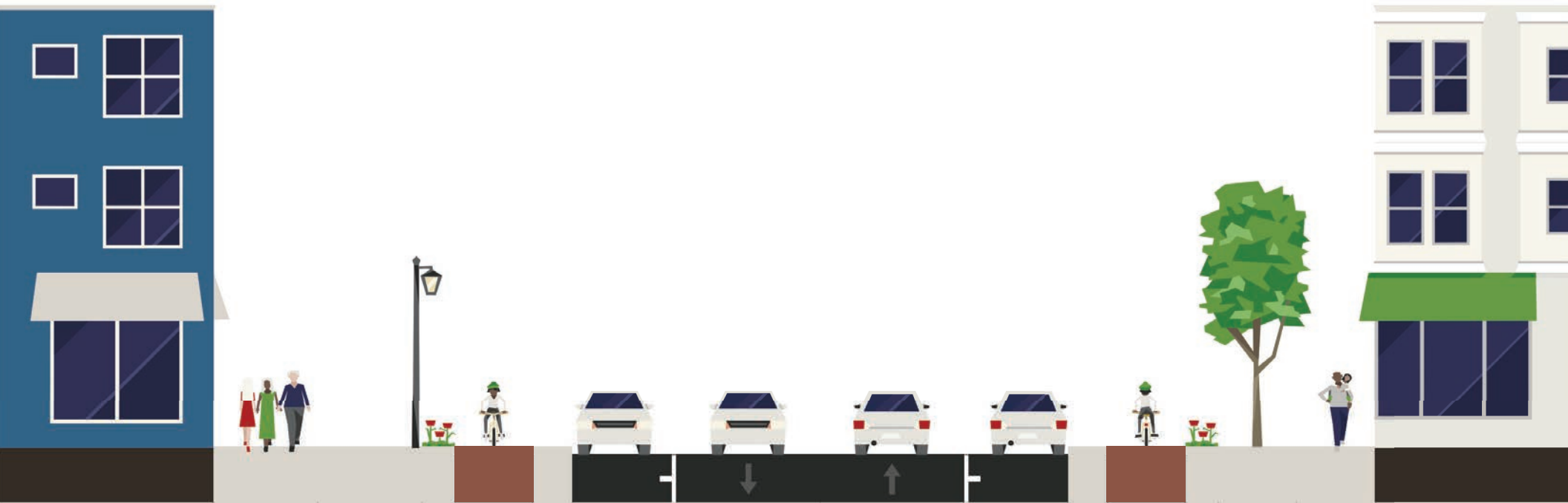


Main Street | Barre Street

Bicycle and Pedestrian Scoping Study STP BP16(13)

Final Report September 2019



Project Team

Steering Committee

Dona Bate, City Council Member & MTIC (Montpelier Transportation Infrastructure Committee)

Katie Budreski, Montpelier Alive Board Member

Jonathan Harries

Celia Riechel, MTIC

Constantinos Stivaros, MTIC

Heather Voisin, MTIC

City of Montpelier

Corey Line, Project Management Director

Kevin Casey, Community Development Specialist

Vermont Agency of Transportation

Ross Gouin, Project Manager

Project Consultants

DuBois & King, Inc. & Hartgen Archaeological Associates

Lucy Gibson, D&K

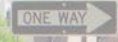
Sophie Sauvé, D&K

Julia Ursaki, D&K

Elise Manning-Sterling, Hartgen Archaeological Associates

Walter Wheeler, Hartgen Archaeological Associates





Sticker on utility pole



Table of Contents

Introduction	5	M3: Hybrid	58
Land-Use Context	7	M4: Greening America’s Capital (GAC) + Elm St Bikeway	61
Purpose & Need	9	Right-of-Way Impacts	66
Project Goals	9	Alternatives Evaluation	67
Public Outreach	11	Traffic Operations	68
Town Meeting Day	11	Parking Impacts	69
Online	11	Public Feedback on Alternatives	73
Public Input Key Takeaways	12	Preferred Alternative	75
Existing Conditions	13	Short Term Recommendations	79
Traffic Volumes	13	Rapid Implementation Projects	89
Safety	13	Barre Street Two-way Bikeway	89
Montpelier Bike Path	14	Main & School Mini Roundabout	90
Roadway Characteristics	15	Quick Builds lead to Long Term Changes	92
Key Intersections	18	Long Term Recommendations	93
Walking in Montpelier	20	Costs	101
Bicycling in Montpelier	22	Implementation Timeline	103
Bicycle Parking	24	Funding Opportunities	105
Right-of-Way	25	Municipal Recommendations	107
Utilities	27	Attachments	
Environmental Resources	29	Attachment A: Archaeological Resource Assessment and Historic Resources Identification	
Cultural Resources	33	Attachment B: Short Term Recommendation Plan	
Alternatives	35	Attachment C: Long Term Recommendation Plan	
Design Elements	35	Attachment D: Traffic Management Plan Questionnaire	
Summary	38	Attachment E: Intersection Capacity Analyses for Roundabouts and Traffic Signal Warrants	
Understanding Impacts	39	Attachment F: Detailed Cost Estimates	
Barre Street	40	Attachment G: Meeting Minutes	
B1: Sidepath	41		
B2: Buffered Two-way Bikeway	45		
B3: Buffered Bike Lanes	49		
Main Street	50		
M1: Signals with Bike Lanes	51		
M2: Roundabouts with Bike Lanes	54		

Introduction

The City of Montpelier initiated this scoping study to inventory, analyze and propose improvements to bicycle and pedestrian safety on Main Street between Memorial Drive and Spring Street; and on Barre Street between Main Street and the Montpelier Recreation Center, which coincides with the current eastern terminus of the Montpelier Bike Path (Figures 1 and 2). The City of Montpelier applied for and received funding through the Vermont Bike Pedestrian Grant Program from the Vermont Agency of Transportation (VTrans) for the Montpelier Main and Barre Street Bicycle and Pedestrian Scoping Study – STP BP 16(13).

DuBois & King (D&K) led the scoping study to identify potential improvements and issues associated with pedestrian and bicycling infrastructure within the project area. Hartgen Archaeological Associates provided the assessment of historic and archaeological resources in key areas where proposed alternatives could impact cultural resources. The purpose of this scoping report is to document the analysis and development of alternative improvements; identify advantages and disadvantages of different alternatives based on right-of-way issues and traffic modeling, for example, and provide guidance on how to phase and fund the proposed short and long term recommendations, and to document the public process that led to the selection of a preferred alternative.

The study considered east-west and north-south bicycle circulation, changes to traffic control at key intersections, and street network connectivity enhancements to address the project needs. It built upon other recent planning efforts, including: Montpelier in Motion (2015) and Greening America's Capitals (2015). These two documents identified concepts for consideration for bicycle and pedestrian travel, as well as the integration of green stormwater infrastructure into the right-of-way.

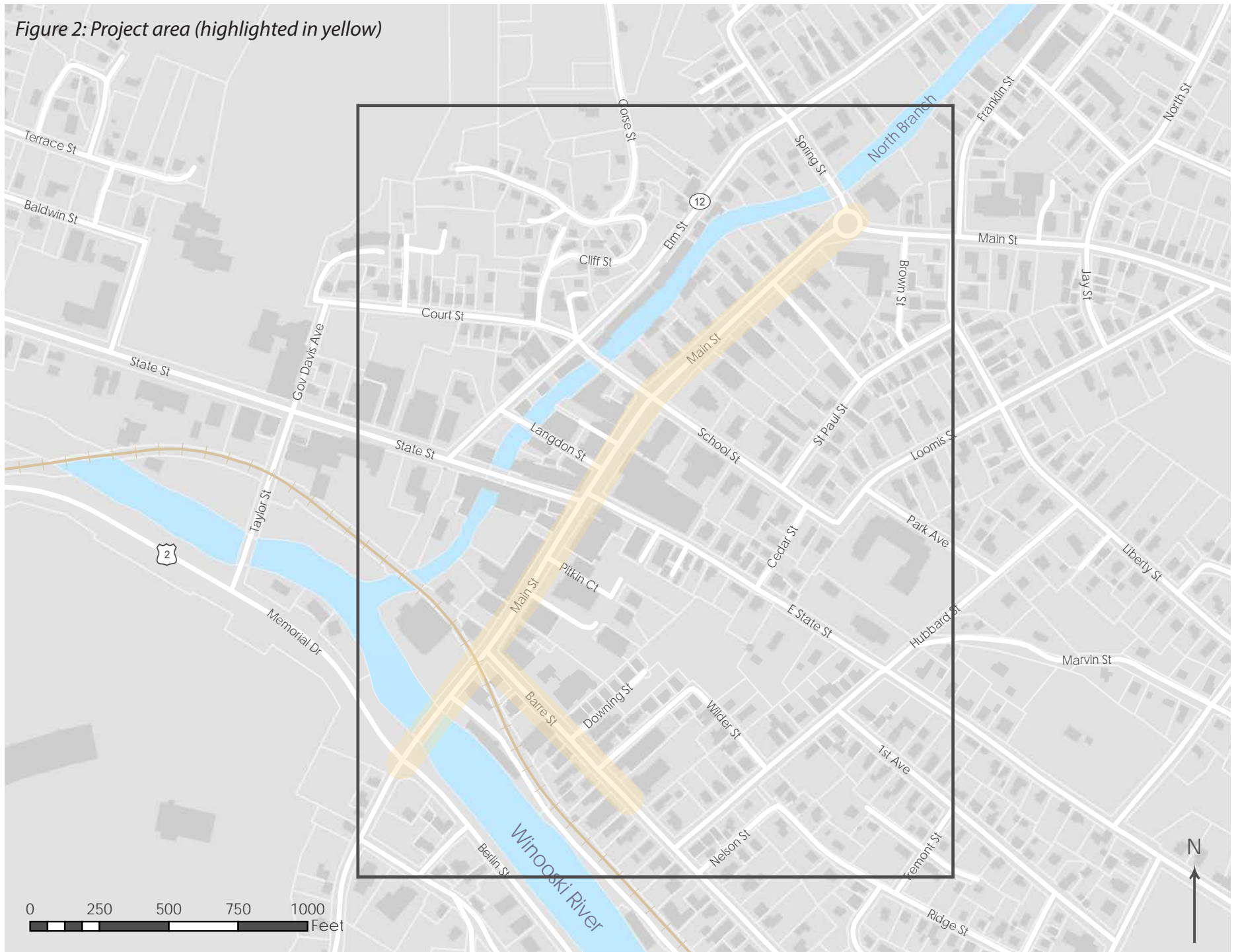
The focus of this study was to evaluate design alternatives, assess financial and constructibility impacts, and identify a preferred option and implementation strategy for a preferred alternative.



Figure 1: Project area (boxed-in) within the Montpelier city limits.

Montpelier is home to about 7,500 residents within a relatively compact area. The city's dense and mixed-use development patterns make it a walkable and bikeable place, despite the challenges of winter weather and hilly topography.

Figure 2: Project area (highlighted in yellow)



Land-Use Context

The City of Montpelier has mixed land uses along Main Street and Barre Street. The downtown consists of several historic buildings, which contribute to Montpelier’s distinct New England charm.

Main Street

The buildings on the southern half of Main Street (between Barre Street and School Street) are typically three to four stories, with storefronts, restaurants, and cafés adjacent to the sidewalk and offices or apartments above. Churches, local government and service buildings, including City Hall and the fire station, are also located on Main Street. Many of these destinations are shown in Figure 3.

Further north along the top section of Main Street (between School Street and the roundabout at Spring Street), the buildings become less dense and further away from the street, which impacts the sense of enclosure on Main Street. The buildings along this stretch include single and multi-family houses, offices, and the public library.

Barre Street

Barre Street comprises more residential buildings, as well as a church, public buildings, restaurants, offices, and commercial retail buildings incorporated into the neighborhood closer to Main Street. The Senior Activity Center, Recreation Center, and the Center for Arts and Learning converge at the current eastern terminus of the bike path.



Figure 3: Destinations in the Project Area

Downtown Montpelier is home to a variety of destinations and services that are within walking distance of each other. Downtown hosts an abundance of restaurants, shops, and services concentrated along Main Street and State Street, but also near intersections with sidestreets such as Barre Street.



Purpose & Need

Purpose

The purpose of this study is to identify a preferred alternative that increases the safety, circulation, and connectivity of people walking, cycling and driving along Main Street and Barre Street in the project area of the City of Montpelier.

Need

The existing transportation networks on Main Street and Barre Street include several vehicular travelways and turn lanes, varying widths of sidewalks, several crosswalks and no bicycle facilities.

On Main Street, at intersections without traffic controls, crosswalks are unsafe due to high traffic volumes and driver confusion over right-of-way and queuing during peak times. Mid-block crosswalks have reduced visibility due to their proximity to parked cars and the absence of bulb-outs. In particular, Main Street at School Street, which is heavily traveled by school children and library patrons, the depth of angled parking requires pedestrians to begin crossing the street before being able to observe any oncoming vehicular traffic.

On Barre Street, there is a need to create a connection between the existing bike path that starts behind the Montpelier Recreation Center

along Stone Cutter's Way and the in-construction connection on the west side of Main Street which runs parallel to the railroad tracks.

The six crashes involving pedestrians on Main Street between 2012 and 2016, a high number for this short roadway, substantiate the needs outlined above that evolved from documenting existing conditions and listening to community members' concerns throughout the public process.



Figure 4: Main & School intersection (Southbound View)

Project Goals

To meet the needs of people walking, cycling and driving in Montpelier, the goals of this study are to:

- Increase mobility options for all ages and abilities*
- Fill gaps in the existing and planned bicycle network by connecting the bike path to downtown
- Identify safety upgrades to existing pedestrian circulation networks
- Ameliorate the efficiency of intersections within the project area to improve the flow, connectivity and safety of vehicular traffic

* Concurrent with Montpelier's Master Plan (2017) and the Central Vermont Regional Plan (2017) goals of reducing auto-dependency



Public Outreach: Local Concerns Meeting

To inform and guide this study, D&K worked with the Town and the Steering Committee to publicize the scoping project and to receive community feedback throughout the process. To gather local concerns, the team tabled at City Hall during Town Meeting Day and created an online survey and map option that was linked to the City website where the public could provide comments and ideas after Town Meeting Day about the existing conditions of the project. Other public outreach is discussed further in the report. Below are summaries of key feedback collected during the existing conditions analysis.

Town Meeting Day



Figure 5: Town Meeting Day Public Input Map

On Town Meeting Day, the project team engaged with voters at City Hall using a mapping exercise. Residents contributed their input by identifying areas of concern with red stickers on a map, and things that they like with green stickers on a map, shown above. Others wrote their ideas on comment cards.

Online

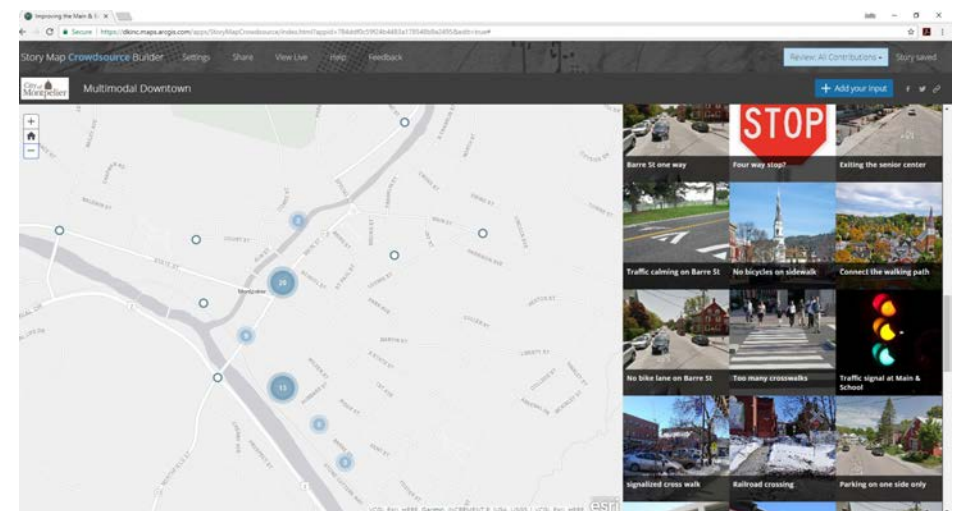


Figure 6: Online Public Input Map

The City of Montpelier created a page on their website with an overview of the project and opportunities to provide input in an interactive map (shown above) or via direct email. Comments related to a specific location from direct emails or the comment cards from Town Meeting Day were also entered into the online map. Additionally, the project team followed discussions on Front Porch Forum about the project area, which aligned with the feedback heard during public outreach on Town Meeting Day.

Public Input Key Takeaways

The Public Input Map to the right shows the compilation of all of responses from public outreach for this project, including the comment cards and sticker map on Town Meeting Day, emails from the webpage, and comments submitted to the interactive map. This study will focus on addressing the commonly mentioned areas of need and to consider solutions that have worked in Montpelier in the past. Overall, these efforts drew input from about 180 residents. The recurring ideas from early public outreach include:

- Make Montpelier more bicycle friendly and safe for bicyclists (most frequent comment)
- Vehicle speeds are high on Barre Street
- Add traffic control to the intersection of Main Street and Barre Street
- People feel unsafe using the midblock crosswalks on Main Street due to a lack of sight distance
- Add traffic control to the intersection of Main Street and School Street
- Using the midblock crosswalks on Main Street feels dangerous
- Exclusive pedestrian phases at Main & State and Main & Memorial make people feel safe when crossing the road

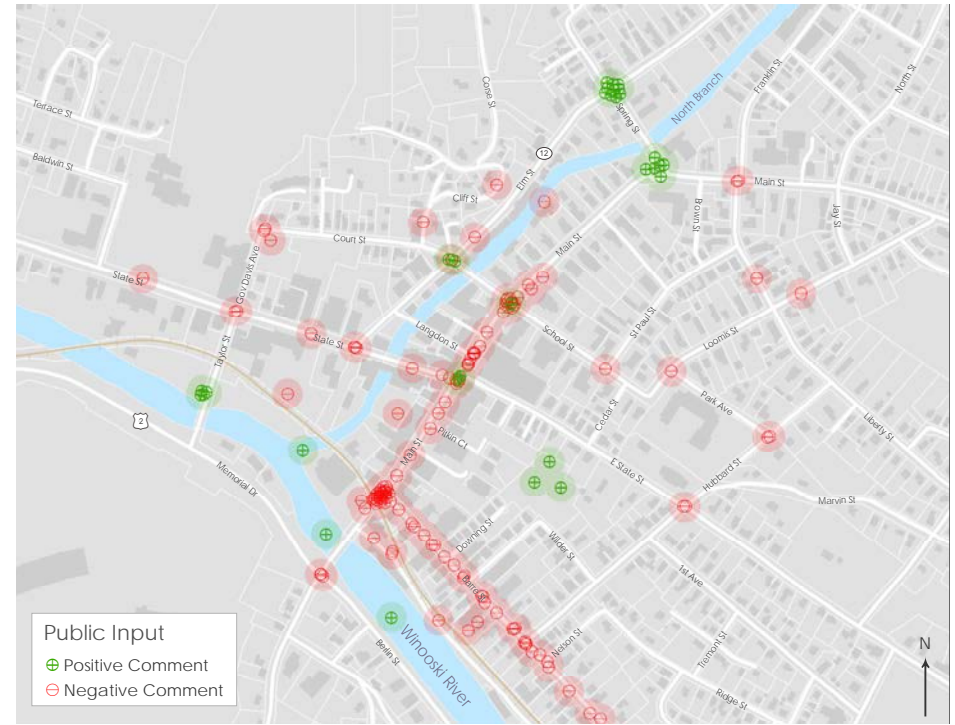
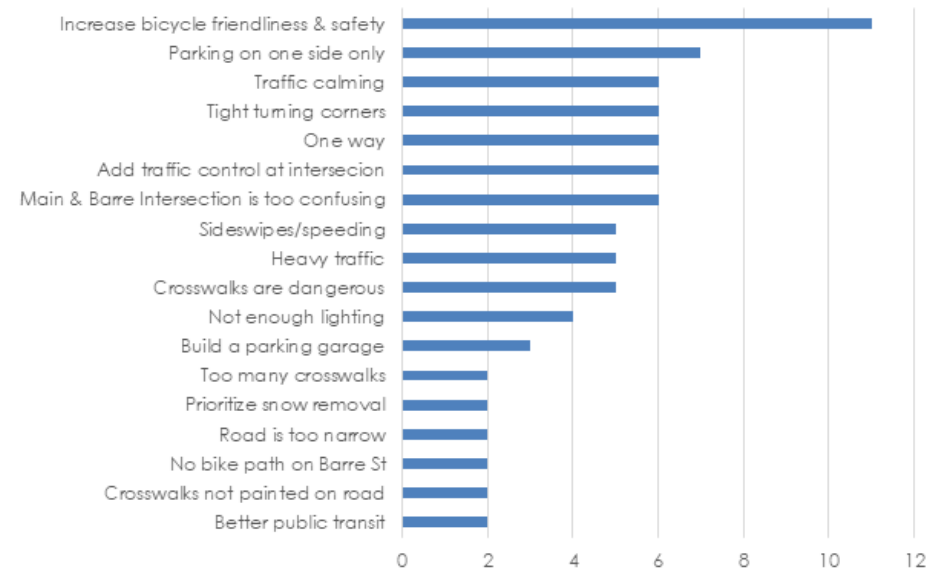


Figure 7 (above): Compiled public input map, including comments from Town Meeting Day and online

Figure 8 (below): Frequency of comments mentioned



Existing Conditions

To identify the best and most feasible ways to make improvements on Main Street and Barre Street, D&K investigated the existing conditions along these roads by looking at the current traffic volumes, safety concerns, characteristics of the roadway, and the experience of walking and bicycling in Montpelier.

Traffic Volumes

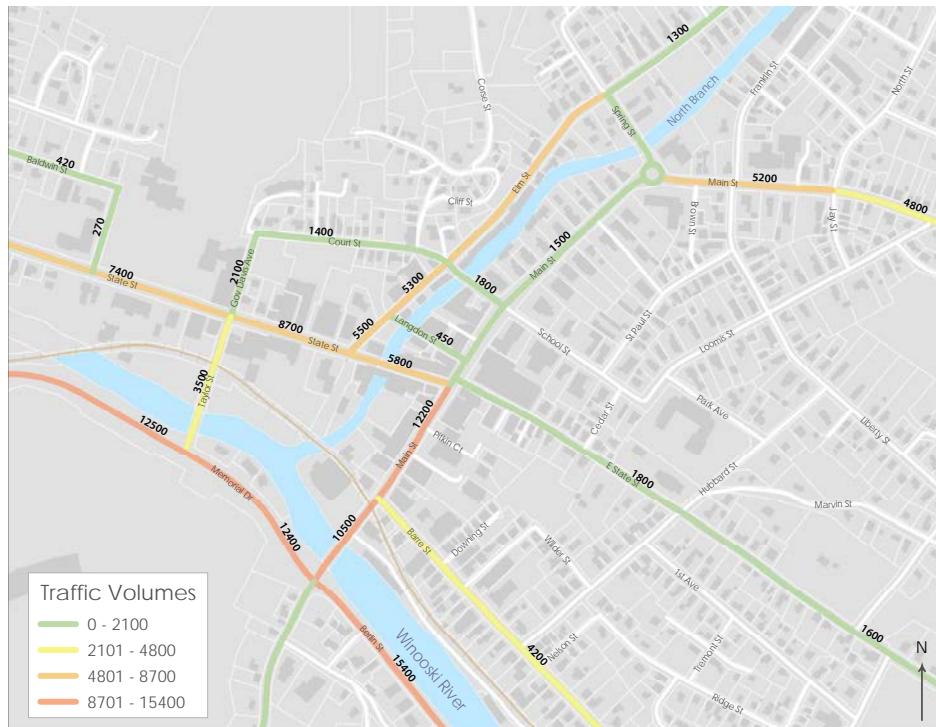


Figure 9: Traffic Volumes. Data from VTrans VT AADT - 2016 GIS data layer, obtained from the VTrans Open Data Portal.

There is a large variation in the volume of traffic traveling on different streets in downtown Montpelier. On Main Street, the traffic volume on the southern section is much higher than on the northern section, which alters the character and functionality between these two sections of the street. The traffic volume on Barre Street lies in between, seeing less traffic than the bottom of Main Street.

Main Street & Barre Street Bicycle and Pedestrian Scoping Study

Safety

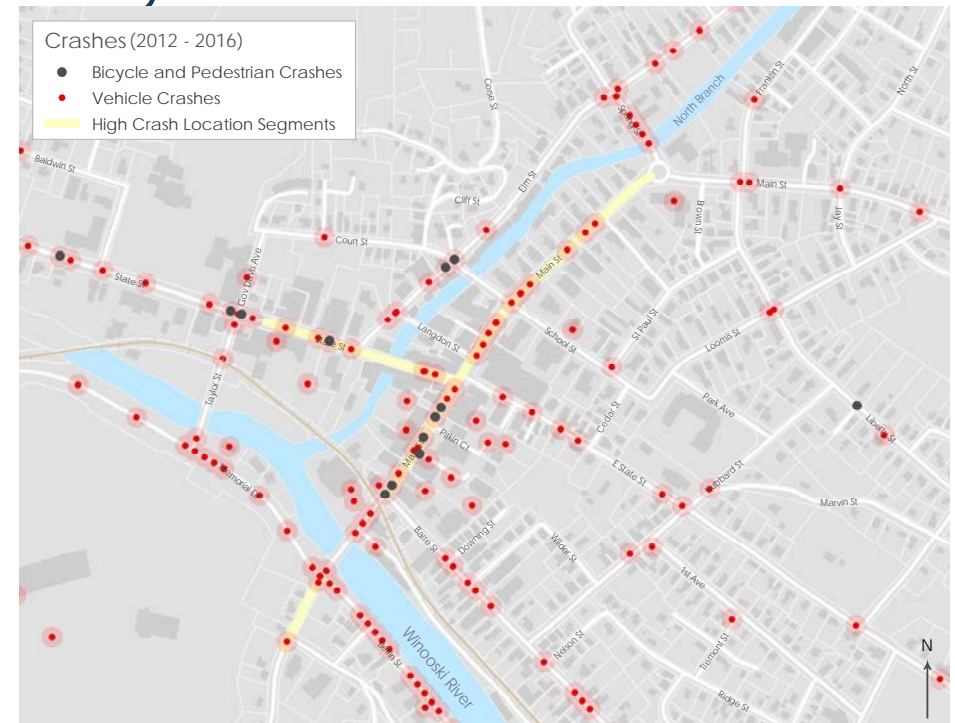


Figure 10: 2012 - 2016 Crashes (Source: VTrans)

Reports of crashes from VTrans over the last five years (2012 – 2016) in the downtown area of Montpelier are mapped in Figure 10. Main Street from Memorial Drive to Spring Street is designated as a High Crash Location segment by VTrans, as is State Street from Main Street to Governor Davis Avenue. Several crashes in the project area were rear-end crashes, which are common in congested areas, and same-direction sideswipes, which typically occur when vehicles are changing lanes. There were also many broadside crashes (when a vehicle is “T-boned”) which can often result in injuries.

There were no fatal crashes in this time-frame, but many did result in an injury. Of the crashes reported, nine involved pedestrians, six of which occurred on Main Street between Barre and State Street. This section of the roadway has high vehicular and pedestrian volumes.

Montpelier Bike Path

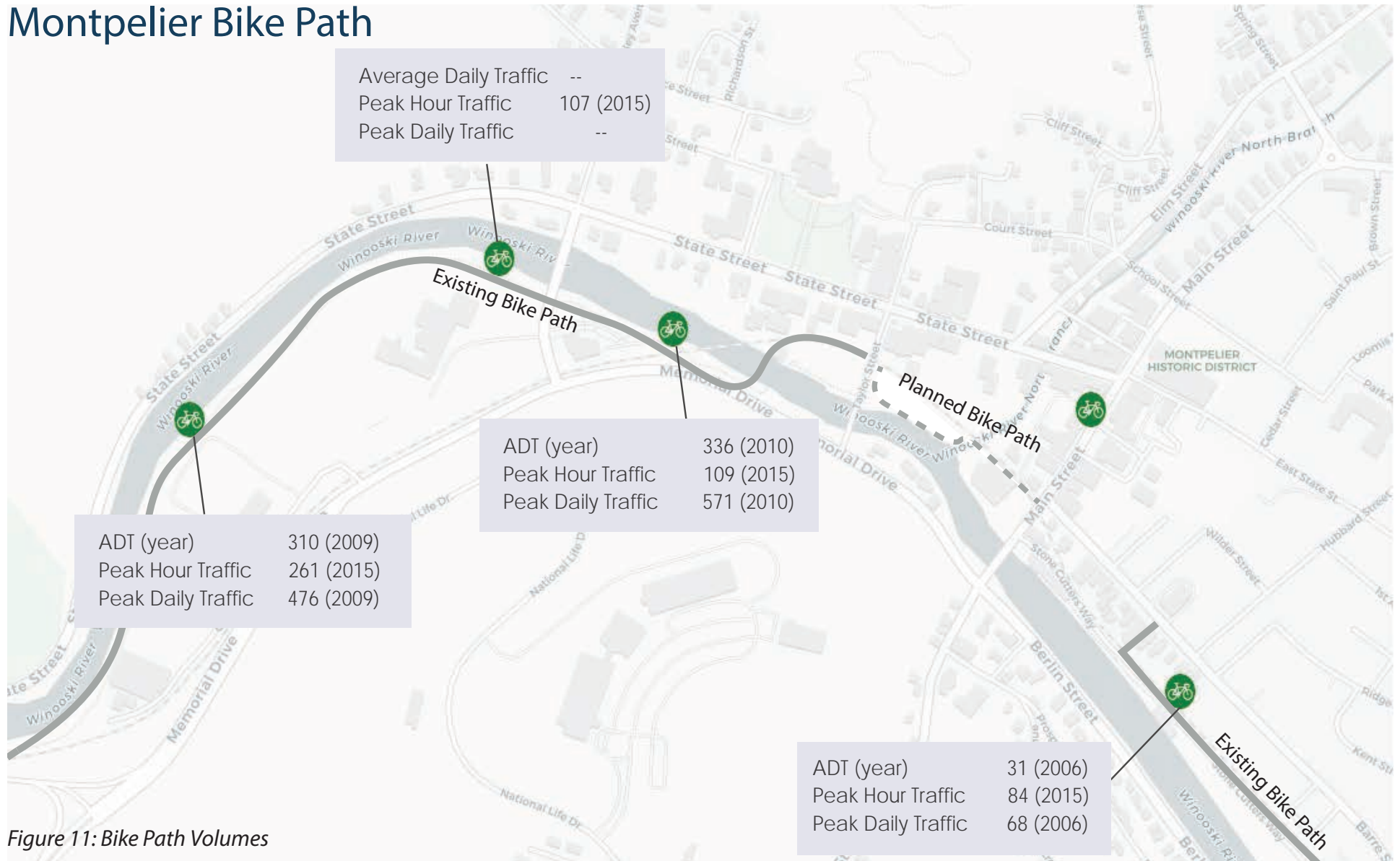


Figure 11: Bike Path Volumes

Over the past several years, VTrans has bicycle and pedestrian counts at four locations along the Montpelier Recreation Path during the late spring and summer (May - August), when use of the Path is highest. They covered the western portion (from Taylor Street and westward) and the eastern portion (from Stonecutters Way and eastward). These VTrans counts were a combination of manual bicycle and pedestrian counts and continuous counters. The figure above also shows the average daily traffic (ADT) for volumes between May and August, and peak hour traffic of the five count locations, four on the bike path and one on Main Street, where data was available. Volumes are much lower on the bike path to the east of Main Street, but will likely increase when the two ends of the bike path at Taylor Street and on Stonecutters Way are connected.

Roadway Characteristics

Main Street and Barre Street are both in the designated downtown of Montpelier. Main Street is classified as a minor arterial as well as a Class 1 Town Highway throughout the length of the study area. Main Street has an at-grade rail crossing near the intersection with Barre Street. The roadway width varies from 30 feet near the entrance to the Spring Street roundabout to over 75 feet at the intersection with School Street.

Barre Street runs parallel to the Winooski River and is classified as a major collector; a Class 2 Town Highway, owned and maintained by the City.

Barre Street (Main Street to Recreation Center)



Eastbound View

Barre Street has a roadway width of approximately 38 feet with two 11 foot travel lanes, eight foot parallel parking lanes, and five foot sidewalks on both sides of the street. There are currently no bicycle facilities.

