

ACTIVE TRANSPORTATION PLAN CHITTENDEN COUNTY, VERMONT

APPROVED APRIL19, 2017



CONTENTS

01 EXECUTIVE SUMMARY

03 CHAPTER 1: INTRODUCTION

1.1 Planning Process and Document Structure	3
1.2 Defining Active transportation	4
1.3 Vision and Goals	4
1.4 Local Bicycle and Pedestrian Plans	6

07 CHAPTER 2: BENEFITS OF ACTIVE TRANSPORTATION

2.1 - Public Health	7
2.1.1 - Physical Health	7
2.1.2 - Mental Health	8
2.2 Economic Development	9
2.3 Quality of Life	11
2.4 Environmental Quality	13

3.2 -3.3 -

15 CHAPTER 3: PUBLIC PROCESS 3.1 - A

Advisory Committee	15
nput Channels	16
nput Results	16
3.3.1.1 - Routes I Currently Walk / Bike	19
3.3.1.2 - Destinations I Currently Walk / Bike	21
3.3.2.1 - Routes I'd Like to Walk / Bike	23
3.3.2.2 - Destinations I'd Like to Walk / Bike	25
3.3.3.1 - Barriers to Walking	26
3.3.3.2 - Barriers to Biking	27
3.3.3.3 - Additional Issues	29

31 CHAPTER 4: EXISTING CONDITIONS

4.1 - Concurrent Plans and Initiatives	3.
4.2 - Facility Types	32
4.3 - Inventory and Condition Assessment	37
4.3.1 - Inventory	37
4.3.2 - Planned Projects	37
4.4 - Safety	4(
4.5 - Transit Access	42
4.6 - Public Health	44
4.6.1 - Obesity and Chronic Disease	44
4.6.2 - Air Quality and Respiratory Problems	44
4.6.3 - Disability	45
4.6.4 - Mental Health	46

CHAPTER 5: REGIONAL NETWORK ANALYSIS

5.1 - Level of Traffic Stress	47
5.1.1 - Level of Traffic Stress in Chittenden County	49
5.2 - Putting It All Together	51

CHAPTER 6: RECOMMENDATIONS

6.1 - Infrastructure and Engineering	57
6.1.1 - Short-term / Immediate to < 5 Years	58
6.1.2 - Long-term / 10+ years	61
6.1.3 - Engineering	62
6.2 - Non-Infrastructure	63
6.2.1 - Education	63
6.2.2 - Encouragement	64
6.2.3 - Enforcement	65
6.2.4 - Evaluation	66

CHAPTER 7: IMPLEMENTATION

.1 - Next Steps for Short-Term / Immediate to < 5 Years Project	67
.2 - Long Term Project Priority and Feasibility	67
.3 - Implementation Priorities	69
7.3.1 - Project 1: Colchester Ave, VT15 and VT117 from Burlington to Richmond	71
7.3.2 - Project 2: US2 from South Burlington to Bolton	72
7.3.3 - Project 3: Mountain View Road in Williston	72
7.3.4 - Project 4: VT15 from Old Stage Road to Essex Way in Essex	73
7.3.5 - Project 5: US7 from Forbes Road to Main Street in Milton	74
7.3.6 - Project 6: US7	74
.4 - Programs for Advancing Priority Projects	75
7.4.1 - Federal and State Funding Sources	75
7.4.2 - Foundations and Other Sources	79
.5 - Maintenance Costs	81

CHAPTER 8: PERFORMANCE MEASURES

CHAPTER 9: CONCLUSIONS AND NEXT STEPS

ENDNOTES

LIST OF FIGURES

Figure 1: Careanabet of wikiman	16
rigure 1. Screensnot of wikiniap	10
Figure 2: Wikimap user types	1/
Figure 3: Routes I currently walk/bike	20
Figure 4: Destinations indicated by the wikimap	22
Figure 5: Routes I'd like to walk/bike	24
Figure 6: Barriers to biking and walking	28
Figure 7: Sidewalk inventory map (Data source: CCRPC)	36
Figure 8: Bicycle inventory map (Primary source: Local Motion)	38
Figure 9: Pedestrian and bicycle crash severity (2008-2012) (Data Source: VTrans)	40
Figure 10: Frequency of crashes involving bicycles 2008-2012 (Data Source: VTrans)	41
Figure 11: GMT stops and ridership for 2013 (source: GMT) and sidewalks (not including LINK routes)	43
Figure 12: Level of traffic stress user categories	48
Figure 13: Level of traffic street analysis results	50
Figure 14: Segments identified from public input	52
Figure 15: Segments identified according to origin and destinations density	53
Figure 16: Proposed segments based on public input, origin-destination	54
Figure 17: Proposed and existing networks	55
Figure 18: Existing and proposed active transportation network in Chittenden County	59
Figure 19: Active transportation barriers that need addressing in Chittenden County	60
Figure 20: Priority-feasibility matrix	67
Figure 21: Proposed regional active transportation network and prioritization {link to web version for higher resolution}	68
Figure 22: High priority-high feasibility projects	70

LIST OF TABLES

Table 1: Advisory committee members	15
Table 2: Number of bike boardings for FY 2013, by route (Source: GMT)	42
Table 3: High priority-high feasibility projects	69
Table 4: Anticipated yearly maintenance costs (per mile)	81

ADVISORY COMMITTEE

Katelin Brewer-Colie	Local Motion/Transportation Advisory Committee (TAC)
Bob Henneberger	American Association of Retired Persons (AARP)/TAC
Nicole Losch	City of Burlington/TAC
Chris Shaw	CCRPC Board Member/South Burlington
lan Stokes	Richmond Trails Committee
Phoebe Spencer	Essex Junction Walk/Bike Advisory Committee
Heather Danis	Vermont Department of Health, Burlington District Office
Nick Meltzer	Vermont Agency of Transportation (VTrans)
Nelson Hoffman	Federal Highway Administration (FHWA)
Sandy Thibault	Chittenden Area Transportation Management Association (CATMA)/TAC
Maren Hill	Vermont Safe Routes to School
David Armstrong	Green Mountain Transit (GMT) (formerly Chittenden County Transportation Authority (CCTA))

CCRPC STAFF

Peter Keating Bryan Davis Project Manager Transportation Planner

CONSULTING TEAM

Toole Design Group (TDG) Town Planning & Urban Design Collaborative (TPUDC) VHB Lead Outreach/Engagement & Document Formatting Data Collection

"The preparation of this report has been financed in part through grant[s] from the Federal Highway Administration and Federal Transit Administration, U.S. Department of Transportation, under the State Planning and Research Program, Section 505 [or Metropolitan Planning Program, Section 104(f)] of Title 23, U.S. Code. The contents of this report do not necessarily reflect the official views or policy of the U.S. Department of Transportation."



