • Exclusive pedestrian phase at south crosswalk • Gateway treatments (north entrance to corridor)	DPW	VTrans, CCRPC, Burlington City Arts, Public	• Initiate planning and design. • Initiate public involvement process. • Identify funding source(s).
Shore Rd/ Heineberg Rd Intersection: Concept 2	• Maintain increased pedestrian crossing times and pedestrian-activated no right turn on red from Concept 1 • Realign Shore Rd (contingent upon St. Mark Church right-of-way donation)		VTrans, CCRPC, Public, Private landowner	• Initiate planning and design. • Initiate public involvement process. • Coordinate with St. Mark Church regarding permanent easement or ROW donation for Shore Rd realignment • Identify funding source(s).

Project	Project Details	Leaders	Direct Partners	Next Steps/Comments
Ethan Allen Pkwy Intersection: Concept 1	• Scoping Study for signal improvements: • Incorporate Little Eagle Bay into signal • Slow high-speed NB right turns with curb extension • Relocate vehicle entrance to park	DPW/CCRPC	VTrans, Burlington Department of Parks and Recreation, Public	• Initiate scoping and design, including alternative for single-lane roundabout. • Initiate public involvement process. • Coordinate with Department of Parks and Recreation to locate a suitable vehicle entrance for Ethan Allen Park. • Identify funding source(s).
Washington St Intersection: Concept 1	• Consider raised intersection with special pavement material • Pedestrian-actuated rapid flash beacon for crosswalk • Gateway treatments (transition between Old and New North End)	DPW	VTrans, CCRPC, Burlington Fire Department, Burlington City Arts, Public	• Initiate planning and design. • Initiate public involvement process. • Identify funding source(s).
North St Intersection: Concept 1	• Pedestrian-activated no right turn on red • Right-in, right-out or curb cut removal at parking lot access • Realign south crosswalk and add pedestrian refuge • Realign north crosswalk to align with push button • Protected/permitted SB left turns • Gateway treatments (southern entrance to corridor and entrance to North Street Historic District)		VTrans, CCRPC, VT Division for Historic Preservation, Burlington City Arts, Public	• Initiate planning and design. • Initiate public involvement process. • Study access to parking lot and Depot St to determine whether right in, right out or curb cut removal is best solution. • Coordinate with the Vermont Division for Historic Preservation regarding potential impacts to North Street Historic District. • Identify funding source(s).
Transit: 15-minute peak period weekday headways on North Ave	• Upgrade AM and PM peak period headways from 30 minutes to 15 minutes.	CCTA		• Continue to develop existing plans for 15-minute service on North Avenue. • Identify funding source(s).
Transit: Increased weekend services on North Ave	• Replace Route 18 (limited Sunday service only) on North Avenue with new Sunday service on Route 7			• Identify funding source(s).

Table 24: Implementation Matrix Long-Term Recommendations

Project	Project Details	Leaders	Direct Partners	Next Steps/Comments

Cross-section Concept D: On-street one-way protected bike lanes	• Consistent 25 mph speed limit
	• 3-lane cross section between Shore Rd and VT 127 ramps (maintained from short-term pilot project)
	• Bicycle facilities:
	  ○ 5’ to 7’ on-street protected bike lanes
	  ○ 2’ to 3’ raised curb buffer
	• 10.5’ travel lanes with 0.5’ shoulders against curbs/parking
	• Potential 8’ parallel parking on one side of the street (pending results of pilot project)
	• Utility burial or relocation, as needed for curb movement
	• Stormwater management (address ponding issues)
	• Use bicycle-friendly drainage grates
		DPW/CCRPC	VTrans, private utilities, CCTA, DPR, VT Division for Historic Preservation, Public	• Initiate scoping study with a robust public involvement process.
				• Evaluate results of the pilot project (Concept A3), including the on-street parking north of Washington St.
				• Coordinate with Department of Parks and Recreation to incorporate clear, safe, and inviting pedestrian and bicycle connections to pathways (Island Line Trail and 127 Path) and parkland via side streets (e.g. Shore Rd, Leddy Park Rd, etc.).
				• Create maintenance and snow plowing policy and action plan for protected bike lanes.
				• Coordinate with utilities regarding burial or relocation as curbs are moved.
				• Coordinate with CCTA regarding bus stop consolidation or relocation, as well as interaction between cycle tracks and bus stops.
				• Coordinate with the Vermont Division for Historic Preservation regarding potential impacts to North Street Historic District.
				• Identify funding source(s).