Main Street (Memorial Dr to Barre St)



Northbound View

Main Street, from Memorial to Barre Street, is one of the gateways into downtown Montpelier. It has four travel lanes for vehicles (two in each direction). This segment includes the entrance to a grocery store that is one of the most popular destinations for vehicular circulation downtown, and also a bus stop, rail crossing, and bridge over the Winooski River. There are currently five foot sidewalks on both sides of the street and no bicycle facilities.

Main Street (Barre St to Langdon St)



Northbound View

The section of Main Street from Barre Street to Langdon Street is characterized by its eight foot parking lanes on both sides, 10 to 16 foot travel lanes, and a turning lane that serves left hand turns between Barre and State Street and right turns for southbound traffic at the Main & State intersection. The two-to-three story mixed-use buildings create a sense of enclosure despite the large road width. There are 10 foot sidewalks on both sides with lights, trees, and other streetscape amenities. There are currently no bicycle facilities.

Main Street (Langdon St to the Library)



Northbound View

The cross section of Main Street becomes wider heading north. From State Street to the School Street intersection, the parking lanes increase to an 18 foot width to accommodate angled parking. There are sidewalks on either side of the road with sparse lighting and some established street trees. There are currently no bicycle facilities.

Langdon Street Crosswalk



View to the East

The Langdon Street crosswalk is located about 80 feet from the intersection of Main & State. Because of this proximity and because this is an unsignalized crossing, motorists become frustrated by the frequent waiting for a pedestrian to cross while there is a green light at Main & State. Pedestrians tend to favor this crossing because of the strong desire line between City Center and Langdon Street, and to avoid needing to wait for the pedestrian signal phase at Main & State. Langdon Street itself is one-way (westbound), with a relatively low AADT of 450 vehicles according to VTrans data from 2013.

Main Street (Library to Spring St)



Northbound View

Main Street gradually narrows in width from School Street to the roundabout at Spring Street, eliminating turning lanes and then parking lanes. There are five foot sidewalks along either side of the street with green buffers separating them from the pavement. There are currently no bicycle facilities.

Key Intersections

Main Street & Memorial Drive



View Southeast

Memorial Drive/Berlin Street is one of the busiest roads through Montpelier. It serves as a key route between many communities in the Northeast Kingdom and Interstate 89. This road has higher speeds and wider widths than other roads in Montpelier. The pedestrian crossing at Main & Memorial is an important link for people who work at National Life and those living south of the Winooski River, to downtown Montpelier. The signalized intersection includes an exclusive pedestrian phase, where people walking in every direction cross the street at the same time and all vehicles are stopped. While this kind of crossing is less efficient for traffic flow, many people informed us that it makes them feel safe when crossing this intersection. This traffic signal is coordinated with the signals at Taylor Street and Bailey Avenue.

Main Street & Barre Street



View Southwest

The intersection of Main & Barre is heavily traveled from each direction, and the proximity of intersecting elements (rail line, transit stop, entrance to a popular grocery store, and a heavily used crosswalk) make it confusing and unclear at times. The City recently installed a rectangular rapid flashing beacon (RRFB) at the crosswalk on the northern leg of the intersection. This crosswalk contributes to traffic intending to turn onto Main Street to back up on Memorial Drive. In addition, the high volume of free-flowing traffic on Main Street makes turning out of Barre Street difficult. The traffic volumes here are high enough to warrant a traffic signal.

Main Street & State Street



View Northeast

The Main & State intersection is in the heart of downtown. The State Street approaches to Main Street are not square, making this intersection unique from the other intersections on this corridor in terms of traffic flow. Currently, the signal also has an exclusive pedestrian phase, which many people told us makes them feel safe when crossing the intersection.

Main Street & School Street



View Northwest

Main & School sees many children crossing due to its proximity to the elementary school and public library. This area has some of the widest pavement widths on all of Main Street, making it a long intersection to cross. Additionally, the angled parking on Main Street blocks the sight distance and visibility of people waiting to cross the street. This intersection has a relatively high volume of traffic turning onto Main Street and the current two-way stop may not be sufficient traffic control. The traffic volumes here also meet the warrants for a traffic signal.

Walking in Montpelier

Montpelier has a compact downtown that is bustling with popular shops, restaurants, and other services. Figure 12 shows data from a VTrans pedestrian counter that collected data on Main Street across from City Hall for several years, between 2007 and 2016. There are over 1,500 pedestrians here daily on average, which is a high volume when considering Montpelier's population of 7,500.

There are several unsignalized crossings along Main Street that give pedestrians the right-of-way and improve the connectivity of destinations on both sides of the street. The two unsignalized crossings south of State Street (at Pitkin Court and Blanchard Court) are well used and tend to work well for pedestrians and motorists, though the visibility of both crossings could be improved by “daylighting” the crosswalks, which would remove parking from within 20 feet of the crossings. The Langdon Street crosswalk is another unsignalized crossing on Main Street that several people expressed frustration about during our public outreach. As previously discussed, its proximity to the intersection of Main & State is frustrating for motorists. The visibility of this crossing is often blocked by parked cars and also vehicles in the queue at the Main & State intersection.

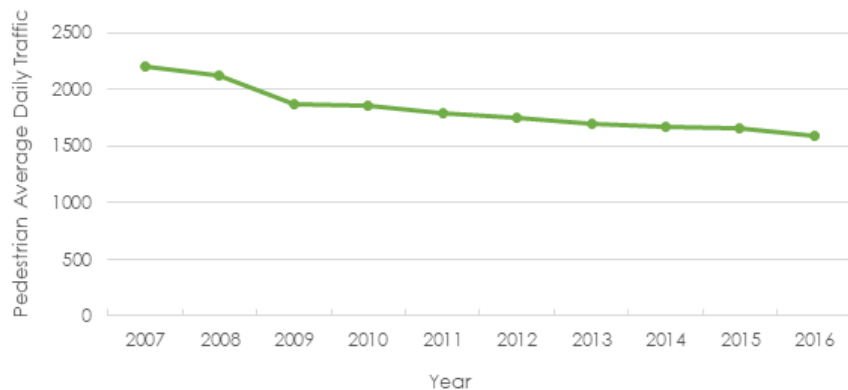


Figure 12: Yearly Pedestrian Volumes on Main Street



Figure 13: Sidewalk on Main Street, looking south towards Main & State



Figure 14: Mid-block crossing on Main Street (View east)



Figure 15: Sidewalk with amenities including benches, trees, trash bins, and bicycle parking on Main Street (View South)



View East

Figure 16: Main & State exclusive pedestrian phase - all vehicles are stopped and pedestrians cross together from all directions

Main Street & Barre Street Bicycle and Pedestrian Scoping Study



View South

Figure 17: Crowded sidewalk near the Main & Barre intersection

Bicycling in Montpelier

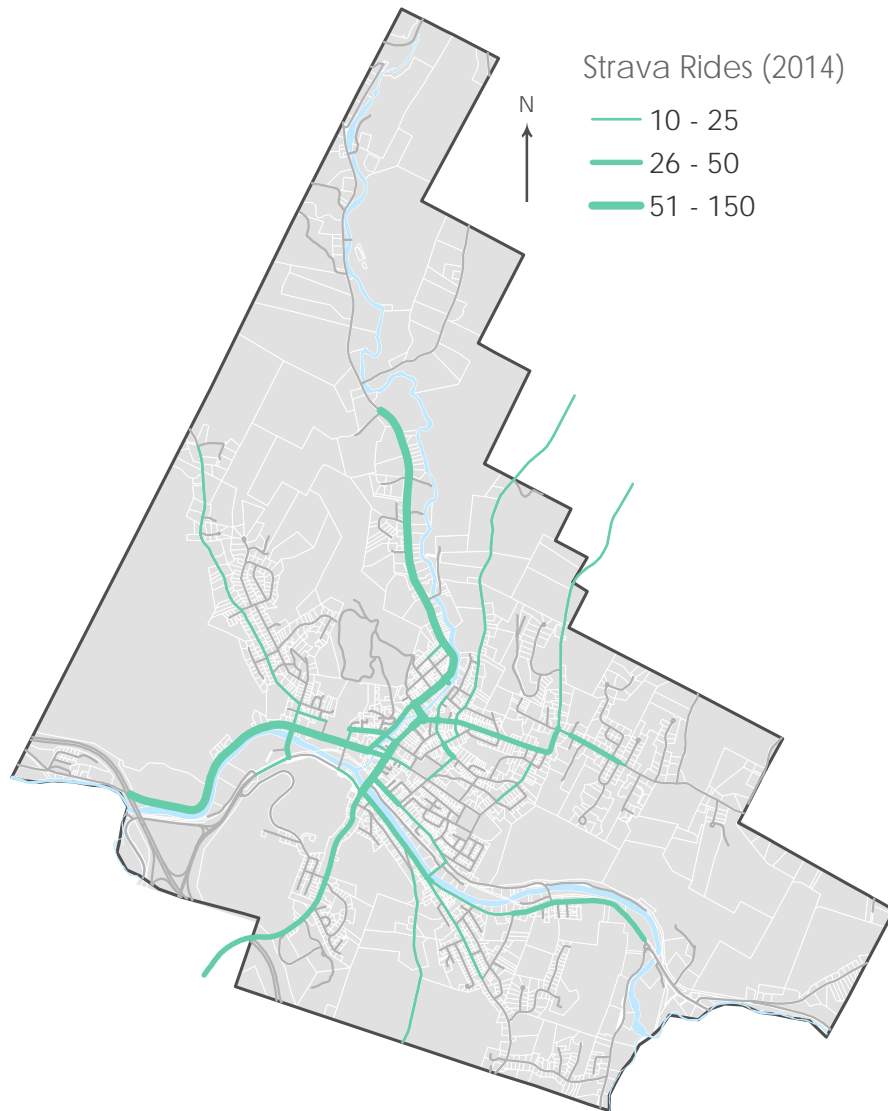


Figure 18: 2014 Bicycle Volumes from Strava

Figure 18 shows bicycle trips in 2014 recorded by Strava, a social media app for smart phones that people use to track their bicycle rides. Strava users are confident cyclists that typically don't have a problem sharing the road with cars and other large vehicles. This data does not include rides on the bike path.

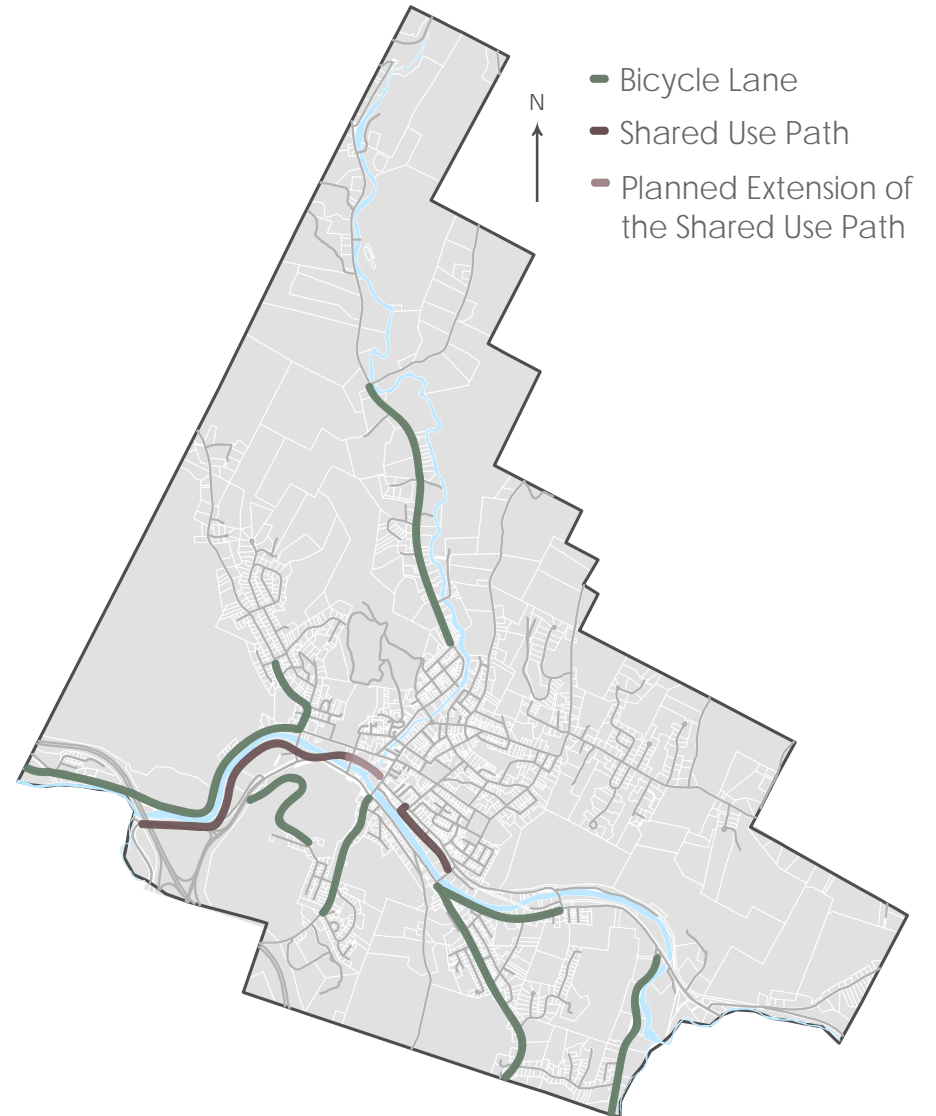


Figure 19: Existing Bicycle Infrastructure

The existing bicycle infrastructure in Montpelier includes the Winooski Bike Path and several bike lanes. The bike lanes are unprotected (immediately adjacent to traffic) and generally aren't maintained during the winter. There are no bicycle facilities through downtown Montpelier, though there is a relatively high volume of bicycle traffic.



Figure 20: School Street - Cycling on the Sidewalk



Figure 21: Main Street & Barre Street Intersection - Cycling on the Sidewalk



Figure 22: Main Street & State Street Intersection - Taking the Lane



Figure 23: Barre Street - Traveling in the parking lane

Bicycle Parking

In the project area, there are several unofficial opportunities for bicycle parking (locking a bike to a street light or other pole), but few bike racks. There are two “wave” racks (one hump) on the southeast corner of Main & State, and another on the northwest corner of the Landgon Street and Main Street intersection. These types of racks can typically hold 2 bikes each, one on either side.



Figure 24: Bike racks at Main & State (one is blocked by a sandwich board). Image from Google Maps.

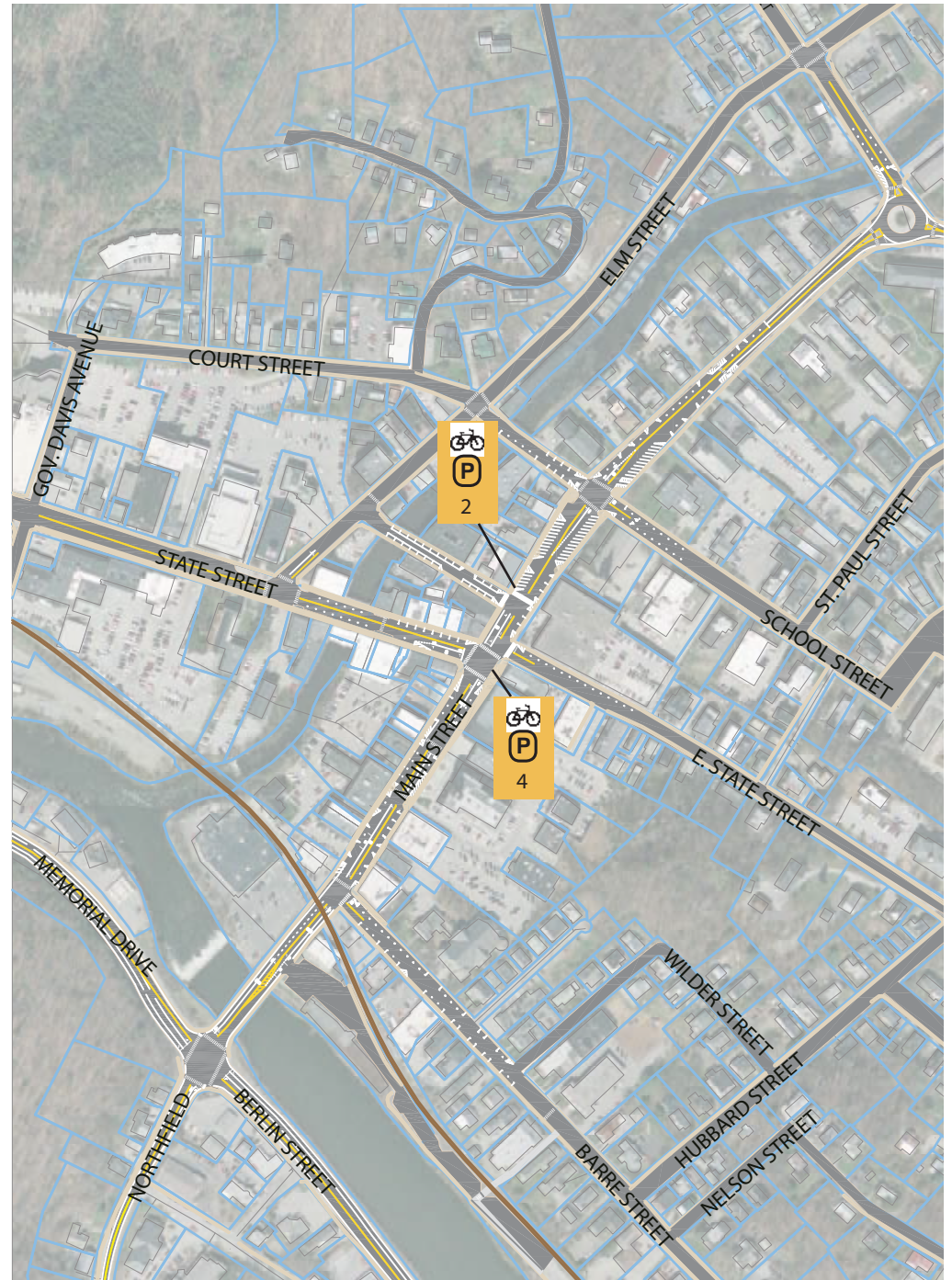


Figure 25: Existing bicycle parking in Montpelier

Right-of-Way

The right-of-way (ROW) for Main Street varies from segment to segment. Crossing the Winooski River, the bridge on Main Street between Memorial Drive and Stone Cutters Way is approximately 54 feet wide, with a curb-to-curb pavement width of 44 feet and five foot sidewalks on both sides. From Stone Cutters Way to State Street, the ROW is 66 feet wide (four rods) with a curb-to-curb pavement width of 54 feet. From the State Street to School Street, the ROW widens from 66 feet at the State Street intersection to 100 feet at the School Street intersection. The pavement width also widens from 54 feet at State Street to 78 feet at School Street. From School Street to the roundabout at Spring Street, the ROW and pavement width narrow to 49.5 feet (three rods) and 34 feet, respectively.

On Barre Street in the project area, the ROW is approximately 54 feet wide, according to GIS parcel data. The pavement is 38 feet wide, with sidewalks on each side.

Figure 28 on the following page shows parcels throughout the project area. Table 1 identifies property ownership information in the project area, which was obtained from the City Assessor's Property Map of the City of Montpelier dated April, 2014.



View South
Figure 26: Main Street bridge



Figure 27: Main Street looking north from the intersection with School Street

Table 1: Property ownership information (2014) in the project area

#	Property Owner	#	Property Owner
1	KROLEWSKI	37	KELLEHER
2	COAKLEY	38	HENEY FAMILY
3	VASSAR	39	OVERLAKE PARK LLC
4	VT ASSOC OF HOSPITALS	40	METHODIST CHURCH
5	BUTSCH	41	KELLOGG HUBBARD LIBRARY
6	MOMIJI LLC	42	BETHANY CHURCH
7	MOMIJI LLC	43	CITY CENTER MONTPELIER LLC
8	ASSOCIATES IN 140 MAIN ST	44	HENEY
9	ILLUZZI	45	HENEY FAMILY MAIN ST LTD
10	VT STATE MEDICAL SOCIETY	46	CITY OF MONTPELIER
11	UNITARIAN CHURCH	47	BIGGLESTONE INV. INC
12	HOWARD BANK (NOW TD BANK)	48	AMERICAN LEGION
13	SATCHEL	49	OVERLAKE PARK LLC
14	N&M REAL ESTATE	50	MONTDRY
15	ALVEREZ	51	POMERLEAU FAMILY PART.
16	MILLER	52	OVERLAKE
17	HOWARD BANK (NOW TD BANK)	53	GUY'S VENTURES
18	KELLEY	54	OVERLAKE
19	KILMURRY	55	BBBH
20	BIG FISH	56	CVCLT
21	TURTLEDOVE	57	CROSSMAN
22	LEWINSTEIN	58	NORTH BRANCH APARTMENTS
23	OVERLAKE PARK	59	CITY OF MONTPELIER REC CENTER
24	AJAX	60	GUARE
25	OVERLAKE PARK LLC	61	LTMG LLC
26	AUBUCHON REALTY CO., INC.	62	TISDALE
27	OVERLAKE	63	PETERSON
28	BEARD	64	WASH. CO. MENTAL HEALTH
29	CITY OF MONTPELIER	65	CITY OF MONTPELIER SENIOR CENTER
30	CITY OF MONTPELIER	66	CATHOLIC CONVENT
31	CITY OF MONTPELIER	67	CVCLT
32	RAILROAD	68	BLOUIN
33	POMERLEAU FAMILY PART.	69	MURPHY
34	MONTPELIER ELDERLY HOUSING PROJECT	70	ROMAN CATHOLIC DIOCESE
35	O.M. FISHER HOME	71	BASHARA
36	UNDERWOOD		

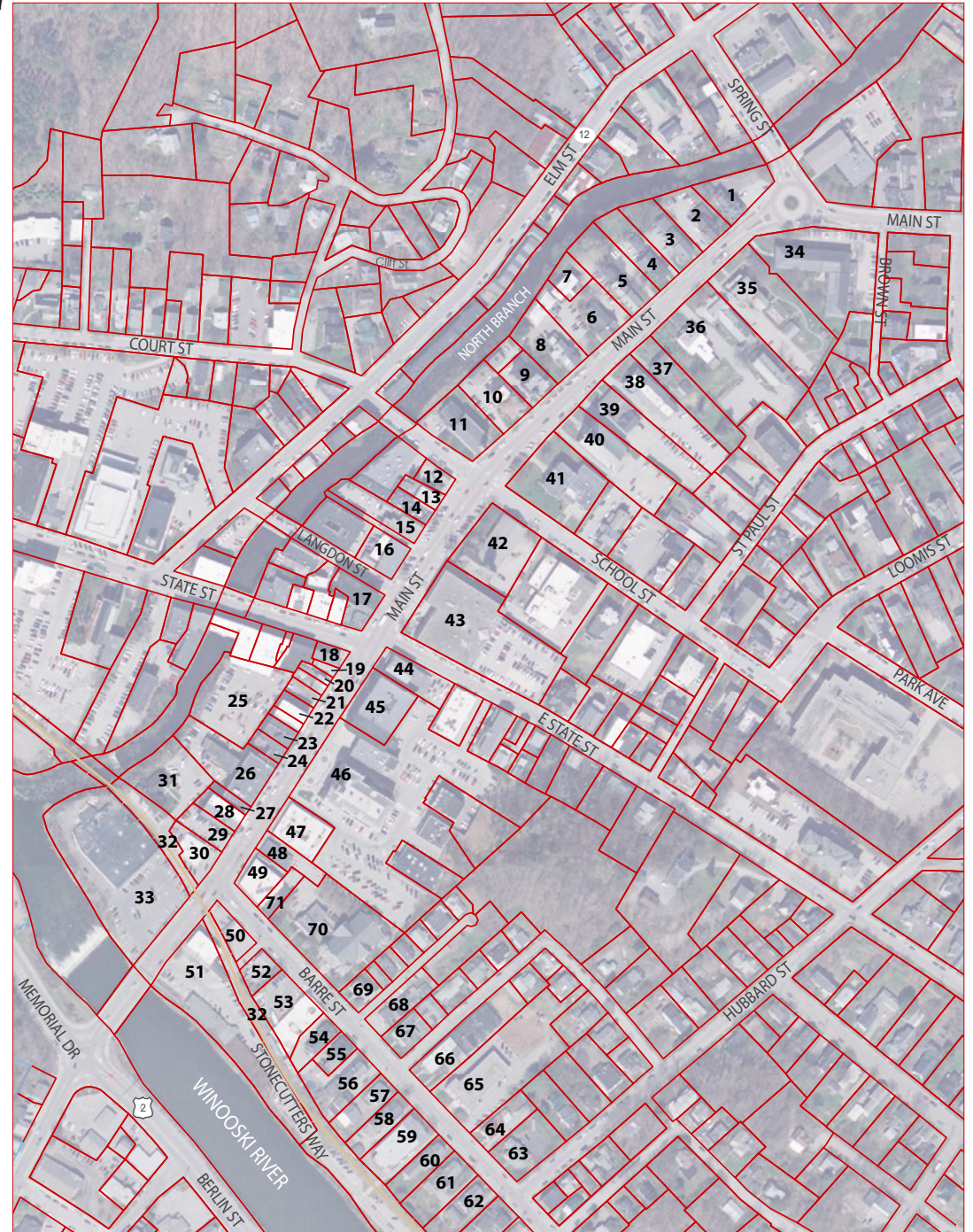


Figure 28: Property ownership in the Project Area

Utilities

Overhead Electric

The power poles in the project area are owned by Green Mountain Power. Overhead utilities include electric lines (Green Mountain Power) and other utilities. Along Barre Street, the utility poles are found primarily on the south side of the road. Some of these poles also have overhead lighting. Along Main Street, there are overhead power lines between School and Spring Street on both sides of the road. These electric utilities are mapped in Figure 27 to the right.

Stormwater

In 2016, The City of Montpelier hired Stone Environmental, Inc. to compile a stormwater master plan for the city. In it, problem areas were identified and prioritized while accounting for both local and state-level stormwater goals, and supporting implementation of projects that are deliberately aimed at managing stormwater at the source. Although the projects identified in the Stormwater Master Plan are not found within this project's areas, the proximity of both the Winooski River and its tributary, the North Branch, to the project area underline the need to consider the affects of any chosen alternative on stormwater and ultimately, our water bodies. Opportunities to install green stormwater infrastructure are considered concurrently with roadway and streetscape improvements proposed herein. Figure 28 on the following page includes a map created from VT DEC's ANR Atlas with information about stormwater in the project area.

Sewer and Water

There are underground water and sewer utilities throughout the project area. They are shown in Figure 29 on page 26.

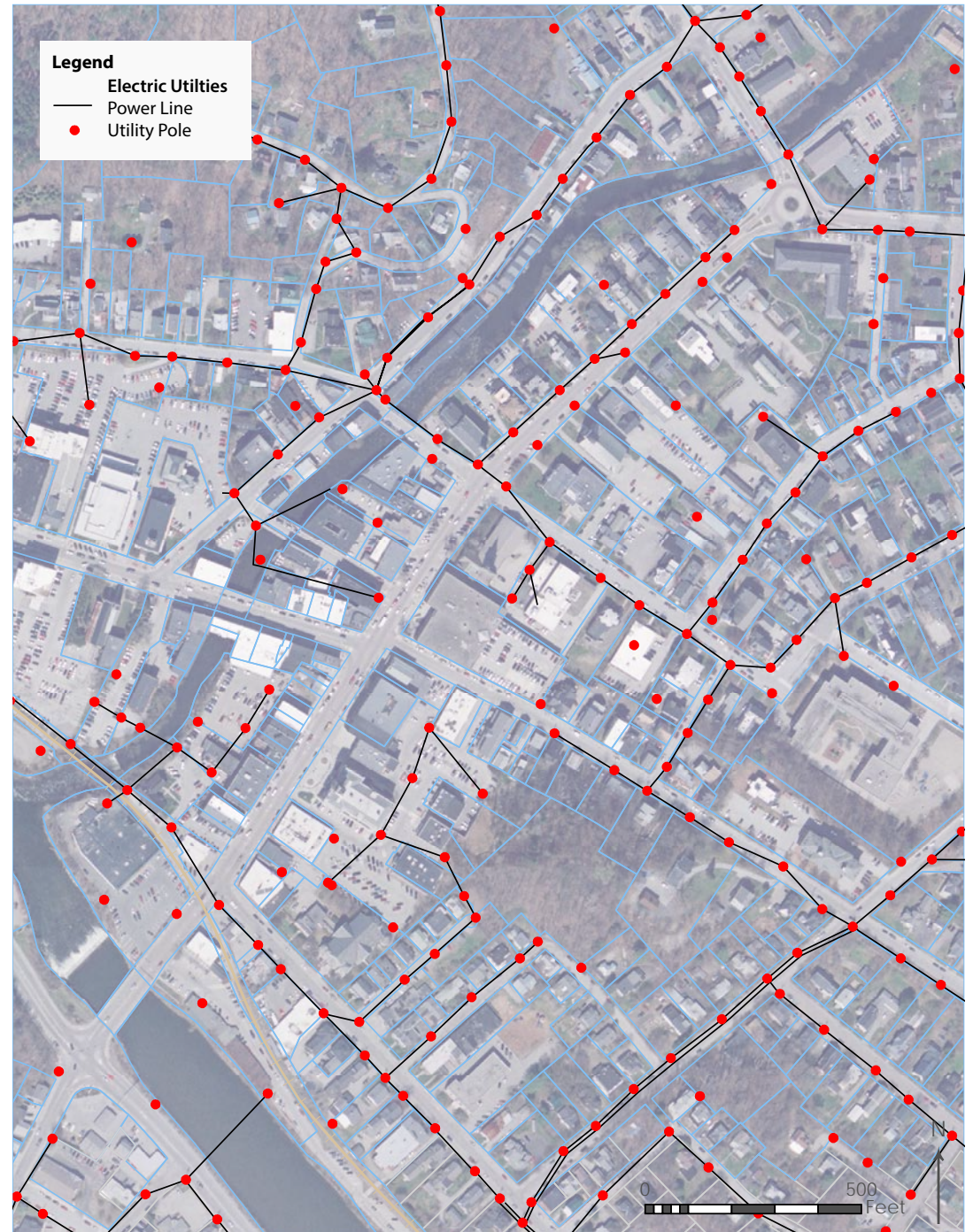
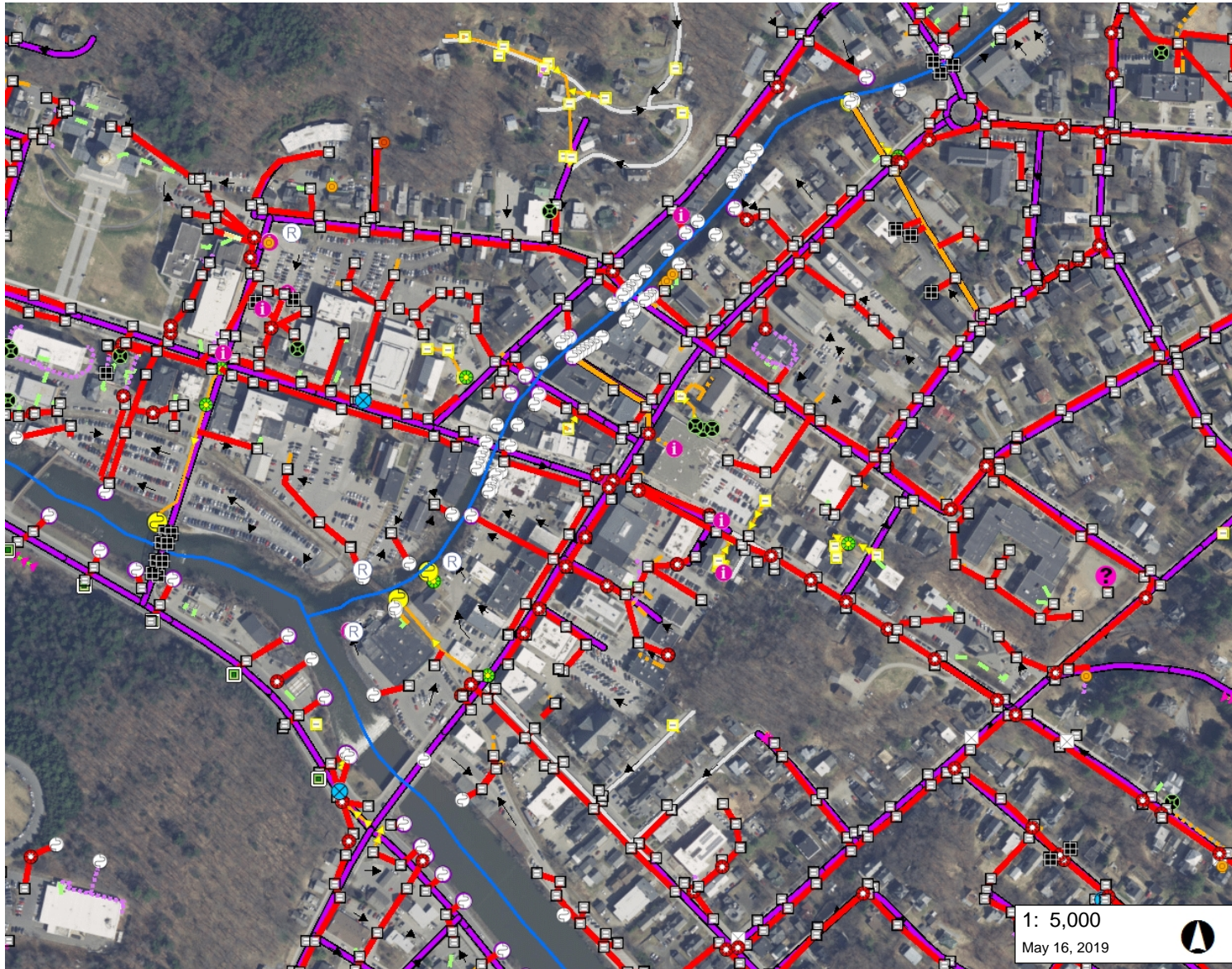


Figure 29: Electric Utilities in the Project Area



LEGEND

Existing stormwater point

- <all other values>
- ⊗ Pipe Cross (not connected)
- Catchbasin
- Dry Well
- ⊠ Drop Inlet
- ⊠ Grate/Curb Inlet
- ⊗ Yard drain
- ⊠ Junction Box
- Stormwater Manhole
- Outfall
- Culvert inlet
- Culvert outlet
- Pond outlet structure
- ⊠ Treatment feature (see notes)
- Ⓡ Retrofit
- ⊗ Unknown Point
- Ⓡ Information Point

Existing stormwater line

- Storm line
- Storm line (old Sanitary line)
- Tunnel (storm)
- Swale
- Footing drain
- Under drain
- Roof drain
- Infiltration pipe
- French drain

NOTES

Map created using ANR's Natural Resources Atlas

254.0 0 127.00 254.0 Meters
 WGS_1984_Web_Mercator_Auxiliary_Sphere 1" = 417 Ft. 1cm = 50 Meters
 © Vermont Agency of Natural Resources THIS MAP IS NOT TO BE USED FOR NAVIGATION

DISCLAIMER: This map is for general reference only. Data layers that appear on this map may or may not be accurate, current, or otherwise reliable. ANR and the State of Vermont make no representations of any kind, including but not limited to, the warranties of merchantability, or fitness for a particular use, nor are any such warranties to be implied with respect to the data on this map.