Active transportation is a vital part of a healthy community. It not only benefits economic development, environmental quality, public and individual health, and the transportation system, but it is a key part of quality of life. This report describes the updated Chittenden County Active Transportation Plan, which defines its goal as creating a safe, comfortable, and connected regional network of pedestrian and bicycle routes that appeal to all ages and abilities. The Active Transportation Plan (ATP) supports CCRPC's regional plan ECOS and was developed in coordination with other concurrent local, regional and state planning efforts. Active transportation has many benefits for physical and mental health, local business districts, quality of life, and the environment.

Public input was an important part of developing the proposed regional active transportation network. Through an online interactive wikimap, in-person charrettes, and online comments, residents were asked to identify routes, destinations and barriers to walking and biking, and to review draft recommendations. A detailed existing conditions assessment was conducted, including a sidewalk and bicycle network inventory, safety data analysis, regional network analysis, transit access assessment, and public health conditions. Chittenden County's roadway system was analysed using a Level of Traffic Stress model, which designates roadway segments according to different categories based on factors associated with users' perceived comfort level.

The result of this planning process is a series of proposed infrastructure and non-infrastructure recommendations organized around the five E's—education, encouragement, enforcement, engineering, and evaluation. Infrastructure and engineering recommendations were developed using a prioritization method that involved feasibility, closing gaps in the network, addressing a high crash location, and serving a population in need (as shown in the figure below). Non-infrastructure recommendations, focusing on the remaining E's (education, encouragement, enforcement, and evaluation), are presented, as well as performance measures that evaluate the ATP's progress in meeting its goals. The ATP guides the process of encouraging active transportation and implementing a network of well-connected, low-stress walking and bicycling facilities that appeal to all ages and abilities throughout Chittenden County.



Through the process of developing the Chittenden County ATP, a number of important points and issues were identified:

- 1. Active transportation has numerous benefits to people in Chittenden County. It is an important part of people's lives for transportation, recreation, and health. There are also economic, environmental, health, and quality of life benefits that affect the entire population, even those who do not walk or bike.
- 2. Enforcement and education, in addition to engineering and infrastructure design, are important factors in improving safety and reducing crashes. This is particularly critical for people using active transportation, as they are more vulnerable to injuries and fatalities than people who are protected by a vehicle.
- 3. Connecting bicycling and walking to other transportation modes such as transit and carsharing is critical for an effective and efficient system that supports quality of life in Chittenden County.
- 4. Proper maintenance is imperative to support a usable and safe active transportation network. Local departments of public works should (if they haven't already) develop inspection programs to document facility condition and indicate needed repairs.
- 5. Lack of lighting and snow clearance can significantly limit usability of the active transportation network. Lighting should be included in path projects whenever possible. Responsibilities for snow and ice clearance (i.e., municipal or private abutter) should be clarified on a municipal level.
- 6. In order to be fully accessible to everyone regardless of age or ability, the infrastructure recommendations need to incorporate universal design. Snow and ice removal is particularly important for accessibility during winter months.
- 7. Many of the segments identified as high priority-high feasibility in the ATP are already on the Chittenden County Transportation Improvement Program (TIP). Coordinating with these projects provides an excellent opportunity to begin implementing connections within the active transportation network.



The ATP presents recommendations for improving network connectivity for active transportation in Chittenden County, but does not specify facility type. By focusing on overall network gaps, context-sensitive solutions for individual projects can be developed later on.

Generally, walking infrastructure in village centers and urban areas is comprehensive. Individual infrastructure projects like sidewalk segments and crosswalks are municipal issues that are not addressed in this regional plan. The ATP recommends programs and policies that can support walking throughout Chittenden County.

Bicycling is a beneficial transportation option for regional trips. Therefore, the ATP recommends both non-infrastructure and infrastructure improvements for active transportation based on an analysis of bicycle network gaps.

CHAPTER 1: INTRODUCTION

The Chittenden County Regional Planning Commission (CCRPC) Active Transportation Plan is an update to the 2008 Regional Bicycle and Pedestrian Plan, and serves as the active transportation element of the CCRPC Metropolitan Transportation Plan. CCRPC hired a consultant team led by Toole Design Group (TDG) to make this update.

The Active Transportation Plan (ATP) supports the CCRPC's 2013 regional plan, ECOS, by having a complementary vision, evaluation criteria, and performance measures. In addition, the ATP was updated at the same time that the City of Burlington developed its first bicycle and pedestrian plan and the City of Winooski updated its transportation plan. VTrans was also in the midst of Phase 1 of developing the Statewide On-Road Bike Plan. The project team worked to ensure that all the plans are consistent and support each another.

The ATP also complements Vermont's Complete Streets Law, enacted in 2011. This law requires that all users, regardless of whether they are travelling by car, bike, foot, or bus, be considered during the planning and design of transportation projects by VTrans and Vermont municipalities.

Developing a plan that addresses both walking and bicycling can be challenging because of the different geographic scales of these modes. Walking can be difficult to address on a regional level because it often involves site-specific issues. In the ATP, walking recommendations are focused on strategy and town-wide initiatives. Bicycling projects, on the other hand, can be well-suited for a regional plan since bicycle trips are typically longer. For both walking and bicycling, the ATP aims to develop a safe, well-connected, regional network that everyone can use, regardless of age or ability.

1.1 PLANNING PROCESS AND DOCUMENT STRUCTURE

The ATP was created under the leadership of an Advisory Committee (described on page 15) which ensured that it represented the variety of interests and stakeholders in Chittenden County. The process to develop the ATP began with an assessment of existing conditions and a review of other relevant plans and studies. Public input provided a foundation for recommendations, supplemented by a technical analysis of regional connectivity. The public input also formed a basis for prioritization of the recommendations, for which general feasibility was also assessed. Finally, next steps for implementation were developed to help ensure that the ATP is implemented.

This document summarizes the findings of the planning process. To tell the story of the state of active transportation in Chittenden County and provide a roadmap for achieving its envisioned future, the document is organized into the following sections:

- **O BENEFITS OF ACTIVE TRANSPORTATION**
- PUBLIC PROCESS
- EXISTING CONDITIONS
- **O REGIONAL NETWORK ANALYSIS**
- RECOMMENDATIONS
- O IMPLEMENTATION
- O PERFORMANCE MEASURES
- **O CONCLUSIONS AND NEXT STEPS**

1.2 DEFINING ACTIVE TRANSPORTATION

Updating the bicycle-pedestrian plan as an 'active transportation' plan emphasizes the role of physically active forms of transportation in improving community health. Furthermore, 'active transportation' reinforces that bicycling and walking are valid forms of transportation, not just forms of recreation, and it is a more inclusive term that reflects the use of mobility assistance devices¹ such as wheelchairs and scooters and other modes, such as skating or skateboarding, often seen on what are traditionally referred to as "bike-ped" facilities. 'Active transportation' also implies a more comprehensive approach to the transportation system which recognizes the importance of active transportation in accessing public transit, and addresses associated infrastructure like bike racks and wheelchair ramps.