Additional pedestrian crossings at unsignalized intersections or mid-block locations	• Staniford Rd • Mid-block at bus stop pair south of VT 127 ramps • Convent Sq • Canfield St	DPW	Public Works Commission, Public, CCTA	• Initiate public involvement process. • Assess the need for flashing beacons or refuge islands are warranted for unsignalized/mid-block crossings. • Coordinate with CCTA regarding bus stop location near proposed crossings (relocate stops if necessary).

Project	Project Details	Leaders	Direct Partners	Next Steps/Comments
				• Identify funding sources.
Plattsburg Ave Intersection: Concept 3	• Mini-roundabout: ○ No flared entry to increase visibility of pedestrians and cyclists to drivers, and to slow turns into roundabout ○ Separated protected bike lane around roundabout • Additional gateway treatments (northern entrance to corridor)	DPW/CCRPC	VTrans, Public, BCA	• Initiate Scoping and alternatives evaluation before proceeding to design. • Initiate public involvement process. • Identify funding source(s).
Ethan Allen Shopping Center Intersection: Concept 2	• Maintain Concept 1 improvements • Reconstruct Farrington's Mobile Home Park entrance • Reconstruct Bamboo Hut sidewalk and curb cuts	DPW	Public	• Initiate design of intersection. • Initiate public involvement process. • Coordinate with Bamboo Hut and Farrington's Mobile Home Park • Identify funding source(s).
Ethan Allen Pkwy Intersection: Concept 1	• Implement medium-term scoping study recommendation	DPW/CCRPC		
VT 127 Ramps: Concept 3	• Gateway treatments (transition between highway speeds and 25 mph corridor) • Remove unused ramp pavement • Scoping study for roundabout: ○ Dual SB approach lanes ○ WB right-turn bypass lane ○ No flared entry to increase visibility of pedestrians and cyclists to drivers, and to slow turns into roundabout ○ Separated cycle track around roundabout	DPW	VTrans, Burlington City Arts, CCRPC, Public	• Initiate scoping and evaluation of alternatives (including a single lane roundabout) before proceeding to design. • Initiate public involvement process. • Identify funding source(s).

Project	Project Details	Leaders	Direct Partners	Next Steps/Comments
Institute Rd Intersection: Concept 2	• Scoping study for roundabout: ○ SB right-turn bypass lane ○ No flared entry to increase visibility of pedestrians and cyclists to drivers, and to slow turns into roundabout ○ Resolve bus driveway access (this is included in Concept 1, but driveway may need to be moved again with a roundabout concept) ○ Separated cycle track around roundabout	DPW	VTrans, CCRPC, BSD	• Initiate scoping and evaluation of alternatives (including a single lane roundabout) before proceeding to design. • Initiate public involvement process. • Coordinate with Burlington School Department to resolve driveway access and regarding ROW needs for a roundabout. • Identify funding source(s).

City Council Resolution

The Burlington City Council, at their October 6th, 2014 meeting voted unanimously to support an Implementation Plan for the North Avenue that includes short-, medium-, and long-term improvement recommendations that will, over time, achieve the corridor's Vision and Goals as defined by the residents and businesses of the New North End, City officials and stakeholders, and the public at large.

The City Council recognized that short-term improvement concepts will have minimal design and additional public process whereas most of medium- and long-term improvement concepts will be further evaluated as they go through appropriate project development processes before implementation. The public and various stakeholders will have ample opportunity for comment throughout these processes.