Figure 30: Stormwater Utilities in the Project Area

Environmental Resources

The Winooski River is an important natural assets for the community, running east-west into Lake Champlain. The North Branch, a tributary of the Winooski River runs north-south, meets the Winooski in downtown Montpelier, behind Shaw's grocery store. Montpelier's main streets: State Street and Main Street were developed almost parallel to the rivers and are the only grid-like roads in Montpelier due city's topography which influenced a more organic city network of roads.

The Vermont Agency of Natural Resources Atlas for the project area was reviewed, as shown in Figures 30 - 34 and summarized in Table 2 on page 29.

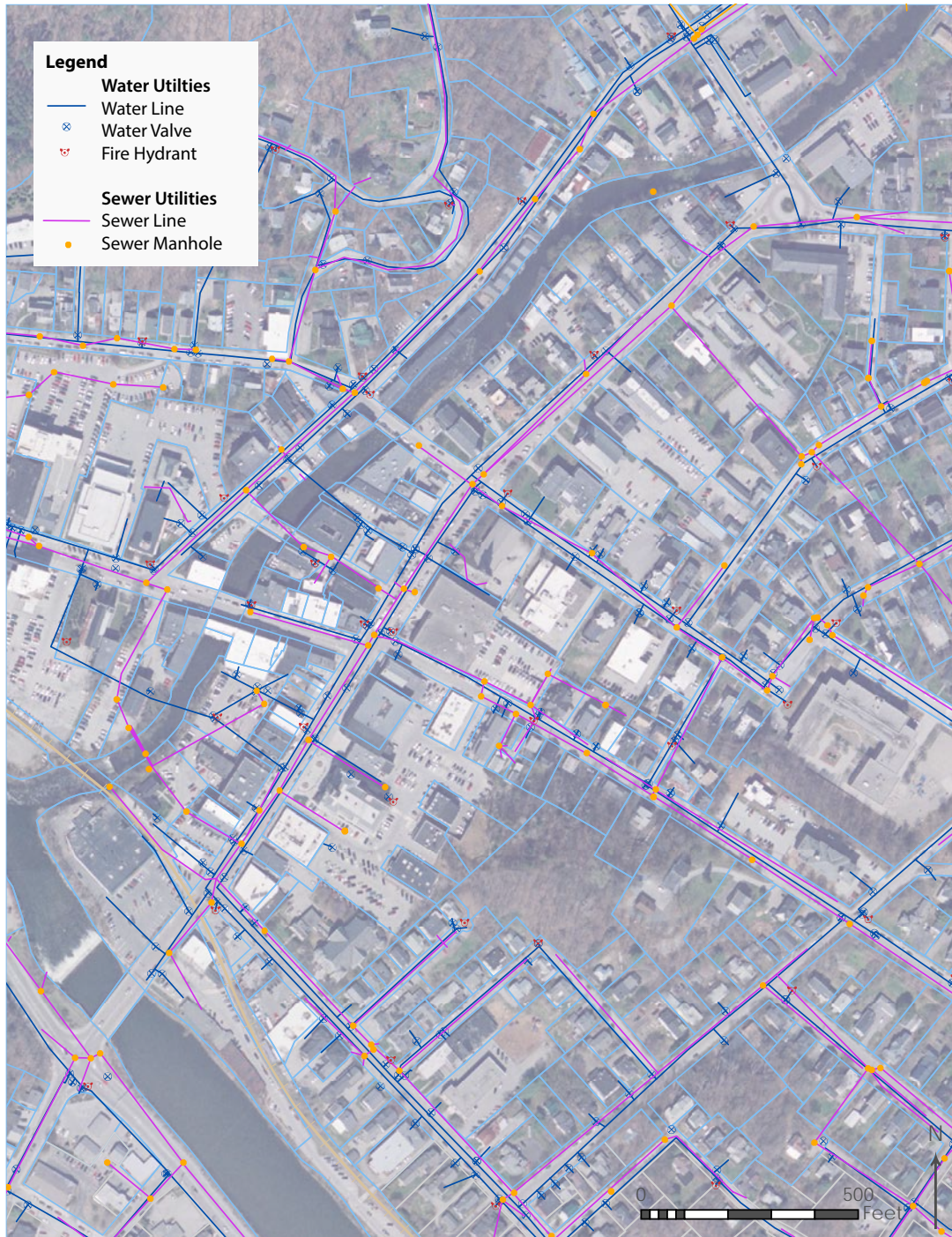


Figure 31: Water and Sewer Utilities in the Project Area



Figure 32: Hazardous Site in the Project Area

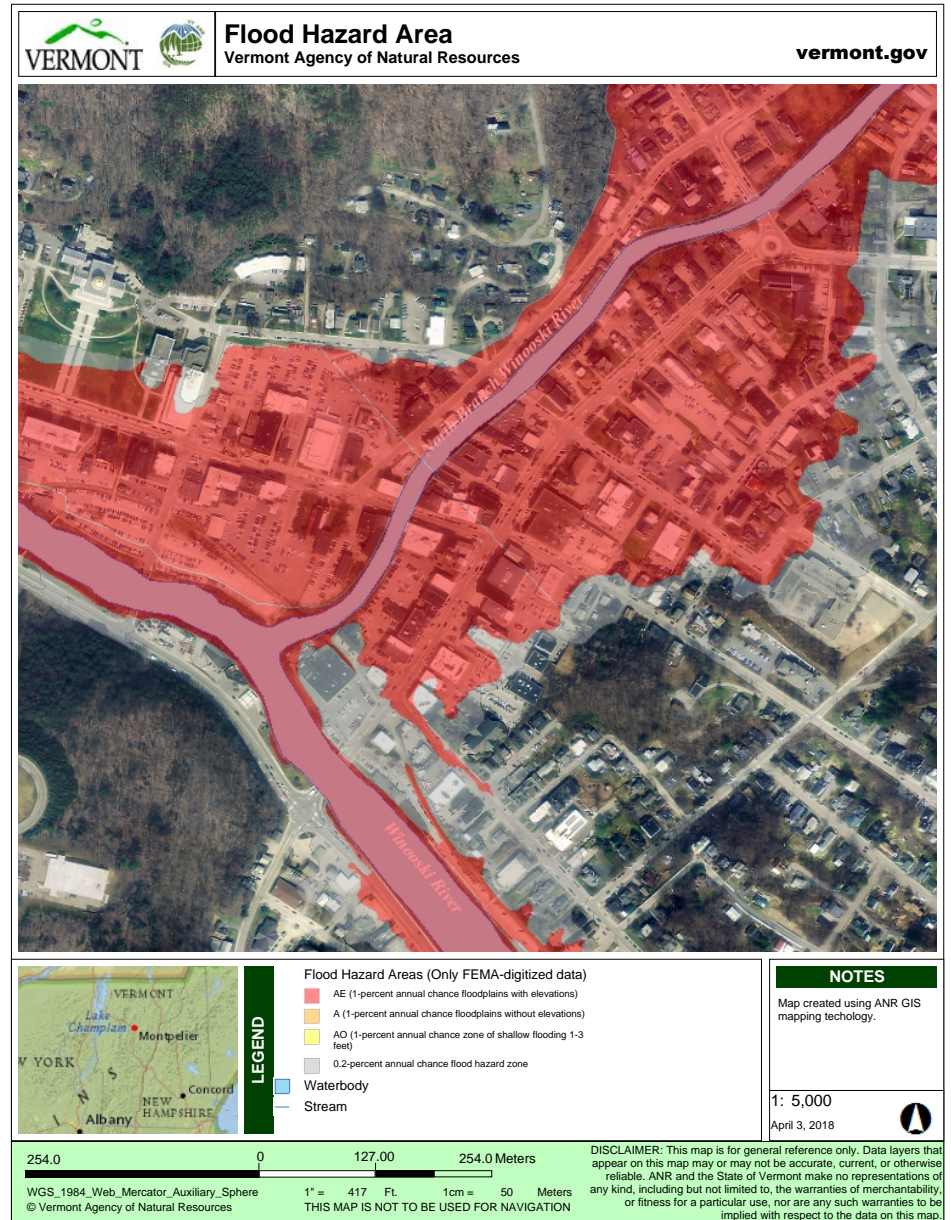


Figure 33: Flood Hazard Areas in the Project Area



Figure 34: River Corridors in the Project Area

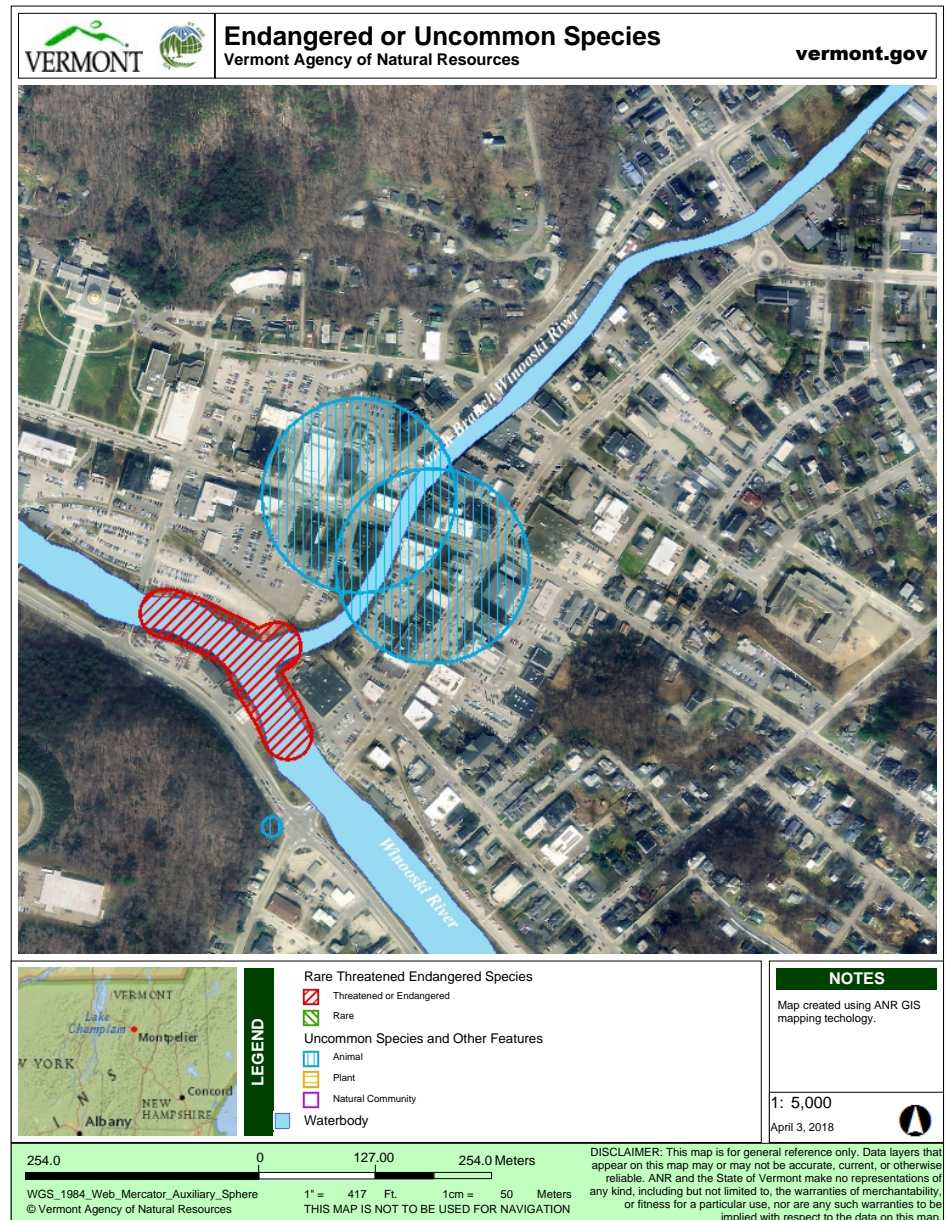


Figure 35: Rare, Threatened or Endangered Species in Project Area

Table 2: Environmental resources in the project area

Potential Resources	Presence/ Absence in Study Area
Wetlands	Wetlands have not been observed in the study area, which is limited to developed areas adjacent to Main Street and to Barre Street.
Lakes/ Ponds/ Streams/ Rivers	The study area is not traversed by any water bodies, however, both Main Street and Barre Street are located within 300 feet or less from either the Winooski River or its tributary the North Branch. Considerations for the effect of any adjustment to the pervious surfaces need to be weighted, as a significant portion of the project area is also considered priority surface water.
Floodplains	There are floodplain and floodway and flood hazard zones throughout the project area. All of Main Street and most of Barre Street that is in the project area are in Zone AE: areas with a 1% annual chance of flooding where base elevations are provided. The remainder of the project area is zoned as having a 0.2 percent annual chance of flooding.
Endangered Species	<p>While not mapped in the project area, the entire State is considered habitat for the Northern Long-Eared Bat (State Endangered, Federal Threatened). Any trees to be cut for any option will require an assessment and coordination with Vermont Fish and Wildlife Department and US Fish and Wildlife Service.</p> <p>Per Vermont BioFinder, between the Main/Barre Street and the Main/State Street intersections, uncommon animal species have been recorded. The area is within or borders riparian wildlife connections due to the proximity of both Main Street and Barre Street to the Winooski River and its tributary. For these reasons, the project area is within higher priority surface water. Rare plant species are also recorded in the forested area behind the buildings along the north side of Barre Street.</p>
Flora/Fauna	Project area is primarily developed land with low potential as habitat for large fauna or native flora.
Stormwater	The Winooski River and the North Branch are apart of the 303(d) list of impaired streams and rivers. The project area is within the Winooski River Watershed. Per the Montpelier Stormwater Master Plan, there is an area at the end of Main/ at the Roundabout which has a moderate stormwater problem severity.
Hazardous Sites	There are seven hazardous sites in the study area including 46 Barre Street (Monteverdi Music School/TW Wood Art Gallery Building) and 39, 40, 41 Barre Street (Barre Street Apartments) which are also brownfields. On Main Street, Montpelier Pharmacy, Bethany United Church of Christ, and the Unitarian Church of Montpelier are identified as hazardous sites. Most of these sites have underground storage tanks, in addition to the Kellogg-Hubbard Library. The Montpelier Recreation Center and Main Street Family Dentistry are hazardous waste generator sites.
Forest Land	Little forestland in the study area; developed portion of the area.

Cultural Resources

An Archaeological Resource Assessment and a Historic Resources Identification of Barre Street (between Main Street and the Montpelier Recreation Center) and the intersection of Main Street and School Street were conducted by Hartgen Archaeological Associates. Hartgen's full reports are found in Attachment A and include a detailed analysis of the area's developmental history and Archaeological Resource Assessment (ARA) based from both research and a field inspection.

The Historical Resources Identification includes detailed historical development background about Montpelier in general and specifically

about the 22 structures in the areas of study. General findings include that structures within the project area built between the mid-19th and mid-20th century are extremely well preserved. Of the 22 structures evaluated as part of this study, six were constructed prior to 1858, seven were constructed between 1858 and 1873, two were constructed between 1873 and 1925 and five structures were constructed after 1945.

The small city which is Montpelier is an example of a rare preservation mix of commercial, residential and governmental buildings. The collection of architecture and property type highlight important elements for statewide contexts for architecture and town developments. Of the 22 structures, 20 are over 50 years old. All are included with the National Register Montpelier Historic District, last updated in 2016. Nineteen of the 22 buildings surveyed as part of this study contribute historically to the District.

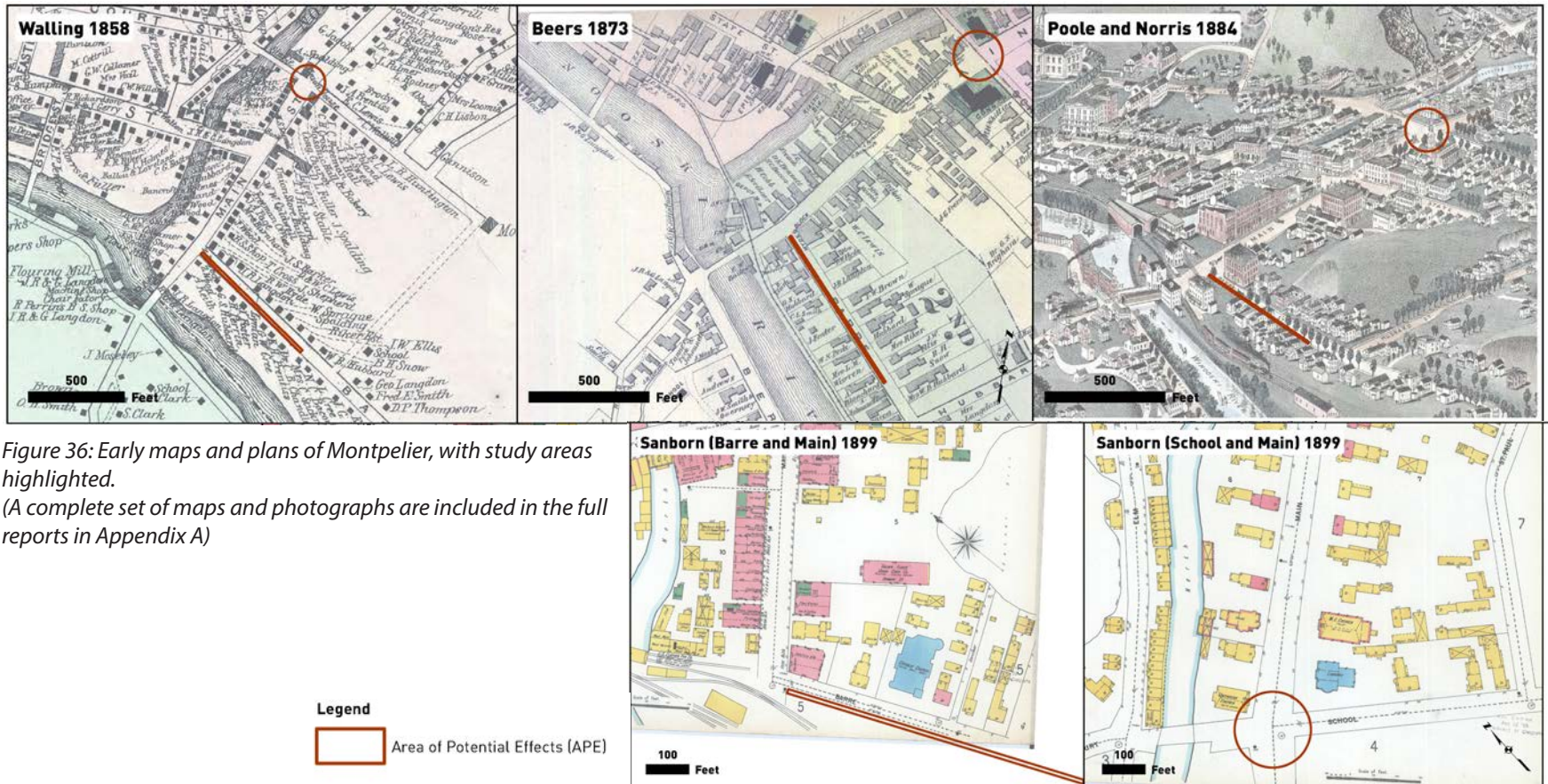
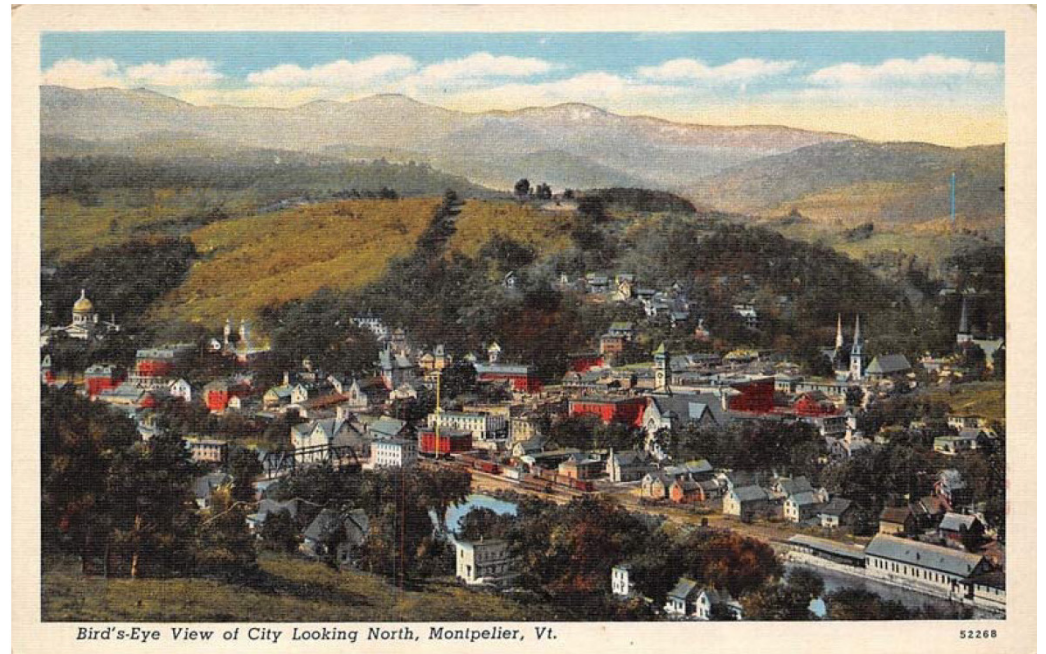


Figure 36: Early maps and plans of Montpelier, with study areas highlighted. (A complete set of maps and photographs are included in the full reports in Appendix A)

School Street and Barre Street project areas are considered to have moderate precontact sensitivity. The School Street/Main Street project Area of Potential Effects (APE) is located approximately 100 feet east of the North Branch of the Winooski River. The western end of the Barre Street APE is located approximately 300 feet east of the confluence of the Winooski River and the North Branch. Soils within the project area are of the Urban land-Udipsamments complex which are typically encountered on flood plain terraces at 300 to 1,200 feet elevation, and are frequently flooded because of low water permeability. They are often considered somewhat disturbed, a result of urban development.

There are three precontact sites located within a one mile radius of the APE and another precontact site located approximately three miles away.

However, due to previous disturbance, including historic development including road, sidewalk and utility installation, the sensitivity of Barre Street is considered low. Similarly, the School Street/ Main Street project areas has also been previously disturbed. This is true for the entire southwest corner of the street intersection and a large portion of the southeast corner where the ground has been impacted by the construction of building or sidewalks. However, the northwest and northeast corners and a small portion of the southeast corner of the intersection, the lawn bordered by sidewalks may be relatively undisturbed. The grass lawns on these three corners are considered to have high precontact sensitivity because of the level terrain located near or adjacent to the North Branch. For this area, a Phase IB archaeological investigation is recommended in the undisturbed portions of the area. No further archaeological investigation is recommended for the remainder of the School and Main Street roundabout and the Barre Street project areas.



Post card view of Montpelier, c. 1930 (private collection).

Figure 37: Post Card view of Montpelier c.1930

Alternatives

The following pages highlight the alternatives developed for Main and Barre Street based on the opportunities and constraints of the existing conditions, public opinion and feedback, as well as design elements that could contribute to addressing the needs and goals of the study. The alternatives are divided between the two corridors: Barre and Main Street, with details on each alternative, including changes to the intersections along Main Street. Advantages, disadvantages and impacts to study goals are elaborated upon for each alternative.

Design Elements

The following design elements were applied in the development of the alternatives in the project area.

Roundabouts slow down traffic, and can leave room for pedestrian refuge islands and make more room for bicyclists by getting rid of turning lanes. They move traffic more efficiently than traffic signals, and reduce the number of crashes at intersections.



Figure 38: Roundabouts

Mini-roundabouts work for intersections with lower traffic volumes and can fit into smaller spaces than full roundabouts, but still accommodate trucks and other large vehicles because they have mountable islands.



Figure 39: Mini-roundabouts

Curb extensions shorten the width of the road that a pedestrian must cross and improve the visibility of pedestrians by bringing them in front of on-street parking.

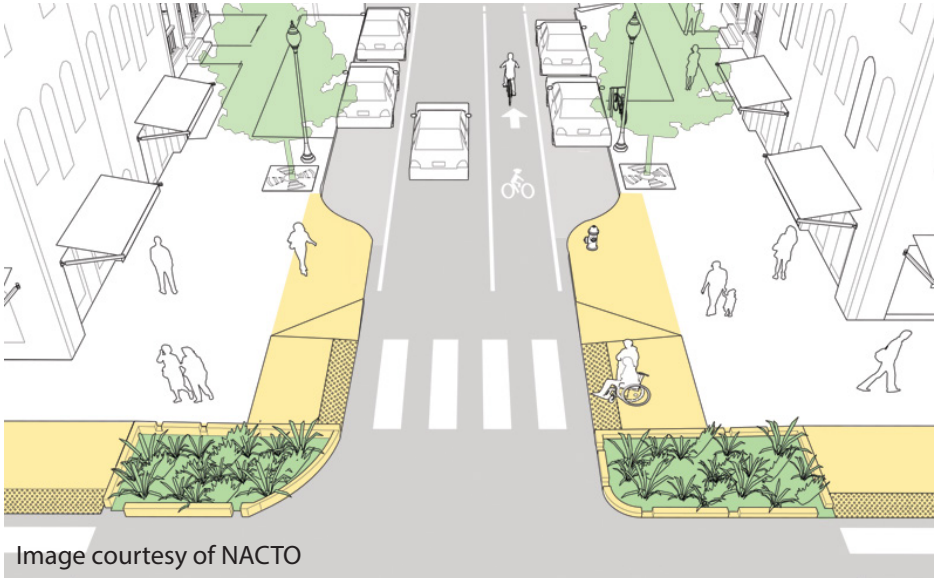


Image courtesy of NACTO

Figure 40: Curb extensions

Raised pedestrian crossings improve the visibility of people walking and slow traffic. They can be designed plow-friendly and would require further design for stormwater drainage.

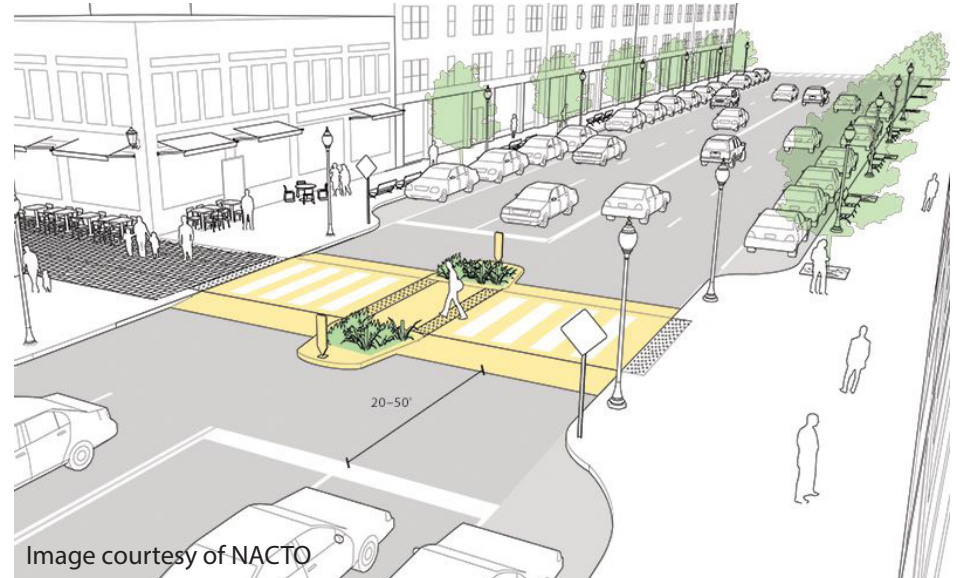


Image courtesy of NACTO

Figure 41: Raised pedestrian crossings

Bike boxes bring bicycles in front of the vehicle queue at an intersection so they are visible and can get a head start making turns.



Image courtesy of NACTO

Figure 42: Bike boxes

Bicycle facilities, including **cycle tracks** protected with parking, **buffered bike lanes**, and **bike lanes** provide a dedicated space for bicyclists where they are separate from vehicles. **Shared lane markings** can help to guide bicyclists on where to ride within the road so that they are out of the door zone and alert drivers to be aware of bicycles, but do not necessarily do anything to improve the safety of a bicyclist riding in traffic. If used, they should be implemented in combination with traffic calming measures to truly create a shared lane.