Re-framing the discussion in terms of 'active transportation' prompts the question whether the network should focus on recreation, transportation, or both. The Advisory Committee considered this question early on, and decided that trip purpose is not as important as building a network that connects origins and destinations regardless of purpose.

The topic of electric bikes (also known as e-bikes) also arose in Advisory Committee discussions. E-bikes can increase the bicycle mode share by attracting potential bicyclists who want or need additional power to climb hills or maintain a slightly higher speed (typically not more than 20 mph). E-bikes fall under the same legal category as standard bicycles that operate solely under human power. (See Appendix A for additional information.) They do not require special facilities beyond those described in the ATP.

1.3 VISION AND GOALS

The Vision and Goals guide the ATP to define project priorities and performance measures to evaluate its progress.

Chittenden County Active Transportation Plan Vision

In the future, Chittenden County residents, employees, and visitors of all ages and abilities are safely connected to origins and destinations by a comprehensive active transportation network. Plentiful opportunities for active transportation make for a healthy community throughout Chittenden County. The network connects towns within Chittenden County and connects to the networks of neighboring counties. Active transportation is an important part of people's lives for transportation, recreation, and health. There are economic, environmental, health, and quality of life benefits that affect the entire population, even those who do not walk or bike. Active transportation becomes the default mode of travel in support of the ECOS Plan and its goals.

GUIDING PRINCIPLES

- ^o SAFE
- **OSUSTAINABLE**
- ACCESSIBLE
- **RESILIENT**
- **VIABLE**
- CONNECTED
- CONVENIENT
 - ATTRACTIVE
 - **THOUGHTFULLY DESIGNED**
 - EQUITABLE

Goals, some of which are from the ECOS Plan, are adopted here to ensure consistency between the two plans. The evaluation measures developed for the ATP tie directly to the goals to evaluate the ATP's implementation and success. The goals are not listed in any particular order.



Provide accessible, safe, efficient, interconnected, secure, equitable and sustainable mobility choices for our region's businesses, residents and visitors.

Conserve, protect and improve the health of native species habitats, water quality and quantity, and air quality.

Reduce greenhouse gas (GHG) emissions contributing to climate change and adapt to become more resilient to a changing climate.

Provide opportunities for Chittenden County residents to be healthy through active transportation.

Improve the safety of the public including the loss of life and property from natural and man-made hazards.

Retain and support existing employers and job growth, grow target sector employers and entrepreneurs, and work to attract a greater diversity of employers and employees.

Effectively and efficiently use existing funding mechanisms to implement recommendations.

Install necessary support facilities, such as bike racks and/or bike lockers, at appropriate locations.

Strengthen partnerships with local, regional and state health organizations in an effort to increase physical activity through increased bicycling and walking.

Encourage walking and biking in local communities through work with towns, schools, businesses and community walk-bike groups.

Expand walking and biking infrastructure to provide interconnection with the region's transit system.

Ensure driver speeds are slow and safe to reduce bicycle-pedestrian crashes.

1.4 LOCAL BICYCLE AND PEDESTRIAN PLANS

An important part of this regional plan is coordination with local plans. Location-specific recommendations that come out of the regional plan and that are also noted in local plans should be top priorities. The figure below notes that four communities have current bike-ped plans in place.



CHAPTER 2: BENEFITS OF ACTIVE TRANSPORTATION

*This section describes the many benefits of active transportation and why it is important to invest in the infrastructure and programs that support it. This section considers public health, economic development, quality of life, and environmental quality.

2.1 PUBLIC HEALTH

The health of Chittenden County's residents may be improved directly or indirectly through investments in active transportation infrastructure and programs. Active transportation, including walking and biking, can help people incorporate routine physical activity into their daily lives. This section describes the health benefits of active transportation, while Section 4.6 describes current health statistics of Chittenden County residents.

2.1.1 PHYSICAL HEALTH

According to the U.S. Health and Human Services Department's (USHHSD) *Physical Activity Guidelines for Americans*, 150 minutes of moderate-intensity aerobic activity (for example, brisk walking) each week reduces the risk of many chronic diseases and other adverse health outcomes. For young people ages 6–17 the USHHSD recommends participating in at least 60 minutes of physical activity every day. Engaging in physical activity beyond these amounts can impart additional health benefits.¹

Solution of moderate-intensity aerobic activity each week reduces the risk of many chronic diseases

Being overweight increases an individual's the risk for many chronic diseases, including hypertension, diabetes, osteoarthritis, cardiovascular disease and stroke, gallbladder disease, arthritis, sleep disturbances, mental health issues, breathing problems, and certain cancers.² Increased opportunity for recreation and destination-oriented trips using active modes of transport are key to reducing obesity and, by extension, the risk for developing chronic diseases.





This year the U.S. Surgeon General issued a *Call to Action to Promote Walking and Walkable Communities* to combat chronic diseases, such as heart disease, cancer and diabetes. The Surgeon General further recommends that urban, suburban, and rural communities provide safe and easy access to spaces and places to walk or wheelchair roll.³

A 20-year study of 5,115 people in four U.S. cities found that walking and biking to work are associated with greater physical fitness among both men and women. Active commuting is also associated with lower obesity rates and better cardiovascular health for men. The study called strategies to enable and encourage active commuting "effective interventions to reduce obesity and improve cardiovascular disease risk."⁴

Research has also found that the health benefits of bicycling instead of driving far outweigh the risks.⁵ For example, one study found that on average, individuals who shifted from driving to bicycling gained an estimated 3 to 14 months of life expectancy, compared to 5 to 9 days lost due to traffic crashes and inhaled air pollution.⁶

NONTH

people gain between 3 to 14 months of life expectancy when shifting from driving to bicycling

2.1.1 MENTAL HEALTH

Physical activity, including walking and biking, can help prevent or treat some mental health conditions. Physical activity reduces depression, can improve the quality of sleep, and has been shown to improve cognitive function for older adults.⁷ Active transportation can also improve social conditions in communities, which also contributes to positive mental well-being among residents. The environment can contribute to an individual's sense of isolation. While there may be many reasons people feel isolated, this can be exacerbated by a lack of social connection brought about by land-use and transportation systems designed around the automobile, where one has to drive, often alone, to work, school, services, and home.⁸



2.2 ECONOMIC DEVELOPMENT

There is overwhelming evidence nationally – and in Vermont – that creating opportunities for active transportation has positive economic impacts by attracting tourism, jobs, and new residents.