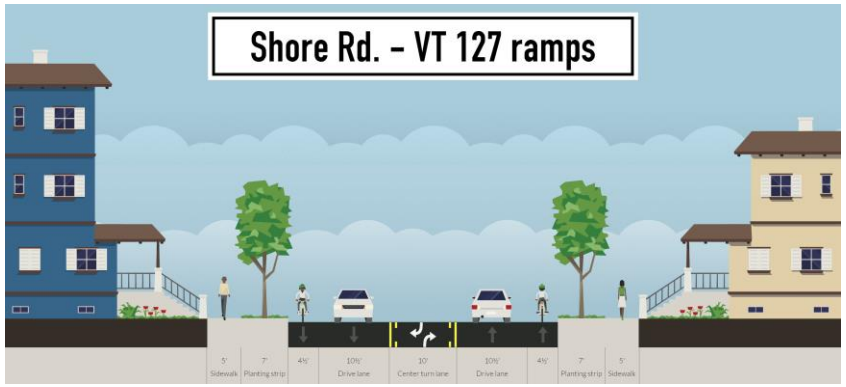
The City Council appointed a North Avenue Task Force and directed them to work collaboratively with City departments, stakeholders and the public to implement the North Ave corridor recommendations. The Task Force charge includes development of a data collection plan as well as performance metrics, and a public outreach plan that includes regular communications with City Council, City Departments and community stakeholders.

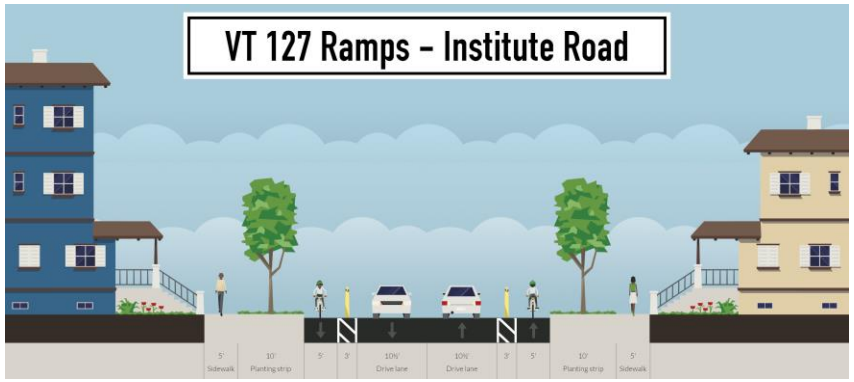
The North Avenue Task Force includes members of the Ward 3, 4, and 7 Neighborhood Planning Assemblies (NPAs); representatives of the Burlington Departments of Planning and Zoning, Community and Economic Development, Public Works, Police, and Fire; CCTA; Burlington School District; and one representative from each Ward (3,4,7) recommended by the area Councilors.

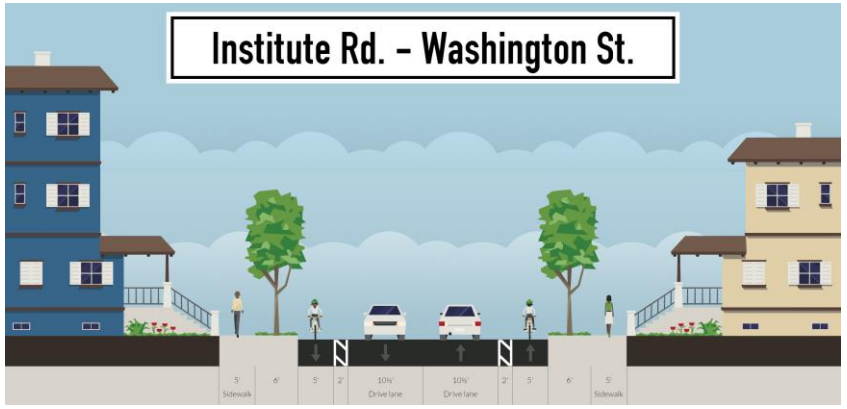
Figure 112 shows the council approved short-term cross-sections for the various segments of the corridor. The entire City Council resolution is included in Appendix F. Selected elements of the North Avenue resolution are listed below:

- At all intersections, upgrade curb ramps to be ADA-compliant, add crosswalks on all approaches of signalized intersections, add audible pedestrian countdown timers with a minimum of five-second push-button activated Leading Pedestrian Interval, and bicycle facilities maintained through the intersections where they are provided in advance of intersections;
- Install new crosswalks (listed in order of priority) at Burlington College, Gosse Court, Killarney Drive / Village Green Drive, Green Acres / Cayuga Court, Ward Street;
- At Shore Road, increase pedestrian crossing times, add pedestrian-activated no right turn on red, and split phasing for Shore Road/Heineberg Road approaches;
- At Ethan Allen Shopping Center, increase pedestrian crossing times and add pedestrian-activated no right turn on red;
- At the VT 127 ramps, optimize the signal timing to achieve greater efficiency, close the high speed northbound ramp, remove the free-flow westbound right-turn movement, the gantry over North Avenue, and add gateway treatments;
- At Institute Road, fix motor vehicle detection, reduce the intersection footprint with paint, relocate the northbound bus shelter to north (far side) of the intersection, realign southbound sidewalk north of Institute Road, and add pedestrian-activated no right turn on red;
- Implement a pilot project to include no parking at least on one side of North Avenue between Institute Road and VT 127 ramps and between Shore Road and Plattsburg Avenue, buffered bike lanes between Washington Street and Institute Road, bike lanes between Institute Road and the VT 127 ramps, a 3-lane cross section with bike lanes between the VT 127 ramps and Shore Road, bike lanes between Shore Road and Plattsburg Avenue, and, as needed, replace drain grates with bike-friendly grates;
- Create up to three additional transit shelters at high ridership stops (pending funding) and larger shelters at Burlington High School; and
- Add buffering and protection for bikes lanes on both sides of North Ave, where width and parking allows.

Figure 112: City Council Approved Short-term Cross-sections for Implementation during the North Avenue Pilot Project







Next Steps

Improving and reconstructing North Avenue will occur in phases. Over the next years and into the next decade, the multimodal improvements outlined in the Implementation Matrix will transform North Avenue into the safe, inviting, efficient corridor the community has envisioned.

The recommendations in this report are concepts and detailed visions for the community to work towards. The next step for many medium- and long-term recommendations will be a Scoping Study, which will clearly define the project and identify any impacts to adjacent resources. The recommendation will be vetted against other potential alternatives, and a more detailed conceptual design and cost estimate will be developed. The scoping process includes a public involvement plan similar to the public involvement for this Corridor Study. Following the scoping process, projects will undergo preliminary and final design, right-of-way acquisition (if needed), and construction. Public outreach and involvement will occur throughout the process, as projects progress from scoping to construction.

Central to these efforts is the identification of funding to complete design and construction work. Implementing any recommended project will require a combination of funding sources, which may include:

- Federal & State:
    - Congestion Mitigation and Air Quality Improvement Program
    - Highway Safety Improvement Program
    - Surface Transportation Program
    - Transportation Alternatives Program
    - Bicycle and Pedestrian Program
    - Planning assistance grants
- Regional:
    - Unified Planning Work Program (Scoping & Technical Assistance)
- Local:
    - Bond measures (popular vote)
    - Capital infrastructure funds
    - Impact Fees
    - Voter-approved sales tax
- Private:
    - Developers
    - Institutions

North Avenue Pilot Project

The first task of the North Avenue Task Force is to coordinate with City departments, stakeholders and the public to plan for the pilot project for the avenue including development of conceptual designs of the temporary changes to the avenue; data plan, performance metrics; and a plan of how to define success and measure public input.