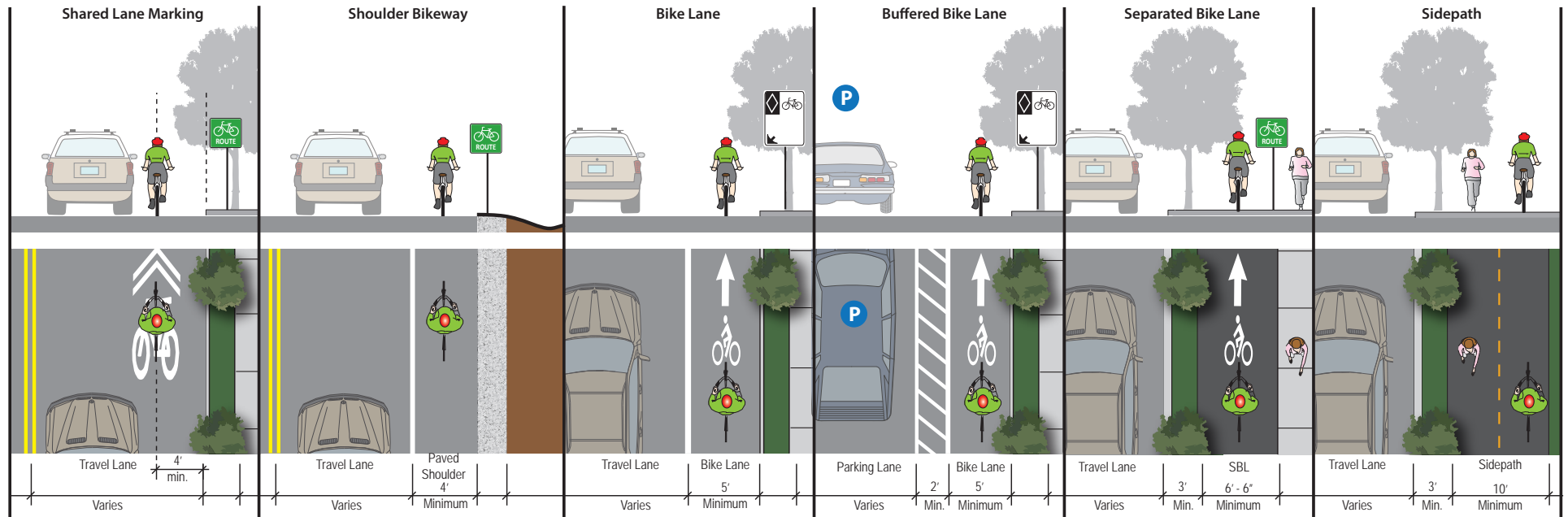


Figure 43: Bicycle facilities, including shared-lane markings, cycle tracks protected with parking, buffered bike lanes, and bike lane. Image courtesy of Alta Planning & Design

Sidepaths, which is a term for shared-use paths that are adjacent to roadways, mix bicycles and pedestrians traveling in both directions. They provide separation from the roadway between motor vehicles and bicycles and pedestrians.



Image courtesy of MDOT
Figure 44: Sidepath

Summary

There are four major intersections and six segments of road (including Barre Street) for which alternatives were developed. Components of each alternative are modular and can function in different combinations; treatments for intersections and segments from different alternatives can be mixed and matched. The diagonal parking on Main Street is reconfigured in all of the alternatives except for M4, because of safety concerns for bicyclists and also because of the poor visibility for vehicles pulling out. Table 3 describes the alternatives for Main Street and Barre Street and design elements associated with each one.

The naming convention used for these alternative uses either “M” for Main Street or “B” for Barre Street, followed by the number assigned to each alternative. For example, M3 denotes the third alternative option for Main Street.

Before these alternatives were developed, capacity analyses and traffic signal warrants were checked for all intersections in the corridor using the most recent turning movement counts published on the VTrans Transportation Data Management System. For the mini roundabouts, the FHWA Capacity Analysis for Planning of Junctions aka “CAP-X” tool was used, and for full size roundabouts, the NCHRP572 Capacity Analysis tool was used to check if roundabouts (or mini roundabouts) were appropriate to install. The reports are in Attachment E of this report, and each of the proposed roundabouts have satisfactory volume to capacity ratios. Signal warrants were also checked for Main & Barre and Main & School, both also attached to the report in Attachment E. Multiple warrants were met at both intersections.

The following alternatives were presented to the public in August 2018. Each alternative and its impacts are explored in-depth in the following pages.

Table 3: Summary of Main Street & Barre Street Alternatives

Alternative		Design Elements
No Build	Existing	No change
M1	Traffic signal corridor with bike lanes	Bike lanes • Bike boxes • Converting diagonal parking to parallel parking
M2	Roundabout corridor with bike lanes	Roundabouts • Mini-roundabouts • Buffered bike lanes • Raised pedestrian crossings • Converting diagonal parking to parallel parking
M3	Hybrid (Signals and Roundabouts) corridor	Mini-roundabouts • Bike lanes and buffered bike lanes • Bike boxes
M4	Greening America’s Capitals (GAC) design + Elm Street bikeway	Roundabouts • Two-way buffered bicycle lanes • Shared lanes • Converting diagonal parking to back-in diagonal parking
B1	Shared-use path	Sidepath (north or south side of the street options)
B2	Buffered two-way bikeway	Buffered bicycle lanes (north or south side of the street options)
B3	Buffered bike lanes	Buffered bicycle lanes

Understanding the Impacts

To understand the impact of the alternatives, each is evaluated using a one-to-five scale for bicycle friendliness, walkability, driving experience, amount of parking, cost of building, and ease of constructibility. Below are explanations of each criteria in the context of the study.



Bicycling. How well does this alternative meet the needs of bicyclists of all ages and abilities? One is the highest stress facility, five is the lowest.



Walking. How well does this alternative meet the needs of pedestrians of all ages and abilities? One is the least safe and convenient five is the safest.



Driving. How well does this alternative meet the needs of drivers in Montpelier? One is the least safe and convenient for drivers, five is the most.



Parking. How much parking can be retained by this alternative? One is the least amount of parking, Five is the most.



Cost. How affordable will this alternative be to construct? One is the least expensive, five is the most.



Constructibility. How realistic and viable is building this alternative in Montpelier? One is the fewest challenges to overcome, five is the most.

Barre Street

On Barre Street, the focus is adding a facility that connects the two ends of the bike path. A primary challenge was determining whether a bicycle facility should be on the north side, the south side or both sides of the street. A key factor in determining the recommended alternative was considering that the western segment of the bike path that is currently under construction on the opposite side of Main Street aligns with the south side of the Barre Street as illustrated in figure 44. It is important to note that designing a shared use path to have the fewest number of road crossings as possible is key to meeting the comfort and safety of bike path users.

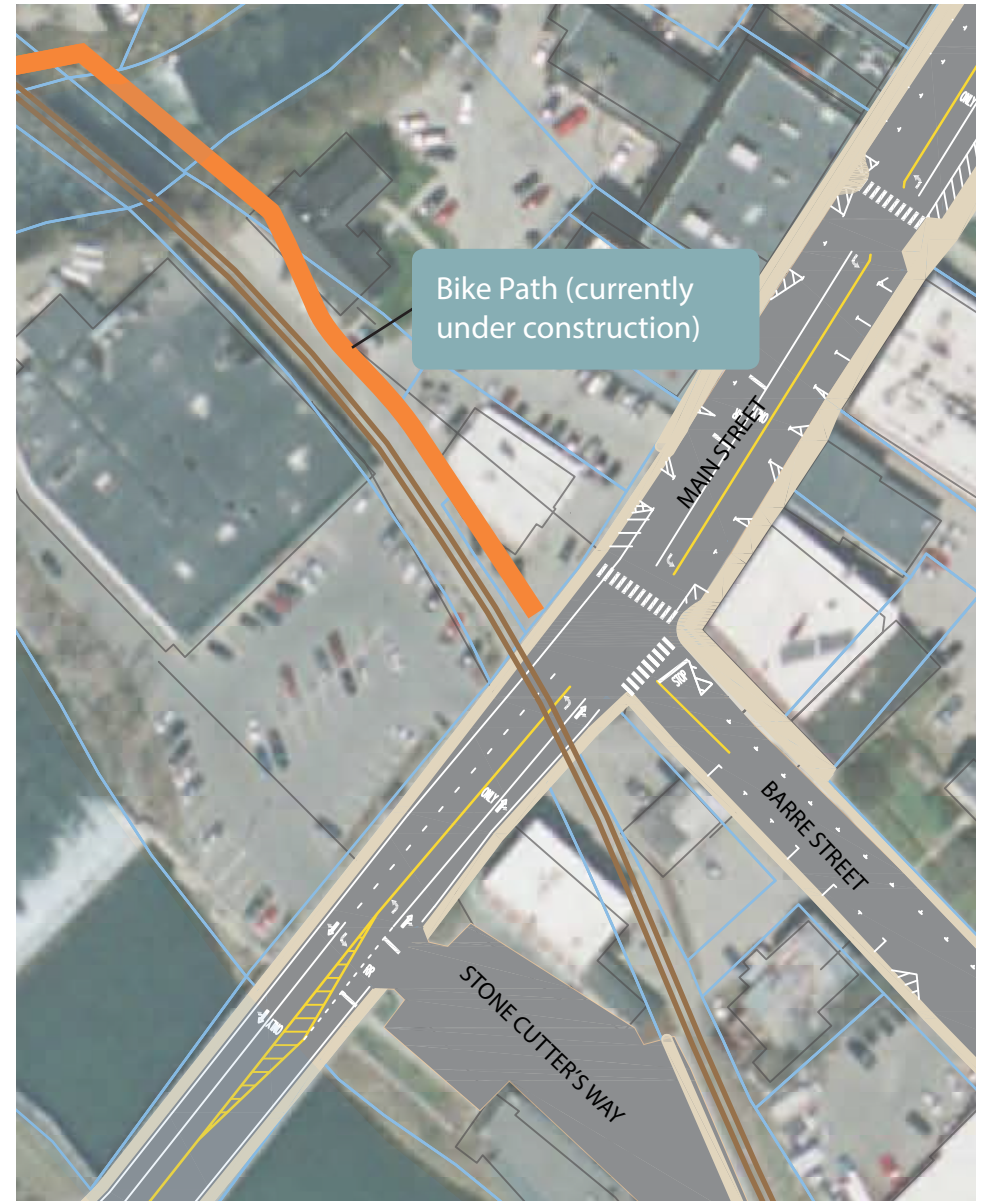


Figure 45: Future terminus of western end of the bike path.

B1: Sidepath

This alternative would create a shared-use path adjacent to Barre Street to fill the gap between the two bike path ends (at the Recreation Center - the eastern terminus of the bike path- and where the western segment will end at Main Street). A sidepath refers to a shared-use path that is next to a roadway.

South Side of the Street

To locate the sidepath on the south side of the street, the sidewalk on the south side of Barre street would be widened to 10 feet with a 4 foot green buffer, which could also be used for snow storage in the winter. Parking would remain as it currently is on the north side of the street, where the church, senior center and the art center are located, and the sidewalk would not be altered.

The significant advantage of locating the sidepath on the south side of the street is that users of the bike path would only need to cross the road once, at Main Street. The eastern terminus at the Recreation Center is on the south side and the in-construction western terminus aligns with the south side of the road. This proposed alternative is feasible with a traffic signal at Main & Barre, as there is enough space in the intersection to add a crossing on the southern approach of Main Street. Along Barre Street, the sidepath would cross five private driveways but no public roads.

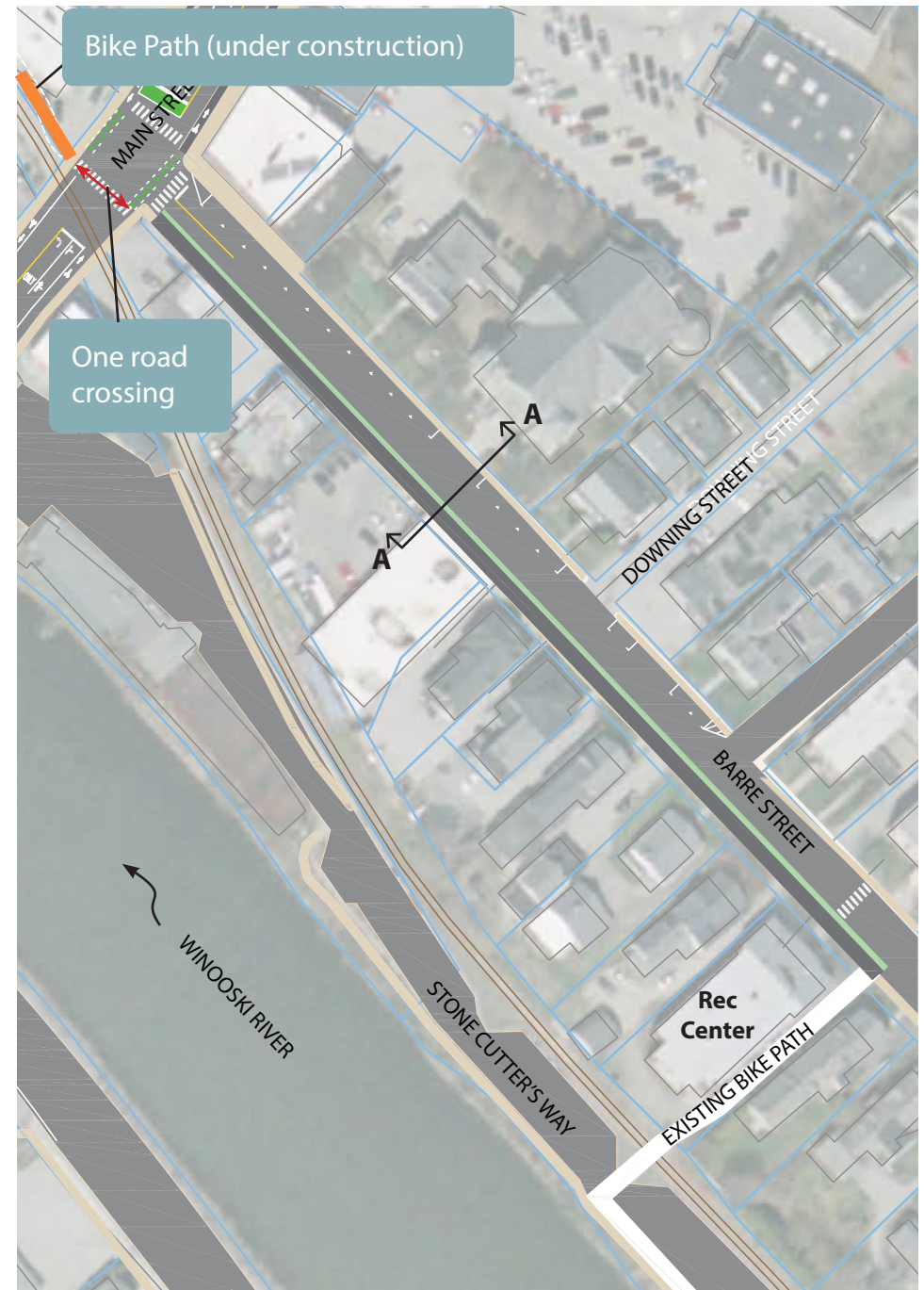


Figure 46: Sidepath on the south side of Barre Street

Sidepath on the South Side of Barre Street



Bicycling. This alternative has a continuous and consistent bicycle facility connecting the two ends of the bike path; path users only have to cross the road once.



Walking. Pedestrian traffic is mixed with bicycles on the south side of Barre Street, but the green buffer between the sidepath and the road creates a more comfortable walking environment. Path users only have to cross the road once.



Driving. Adding a green buffer may reduce vehicle speeds. (Intersection treatment for Main & Barre is discussed in the Main Street alternatives portion of the report.)



Parking. 18 out of the existing 31 parking spaces are retained on the north side of the street.



Cost. This alternative requires demolishing the south side sidewalk, curb reconstruction, and moving six catch basins.



Constructibility. This alternative requires coordinating with businesses along Barre Street for deliveries and access during construction. Barre Street may need to be closed or reduced to one-lane during construction.

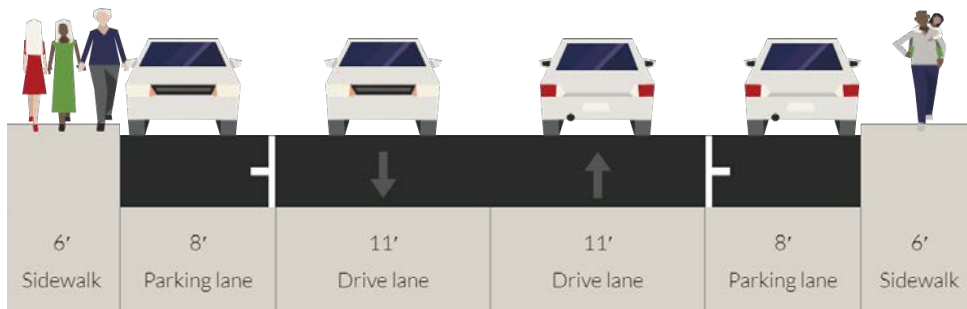


Figure 47: Existing Section A-A, Barre Street



Figure 48: Section A-A, Sidepath on the south side of Barre Street

North Side of the Street

To locate the sidepath on the south side of the street, the sidewalk on the north side of the street would be widened to 10 feet with a 4 foot green buffer, which could be used for snow storage in the winter. Parking would be retained on the south side of the street, and the sidewalk on the south side would not be altered.

An important disadvantage of the sidepath on the north side of the street is that it requires path users to cross the road three times. Crossings would occur: once to cross Barre Street at the Montpelier Recreation Center, again at Main Street, and a third time across the proposed road and parking lot to the city-owned property for which the use is at the writing of this report, undetermined.

On Barre Street, the sidepath would cross a few private driveways and two public roads. There is a wide curb cut for a commercial building at the corner of Downing Street and Barre Street that the path would be adjacent to which may require access management to reduce potential vehicular and bicycle conflict.



Figure 49: A sidepath on the north side of the road would require three road crossings between the (under-construction) bike path on the west side of Main Street and the existing bike path at the Recreation Center.

Sidepath on the North Side of Barre Street



Bicycling. Though this alternative has a continuous and consistent bicycle facility connecting the two ends of the bike path, path users have to cross the road three times.



Walking. Pedestrian traffic is mixed with bicycles on the north side of Barre Street, but the green buffer between the sidepath and the road creates a more comfortable walking environment. Path users need to cross the road three times.



Driving. Adding a green buffer may reduce vehicle speeds. (Intersection treatment for Main & Barre is discussed in the Main Street alternatives portion of the report.)



Parking. 13 out of 31 parking spaces are retained on the north side of the street.



Cost. This alternative requires demolishing the north side sidewalk, curb reconstruction, and moving 6 catch basins and 1 utility pole.



Constructibility. This alternative requires coordinating with businesses along Barre Street for deliveries and access during construction. Barre Street may need to be closed or reduced to one-lane during construction.

B2: Buffered Two-way Bikeway

A two-way bike lane along Barre Street would also fill the gap between the two ends of the bike path. Both bike lanes would be 4 feet wide with a 2 foot buffer separating them from vehicles.

This alternative only meets minimum design standards for separated bike facilities. The narrow width of the bike lanes and buffer is not a recommended practice. The bikeway may make the road feel more constrained for vehicles than it already does.

South Side of the Street

Parking would remain on the north side of the street while the two-way buffered bikeway is on the south side.

As previously discussed in B1: Sidepath, the significant advantage of the bikeway on the south side of the street is that path users only need to cross the road once, at Main Street. This is possible with a traffic signal at Main & Barre, because there is enough space in the intersection to add a crossing on the southern approach of Main Street. Along Barre Street, the bikeway would cross five driveways but no public roads.

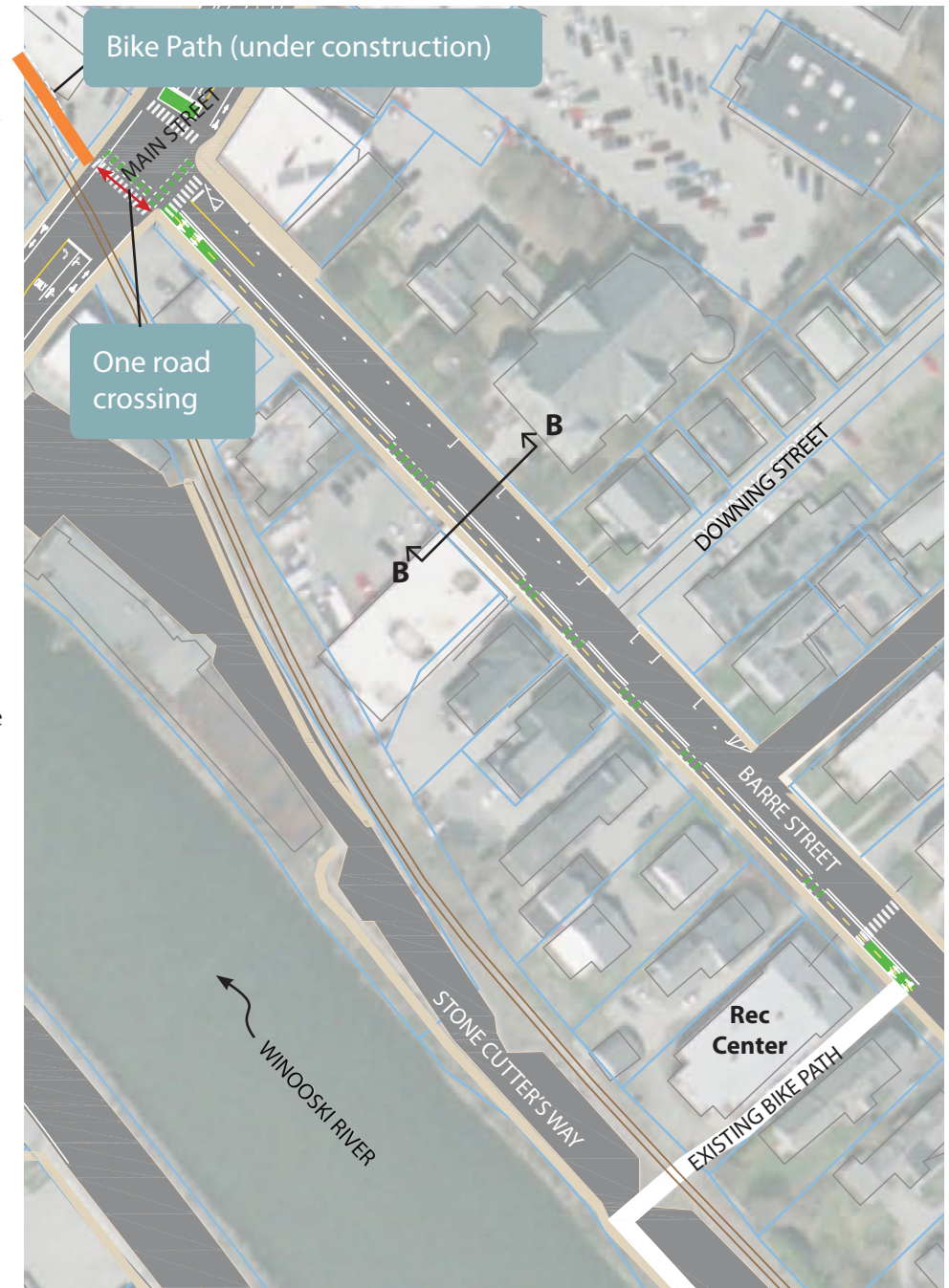


Figure 50: Two-way buffered bikeway on the south side of Barre Street

Buffered Two-way Bikeway on the South Side of Barre Street



Bicycling. This alternative introduces a new type of bicycle facility between the two ends of the bike path, but it is separated from vehicles. Path users only have to cross the road once.



Walking. On the south side of the street, pedestrians on the sidewalk would be walking next to a bikeway instead of parked cars. Path users only have to cross the road once.



Driving. Narrowing the travel lanes to build the bikeway may reduce vehicular speeds. (Intersection treatment for Main & Barre is discussed in the Main Street alternatives portion of the report.)



Parking. 18 out of 31 parking spaces are retained on the north side of the street.



Cost. This alternative is very low cost and only requires restriping.



Constructibility. Painting the bikeway could be done quickly. It could also be tested as a demonstration project, or an interim solution that could be implemented as soon as the current bike path construction is complete.

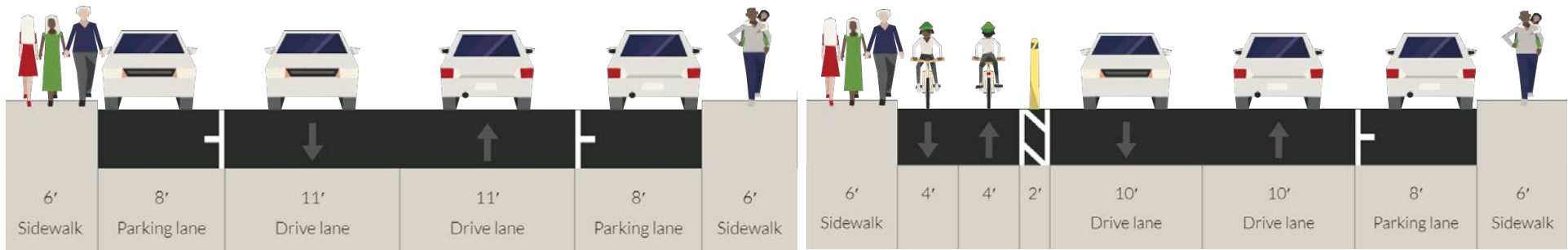


Figure 51: Existing Section A-A, Barre Street

Figure 52: Section B-B, two-way buffered bikeway on Barre Street

North Side of the Street

Parking would remain on the north side of the street while the two-way buffered bikeway is on the south side.

As discussed, an important disadvantage of the bikeway on the north side of the street is that it requires Path users to cross the road three times. Once to get across Barre Street at the Rec Center, then at Main Street, and again at the new road to the parking lot that is under construction.

Along Barre Street, the bikeway would cross a few driveways and two public roads. There is a wide curb cut for a commercial building at the corner of Downing Street and Barre Street that the path would have to run adjacent to.



Figure 53: Two-way buffered bikeway on the south side of Barre Street

Buffered Two-way Bikeway on the North Side of Barre Street



Bicycling. This alternative introduces a new type of bicycle facility between the two ends of the bike path; Path users have to cross the road three times.



Walking. On the north side of the street, pedestrians on the sidewalk are walking next to a bikeway instead of parked cars. Path users have to cross the road three times.



Driving. Narrowing the travel lanes and adding a green buffer on the south side of the street reduced vehicle speeds. (Intersection treatment for Main & Barre is discussed in the Main Street alternatives portion of the report.)



Parking. 13 out of 31 parking spaces are retained on the north side of the street.



Cost. This alternative is very low cost and only requires restriping and flexible delineators.



Constructibility. Painting the bikeway could be done quickly. It could also be tested as a demonstration project, or an interim solution that could be implemented as soon as the current bike path extension on the west side is complete.

B3: Buffered Bike Lanes

Bicycle Facilities

To fit bike lanes on both sides of the street, all of the on-street parking on Barre Street from the Recreation Center to Main Street would need to be removed, which would leave room for five foot bike lanes in either direction with three foot buffers.

Please note: although considered, this alternative was not developed further because the community expressed a strong desire to keep as much parking as possible on Barre Street.

Advantages

- Provides a comfortable separated bicycle facility
- Low cost

Disadvantages

- Removes parking on both sides of the street

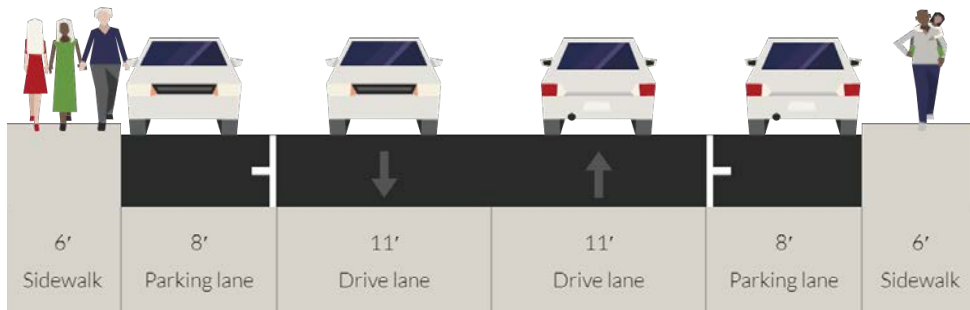


Figure 54: Existing Section, Barre Street



Figure 55: Buffered bicycle lanes on both sides alternative on Barre Street

Main Street

On Main Street, several safety, connectivity and circulation issues were examined and alternatives presented. A combination of solutions sought to address top concerns including: intersections without traffic controls; unsafe crosswalks due to high traffic volumes; poor visibility and wide travelways and parking lanes; driver confusion over right-of-way and queuing during peak times; and an absence of any bicycle facilities.

M1: Signals with Bike Lanes

Intersections

Main & School
 New traffic signal
 Bike crossings
 Curb extensions

Main & State
 Traffic signal (existing)
 Bike boxes
 Raised pedestrian crossing

Main & Barre
 Traffic signal
 Bike boxes
 New crosswalk on southern leg

Main & Memorial
 Bike box

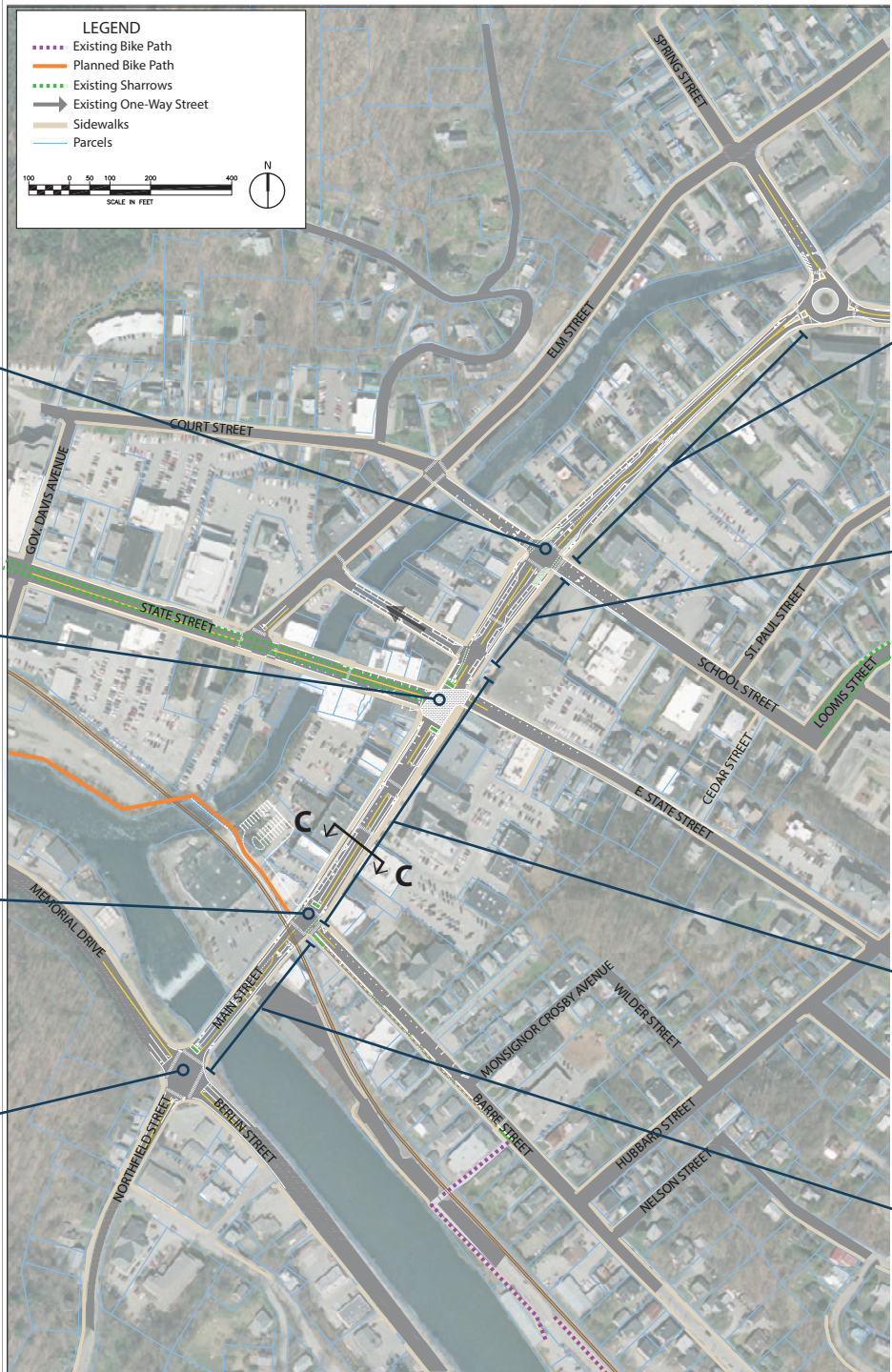


Figure 56: Alternative M1 plan (right)

M1: Signals with Bike Lanes

Traffic Circulation

The M1 alternative adds new traffic signals at Main & Barre and Main & School. This would make it easier for vehicles turning onto Main Street from the side streets. In addition, the City is considering options for installing adaptive traffic signal technology throughout this corridor, which would move traffic more efficiently based on the real-time traffic conditions.