In VTrans' 2012 *Economic Impact of Bicycling and Walking in Vermont*,⁹ researchers found a positive return on investments in bicycling and walking: 1,418 jobs, with over \$40 million in employee earnings and taxes and fees contributed a net positive of \$1.6 million in for the State of Vermont in the study year 2009. For example, over two hundred jobs are created annually from building and maintaining bicycle and pedestrian facilities. Visitors spend \$6 million in the state on lodging, food, gas, and shopping for the state's 40 major bicycling and walking events each year. Bicycling- and walking-oriented businesses generate \$37.8 million in economic activity, which supports 820 jobs. Furthermore, bicycling and walking activities attract spending to Vermont. Two-fifths of the sales in businesses such as bicycle and bicycle clothing manufacturers, bicycle wholesalers, sporting goods, bike shops, and bicycle and walking tour operators are to out of state visitors.







of surveyed merchants believed that bike lanes had a positive impact on their business

Numerous studies from around North America have consistently found the economic benefits of active transportation. Studies on commercial corridors in Portland, Oregon,¹⁰ New York, New York, and Toronto, Ontario¹¹ showed that bicyclists and pedestrians spent more at restaurants, bars, and convenience stores than drivers. In downtown Davis, California, bicyclists spent more per trip and made more trips than drivers.¹² On Valencia Street in San Francisco, California, four and a half years after bike lanes were installed, 65 percent of the merchants believed that the bike lanes had a positive impact on their business and would support more traffic calming on the street.¹³

The American Planning Association has produced briefing papers^{14, 15} that indicate that a strong active transportation network:



QUALITY OF LIFE

Comfortable and accessible bicycling and walking provide a host of quality of life benefits. They increase the number of travel options for everyone and can lead to a sense of independence in seniors, young people, and others who cannot or choose not to drive. Providing a high quality active transportation network is important for the quality of life for the state's non-drivers. An estimated 92,000 people in Vermont – 15 percent of Vermont residents – do not have full time access to a vehicle. This includes people who are under 16 years-old, unlicensed adults, suspended drivers, and people who live in households with more drivers than vehicles.

Active transportation options are associated with inviting places for people to live and work.¹⁶ Bicyclists often report greater satisfaction with their commute than people who drive to work.¹⁷ In communities that have invested in bicycling and walking infrastructure, bicyclists and pedestrian commuters report the highest levels of "commute well-being," which is a measure of commute-based stress, confidence in arrival time, boredom or enthusiasm, excitement, pleasure, and ease of trip. A study of bicyclists in Portland, Oregon found that traffic congestion reduces commute well-being for car and bus commuters, but not bike commuters.¹⁸



of Vermont residents do not have full access to a vehicle



Additionally, more "eyes on the street" improve safety and support more activity: one study found that violence and the fear of violence prevent people from being physically active and spending time outdoors, causing a ripple effect of reduced social interactions, reduced community cohesion, and more barriers to community investment.¹⁹

One way to measure this quality of life benefit is to look at where people choose to live. In the *Economic Impact of Bicycling and Walking in Vermont*, the effect of walkability on the value of home sales was evaluated. Walkability was measured based on how close a home is to businesses, employment, schools, and other destinations. The study looked at 18,500 home sales in Vermont to see how walkability impacted home sales. It found that a home in a walkable neighborhood sells for \$6,500 more than a comparable home in a car-dependent location. Walkability adds an estimated \$350 million to home values in Vermont.²⁰

Owning and operating a car also consumes a significant share of household spending. The American Automobile Association (AAA) has determined that the average annual cost of owning and operating a vehicle in the US is \$8,698 and includes fuel, insurance, maintenance, finance charges, license, taxes, registration, tires, and depreciation.²¹ Estimates for owning and operating a bicycle vary, but typically average around \$350 a year, so reducing car use and ownership can have noticeable savings, even without going car-free.²² Moreover, walking and biking for short trips is often more convenient, saves fuel, is faster, and does not require paying for parking.





ENVIRONMENTAL QUALITY

Support for bicycling and walking comes in part from concerns about greenhouse gas emissions, stormwater runoff from highway facilities, and other environmental implications of widespread personal vehicle use.²³ In Vermont, transportation accounts for 33% of the state's total energy consumption.²⁴ Shifting to bicycling and walking trips, and concentrating development in dense walkable and bikeable communities can reduce transportation-based emissions and sprawling land use that impacts the natural environment.²⁵

Exhaust from automobiles increases local air pollution, which can cause or trigger respiratory and cardiovascular problems. People with sensitivities to air pollution, including older adults, children, and those with diseases such as asthma or congestive heart disease, are more likely to be affected by contact with pollution from particulate matter, which includes pollutants from automobile exhaust.^{26,27} Multiple studies have found that low-income, minority communities bear the greatest burden of auto-related emissions due to proximity to high-volume roads.^{28,29,30} Reducing the number of vehicles on the road can reduce air pollution and improve air quality.³¹ Researchers have proposed that increasing the supply of active transportation facilities (e.g., sidewalks, bike paths, etc.) can help reduce exposure to harmful pollutants.³²





People using active forms of transportation face higher exposure to auto emissions because of proximity to traffic and increased respiration due to physical activity. One study conducted in Berkeley, California compared bicyclists' exposure to ultrafine particulate matter, carbon monoxide, and black carbon on low-traffic routes with exposure on high-traffic routes. Using bicycle-mounted pollutant monitors, the researchers found elevated levels of pollution on high-volume routes.³¹ A related study found statistically significant differences in the amount of ultrafine particulate in standard bike lanes compared with bike lanes separated from traffic by a row of parked cars.³³ This research suggests that all active transportation users would benefit from dedicated routes separated from traffic.





CHAPTER 3: PUBLIC PROCESS

This section summarizes the public input that was gathered and forms the foundation of the recommendations in the ATP.

3.1 ADVISORY COMMITTEE

The ATP was guided by an Advisory Committee comprised of local, county, and state agency representatives as well as local stakeholders (Table 1). A project website was created, and Front Porch Forum, the CCRPC email list, and the CCRPC newsletter were used to disseminate updates and information.

KATELIN BREWER-COLIE	Local Motion/Transportation Advisory Committee (TAC)
BOB HENNEBERGER	AARP/TAC
NICOLE LOSCH	City of Burlington/TAC
CHRIS SHAW	CCRPC Board Member/South Burlington
IAN STOKES	Richmond Trails Committee
PHOEBE SPENCER	Essex Junction Walk/Bike Advisory Committee
HEATHER DANIS	Vermont Department of Health, Burlington District Office
NICK MELTZER	Vermont Agency of Transportation (VTrans)
NELSON HOFFMAN	Federal Highway Administration (FHWA)
SANDY THIBAULT	Chittenden Area Transportation Management Association (CATMA)/TAC
MAREN HILL	Vermont Safe Routes to School
DAVID ARMSTRONG	Green Mountain Transit (GMT) (formerly Chittenden County Transportation Authority (CCTA))

TABLE 1: ADVISORY COMMITTEE MEMBERS

3.2 INPUT CHANNELS

The project team developed an interactive online map (a wikimap) that was available for input between late September 2015 and early November 2015. This allowed the public to provide geographically specific information about informal connections, desirable routes, and roadways of concern. Users were asked to identify routes they already ride or walk, ones they would like to ride or walk, and barriers to bicycling or walking throughout Chittenden County. The map, shown in Figure 1 on page 17, was available as a link from the CCRPC website (http://www.ccrpcvt.org/transportation/active-transportation-plan).

Prior to providing data, users were asked to complete a brief survey. As seen in Figure 2 below, more women than men participated in the wikimap and 66 percent of all respondents are between 36 and 65. Wikimap users were also asked to identify their home zip code. The majority of users were concentrated in Burlington, Winooski, South Burlington and Essex, which is also reflective of where most people in Chittenden County live.

Input received from participants at the charrettes was very consistent with comments made on the wikimap. There were relatively few participants in the charrettes relative to the number of wikimap users. The following sections summarize the responses we received through both the wikimap and the charrettes.

Comments from the ATP were solicited via "Live at 5:25" on local cable, the CCRPC newsletter, the project charrettes, posts on Front Porch Forum, direct contact with local bicycle and pedestrian committees, and organizations/outlets represented on the Advisory Committee.

In-person engagement was also an important component of gathering feedback from Chittenden County residents. Mini-charrettes were held in Milton, Jericho, Essex, and Hinesburg in late October 2015. These were interactive workshops during which participants were asked to mark routes and destinations on a map where they currently ride or would like to ride. In April 2016, draft recommendations were posted on the CCRPC for public review and comment.



* Four percent of respondents did not want to share their age or sex

Figure 2: Wikimap User Types

3.3 INPUT RESULTS

There were 385 unique wikimap users. These users made 2,750 comments including "likes" and "dislikes" of others' contributions. There were a total of 930 comments not including "likes" and "dislikes." Input to PlanBTV Bike-Walk and the Vermont Statewide On-Road Bicycle Plan (plans currently in development) were also incorporated into the wikimap.



Figure 1: Screenshot of Wikimap



CHAPTER 3: PUBLIC PROCESS

3.3.1 WHERE I CURRENTLY WALK/BIKE

3.3.1.1 ROUTES I CURRENTLY WALK/BIKE

The project team asked the public to show which routes they currently walk or bike in Chittenden County. Wikimap users identified 266 routes on which they currently walk or bike (see Figure 3). Not surprisingly, the downtown Burlington core is widely used. Additionally, VT 15, US 7, Mountain View Road, US 2 in Richmond, VT 289, VT 117, and Barbers Farm Road/Browns Trace/Lee River Road were well used routes.

Charrette participants focused on the Old North End, Riverside Avenue, and the Hill section in Burlington; and Kennedy Drive, Swift Street, and Dorset Street in South Burlington. Other heavily travelled routes, according to charrette participants, include:

- 1. VT 15 (Essex and Jericho)
- 2. North Avenue (Burlington)
- 3. Mountain View Road (Williston)
- 4. Dorset Street (South Burlington)
- 5. Harbor Road (Shelburne)
- 6. Patchen Road/Airport Parkway/River Cove Road (South Burlington and Williston)
- 7. Cochran Road (Richmond)
- 8. Mount Philo Road (Shelburne)



Figure 3: Routes I Currently Walk/Bike

3.3.1 WHERE I CURRENTLY WALK/BIKE

3.3.1.2 DESTINATIONS I CURRENTLY WALK/BIKE

The project team asked the public to show where they currently walk and bike in Chittenden County (see Figure 4). Asking this question helped the project team to understand where there is currently demand for walking and biking.

Wikimap users indicated that they currently walk or bike to:

- 1. Downtown Burlington
- 2. University of Vermont
- 3. Dorset Park (South Burlington)
- 4. Sand Bar National Waterfowl Management Area (Milton)
- 5. Niquette Bay State Park (Colchester)
- 6. Oakledge Park (Burlington)
- 7. Twin Orchards (South Burlington)



Figure 4: Destination indicated by the wikimap

3.3.2 WHERE I'D LIKE TO WALK/BIKE

3.3.2.1 ROUTES I'D LIKE TO WALK/BIKE

The project team also asked the public to show which routes they would like to walk or bike within Chittenden County.

Wikimap users identified 337 routes on which they would like to walk or bike (see Figure 5). The most common routes people would like to walk or bike include:

- 1. VT 15 (Winooski, Colchester, Essex)
- 2. US 7 (South Burlington and Shelburne)
- 3. Mountain View Road (Williston)
- 4. US 2 (Richmond)
- 5. VT 289 (Essex)
- 6. VT 117/River Road (Jericho)
- 7. Barber Farm Road/Browns Trace/Lee River Road (Jericho)



Figure 5: Routes I'd like to walk/bike

3.3.2.2 DESTINATIONS I'D LIKE TO WALK/BIKE

The project team asked the public to show where they would like to walk and bike in Chittenden County (see Figure 4 above). Asking this question helped the project team to understand where there is currently demand for walking and biking that is not being met by the infrastructure.

If people do not walk or bike to a destination but would like to, it can be assumed that they do not feel safe doing so based on current conditions. Wikimap users indicated that they would like to bike to:

- 1. Eagle Mountain Natural Area (Milton)
- 2. North Avenue (Burlington)
- 3. Battery Park (Burlington)
- 4. University of Vermont
- 5. Dorset Street (South Burlington)
- 6. Bay Road and Harbor Road (Shelburne)
- 7. Champlain Valley Union High School (CVU) (Hinesburg)
- 8. Mount Mansfield Union High School (Jericho)
- 9. Mountain View Road (Williston)

3.3.3 BARRIERS

3.3.3.1 BARRIERS TO WALKING

The project team asked the public to show which locations they see as barriers to walking in Chittenden County.

Wikimap users identified a total of 347 deterrents to walking (Figure 6). Common comments included:

- 1. Lack of crosswalks and a failure to yield to pedestrians along Williston Road (eleven deterrents were marked along Williston Road between University Heights and Airport Drive)
- 2. Dangerous intersection at Battery Street and Maple Street in downtown Burlington
- 3. Crossing Dorset Street is difficult for people walking
- 4. Spear Street has a wide shoulder on one side and a narrow shoulder on the other
- 5. The pedestrian access across Hwy 189 from Shelburne Road is a deterrent
- 6. Bay Road near Shelburne Bay Park doesn't have a shoulder and is challenging to walk along

Charrette participants were also asked to identify locations which they saw as barriers to walking, including spot locations and roadway segments:

- 1. US 2 at the I-89 Exit 14 interchange and the Jughandle
- 2. US 7 in South Burlington at the I-189 terminus
- 3. Bay Road in Shelburne (see above)
- 4. The Winooski Circulator and bridge to Burlington
- 5. Riverside Avenue in Burlington
- 6. VT 127/Manhattan Drive in Burlington



3.3.3.2 BARRIERS TO BIKING

The project team asked the public to show which locations they see as barriers to biking in Chittenden County.