Moving the Langdon Street crosswalk further north along Main Street allows vehicles to travel further past the intersection before potentially needing to stop for pedestrians. This spacing of unsignalized crossings is closer to the spacing of crosswalks along Main Street between Barre Street and State Street.

Bicycle Facilities

This alternative includes northbound and southbound bike lanes on Main Street from Memorial Drive to just before Spring Street. The northbound bike lane is not separated from traffic anywhere. The southbound bike lane is parking protected in some locations. Where appropriate, bike boxes and bicycle crossings are included at the intersections on Main Street. There are bicycle crossings at the Main & Barre and Main & School intersections, and pavement markings could also be incorporated into the raised pedestrian crossing at Main & State.

Pedestrian Improvements

An additional crosswalk at Main & Barre on the southern leg of the intersection creates a safe crossing along the desire line between Barre Street and Shaw's and the bus stop. The exclusive pedestrian phase at Main & State allows people walking to cross the street diagonally, but the large roadway width increases the intersection's abundance of pavement. A raised intersection would increase the crossing's visibility and be welcoming to pedestrians. Design for drainage will need to be considered for the raised crossing.

Curb extensions at Main & School narrow the width of the road when crossing and improve the visibility of those waiting to cross by increasing their visibility ahead of the parked cars along Main Street.

Parking

This alternative has parallel parking on the west side of Main Street between Barre Street and State Street. From State Street to Spring Street, existing diagonal parking is reconfigured to parallel parking on both sides of the road. Parking is retained along the southern side of Barre Street. In total, there are 55 parking spaces in the project area for M1.

Traffic Signal Corridor and Bike Lanes on Main Street



Bicycling. While this alternative has bicycle facilities throughout the project area, unprotected bicycle lanes are not comfortable for many users.



Walking. A traffic signal at Main & Barre can include an exclusive pedestrian phase for people crossing Main Street and Barre Street, including bike path users.



Driving. A traffic signal at Main & Barre will make it easier to turn out of Barre Street onto Main Street. Traffic congestion during peak hours will not change.



Parking. 55 out of 117 parking spaces are retained, the fewest out of any alternative.



Cost. This alternative does not require any additional right-of-way or changes to the curb, so it has a moderate cost.



Constructibility. This alternative requires restriping Main Street to add bike lanes and adding a traffic signal at Main & Barre.



Figure 57: Existing Section C-C on Main Street (outside of Rite Aid)

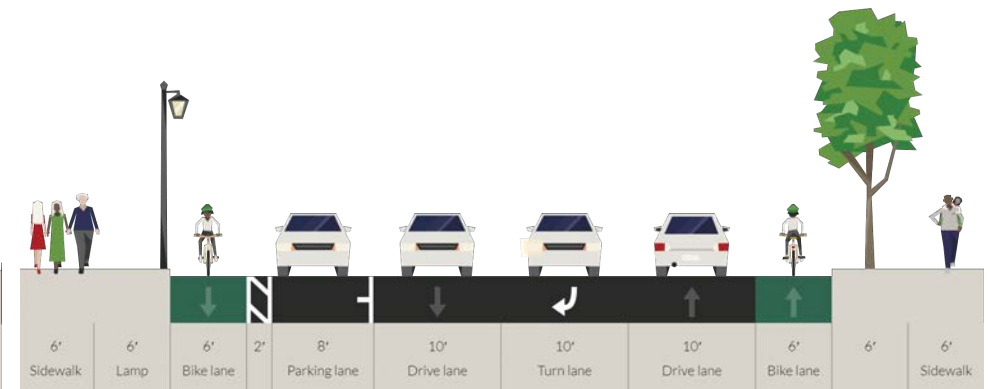
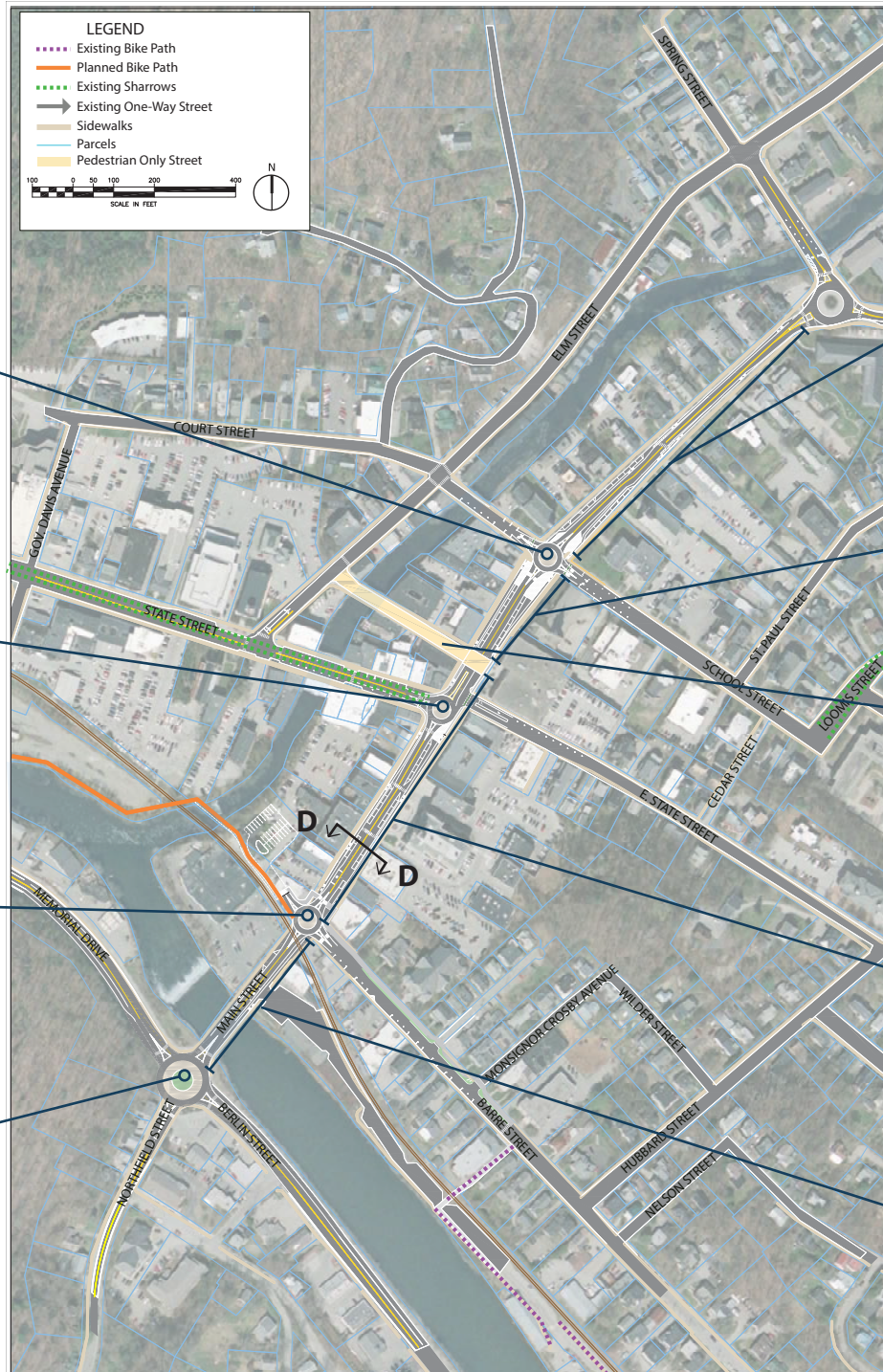


Figure 58: Section C-C on Main Street for alternative M1 (outside of Rite Aid)

M2: Roundabouts with Bike Lanes

Intersections



Main & School
Mini-roundabout
Bike crossings
Curb extensions

Main & State
Mini-roundabout (*left turns out of E State St are prohibited*)
Separated bike crossings

Main & Barre
Mini-roundabout

Main & Memorial
Roundabout

School St - Spring St
5 to 7 foot bike lanes

Langdon St - School St
6 foot buffered bike lanes, protected with parking

Langdon St
Raised pedestrian crossing at the Langdon St intersection ; Langdon Street is pedestrian only

Barre St - Langdon St
5' buffered bike lanes, protected with parking

Memorial Dr - Barre St
7' buffered bike lanes

Figure 59: Alternative M2 plan (right)

M2: Roundabouts with Bike Lanes

Traffic Circulation

Roundabouts move traffic with a slow but steady flow, which can conflict with the stop-go operation of a traffic signal. The intersections along Main Street are relatively closely spaced, so the traffic flow at each intersection has a significant effect on the others, as well as adjacent side streets. Transforming all of the intersections along Main Street into roundabouts or mini-roundabouts results in the most improvement of traffic flow throughout the corridor.

However, due to the alignment of the intersection of State and Main Streets, where East State Street is not in line with State Street, vehicular traffic would not be able to enter the mini roundabout from the East State Street approach; thus requiring an inconvenient detour for any traffic trying to turn left onto Main Street or travel straight through to State Street (see the following pages). With a mini roundabout blocking westbound traffic on East State Street from turning left and straight, large amounts of traffic would be re-routed. These could likely try to use Langdon Street (further discussed in alternative M4). In this alternative, we explored Langdon Street becoming pedestrian only so that the new through traffic pattern would not change the low volume and low speed character of this street (that has many businesses). The impacts to School Street, however, are illustrated in Figures 61 & 62.

While the mini roundabout at Main & School may accommodate some U-turns, it would be a tight turn and not possible for trucks or buses. It would not be intuitive for cars to maneuver a U Turn, as it is at a full-size roundabout.

Bicycle Facilities

Because roundabouts eliminate the need for turning lanes, there is room for buffered bike lanes on both sides of Main Street for the entire study area. However, at Main & Barre and Main & State, there is not room for separate bicycle facilities at the intersection. Bicyclists have to merge with motor vehicles and travel through the roundabout, or use the sidewalk.

At the bike path crossing of Main Street, there is not enough room for a crossing on the southern leg of Main Street with a mini roundabout. This means that with a roundabout or mini roundabout at Main & Barre, Path users will have to cross the road three times to get between the two ends of the bike path, whether the facility on Barre Street is on the north side or south side of the street.

Pedestrian Improvements

A significant benefit of roundabouts is that they reduce the number of lanes, and therefore the width of roadway, that pedestrians need to cross. Their design can also incorporate pedestrian refuge islands, like at the existing Main & Spring roundabout. On the other hand, people walking would be mixed with people cycling at every intersection (except for very confident riders who could ride in the roundabout with vehicular traffic). In addition, pedestrian crossings at roundabouts are more challenging for the visually impaired because the crossing is not typically in line with the sidewalk, to make space for the roundabout entrances and exits.

Parking

On Main Street, parallel parking is retained on both sides of the road throughout the corridor. The diagonal parking is reconfigured to parallel. On Barre Street, parking is retained on the south side of the road. In total, M2 has 64 parking spaces.



Figure 60: Route for all vehicles wanting to turn left from East State Street to the southern portion of Main Street. According to traffic data from VTrans, approximately 43% of the westbound traffic on East State Street turn left onto Main Street (approximately 775 vehicles per day; the AADT of School Street in 2013 was 1800).

The AADT of School Street in 2016 was 845 according to VTrans data. Adding this volume of re-routed traffic would almost double the AADT of School Street.

The AADT of Elm Street in 2016 was 2400 according to VTrans data. Adding the re-routed traffic would have big impacts to the State & Elm intersection. This would also add additional traffic to the Main & State intersection.



Figure 61: Route for all vehicles wanting to go straight through the intersection from East State Street to State Street.

According to traffic data from VTrans, approximately 40% of the westbound traffic on East State Street go through to State Street (approximately 720 vehicles per day).

The AADT of School Street in 2016 was 845 according to VTrans data. Adding this volume of re-routed traffic would almost double the AADT of School Street—and almost triple in addition to the traffic volumes discussed.

The AADT of Elm Street in 2016 was 2400 according to VTrans data. Adding the re-routed traffic in addition to the traffic volumes discussed would have big impacts on Elm Street.

Roundabout Corridor and Separated Bike Lanes on Main Street



Bicycling. Protected bike lanes on Main Street are comfortable for most users. ⚠️ Path users need to cross the street 3 times to get from between the east and west sides of Main Street.



Walking. At each roundabout, cyclists would either ride around the roundabout with vehicular traffic or would mix with pedestrians on a shared use path around the intersection. There is already limited space for pedestrians and storefronts between the road and buildings downtown. Pedestrians are diverted from their desire lines.



Driving. While roundabouts may reduce some traffic congestion, detours at the Main & State intersection will have big impacts on traffic circulation. All westbound traffic turning straight or left from East State Street would be rerouted.



Parking. 64 out of 117 parking spaces are retained.



Cost. Right-of-way acquisition and building four roundabouts will be costly.



Constructibility. There is limited space in this downtown setting for changing the width of the sidewalks to accommodate bicyclists at the intersections. Coordinating with the railroad and other landowners to build the mini roundabout at Main & Barre will add years to the construction schedule. High traffic volumes at the Main & Memorial intersection would make constructing a roundabout difficult.

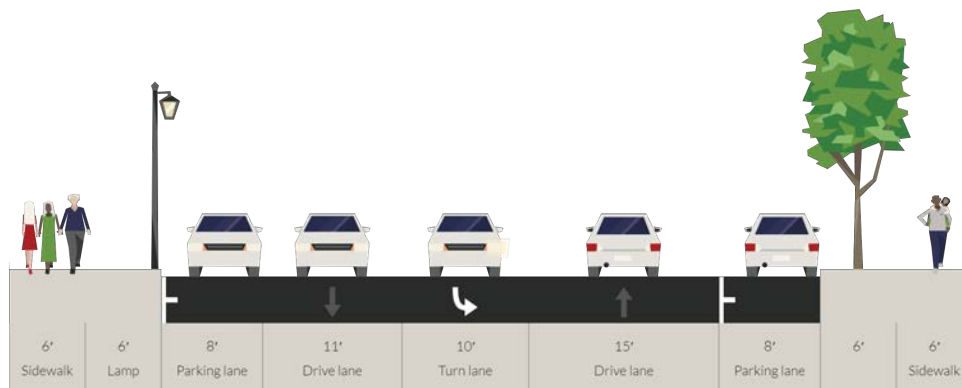


Figure 62: Existing Section DD on Main Street (outside of Rite Aid)

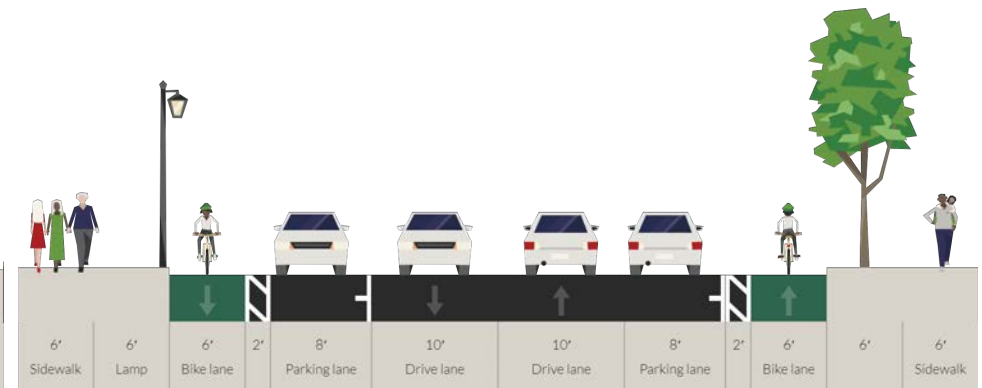


Figure 63: Section DD on Main Street for alternative M2 (outside of Rite Aid)

M3: Hybrid

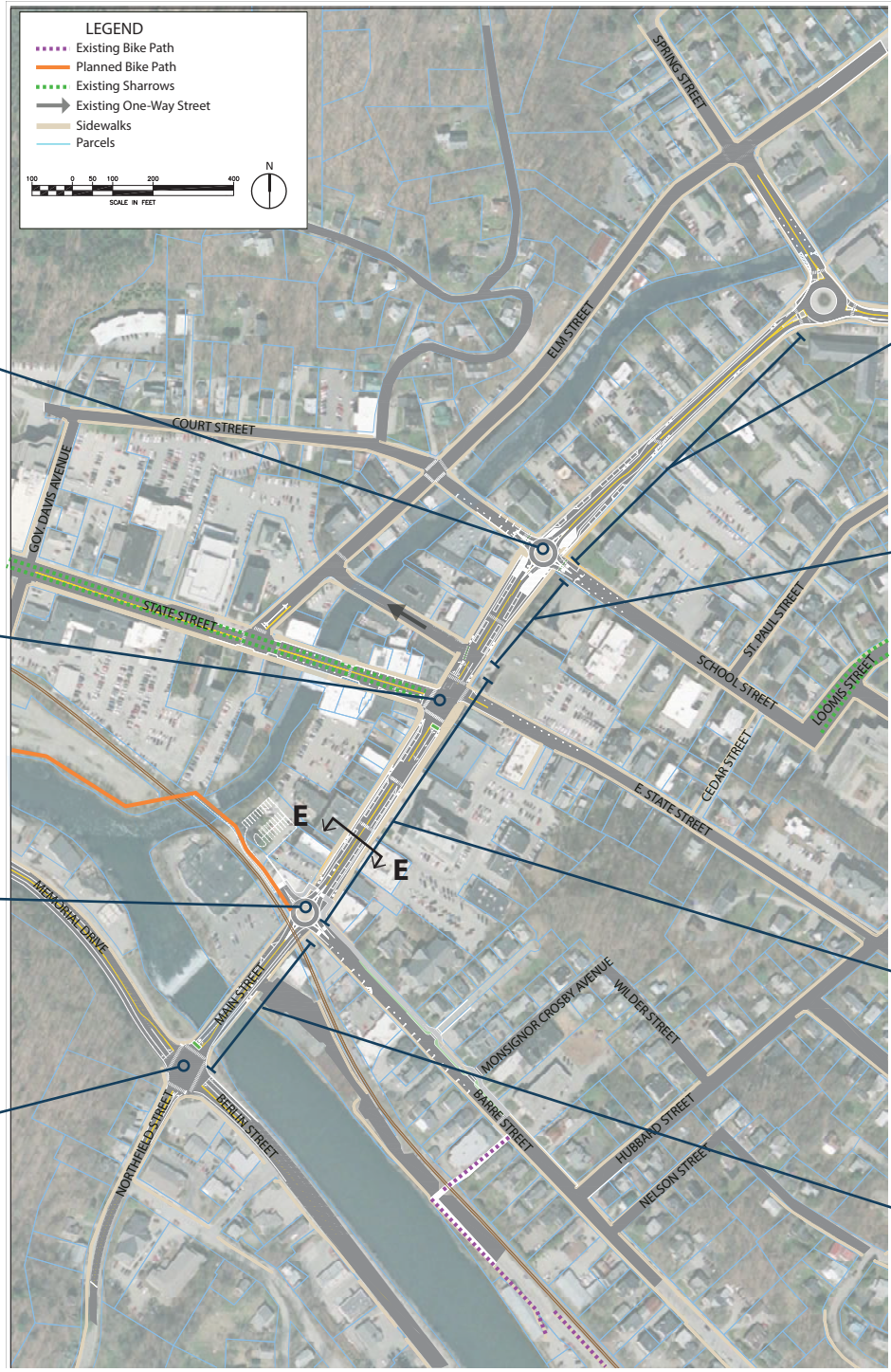
Intersections

Main & School
 Mini-roundabout
 Bike crossings
 Curb extensions

Main & State
 Traffic signal
Northern leg crosswalk is moved 30' north
 Bike boxes

Main & Barre
 Mini-roundabout

Main & Memorial
 Traffic signal (existing)
 Main St northbound leg width is reduced
 Bike box



School St - Spring St
 5 to 7 foot bike lanes

Langdon St - School St
 5 to 7 foot buffered bike lanes

Langdon St Crossing
 Moved 80' north to align with Hazen Place

Barre St - Langdon St
 NB: 6' bike lane
 SB: 5' buffered bike lane, protected with parking where possible

Memorial Dr - Barre St
 6' buffered bike lanes

Figure 64: Alternative M3 plan (right)

M3: Hybrid

Traffic Circulation

The hybrid alternative aims to combine the advantages of signals and roundabouts at the intersections where each works best. There are mini-roundabouts proposed at Main & Barre and Main & School, and the traffic signals at Main & Memorial and Main & State would remain.

Changing the phasing at Main & State so that pedestrians cross concurrently with traffic would reduce delay at this intersection and ease the congestion along the corridor. To make this possible, the crosswalk on the north leg of the intersection (across Main Street) would be moved north, to the northern edge of East State Street. However, traffic counts show that the majority of the vehicles coming from State Street and East State Street are turning onto Main Street, which would often conflict with pedestrians crossing concurrently. Also, while this change would reduce delay for vehicles, during our public engagement many members of the community stated that they like the exclusive pedestrian phase, which makes them feel safe and comfortable walking through this complicated intersection.

With this hybrid of signals and roundabouts, there may be traffic back-ups during peak hours through the mini-roundabout at Main & Barre. This would occur during the afternoon peak hours. However, Barre Street traffic would have an easier time turning onto Main Street, and the improvements at Main & State would reduce queuing for northbound Main Street traffic.

Bicycle Facilities

There is room for buffered bike lanes on both sides of Main Street for the entire study area. Bike boxes at the signalized intersections, including Main & State and Main & Memorial, would improve their visibility and safety. However, at Main & Barre there is not room for a bicycle crossing for cyclists traveling on Main Street, and bicyclists will have to either dismount and cross as a pedestrian or merge with motor vehicles.

Pedestrian Improvements

The mini-roundabouts would make crossings easier for pedestrians by narrowing the width of pavement that they need to cross. The travel lanes on Main Street will also be narrowed, which slows down traffic and makes streets crossings more safe. Curb extensions and reconfiguring diagonal parking to parallel also improves the safety of crossings.

Parking

This alternative has parallel parking on both sides of Main Street where it fits. The diagonal parking is reconfigured to parallel. Barre Street has parking on the south side of the street. In total, there are 66 parking spaces retained in this alternative.

Notes

- Reduces lanes for pedestrians crossing at Main St & Barre St

Hybrid (Traffic Signals and Roundabouts) Corridor and Bike Lanes on Main St



Bicycling. Separated bike lanes along most of Main Street are comfortable for most users, but conventional bike lanes between Barre Street and Langdon Street are not. ⚠️ Path users need to cross the street 3 times to get from between the east and west sides of Main Street.



Walking. At each roundabout, bicycles would be mixed with pedestrians on a shared use path around the intersection. There is already limited space for pedestrians and storefronts between the road and buildings downtown. Pedestrians are diverted from their straight-line path at intersection crossings.



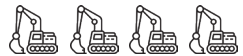
Driving. Turning out of Barre Street onto Main Street would be easier during off-peak hours. However, being between two intersections with traffic signals, the Main & Barre mini roundabout would lock up during peak hours so traffic congestion would not be improved.



Parking. 66 out of 117 parking spaces are retained.



Cost. Right-of-way acquisition at Main & Barre and building the roundabouts add to the moderate cost of this alternative.



Constructibility. Coordinating with the railroad and other landowners to build the mini roundabout at Main & Barre will add years to the construction schedule.

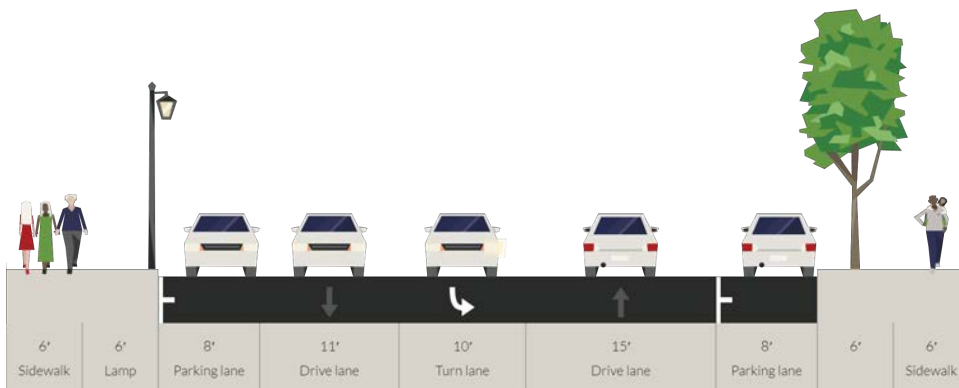


Figure 65: Existing Section E-E on Main Street (outside of Rite Aid)

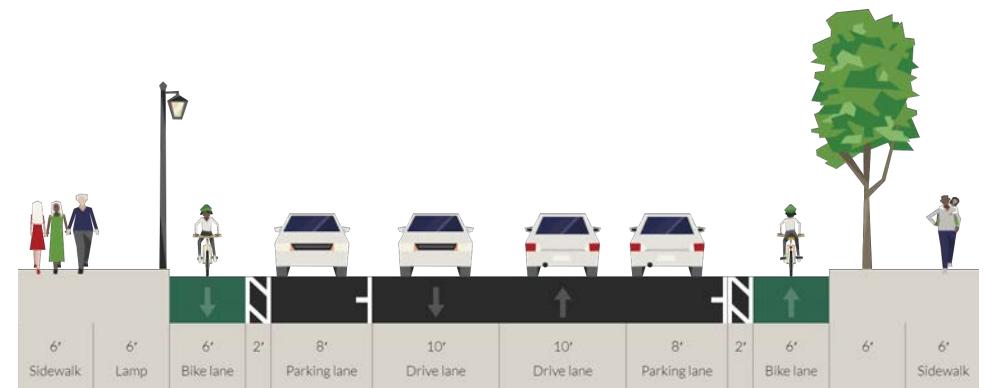


Figure 66: Section E-E on Main Street for alternative M3 (outside of Rite Aid)

M4: Greening America's Capitals + Elm St Bikeway

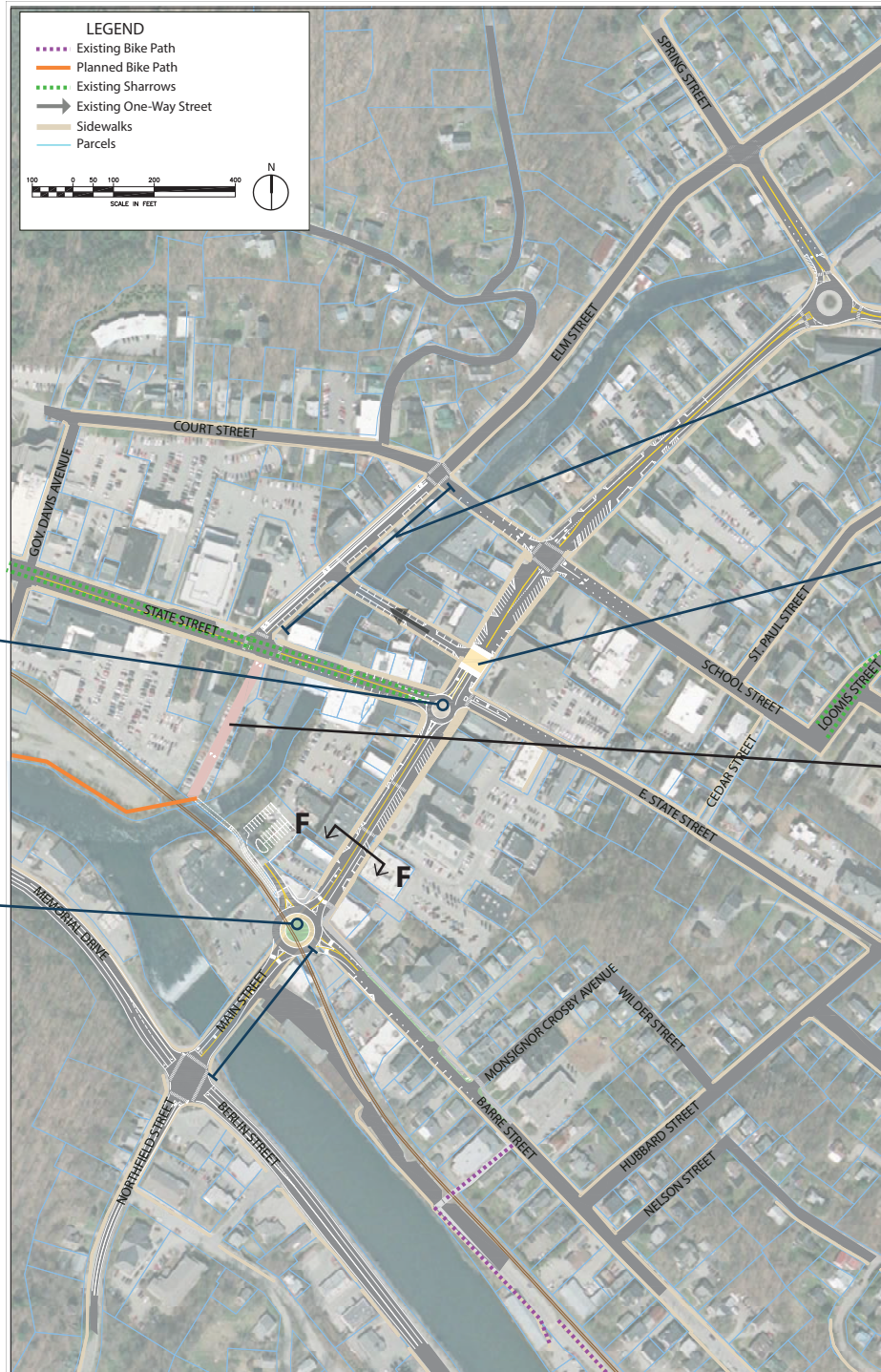
Intersections

Main & School
No change

Main & State
Mini-roundabout (left turns out of E State are prohibited)

Main & Barre
Roundabout

Main & Memorial
No change



Elm Street (State to School)
Two-way buffered bikeway
One way vehicular traffic

Langdon St Crossing
Raised pedestrian crossing at the Langdon St intersection

Heney and Jacobs Parking Lots
Festival street

Back-in Angled Parking
Where possible on Main St

Figure 67: Alternative M4 plan (right)

M4: Greening America's Capitals + Elm St Bikeway

Traffic Circulation

As proposed in the 2015 Green America's Capitals (GAC): Montpelier report, this alternative includes a full sized roundabout at Main St & Barre St and a mini-roundabout at Main St & State St.

Because this design does not allow room for any bicycle infrastructure on Main Street, to include a north-south bicycle route downtown this alternative converts the section of Elm Street between State Street and School Street to one-way for vehicle traffic to make room for a two-way bike lane. If this segment was converted to one-way southbound traffic, the left-turning traffic from State St onto Elm St would be diverted to Main & State (from State to Main). This would have a significant impact at an already congested intersection; therefore, converting the segment to one-way northbound is a better option for traffic circulation downtown. This would add more right-turning traffic at Main & State (from Main to State), which would not have a large impact on the capacity of the intersection.

Additionally, the same inconvenient detours for westbound traffic on East State Street exist because of the mini roundabout at Main & State (see the following pages).

Bicycle Facilities

Preserving the parking on Main Street and reconfiguring some to diagonal spaces does not leave any room for bicycles on Main Street. Though the proposed design includes adding sharrows to Main Street, it puts bicyclists in the same space as motor vehicles, which is not suitable for children and other vulnerable bicyclists. The Elm Street one-way conversion makes room for a two-way cycle track on Elm Street, parallel to Main Street, between School Street and State Street. It would have two 5 foot bike lanes with a 2 foot buffer from traffic. There is a connection to Main Street from Elm & State via the proposed festival street in the

Heney & Jacobs parking lot and the new bike path.

Pedestrian Improvements

The roundabouts at Main & Barre and Main & State reduce the number of lanes a pedestrian must cross and also can provide a refuge island. They will also slow down traffic and add opportunities for streetscaping.

Parking

This alternative has a combination of back-in angled parking and parallel parking along Main Street. Parking is retained on the south side of Barre Street. There are 105 parking spaces retained in the project area for this alternative.

Notes

- Rail crossing through the roundabout is unconventional and would require warning signals stopping all traffic if a train is coming
- Two travel lanes (left turn lanes not needed at roundabouts)
- Festival street has shared lanes for bikes and vehicles
- Elm Street bikeway and festival street could be part of a long-term bicycle network in Montpelier, in conjunction with another Main Street alternative
- No bicycle facilities on Main St (a main goal of this scoping study)

Greening America's Capitals Plan on Main Street and Elm Street Bikeway



Bicycling. There are no bicycle facilities on Main Street. ⚠️ Bike path users need to cross the street 3 times to get from between the east and west sides of Main Street.



Walking. At each roundabout, bicycles would mix with pedestrians on a shared use path around the intersection. There is already limited space for pedestrians and storefronts between the road and buildings downtown. Pedestrians are diverted from their straight-line path at intersection crossings.



Driving. While roundabouts may reduce some traffic congestion, detours at the Main & State intersection have big impacts on traffic circulation. All westbound traffic turning straight or left from East State Street would be rerouted. In addition, converting Elm Street to one-way creates a detour for northbound traffic on Elm Street and limits access to businesses on Elm Street between State Street and School Street.



Parking. 105 out of 117 parking spaces are retained.



Cost. Significant amounts of right-of-way acquisition for a full size roundabout at Main & Barre makes this option costly.



Constructibility. Coordinating with the railroad and other landowners to build the full size roundabout at Main & Barre will add years to the construction schedule. The grocery store's parking lot will lose parking spaces and the entrance will be effected.

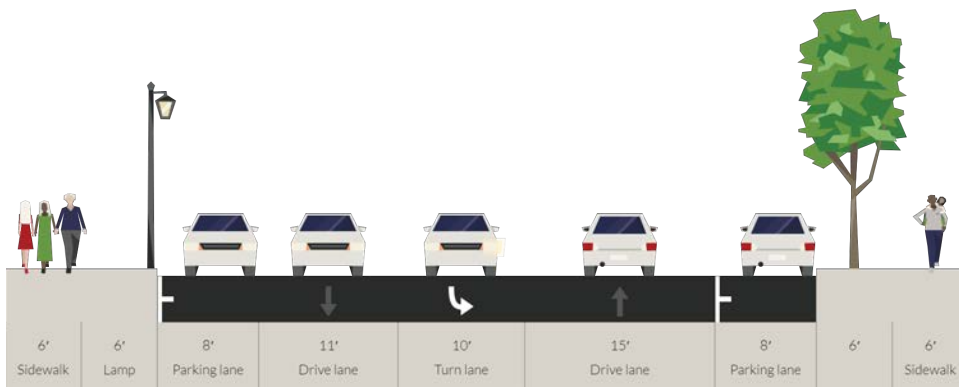


Figure 68: Existing Section FF on Main Street (outside of Rite Aid)



Figure 69: Section FF on Main Street for alternative M4 (outside of Rite Aid)



Figure 70: Route for all vehicles wanting to turn left from East State Street to the southern portion of Main Street. According to traffic data from VTrans, approximately 43% of the westbound traffic on East State Street turn left onto Main Street (approximately 775 vehicles per day).

The AADT of Langdon Street in 2016 was 170 according to VTrans data. Adding this volume of traffic would significantly increase the AADT of Langdon Street. Vehicles waiting to turn left onto Langdon Street from Main Street would often back up traffic into the Main & State roundabout.

This would also add additional traffic to the Main & State intersection.

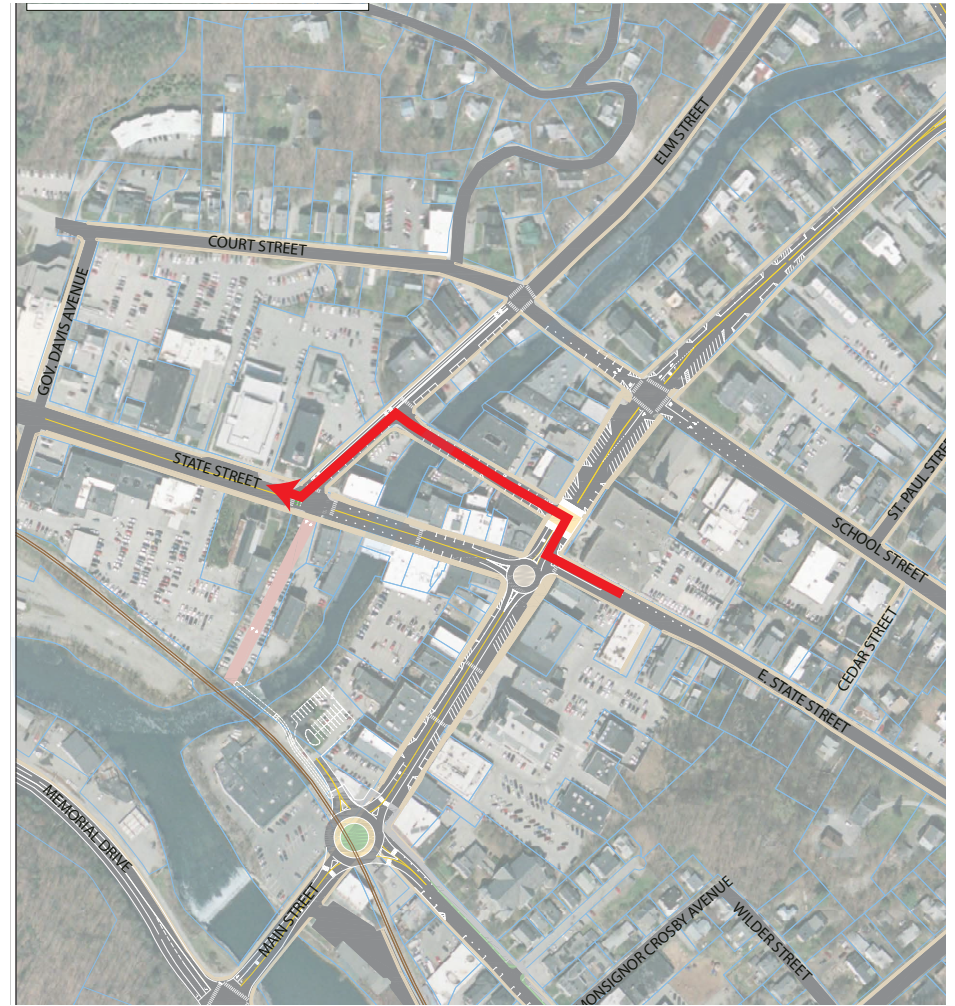


Figure 71: Route for all vehicles wanting to go straight through the intersection from East State Street to State Street.

According to traffic data from VTrans, approximately 40% of the westbound traffic on East State Street go through to State Street (approximately 720 vehicles per day).

The AADT of Langdon Street in 2016 was 170 according to VTrans data. Adding this volume of traffic would significantly increase the AADT of Langdon Street—not to mention the traffic challenges previously discussed. Vehicles waiting to turn left onto Langdon Street from Main Street would often back up traffic into the Main & State roundabout.



Figure 72: Route options for all vehicles getting from State Street to Elm Street (Route 12) northbound.

Right-of-Way

The Heney and Jacobs parking is currently being leased by the City for public parking. Acquiring this parcel would be required for the proposed festival street.

At the Main & Barre intersection, the parcel on the southeast corner of the intersection, where there is currently a dry cleaners, the City would need to purchase part of the right-of-way to accommodate a roundabout.

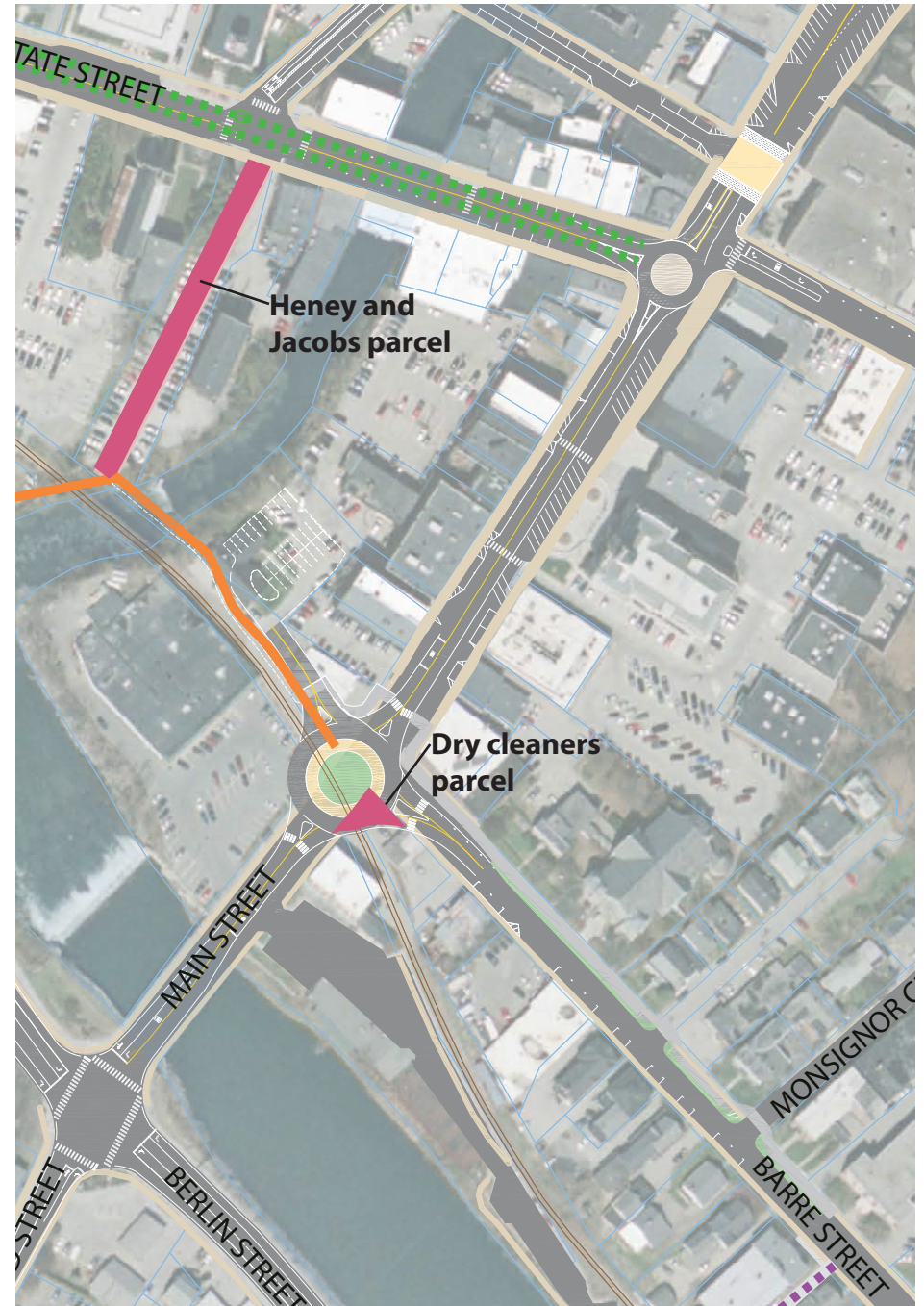


Figure 73: Right-of-Way impacts for festival street and roundabout at Main and Barre Street.

Alternatives Evaluation

The following pages provide data that was utilized to compare the presented alternatives from a quantifiable perspective, including: impact on traffic operations and parking changes. To evaluate the alternatives against the project needs, purpose and goals, a matrix provides an at-a-glance perspective on qualitative data that compares the different options by highlighting their benefits, as well as their shortcomings. Combined with public feedback, input from the City and direction from the Steering Committee, a preferred alternative was selected and both short and long term projects were identified.

Traffic Operations

The effects of changes to the traffic control at the intersections along Main Street were examined using Synchro, a traffic modeling tool. The model uses afternoon (PM) peak hour traffic volumes, which are historically higher than the morning volumes.

Average Delay

Average delay is the amount of time in seconds that a vehicle waits to get through an intersection. Lower delays mean that people don't have to wait as long at the traffic signal. Because the intersections at Main & Barre and Main & School are currently unsignalized, adding any kind of traffic control increases the delay at the intersection for the Main Street approaches, and thus the overall intersection. Roundabouts have less delay than traffic signals at all of the intersections studied.

Volume and Capacity

The ratio of volume to capacity measures how many vehicles an intersection can accommodate relative to the amount of vehicles that go through that intersection. The higher the ratio between volume and capacity, the more traffic congestion and queuing is to be expected. Roundabouts improve the volume to capacity ratio the most of each alternative.

It is important to note that this traffic model is a simplified representation of the real-world conditions, and does not capture the nuances of all traffic interactions in a downtown setting. For example, the mid-block crossings and small alleyways leading to parking lots off of Main Street often require vehicles to stop, which can back up traffic through all of these intersections.

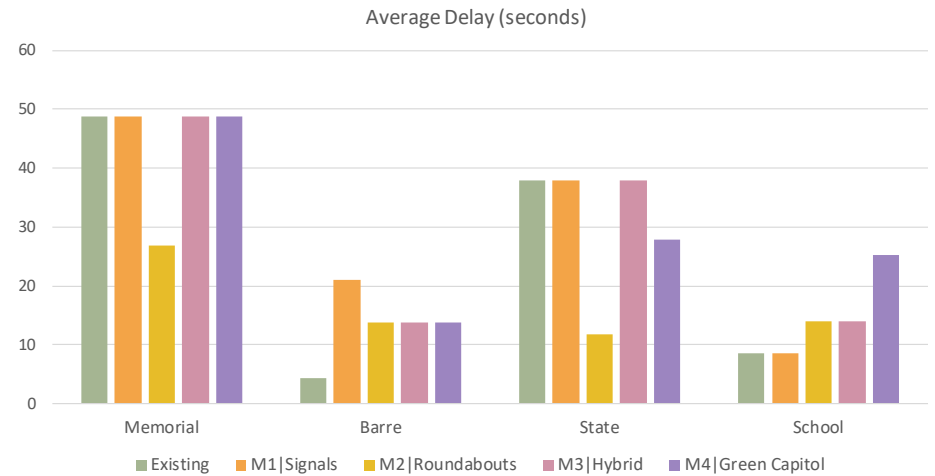


Figure 74: Average delay alternatives comparison

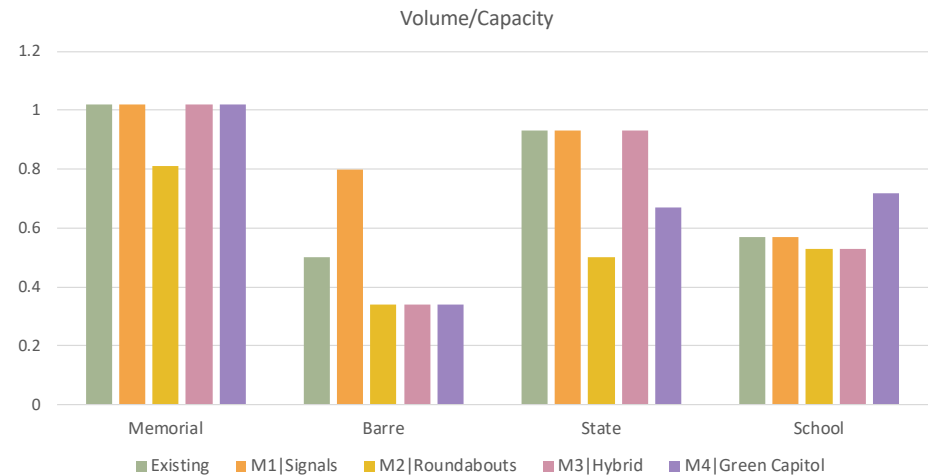


Figure 75: Volume to capacity ratio alternatives comparison

Parking Impacts

The impacts to parking were balanced with the goals set forth at the beginning of this study, namely to accommodate a wider range of community members who desire to walk and bike in this area. The largest reduction in parking comes with the M1 signals option. The roundabouts in the other alternatives allow the turn lanes on Main Street to be reduced, which leaves room for parking and bicycle lanes. The M4 alternative preserved the most parking, but does not provide any bicycle facilities on Main Street.

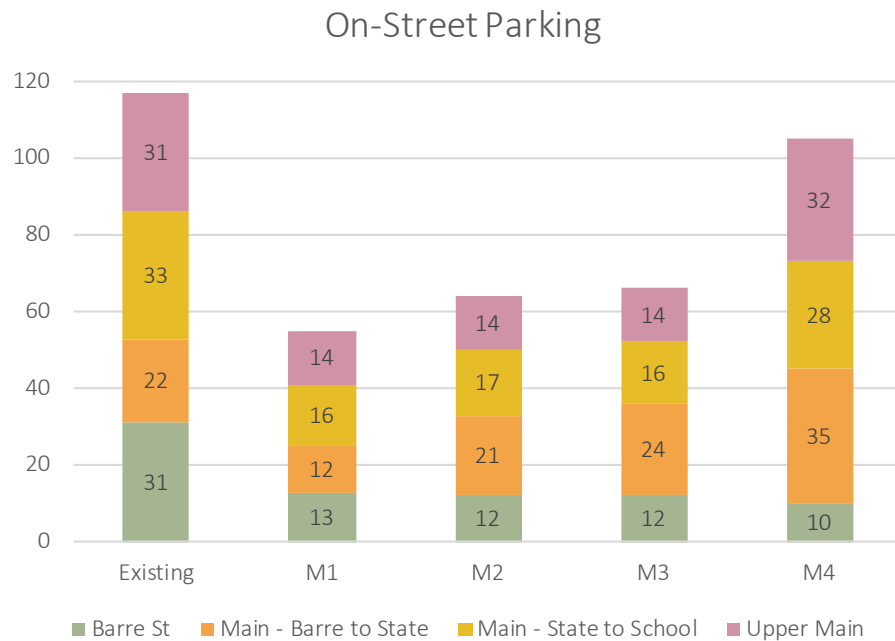


Figure 76: Parking counts alternatives comparison



Figure 77: Space dedicated to vehicles - roads and parking areas - account for a considerable amount of the surface area in downtown.

Alternatives Comparison

Table 5: Evaluation of Main Street alternatives

	No Build	M1	M2	M3	M4
		Signals with bike lanes	Roundabouts with bike lanes	Hybrid - Signals & Roundabouts)	Greening America's Capitals + Elm Street bikeway
Meets project goals					
Increases bicycle safety	No change	Unprotected bike lanes	Protected bike lanes Barre St to School St	Some protected bike lanes	No bicycle facilities on Main St
Increases pedestrian safety	No change	Daylighting crosswalks, additional crosswalk at Main & Barre	Pedestrians are mixed with bicycles	Daylighting crosswalks	Pedestrians are mixed with bicycles
Reduces traffic congestion	No change	Adaptive signal timing optimizes traffic flow	Reduction in delay and increase in volume/capacity	Main & Barre mini roundabout is between 2 signals	Reduction in delay and increase in volume/capacity
Improves traffic circulation	No change	Easier to turn out of Barre St	No left turn or thru at Main from E State	Easier to turn out of Barre St	No left turn or thru at Main from E State; Elm St is one-way
Other impacts					
Impacts to parking	No change	Lose 62 spaces	Lose 53 spaces	Lose 51 spaces	Lose 12 spaces
Impacts to natural resources ¹	No change	No change	Main & Memorial roundabout encroaches on Winooski River Corridor	No change	No change
Impacts to cultural resources ²	No change	No disturbance beyond existing curbs; no potential disturbance	Potential encroachment at roundabouts	Potential encroachment at roundabouts	Potential encroachment at roundabouts
Maintenance requirements	No change	No change	Median and splitter island landscaping	Median and splitter island landscaping	Median and splitter island landscaping
Permitting issues	No change	None identified	None identified	None identified	None identified
Utility impacts	No change	None	Move 1 utility pole, 5 catch basins, 1 light, remove 9 traffic poles	Move 1 light and remove 5 traffic poles	Move 1 utility pole, 3 catch basins, 2 lights, remove 5 traffic poles
ROW impacts	No change	None	Less than 500 SF	Less than 500 SF	Approximately 2500 SF at Main & Barre, 26,600 SF at Heney & Jacobs parking lot
Cost	No change	\$\$	\$\$\$\$	\$\$\$	\$\$\$\$

1. All alternatives have some opportunities to address stormwater management (except for no build)

2. Impacts limited to the School/Main Intersection, where excavation is possible.

Table 6: Evaluation of Barre Street alternatives

	No Build	B1		B2		B3
		Sidepath on the south side of the street	Sidepath on the north side of the street	Buffered Two-way Bikeway on the south side of the street	Buffered Two-way Bikeway on the north side of the street	Buffered Bike Lanes
Meets project goals						
Increases bicycle safety	No change	Continuous facility type; trail users only cross the road once	Continuous facility type; trail users cross the road 3 times	Only meets minimum width requirements, trail users only cross the road once	Only meets minimum width requirements, trail users only cross the road once	Protected bike lanes, comfortable width
Increases pedestrian safety	No change	Pedestrians are mixed with bicycles; Trail users only cross the road once	Pedestrians are mixed with bicycles; Trail users cross the road 3 times	Trail users only cross the road once, no significant change on Barre St	Trail users cross the road 3 times, no significant change on Barre St	No change
Reduces traffic congestion	No change	No change	No change	No change	No change	No change
Improves traffic circulation	No change	No change	No change	No change	No change	No change
Other Impacts						
Impacts to parking	No change	Lose 13 spaces	Lose 18 spaces	Lose 13 spaces	Lose 18 spaces	Lose all parking
Impacts to natural resources ¹	No change	No change	No change	No change	No change	No change
Impacts to cultural resources ²	No change	No change	No change	No change	No change	No change
Maintenance requirements	No change	Plowing sidepath	Plowing sidepath	Bike lane maintenance (paint)	Bike lane maintenance (paint)	Bike lane maintenance (paint)
Permitting issues	No change	None identified	None identified	None identified	None identified	None identified
Utility impacts	No change	Move 6 catch basins	Move 6 catch basins and 1 utility pole	None	None	None
ROW impacts	No change	None	None	None	None	None
Cost	No change	\$\$	\$\$	\$	\$	\$

1. All alternatives have some opportunities to address stormwater management (except no build)
2. Impacts limited to excavation on undisturbed soils



Public Feedback on Alternatives

Throughout the development of alternatives, D&K met regularly with the City and the project steering committee to discuss different options, feasibility and constructability. Alternatives were presented to the general public in August 2018, to Montpelier City Council in April 2019 and to the general public again on two occasions in July 2019. The following provides an overview of key themes received during these public forums, which informed the development of the preferred alternative presented hereafter. Media was present at the two alternatives presentations in July 2019, including local television ORCA media, Local 44 News, The Times Argus and The Bridge. (A summary of meeting minutes and public comments is included in Appendix G.)

Road Corridors

Barre Street Improvements:

- Concerns about removal of parking near the intersection (especially impacting the laundromat)
- Concerns with installing a two-way bike lane - safety of cyclists
- Request that a study of the entire Barre corridor be undertaken to address Barre and the Barre/Main intersection; including the impact of the new business on Barre Street and any forthcoming development east on Barre Street

Main Street Improvements:

- All roundabouts would improve traffic flow and slow traffic at each intersection
- Roundabouts are challenging for the young, for the elderly and for anyone with visibility challenges; roundabouts are also challenging for everyone in the evening (drivers, cyclists and pedestrians)
- Concerns about loss of parking with any changes
- Curb extensions would be beneficial at mid-block crossings
- Langdon Street crosswalk needs improvement - whether moving it or adding markings so cued cars do not block the crosswalk and intersection

Intersections

Main Street/ Memorial Drive

- Consider a roundabout, especially if one is installed at Main/Barre
- Current concerns of drivers from all directions trying to get onto Main and burning red lights needs a solution in the short term

Main Street/ Barre Street

- Need for bike path to align with new bike facility and minimize frequency of street crossings for people walking and biking
- Consider left priority signals if intersection signalized
- Desire lines between the two sides of the street need to be taken into consideration

Main Street/ State Street

- Concerns of impact to side streets if a roundabout is installed and traffic is diverted
- It works relatively well as it is - do not change it
- Removing or moving the Langdon Street crosswalk should be a priority

Main Street/School Street

- A mini-roundabout should be tested



School St



COMING NEXT

NEW LEAF



Preferred Alternative

Based on existing conditions, including site constraints, public feedback and both quantitative and qualitative evaluations of each alternative, a preferred alternative was developed. The preferred alternative is “M1”, a signalized corridor for the majority of the Main Street Corridor combined with “B1”, a sidepath on the south side of Barre Street.

Intersections

Main Street

M1: signalizing Main Street, with the exception of the intersection of Main Street and School Street.

The intersection of Main & State and Main & Barre are within Montpelier’s commercial district, which has high traffic volumes. Main & State is already equipped with traffic signals. The recommendation for the Main & Barre intersection is to add traffic signals as soon as possible. This intersection is, by far, of concern to everyone and affects every mode of transportation. The need for change at this intersection is critical and the recent installation of an RRFB for pedestrians is not enough to positively impact pedestrian safety.

No changes are proposed for the Main & State intersection. The traffic circulation restrictions of a mini-roundabout at Main & State have negative ramifications for East State Street traffic. As a major route for the elementary school vehicular traffic, including buses and commuter buses from neighboring towns, as well as the neighborhoods east of Main Street, detours to State Street or onto south Main Street would negatively impact the level of service on side streets and the circulation challenges that other options would improve. Due to the restrictive nature of the existing conditions at this intersection, we recommend keeping a traffic signal at Main & State. Because the intersections along Main Street are closely spaced and the traffic flow at each intersection has a significant effect on the others, keeping the traffic signal at Main & State lends itself to keeping traffic signals along the rest of the Main Street corridor. This has several other advantages, including lower costs, no utility or ROW

impacts, and constructibility.

Main & School, however, has lower traffic volumes (see Figure 9) and fewer constraints in constructability of a mini-roundabout: the intersection is aligned at all approaches, there is only one curb cut near the intersection (current TD Bank building), and there are not any right-of-way challenges, nor a need for easements: a mini roundabout fits within the existing pavement. This intersection is on the edge of the downtown commercial district, not in the heart of it and although the intersection may still back up with traffic during peak hours, it is not sandwiched between two major signalized intersections dictating the flow of traffic through this segment of road. Curb extensions will significantly improve the safety and visibility of pedestrians crossing the road, which is of particular concern here because this is a busy crossing due to the proximity to the elementary school and the public library.

Adaptive Signal Controls, installed throughout the corridor, would help improve traffic flow and are recommended to lessen wait times for everyone, thus reducing vehicular carbon emissions. However, education of residents and employees in the area who are accustomed to the existing light cycles at Main & State, would need to be informed and would need to adapt to any change.

In addition, again, due to existing site constraints, the installation of roundabouts at either Main & State or Main & Barre would require bicyclists to either merge with traffic in the roundabout, which does not meet the needs of bicyclists of all ages and abilities, or merge with pedestrian traffic onto the sidewalk, which is already constrained by existing buildings, storefronts, and sidewalk amenities like street lights, trees, benches, and garbage bins, that are a vital part of the downtown streetscape.

Barre Street

B1: a sidepath on the south side of Barre Street.

A significant benefit of installing a signal at the Main & Barre intersection is that it leaves room for a shared-use path crossing on the south side of the intersection, aligned with the extension of the shared-use path that is currently under construction. This reduces the number of crossings for both bicyclists and pedestrians at Main Street and at the Recreation Center, which is an important factor for a shared-use path facility that is designed for all user levels and ages. Having the side path along Barre Street on the south side of the road also preserves more parking overall, and the retained parking is on the same side of Barre Street as the laundromat, the Montpelier Senior Activity Center, the church and the Arts Center .

Jeff Speck, an American city planner and author known for his book *Walkable City*, offers a walkability perspective on roundabouts in downtown settings in his book *Walkable City Rules*.¹

Build modern roundabouts according to best practices to solve problems of safety and/or congestion, but do not locate them in shopping districts and other places where pedestrian vitality is desired. ---Jeff Speck

There are several reasons why roundabouts do not support downtown vitality by impacting walkability. First, pedestrians are diverted from their desired path—straight across the intersection in line with the sidewalks—to cross before the entrance and exit of the roundabout for vehicles (or mini roundabout). This is especially challenging for pedestrians with visual impairments because the path does not follow a straight line. Secondly, roundabouts create dynamic environments. Vehicles are not obligated to stop before entering. The curvature leading to the roundabout requires, in most cases, vehicles to slow down, but not stop. We heard during our public engagement that people felt safe crossing the road with exclusive pedestrian phases because all of the cars are stopped. According to Speck, pedestrians prefer static environments

¹ Jeff Speck, *Walkable City Rules: 101 Steps to Making Better Places* (Washington DC: Island Press, 2018), 164-165.

where they are not on high alert checking if they can cross and on the lookout for moving cars. We also heard that people avoid the existing roundabout at Main & Spring street at night because cars do not stop, lighting is challenging and pedestrians do not feel 'seen'. This is especially concerning for individuals with visual impairments. There are not any cues for people to cross roundabouts on foot.

Third, roundabouts are principally designed for vehicles. Their curves signal that the intersection is more for people driving, not walking or cycling.

Bicycle Facilities

In the first iteration of alternatives, the M1 alternative proposed unprotected bike lanes. Upon refining the preferred alternative, this option was developed further to include lower-stress bicycle facilities. Due to space constraints, grade separated bicycle lanes are proposed as part of the preferred alternative for Main Street. Grade-separated bicycle lanes are comfortable for cyclists requiring less horizontal buffer between bicycles and vehicles, since bicycles are on a different level than cars. Based on the FHWA Separated Bike Lane Planning and Design Guide, the preferred minimum width of separation between a raised bike lane and travel way is two feet. This facility would need to account for adequate drainage.

For the Barre Street shared-use path connection, constructing a sidepath along Barre Street will create a continuous facility for segments of the shared-use path to the east and west of the current gap.

These are the long term recommendations for Main and Barre Street.

Short term recommendations are an opportunity for rapid implementation and installing lower-cost projects in the near future. For Main Street, this includes a quick-build mini-roundabout Main & School and unprotected bike lanes along Main Street that only require restriping, not curb reconstruction. For Barre Street, converting one parking lane into a two-way buffered bikeway would serve as a connection for the east and west segments of the shared-use path for bicycles until the sidepath can be constructed. These short and long term recommendations are further detailed in the following sections.

Why Separated Bike Lanes?

Around the country, researchers and planners have determined that people are more likely to use a separated bike lane than a painted one. Separated bike lanes are safer and more appealing to a wider group of bicyclists. One study in Canada showed that a bicyclist's risk of injury is reduced by 90% when riding on a separated bicycle facility, while only being reduced by 50% when riding in a painted bike lane, when compared to riding on a street with no bicycle facilities.¹ Furthermore, people perceive separated bike lanes as more comfortable to ride in than painted bike lanes.² This perception of safety is more likely to encourage a broader range of bicyclists to use the bike lanes.

The most frequent comment that we heard during our public outreach called for increasing bicycle friendliness and safety in Montpelier. Upgrading to grade-separated bike lanes in downtown Montpelier provides a safe north-south bicycle facility that is accessible to more people in the community than painted bike lanes.



Figure 79: Retrofit grade separated bike lanes (Image courtesy of NACTO)

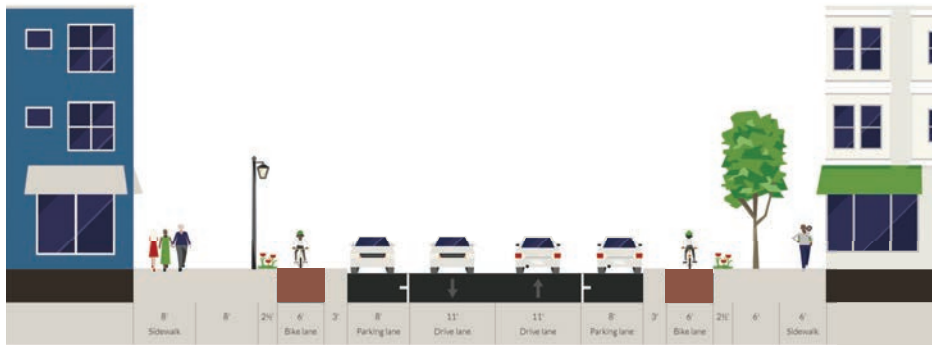


Figure 78: Typical Cross Section - Main Street at the Three Penny Taproom

1 Teschke, K. et al. Route infrastructure and the risk of injuries to bicyclists: a case-crossover study. *American Journal of Public Health*. 2012; 102:12.

2 McNeil, Nathan; Monsere, Christopher M.; and Dill, Jennifer, "The Influence of Bike Lane Buffer Types on Perceived Comfort and Safety of Bicyclists and Potential Bicyclists" (2015). *Civil and Environmental Engineering Faculty Publications and Presentations*. 221. https://pdxscholar.library.pdx.edu/cengin_fac/221



Figure 80: Bike lanes at sidewalk grade (Image courtesy of MassDOT)



POLICE



Blanchard St

ROAD WORK AHEAD

BIRD

Short Term Recommendations

A full size plan of the short term recommendation is located in Attachment B, and plan views by segment next to the existing conditions are shown on the following pages.