Wikimap users identified a total of 1,405 deterrents to biking (Figure 6). Common comments included:

- 1. Poor cyclist detection at signalized intersections (Elmwood Avenue, Intervale Avenue, Shelburne Road)
- 2. Waterfront Bike Path (narrow and bumpy)
- 3. Willard Street and Locust Street challenging intersection
- 4. VT 116 (high vehicle speeds, heavy traffic, narrow street)
- 5. Shelburne Road (difficult crossings)
- 6. North Avenue (high speeds, narrow shoulder)
- 7. Riverside Avenue (seven deterrents marked between Hyde Street and where it merges with Colchester Avenue)
- 8. Airport Parkway by Ethan Allen Drive (lack of shoulders, narrow street with guard rails)
- 9. VT 15 (challenging due to sight lines, narrow shoulder, etc.)

Top bicycling issues identified by public input were:

- 1. I-89 interchanges/ramps throughout Chittenden County
- 2. Bridges
- 3. Bike lanes dropped at intersections
- 4. Turning vehicles (especially at commercial driveways)
- 5. Lack of bike detection at signalized intersections
- 6. Motorist compliance



Figure 6: Barriers to biking and walking

3.3.3.3 ADDITIONAL ISSUES

Draft recommendations were available for public comment and review in April 2016. (A complete summary of public comments is provided in Appendix B.) While the ATP does not address facility type and focuses more on regional issues than local issues, there were several widely repeated themes in the comments on items that should be addressed:



Winter maintenance (that is, lack of snow removal or treatment of ice/ slippery conditions) is a major impediment to walking and biking. A particular issue is when driveways are plowed and create a snowbank that blocks the sidewalk.



Education and enforcement of motorist, pedestrian, and bicycling behavior is an important factor in building a successful active transportation network.



Universal design is a critical component of ensuring that facilities are accessible to everyone, regardless of age or ability.



Tying transit, universal design, carsharing, and walking and biking together is important for a successful plan. For example, how can users easily use one mode to get to another? Include bike racks at bus stops and carshare pods, and make sure they are all universally accessible with curb ramps.



Overall, there needs to be better maintenance (including drainage problems) of walking and bicycling facilities. For example, pedestrian lights need to be regularly tested to ensure that the button triggers the walk signal.

This page is left blank intentionally.

CHAPTER 4: EXISTING CONDITIONS

This section summarizes the findings from the existing conditions assessment, including a review of other plans and initiatives, a facility type glossary, an infrastructure inventory and condition assessment, and a review of safety, transit, and public health.

4.1 CONCURRENT PLANS AND INITIATIVES

At the same time this county-wide initiative is taking place, the following state, local, and institutional level pedestrian and bicycle plans are under development:

The **City of Burlington** is developing PlanBTV: Walk Bike to enhance safety and increase active mobility. The plan will identify priority projects and include scoping studies for them as a first step towards implementation. Draft plan materials are being circulated for public comment, and final recommendations will be considered for coordination with the ATP. The latest details of the plan are available online at: <u>http://www.planbtvwalkbike.org/</u>.

The Winooski Transportation Master Plan is being developed by the **CCRPC** and the **City of Winooski**. This will be a comprehensive, multi modal transportation plan that will result in recommendations for roadways, transit, bicycle facilities, walking facilities, and streetscape improvements. The plan is currently under development. Details are available online at: <u>http://www.ccrpcvt.org/our-work/transportation/current-projects/corridors-circulation/winooski-transportation-master-plan/</u>.

The **University of Vermont** is currently developing an Active Transportation Plan. This plan is in the phase of assessing existing conditions and has found that major east-west connections for the campus are mostly provided by public roads, except from Prospect Street to the Bailey-Howe Library. North-south connections are largely via campus roads and paths, providing greater separation between bicyclists, pedestrians, and traffic. As the campus comprises a large area and a major regional destination, connections to and through it will be an important part of the ATP. Information can be found online at: http://www.localmotion.org/uvm_active_transportation_plan.and http://www.localmotion.org/uvm_active_transportation_plan.and http://www.localmotion.org/uvm_active_transportation_plan.and http://www.localmotion.org/uvm_active_transportation_plan.and <a href="http://www.localmotion.org/uvm_active_transpor

VTrans has concluded Phase I of its Statewide On-Road Bicycle Plan. This plan will categorizes state roads into high-, moderate- and low-use corridors based on current and potential bicycle use. The Plan will assist VTrans in understanding where to focus limited resources towards bicycle improvements and allow better integration into Agency projects. As with other concurrent planning projects, the ATP will be coordinated with the statewide to ensure consistency. Details can be found online at: <u>http://vtransplanning.vermont.gov/bikeplan/</u>.

Bike share programs are also underway, although the current programs are not for public use. The **City of Burlington** launched an internal program for its staff and both UVM and Champlain College have their own campus programs. Local Motion evaluated the feasibility of a regional bike share in 2012. Their report, Chittenden County Bike Share Feasibility Study, found that there is potential for a viable regional program. A pilot bike share system open to the public is to be launched by CATMA, UVM and Champlain College in 2017. Phase 1 will include hubs in Burlington, South Burlington and Winooski.
4.2 FACILITY TYPES

This section provides an overview of the different facility types that could be used in creating the active transportation network. The selection of a facility type depends on the type of user (experienced and confident or prefers to be separated from vehicles) as well as the context. For example, in rural areas, a shared use path or a shared street will serve both walkers and bicyclists, but in urban areas that may be more congested, it will be important to give different users their own space: pedestrians will need sidewalks while bicyclists should have bike lanes.

Facilities such as bike parking, lighting, and wayfinding are also critical pieces of a successful active transportation network, and need to be included as this plan is implemented.



01. BIKE LANE

A bike lane is a pavement marking that designates a portion of a street for the preferential or exclusive use of bicycles.





02. BUFFERED BIKE LANE

Buffered bike lanes are created by striping a buffer zone between a bike lane and the adjacent travel lane, between a bike lane and adjacent parking lane, or both.



03. CONTRAFLOW BIKE LANE



Contraflow bike lanes run in the opposite direction of other traffic on a one-way street, allowing bicyclists to legally ride against traffic.

BATIONS

04. SEPARATED BIKE LANE (CYCLETRACK)



A separated bike lane, sometimes called a cycletrack, is an exclusive space for bicyclists along or within a roadway that is physically separated from motor vehicles and pedestrians by vertical and horizontal elements.

05. SHOULDER (PAVED)

The shoulder is the section of the roadway outside of the travel lanes. When paved and of sufficient width, paved shoulders can serve as a bicycle accommodation.





06. SHARED-USE PATH

A shared use path is an off -street bicycle and pedestrian facility that is physically separated from motor vehicle traffic. Shared-use paths can be used by any non-motorized user including skaters, wheelchair users, and joggers.

<image>

07. SHARED LANE MARKING (SHARROW)



Shared lane markings (sharrows) are used on streets where bicyclists and motor vehicles share the same travel lane.

CONDITIONS



08. SHARED ROAD

Shared roads are roads on which vehicles, bikes, and walkers share space. They are low-volume, and typically slow speeds. In Vermont, some unpaved rural roads could be considered shared as they are used by a mix of different user types.

4.3 INVENTORY AND CONDITION ASSESSMENT

The project team performed an inventory and condition assessment for bicycle and pedestrian facilities across Chittenden County in November 2015. This inventory and assessment included multi-use paths, bike lanes, shared lanes, shoulders, sidewalks, and proposed sidewalk locations. An assessment of Americans with Disabilities Act (ADA) compliant facilities such as curb ramps was not included, but all new projects must be ADA compliant.

The inventory and condition assessment was conducted using fieldwork to locate and verify the existence and type of each facility that was identified in the non-motorized facility databases developed by CCRPC and Local Motion.³ A majority of the assessments were performed by driving to each location and getting out of the vehicle to perform the assessment. As such, paths that veered from the roadway were evaluated only at the endpoints. However, most facilities in Burlington were evaluated by bicycle which provided an opportunity for a more in-depth assessment of each facility and the bicycle network as a whole. Most shoulders were evaluated visually, by vehicle, in passing. After each bicycle facility was located, the width was measured using a measuring tape, and the material of the facility was classified as either asphalt, concrete, or gravel. Lastly, each bicycle facility was categorized into one or a combination of two conditions: good, fair, or poor.

This section provides the results of the inventory and condition assessment.



The sidewalk inventory map is shown in Figure 7. Several sidewalk projects are planned and moving forward in Hinesburg, Milton, Colchester, Essex, and Richmond. This is partly a reflection of successful applications to the CCRPC Sidewalk Grant Program which was in place from 2005 to 2015.

It should be noted that these inventory maps show the networks in well-lit, summer conditions. At night or during the winter, few facilities are lit, and some are not cleared of snow and ice. Therefore, the maps may overestimate the actual usability of the networks. Virtually no trails outside of a road right-of-way are lit except for the UVM paths. The following municipalities clear prioritized sidewalks and paths of snow:

Burlington Colchester Essex Essex Junction Hinesburg Milton Richmond Shelburne South Burlington Williston Winooski

The bicycle inventory map is shown in Figure 8. A condition assessment was conducted as well and is included in Appendix C.

PLANNED PROJECTS

The project team identified planned and scoped pedestrian and bicycle projects. (See Appendix D.) Planned projects include concepts that have been suggested but haven't undergone a detailed study to add specification. Scoped projects include concepts that have been formally developed from an idea to a vetted project. The majority of projects and concepts are in and around Burlington and Colchester. While these projects may be planned and/or scoped, the full build out is not anticipated to be completed in the short-term.





Figure 7: Sidewalk inventory map (Source: CCRPC)



Figure 8: Bicycle inventory map (Primary Source: Local Motion)

4.4 SAFETY

People engaging in active transportation are particularly vulnerable because they are not protected by the body of a vehicle. While motor vehicle-related hospitalizations are the second leading cause of injury-related hospitalizations in Vermont (accounting for about one in eight injury-related hospitalizations (13%)), 6% of those hospitalized were pedestrians or bicyclists.

Safety for pedestrians and bicyclists was assessed using VTrans' High Crash Location (HCL) report.⁴ A roadway section or intersection is identified as an HCL if it has had five or more crashes in a five year period and its actual crash rate is more than the critical crash rate (as calculated by VTrans) for that type of facility. This data includes vehicle crash reports from 2008-2012 which resulted in, at a minimum, at least \$3000 of property damage, an injury, or a fatality. Showing the HCLs against the network assists in identifying gaps, and will be especially important as those gaps are evaluated and prioritized.



Figure 9: Pedestrian and Bicycle Crash Severity (2008-2012) (Data Source: VTrans)

Roughly 2.5 percent of reported vehicular crashes involve bicycles or pedestrians. Figure 9 shows that of the 110 crashes involving a bicyclist or pedestrian in Chittenden County in 2014, 86 involved an injury (78 percent) and two were fatal (less than 2 percent). Consistent with Figure 9, the frequency of crashes involving people walking and biking (Figure 10) occur in busy and complex areas such as downtown Burlington, downtown Winooski, Five Corners in Essex Junction, and the US 2 and Shelburne Street corridors in South Burlington. With the vast majority of crashes involving injuries or fatalities, there is a need for safer facilities to support vulnerable active transportation participants.







Figure 10: Frequency of crashes involving bicycles 2008-2012 (Data Source: VTrans)

4.2 TRANSIT ACCESS

Green Mountain Transit (GMT; formerly Chittenden County Transportation Authority (CCTA)) shared data on numbers of people getting off and on by stop for the year 2013. GMT boarding and alighting data were mapped with the sidewalk and bicycle network (Figure 11). The data indicate that GMT service routes have relatively adequate biking and walking access. GMT annually provides over 2.7 million trips.

Most GMT buses are equipped with bicycle racks on the front that hold two bicycles; LINK Express buses have storage for four bicycles underneath the bus. This is especially important for people who bike to get to and from the bus. Table 2 shows that in 2013, over 35,500 bikes were transported via these bus racks.



 Table 2: Number of Bike Boardings by FY 2013, by route (Data Source: GMT)



Figure 11: GMT stops and ridership for 2013 (Data Source: GMT) and sidewalks (not including LINK routes)

4.6 PUBLIC HEALTH

This section describes the health of Chittenden County's residential population and the relationship between health and active transportation. Additional detail is provided in Appendix E.

4.6.1 OBESITY AND CHRONIC DISEASE

Despite having a lower prevalence of obesity than the state as whole, obesity rates in Chittenden County have been climbing, mirroring the statewide and national trend. In 2000-2002, the prevalence was 16% and in 2012-2013 it was 21%, overall. Overweight individuals are also at significant risk for developing chronic conditions such as cardiovascular diseases, diabetes, high cholesterol, and hypertension.³⁵

Vermont is often recognized as one of the healthiest states in the nation, with Chittenden County, specifically, as the healthiest county in Vermont.³⁶ This may be due in part to generally higher income and education levels in Chittenden County. However, individuals living in poverty and other vulnerable populations endure disproportionately higher rates of chronic disease despite the ranking of the county overall. Issues of equity such as this were taken into account during the prioritization of ATP recommendations.