To improve traffic circulation throughout the signalized corridor, the City is considering installing adaptive traffic signal technology along Route 2 (Memorial Drive) and Main Street. This technology has the ability to collect real-time data and optimize the sequence of traffic signals accordingly based on the current traffic conditions. With this program, a traffic signal would be installed at Main & Barre that would be optimized with the Main & State traffic signal and the others along Memorial Drive. This adaptive signal technology would result in different operations than what we found in our traffic analyses, and will likely be efficient without the significant impacts of installing roundabouts. The smaller-impact mini roundabout at Main & School is still recommended for its traffic calming and pedestrian benefits.

In addition, in the short-term plan, the storage lengths of the left turn lane onto Barre Street from Main Street has been reduced to fit its downtown setting. At this time, Main Street does not have any traffic control at this intersection and the 95th percent queue length is currently unknown. The most recent count data from VTrans shows that 83 vehicles in total took this left during the peak hour. A left turn lane with a storage length of 60 feet (for approximately three vehicles at a time) with a taper length of 40 feet is shown on the plan, though these distance can be adjusted based on needs of the traffic signal.



Figure 81: Crosswalk next to a bicycle crossing. Image: Wash Cycle

Adaptive Signal Control

Adaptive Signal Control is technology that is added to existing (or new) traffic signals. It captures information about the current traffic conditions, including vehicle stacking (queues), how long people are waiting at intersections, and the volume of vehicles moving from one intersection to another. It uses this data to optimize which lanes have green lights and how long the light is green. Corridors throughout the US that have installed adaptive signal control have seen reductions in crashes, emissions, and vehicle delay.

Bicycle Facilities

Main Street

In the short term, bicycle lanes can be added to Main Street at a low cost and with relatively small impacts. Restriping the pavement markings to include bicycle lanes and reconfigure some parking spaces takes advantage of the existing pavement width to share the space among different users, without negatively impacting traffic operations. The VTrans Highway Safety & Design Detail (HSD - 646.01) provides a typical for bicycle markings at intersections. It consists of 2 by 6 foot dashed green pavement markings that improves the visibility of bicyclists at intersections.

Barre Street

In the short term, a two-way buffered bicycle lane can be striped along the south side of Barre Street, in place of the parking lane. The south side of the road is preferred because it provides easier access to important destinations on the north side of the road, like the senior center and church. This facility will connect the existing and planned extension of the bike path as soon as the new section of the bike path is built from Taylor Street to Main Street. Narrowing the lane widths of Barre Street to add the bicycle facility may also have a traffic calming effect.

Implementation (short term)

Parking Count

Main Street	65 spaces
Barre Street	18 spaces
Total	83 spaces (lose 28% of parking, 34 spaces)

Transportation Management Plan

Restriping the bike lanes on Main Street would involve some repaving to remove the existing pavement markings, which would also preserve the life of the pavement constructed during the 2017 VTrans project. As such, there will be a need for traffic management and likely a detour

route during construction on Main Street. Painting the bike lanes on Barre Street will be much simpler, and construction could likely be completed in a day with little disruption to traffic. Because the planned extension of the bike path will be completed soon, connecting the two current ends of the bike path is a main priority for the City. A traffic management plan questionnaire is in Attachment D.



Figure 82: Two way bike lanes. Image courtesy of Neil Hodges

Barre Street Signal & Two-way Buffered Bikeway

At the Main Street crossing, the City may consider an exclusive pedestrian phase for the signal to match the Main & State and Main & Memorial intersections. Along the 2-way bikeway on Barre Street, high visibility pavement markings and signs at crossings are imperative for providing a safe facility for bicyclists. Green pavement markings and warning signs can provide this visibility to reduce the risk of crashes.

Barre St, Existing

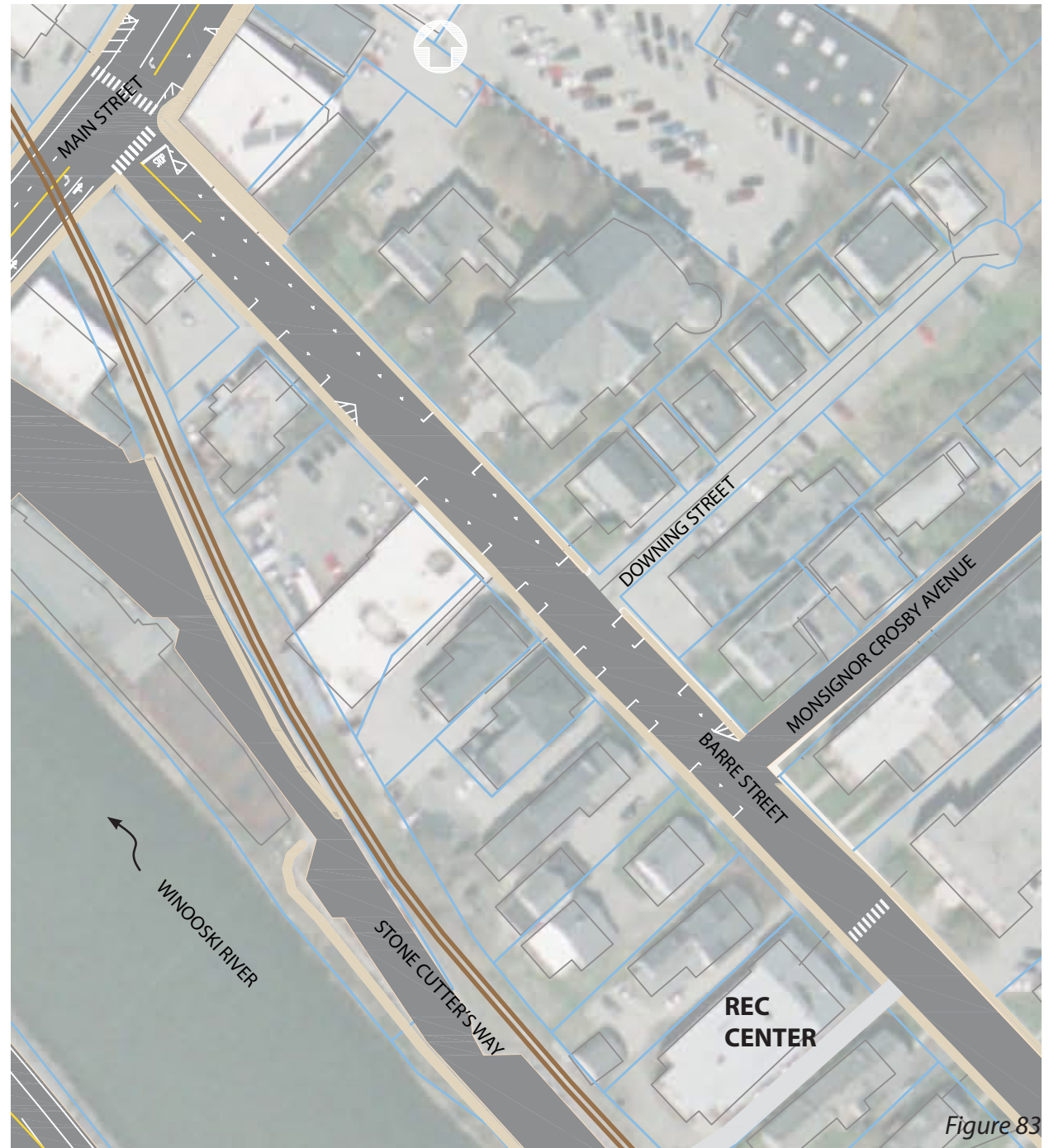


Figure 83

Barre St, Two-way Bikeway

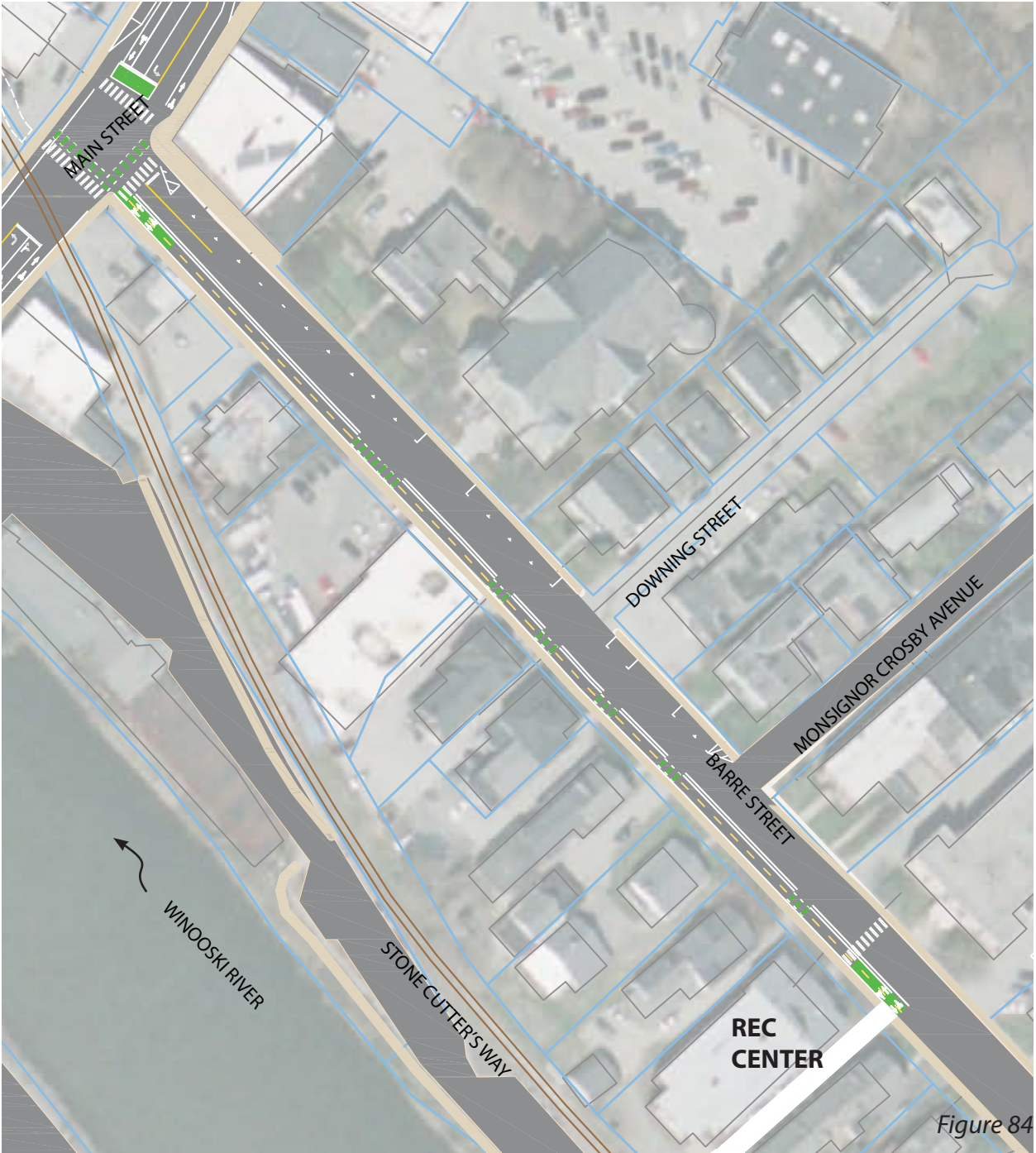
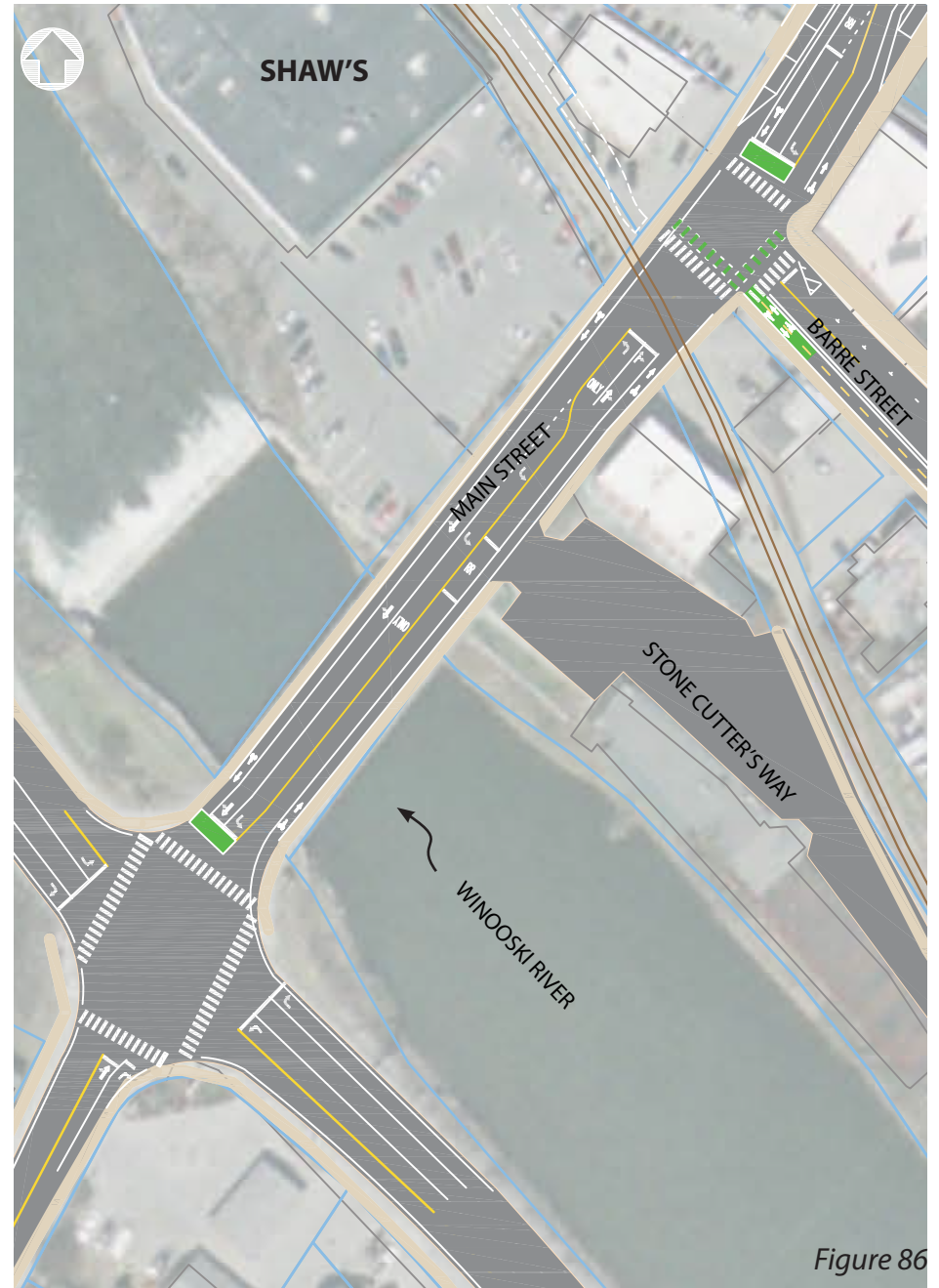


Figure 84

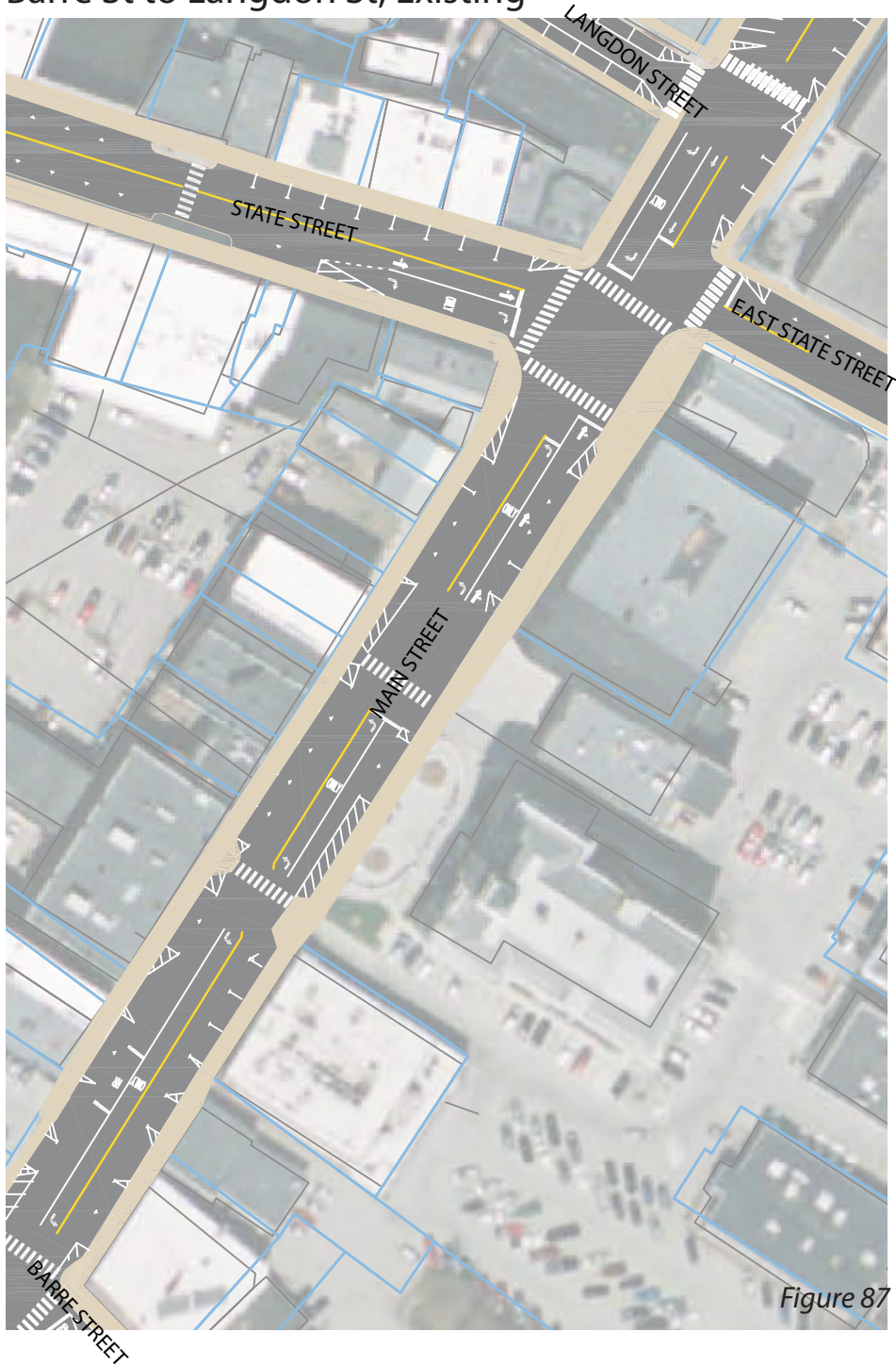
Memorial to Barre St, Existing



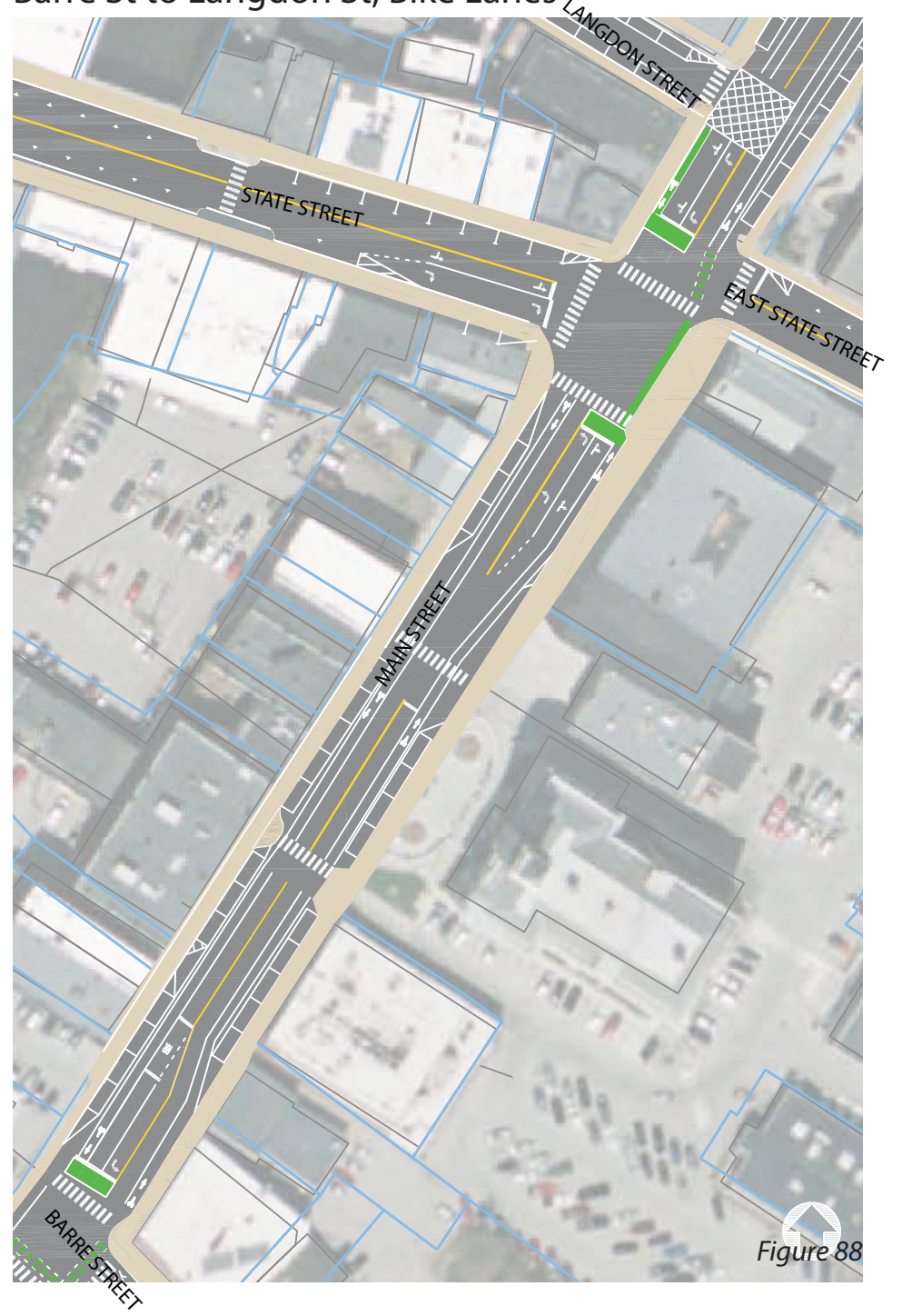
Memorial to Barre St, Bike Lanes and Traffic Signal at Main & Barre



Barre St to Langdon St, Existing



Barre St to Langdon St, Bike Lanes



Langdon St to School Street, Existing

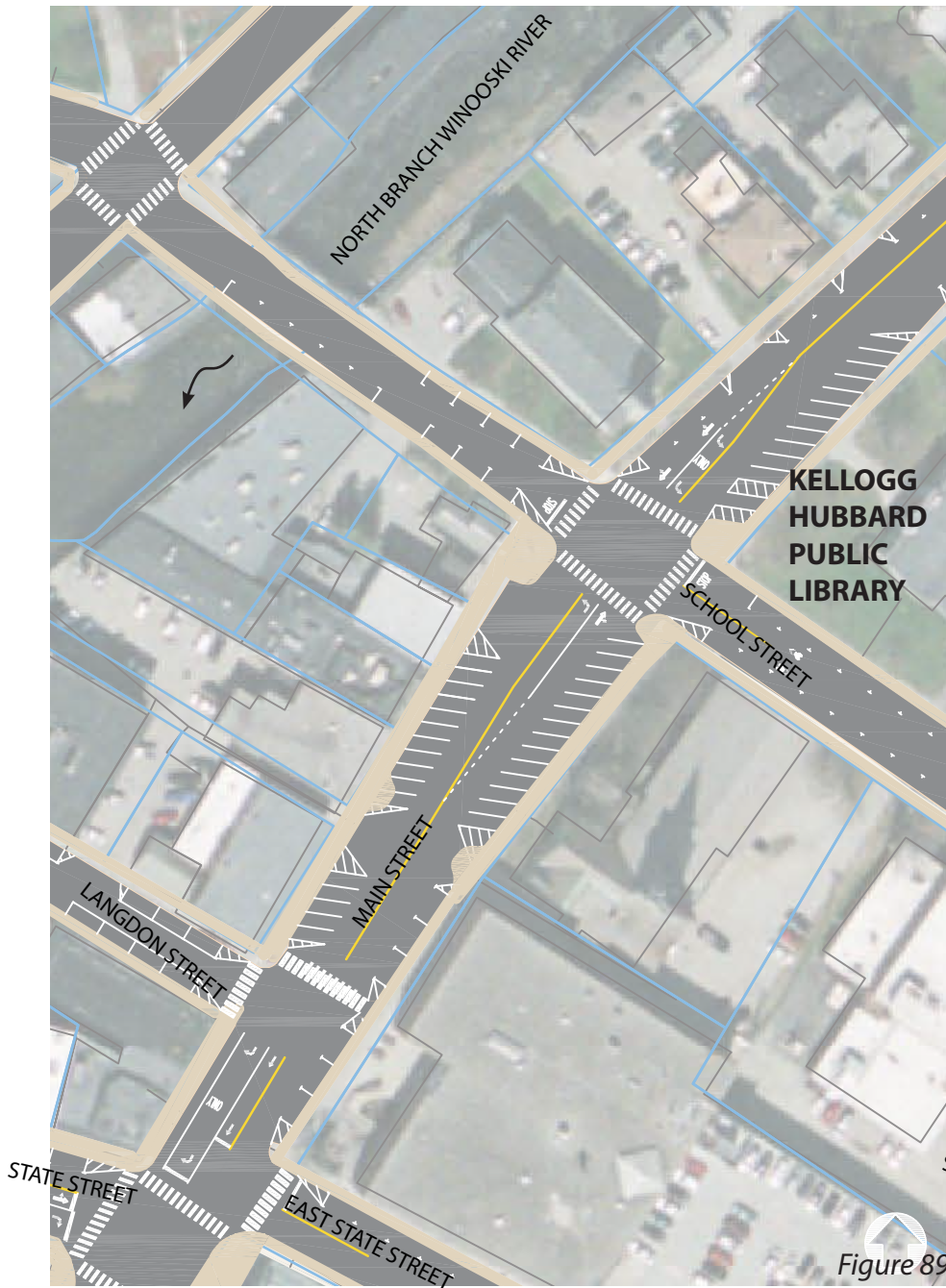


Figure 89

Langdon St to School St, Bike Lanes and Mini Roundabout

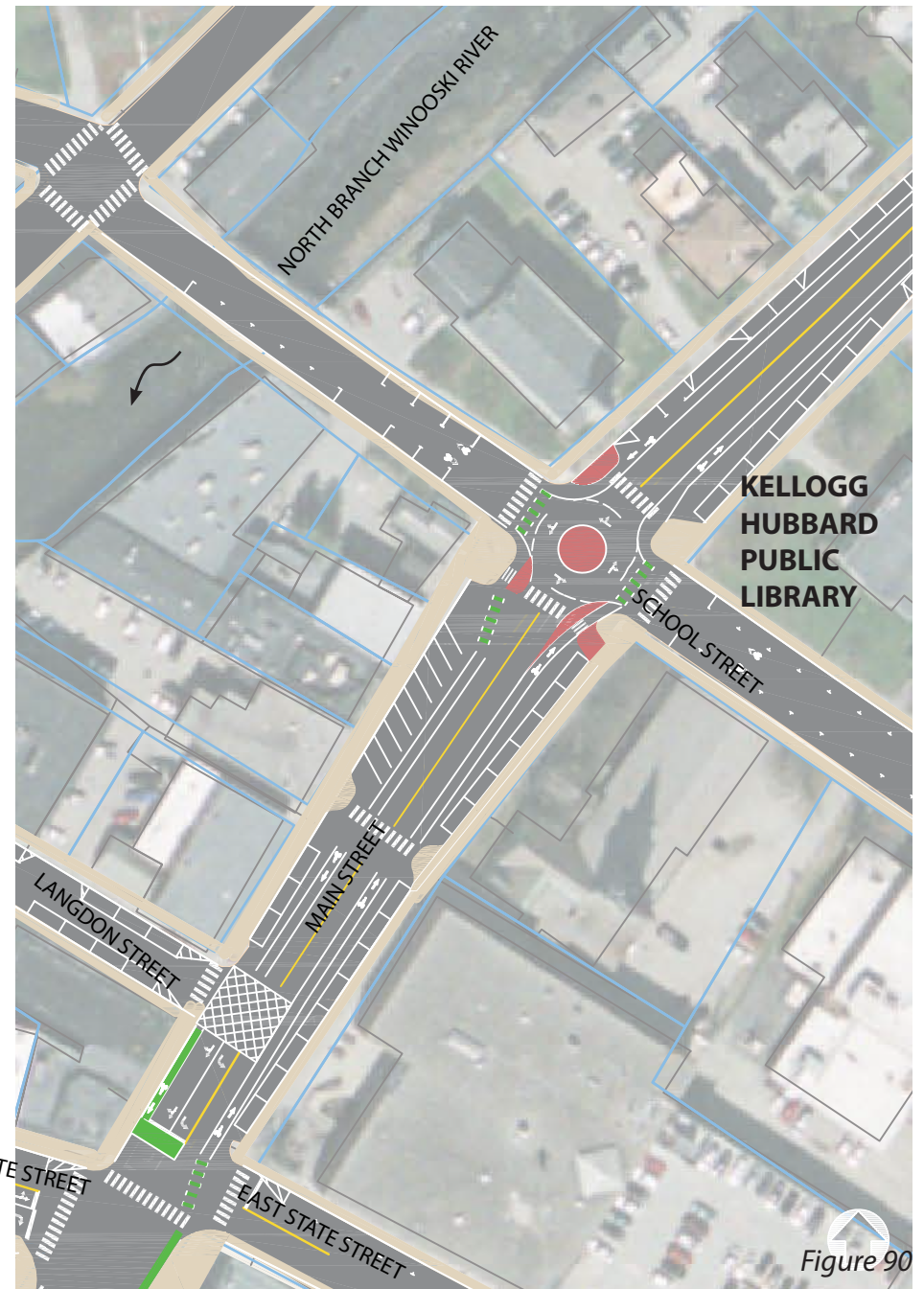


Figure 90

School Street to Spring Street Roundabout, Existing



School Street to Spring Street Roundabout, Bike Lanes



Figure 92



LY LY NAIL SALON
Professional Nail Care
& Spa

Hazen Pl

JCT
BUSINESS
2

OPEN
SUNDAY

Yarn



Rapid Implementation Projects

Rapid implementation, or Quick Build, is an approach to implement bicycle and pedestrian safety projects at low cost and with minimal impacts. The graphic to the right shows the spectrum of implementation options ranging from a short term demonstration (a week or less), to a pilot project (often lasting several months) to interim design, which is a semi-permanent installation that may be in place up to several years. The final step, once adjustments have been made to designs through the earlier phases, is permanent installation through a capital project.



Figure 93: Implementation Spectrum, from People for Bikes Quick Build for Better Streets

Barre Street Two-way Bikeway

Examples from Burlington, VT and Bella Vista, AR below show examples that can inform the rapid implementation of the Barre Street short term bike lanes.



Figure 94: Cycle Lane Delineator in Bella Vista, Arkansas. Image: Street Plans

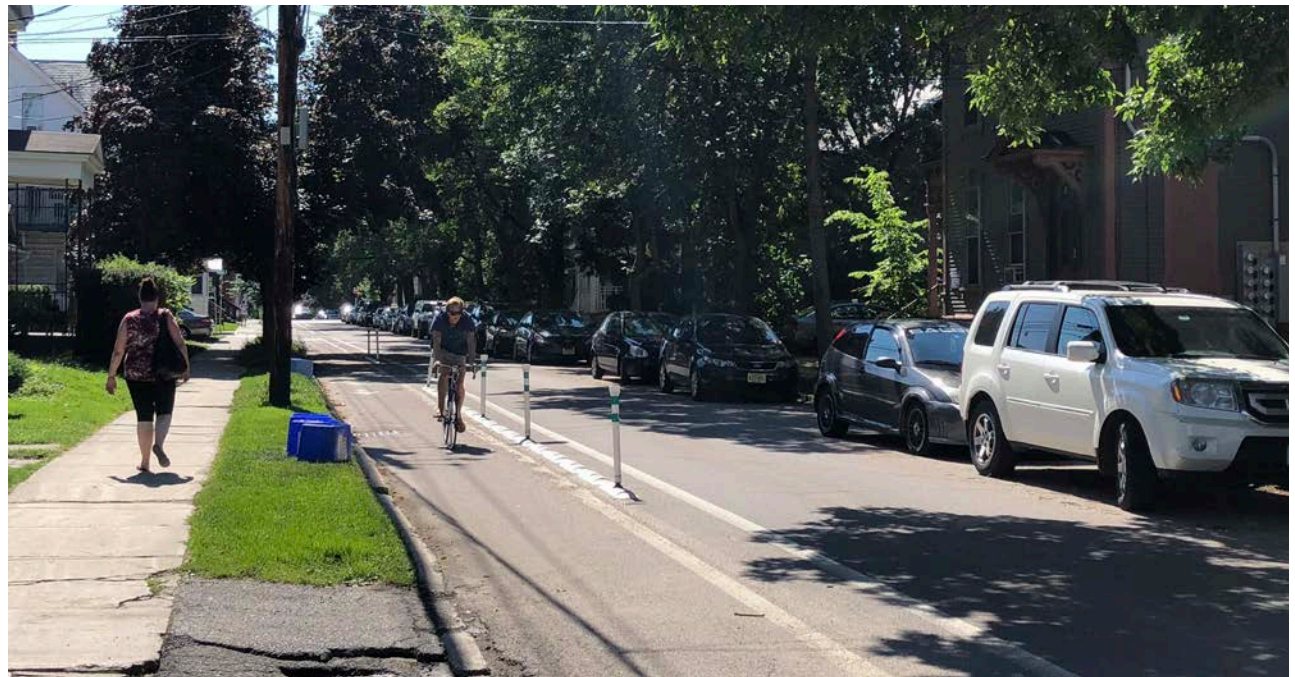


Figure 95: Tuff Curb XLP with Delineator Posts on North Union St in Burlington, VT. Image: Street Plan

Main & School Mini Roundabout

The mini-roundabout could be installed using quick build materials within the existing pavement, creating a safer and more attractive intersection, and providing a period for public input and feedback before a more permanent design is considered. The figure below it from the Quick Build BTV (Burlington, Vermont) Guide, shows examples of materials and designs that could be used at Main & School. One example is the Gummitechnik rubber roundabout island that can be bolted into the pavement (image is shown on the following page). Other options include using paint and bollards to reconfigure the space. The City can decide which materials and approach fits their needs and budget.

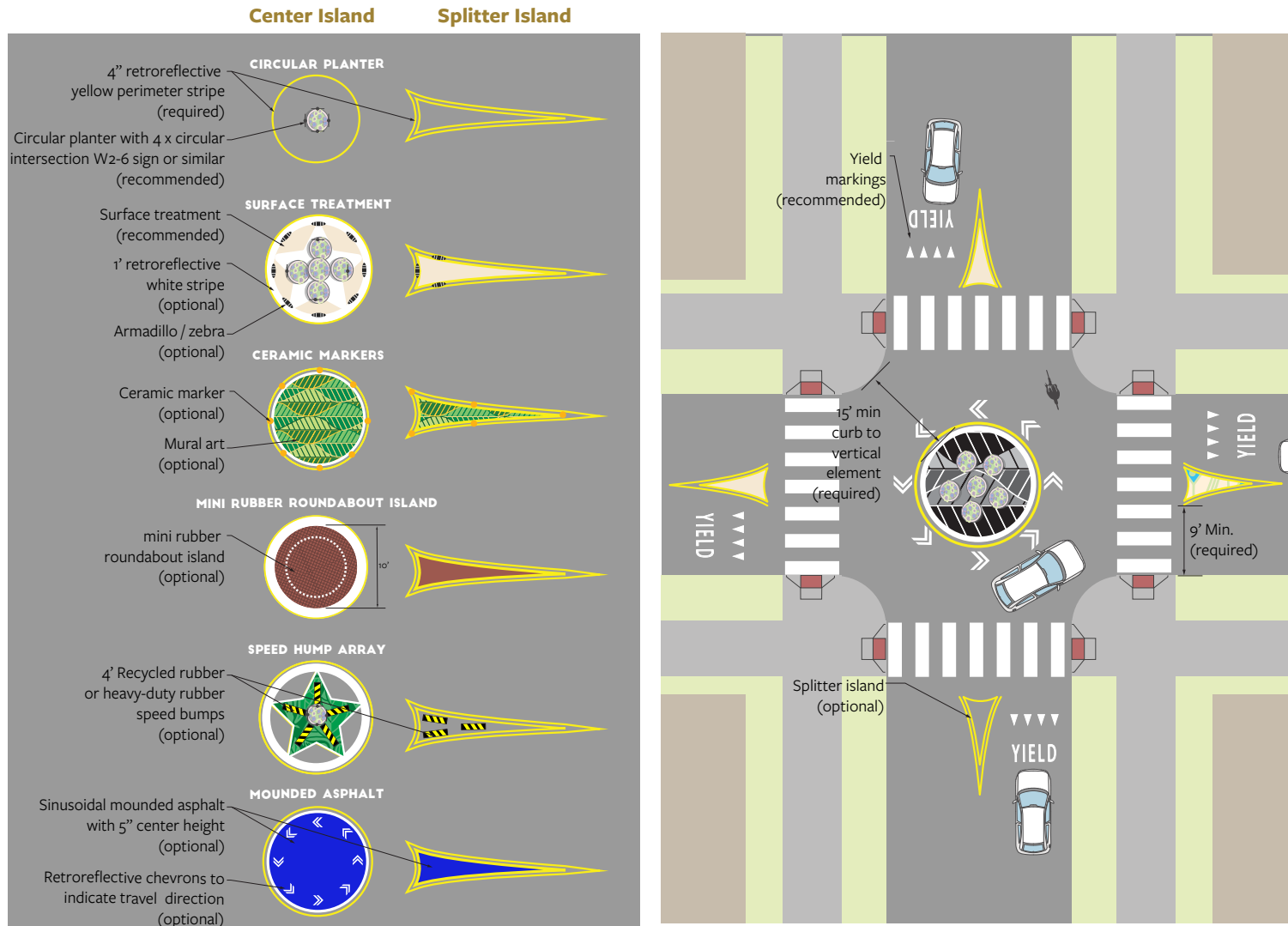


Figure 96: Quick Build Standards and Materials for Mini-Roundabouts, Quick Build BTV (Burlington, Vermont)



Figure 97: Temporary Roundabout, Sao Paolo.
Image: NACTO



Figure 98: Quick Build Curb Extension, Pearl St, Burlington VT.
Image: Street Plans Collaborative



Figure 99: Gummitechnik Mini-Roundabout (rubber roundabout island).
Image: Ph Gummitechnik GmbH & Co

Quick Builds lead to Long Term Changes

After several bicycle and pedestrian safety projects are installed using rapid implementation methods in the short-term, the City can get feedback on interim changes and install permanent features.



Figure 100: Stormwater curb extensions. Image: NACTO Urban Street Stormwater Guide



Figure 102: Sidepath rendering. Image: RDG Planning & Design



Figure 1001 Mini roundabout rendering. Image: AARP, The Walc Institute, and TDC Design Studio

Long Term Recommendations

A full size plan of the long term recommendation is located in Attachment C and plan views by segment next to the existing conditions are shown on the following pages.

Main Street

In the long term, providing a bicycle lane on Main Street that is separated from both vehicles and pedestrians will meet the needs of more users of the roadway than the short term recommendation of unprotected bicycle lanes. This is the first goal of this study, to accommodate a broad range of ages and transportation mode choices on this corridor. Without significant right-of-way impacts or taking space away from pedestrians, Montpelier can provide grade-separated bicycle lanes on both sides of the road.

Reducing the width of the turning lane from Main Street onto Barre Street adds space for more separation between the bike lane and travel lane as well as landscaping or green stormwater infrastructure.

Curb extensions at Main & School will narrow the width of the road needed to cross the street by foot and improve the visibility of those waiting to cross by bringing them in front of the parked cars along Main Street. Additionally, “daylighting” the midblock crossings by adding curb extensions restricting parking within 10 feet of the crosswalk makes people and vehicles more visible to each other. This space can be filled with bicycle parking or other pedestrian amenities, depending on the context.

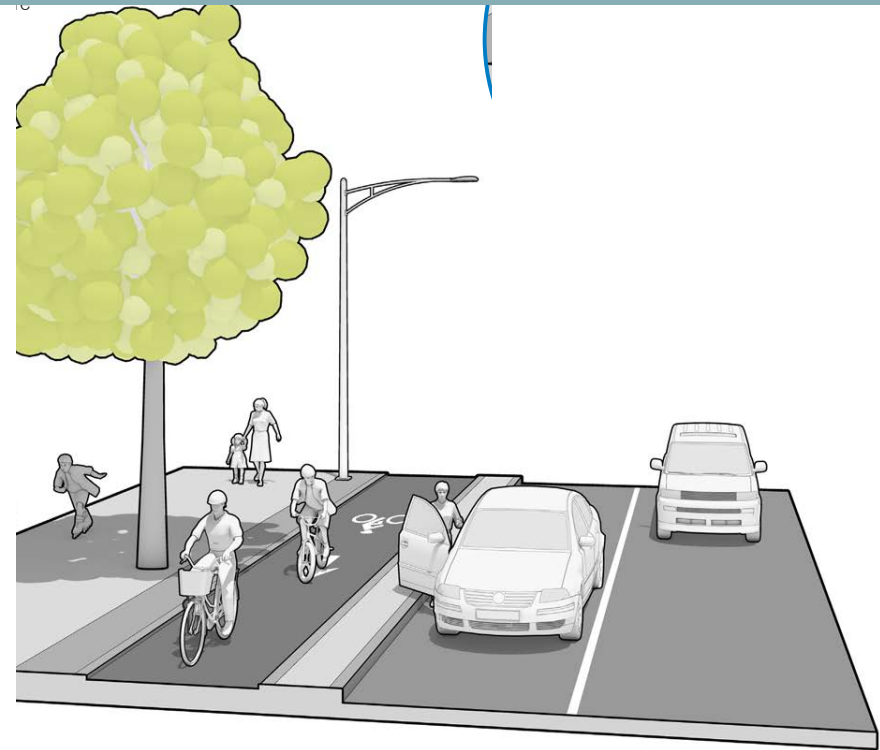


Figure 103: Schematic of grade separated bike lanes (Image courtesy of MassDOT)

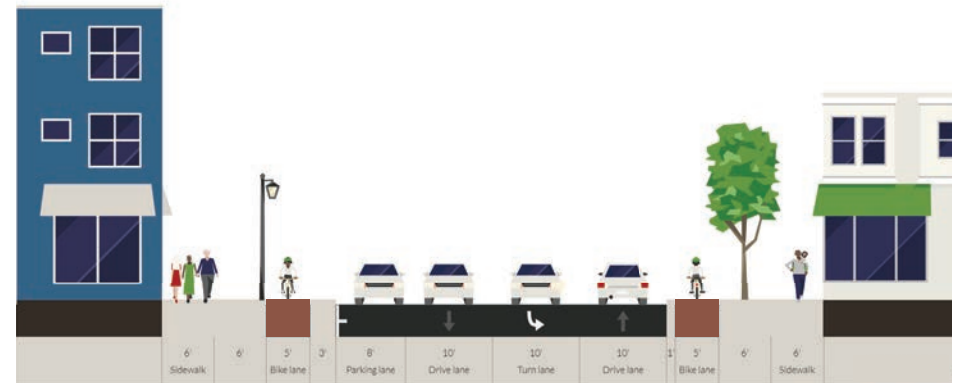


Figure 104: Typical Cross Section - Main Street at Rite Aid



Barre Street

The shared-use path along Barre Street from Main Street to the Recreation Center would connect the two ends of the bike path. It separates users from the roadway providing a low stress east-west bicycling route through Montpelier.

The design of a shared-use path next to a roadway focuses on providing comfortable widths for users and safe crossings at intersections. On Barre Street, there are 14 feet available within the right-of-way for a shared-use path, with 8 feet from removing the northern parking lane and 6 feet from the existing sidewalk. Currently, there are relatively low volumes of bicyclists and pedestrians using this sidewalk, making a 10 to 12 foot path appropriate. Depending on the width of the path, there can be a 2 to 4 foot street buffer, which could benefit snow storage.

There are trade-offs associated with allocating the available width to the path or the buffer. A wider path provides more comfort for users and space for passing, while a wider buffer offers more protection from moving vehicles and more room for snow storage. Based on the relatively low bicycle and pedestrian volumes and the need for snow storage, we recommend a 10 foot path with a 4 foot street buffer along Barre Street.

Implementation (long term)

Parking Count

Main Street	63 spaces
Barre Street	18 spaces
Total	81 spaces (lose 33% of parking, 40 spaces)

Transportation Management Plan

Installing retrofitted grade-separated bicycle lanes on Main Street would require repaving and reconstructing the curb, so traffic management and a detour route would be required during construction. Building the sidepath on Barre Street would also require curb reconstruction and may also require road closure and a detour route.

Memorial to Barre St, Existing



Memorial to Barre St, Bike Lanes and Traffic Signal at Main & Barre



Barre St to Langdon St, Existing

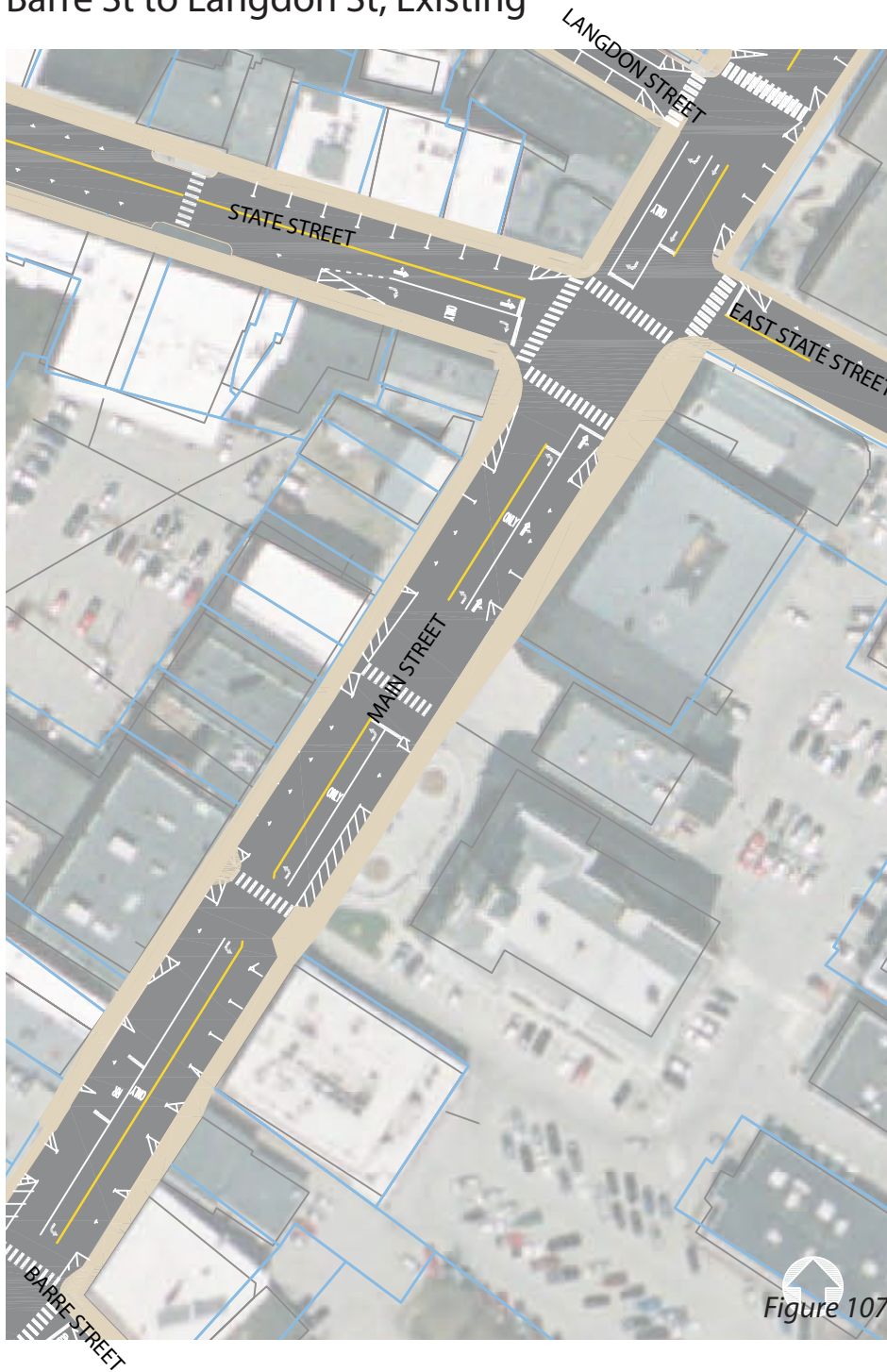


Figure 107

Barre St to Langdon St, Grade-Separated Bike Lanes

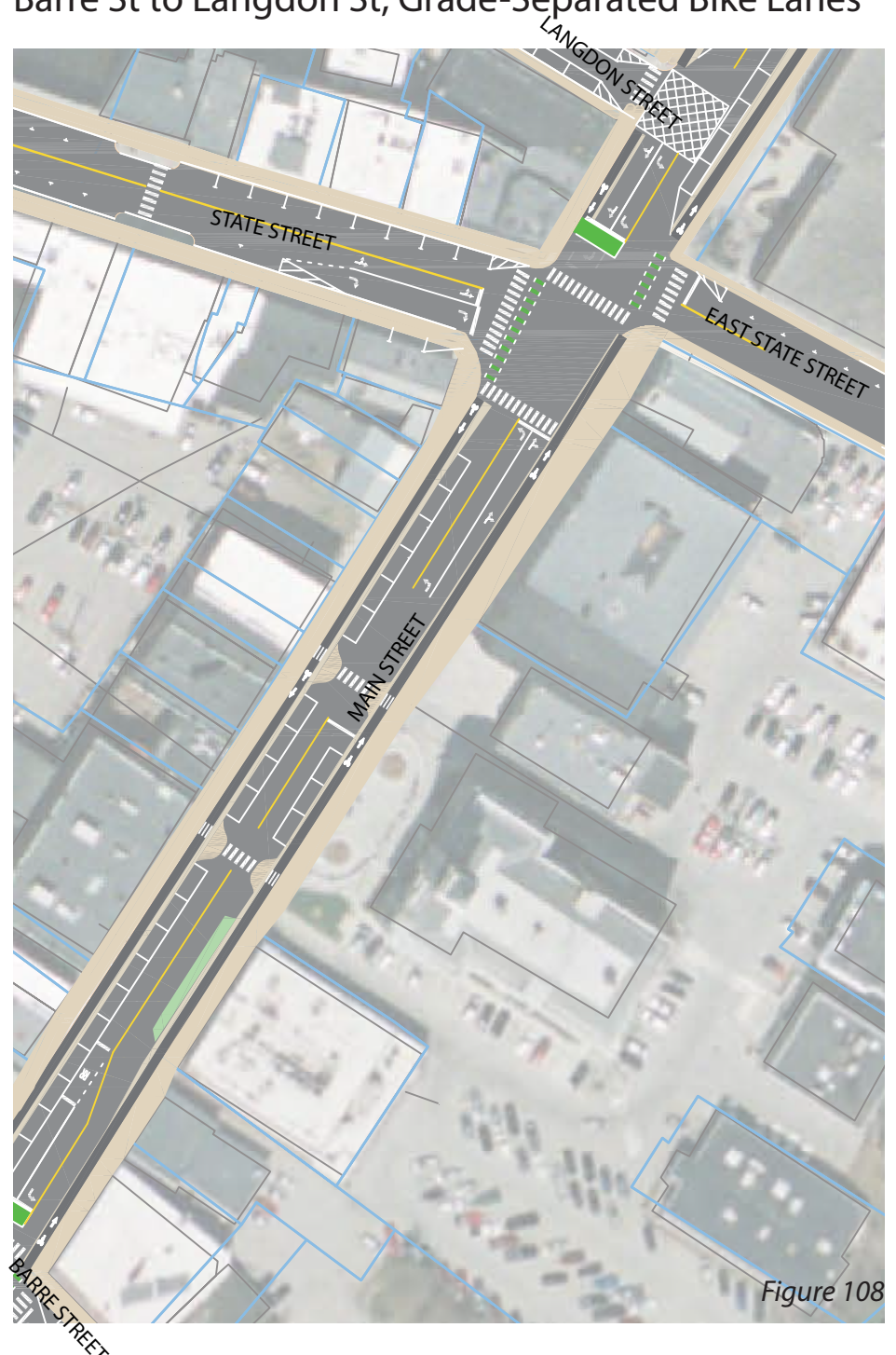


Figure 108

Langdon St to School St, Existing



Figure 109

Langdon St to School St, Grade-Separated Bike Lanes and Mini Roundabout

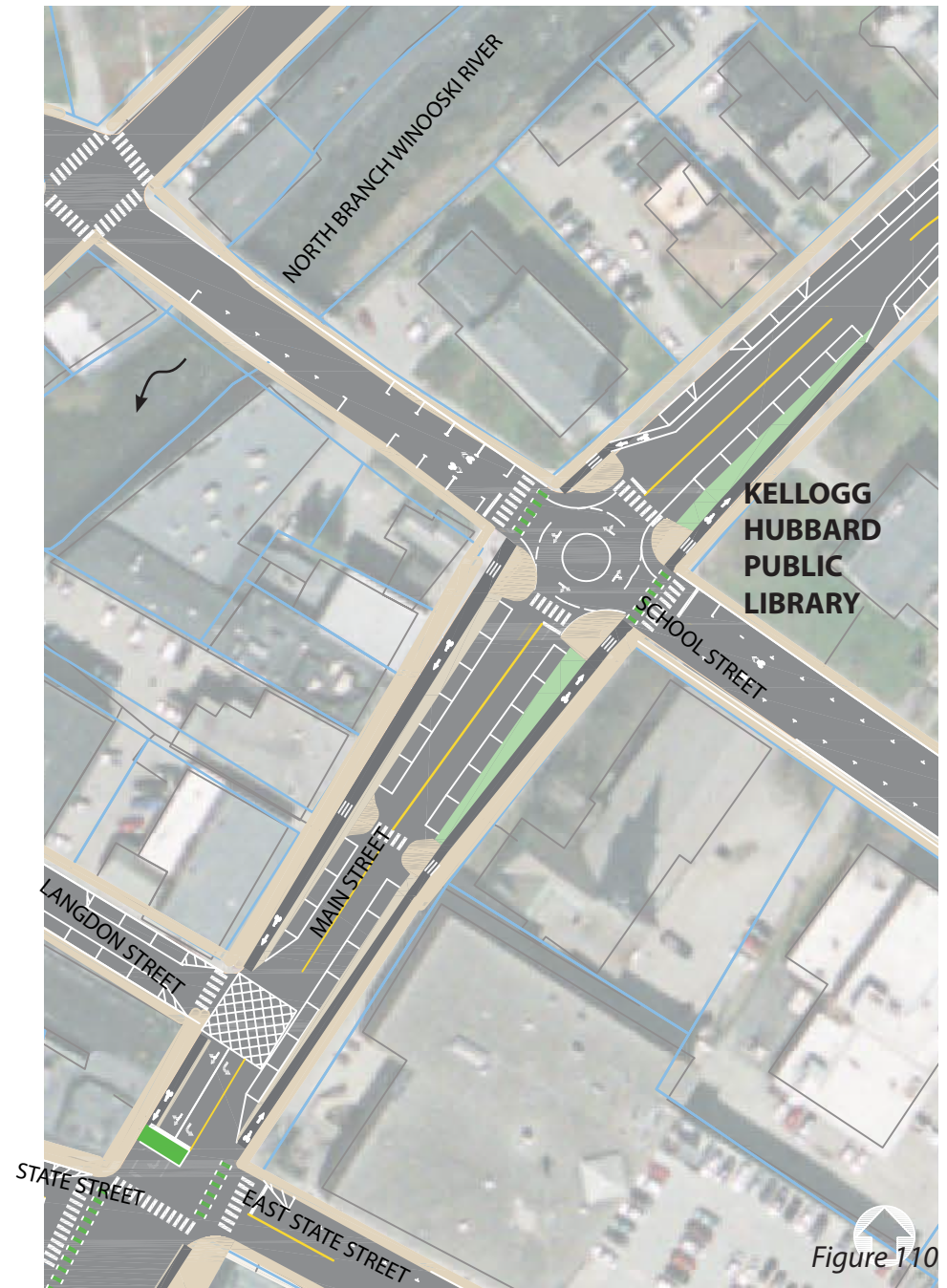


Figure 110

School Street to Spring Street Roundabout, Existing



Figure 111

School Street to Spring Street Roundabout, Bike Lanes





↑ Northfield 10
← E. Montpelier 7
← St. Johnsbury 34
FAST SOUTH WEST

ONLY

01A 626

00M 475

Costs

Planning level cost estimates were developed for the short and long term recommendations. Detailed estimates are included in Attachment F.

Table 7: Planning Level Cost Estimates

Location	Short Term			Long Term		
	Project	Cost	Notes	Project	Cost	Notes
Barre Street	2-way bikeway rapid implementation			Street Sidepath		
	Construction	\$ 40,000.00	Includes removing existing parking stall markings, painting the bike lanes, traffic control, mobilization	Construction	\$ 165,000.00	Includes excavation, sidepath construction, moving stormwater infrastructure, moving the curb, removing parking meters, traffic control, and mobilization
	Design Fee	\$ 10,000.00		Design Fee	\$ 25,000.00	
	\$ 50,000.00			\$ 190,000.00		
Main & Barre	Main & Barre Traffic Signal		Includes buying and installing traffic signal hardware and traffic control, and mobilization.	Adaptive Signal Control		
	Total	\$ 300,000.00		Total	\$ 250,000.00	Includes Main & Memorial, Main & Barre, Main & State
Main & School	Mini Roundabout rapid implementation			Mini Roundabout		
	Construction	\$ 25,000.00		Construction	\$ 150,000.00	Includes curb reconstruction, curb extensions, changing elevations of utilities, pavement markings, traffic control, mobilization; assuming repaving is concurrent with a Main St bike lane project
	Design Fee	\$ 5,000.00		Design Fee	\$ 25,000.00	
	\$ 30,000.00			\$ 175,000.00		
Main Street	Bike Lanes			Protected Bike Lanes		
	Construction	\$ 500,000.00	Includes repaving and restriping, traffic control, and mobilization.	Construction	\$ 1,050,000.00	Includes repaving and restriping, bike lane construction, moving stormwater infrastructure, moving the curb, traffic control, and mobilization.
	Design Fee	\$ 65,000.00		Design Fee	\$ 160,000.00	
	\$ 565,000.00			\$ 1,210,000.00		



Implementation Timeline

Neither the short, nor the long term recommended alternatives require acquiring right-of-way, reducing both the cost and the length of time required to implement projects in the next few years. Below, the recommendations are divided into projects, some of which can be implemented as a pilot or rapid-implementation project if additional public support is sought, or to address an issue in the short-term without requiring additional design (such as striping the bikeway on Barre Street).

Table 8: Estimated Implementation Timeline

Activities	Estimated Timeline																	
	2020		2021			2022			2023			2024+						
Short-Term: Rapid-Implementation or Pilot Projects which can be implemented in the short-term or much-needed solutions to key area problems.																		
1) Barre Street: Rapid Implementation: Two-Way Bikeway			█															
2) Temporary Curb Extensions at Main and School Street			█	█	█													
3) Daylight Mid-Block Crossings on Main Street						█												
4) Signal at Main and Barre Intersection							█	█	█	█	█	█	█	█	█	█	█	█
5) Adaptive Signal Controls							█	█	█	█	█	█	█	█	█	█	█	█

	Estimated Timeline																			
Activities	2020				2021				2022				2023				2024+			
Medium-Term: After testing potential solutions in the short-term, implement additional changes that can further meet safety goals. Implement short-term steps to significant changes to circulation.																				
6) Rapid Implementation Mini Roundabout at Main Street and School Street																				
7) Restriping of Main Street to include Bike Lanes																				
Long-Term: Projects that require additional design work and larger financial and public support.																				

	Estimated Timeline																			
Activities	2020				2021				2022				2023				2024+			
8) Barre Street Sidepath Construction																				
9) Main Street Construction of Grade-Separated Bike Lanes																				

Funding Opportunities

Funding for these types of projects and magnitude of cost can be sought from VTrans' Bicycle and Pedestrian program, the Transportation Alternatives Program or the Agency of Commerce and Community Development's Downtown Transportation Fund.

Requirements for a local match can be challenging for larger projects, but it is not necessary to have the matching funds available at the time of the application, and it will typically be several years before construction occurs. Therefore, it is recommended to build up dedicated funds over time for larger projects. Some ways that Vermont communities have raised the local funds needed for a significant project such as this include:

- Allocating a percentage of the total town roadway funding for pedestrian projects, and setting aside these funds for the project match.
- Municipal bonding for significant project costs
- Dedicate a small tax increment to the project for a limited time until the project funding is secured

Bicycle and Pedestrian Program Grants

The Bicycle and Pedestrian Program administered by VTrans can also provide funding for design and construction of bicycle and pedestrian facilities, including sidewalks, improved pedestrian crossings, lighting, shared use paths, etc. after a scoping study is completed. This funding source requires local match, depending on which grant is being sought. Grant applications are generally announced in early spring, with completed applications due at the beginning of summer.

For up-to-date information and grant application deadlines, visit: <http://vtrans.vermont.gov/highway/local-projects/bike-ped>

Transportation Alternatives Program (TAP)

The TAP provides grant funding for scoping, design and construction of on and off-road facilities for pedestrians, bicyclists and other non-motorized forms of transportation, including sidewalks, bicycle infrastructure, pedestrian and bicycle signals, lighting and other safety and accessibility related infrastructure, environmental remediation related to transportation, community improvement related to transportation, Safe Routes to School programs.

For up-to-date information and grant application deadlines, visit: <https://vtrans.vermont.gov/highway/local-projects/transport-alt>

Downtown Transportation Fund

Downtown transportation grants are administered by the State of Vermont for municipalities to finance transportation related capital improvements in support of economic development, within or serving a Designated Downtown. Examples of funded projects include streetscape and public space improvements, parking facilities, rail or bus facilities, utility relocations, lighting, wayfinding signage.

For up-to-date information and grant application deadlines, visit: <https://accd.vermont.gov/community-development/funding-incentives/downtown-transportation-fund>.



yoga
mountain center



STATE LAW
YIELD TO PEDESTRIAN

214
214
GVT

Municipal Recommendations

As previously outlined, consultations with the Main/Barre Street Steering Committee and the Montpelier Transportation Infrastructure Committee occurred at several meetings held between January 2018 and June 2019. In addition to these committee meetings, the public was invited to three public meetings to discuss alternatives between August 2018 and August 2019, in addition to two presentations to the Montpelier City Council. The dates of the public meetings are summarized here:

Local Concerns Meeting	- Town Meeting Day, March 2018 (Summary of feedback provided on p.11)
Alternatives Presentation to Public	- August 29, 2018
Presentation to Montpelier City Council	- April 10, 2019
Alternatives Presentation to Public	- July 25th, 2019 & July 31st, 2019 (Summary of feedback provided on p.73)
City Staff Presentation to Montpelier City Council	- August 29th, 2019

Municipal Preferred Alternative

A critical piece of the scoping study was to provide a municipal preferred alternative. The city staff preferred alternative was submitted for review to Montpelier's City Council on August 29th, 2019 and included: signaling the intersection of Main/Barre and connecting the west-east existing shared use path along the south side of Barre Street (Full Staff Recommendation included in Appendix G). Further investigations and piloting a mini-roundabout at the Main/School Street intersection were also supported. Other priorities included moving the crosswalk at Langdon Street/ Three Penny to Hazen Place, as well as providing bicycle facilities along Main Street. Montpelier City Council discussed each of the proposed key alternatives to the scoping study before deciding to vote and adopt the municipal preferred alternative. Ultimately, the result is endorsement of alternatives M1 and B2. This alternative provides vital steps for the City to take in fulfilling its vision of a walkable and bike-friendly community within the project area and in connecting a vital piece of the regional bicycle path to Downtown Montpelier.