4.6.2 AIR QUALITY/RESPIRATORY PROBLEMS

Air in Chittenden County, and throughout Vermont, meets National Ambient Air Quality Standards (NAAQS). In 2010, Chittenden County had an average ambient concentration of Particulate Matter (PM2.5) of 7.1 µg/m.³⁷ This is below the NAAQS of 15 µg/m.³⁷ In Chittenden County, from 2000 to 2010, there was an average of 2.3 days with the maximum 8-hour ozone concentration above the NAAQS of 0.075 ppm.³⁸ While Chittenden County has maintained clean air, it is important to continue this trend.



For some people with disabilities, walking and biking can provide mobility options when their disability prevents them from driving an automobile. Active transportation infrastructure must be adapted to individuals with disabilities. Increased walk times at intersections and audible/visual indicators are examples of accommodations that can be made.



Rates of disability are higher among adult Vermonters who have low incomes or less education. In Chittenden County, of those making less than \$25,000 annually, 39% report one or more disabilities versus 14% of those making \$50,000 or more, annually.





As noted on page 12, active transportation has been shown to improve certain mental health conditions. In Chittenden County, 9% (2012-2013) of adults reported that they are in poor mental health, meaning they experienced at least 14 poor mental health days in the last month. Among high school students, 19% report feeling sad or hopeless almost every day for two weeks or more, over the past 12 months. Among middle schoolers, 16% said they felt so sad or hopeless almost every day for two weeks or more in a row that they stopped doing some usual activities during the last 12 months. Both the high school and middle school rates are lower than the state average of 21%.³⁹

Poor Mental Health / Sad or Hopeless during last 12 months





Middle School Students



Photo credit: Photo by Lee Krohn

CHAPTER 5: REGIONAL NETWORK ANALYSIS

This section summarizes the process used to develop the proposed county-wide active transportation network, presented in the Recommendations section. Numerous factors were considered during this process, including comments received from the public, existing conditions, identified low stress network gaps, trip origins and destinations, and previous plans and studies.

As noted earlier, recommendations for walking are focused on strategy and town-wide initiatives, and locally, the walking network is quite strong in village centers and urban areas of Chittenden County. This regional network analysis focuses on bicycling since those trips are typically longer and more regional in scale. For example, in the schematic to the right, regional trips (more likely to be completed by biking than walking) are served by connections (A) to village centers and urban areas (B). These nodes have dense sidewalk networks within them to support shorter walking trips.



The types of facilities that are eventually built on the segments proposed in the ATP can and should address the needs of everyone using active transportation.

The regional network analysis identifies gaps in the network, whether due to lack of a facility or the inadequacy of the facility. For example, Shelburne Road in South Burlington has a bike lane, but not everyone riding a bicycle is comfortable using it due to the high volumes and high speeds of adjacent traffic. For the majority of people who ride bicycles, this segment would be very stressful to ride along. The Level of Traffic Stress analysis described below considers the network from this perspective.

5.1 LEVEL OF TRAFFIC STRESS

For analysis purposes, people who ride bicycles can be classified based on their willingness or aversion to bicycle alongside motor vehicle traffic.⁴⁰ By starting with this classification, a street segment can be assessed in terms of the level of "traffic stress" that it may present for different rider types, and therefore, the segment's suitability for bicycling. The Minesota Transportation Institute developed the Level of Traffic Stress (LTS) model to loosely correlate a street segment's LTS with the rider classifications outlined in Figure 12.⁴¹ LTS categories are defined as the following:

- LTS 1 is suitable for the entire population. These include shared use paths, as shown on the left of Figure 12.
- LTS 2 is suitable for some "Interested but Concerned" and all "Casual and Somewhat Confident" bicyclists (see center photo in Figure 12). These are low stress routes with little traffic and slow speeds, and/or bike lanes.
- LTS 3 is only suitable for "Experienced and Confident" bicyclists. These facilities have little to no separation from high volume and/or high speed traffic (see photo on right of Figure 12).



Figure 12: Level of traffic stress user categories

As opposed to other street assessment methods, LTS lends much greater weight to motor vehicle traffic speeds and volumes, requiring physical separation between bicycles and cars when traffic volumes and speeds exceed certain thresholds. The method uses several base criteria for determining traffic stress that change depending on facility type. These criteria include street width, motor vehicle speed, presence of on-street parking, bike lane width, traffic volume when streets do not have bike lanes, and number of driveway entrances.

In the end, this model helps Chittenden County identify the traffic stress that may be experienced along each part of their street and road system. It also serves as a tool to help develop interconnected systems of low-stress bikeways that will appeal to the majority of the population (the "Interested but Concerned" and "Casual and Somewhat Confident" groups). A similar approach has been taken by the Dutch for decades, resulting in approximately 80% of the population riding a bicycle at least once per week and 25-50% of the population in larger cities biking to work on a daily basis.



Photo credit: Photo by Lee Krohn

LEVEL OF TRAFFIC STRESS IN CHITTENDEN COUNTY

Higher stress segments (LTS 3) generally reflect the regional arterials which connect major origins and destinations. While these routes indicate connections that all travelers (including people who bike and walk) want to make, their high use and volumes make them barriers unto themselves. That is, the high volumes reflect that the street is a valuable connection, but for vulnerable users, the high vehicle volumes and lack of separation from them also present a deterrent.

For example, although Shelburne Road/US 7 in South Burlington has bike lanes, it is a higher stress (LTS 2) facility due to the fact that there is no physical separation from the high volumes of traffic. Likewise, VT 15 has a paved shoulder for bicyclists, but high speeds make this a stressful experience for the majority of bicyclists. Therefore, it is rated LTS 3.

Despite the high stress level, these segments provide valuable connections between origins and destinations and are desired by both people on foot and riding bikes, and the ATP focuses on how they can be made safer and more accessible to all users.

Identifying the high stress connections indicates segments that should be addressed to by this ATP. Section 6.1 includes recommendations.





5.2 PUTTING IT ALL TOGETHER

The proposed regional network was developed in GIS (Geographic Information Systems) using a three-step methodology:







Figure 14: Segments identified from public input

2. Origins were identified using residential address data (analysed in GIS). Destinations (addresses identified as office, retail, public, etc.) were identified to indicate trip ends. Origins and destinations were combined on one map. Network segments were established to connect bicycling and walking origins and destinations. Figure 15 reflects new segments for which a low-stress alternative does not already exist (for example, a shared use path on a parallel alignment).



Figure 15: Segments identified according to origin and destination density

3. Segments recommended by previous plans and studies are mapped.

All of the segments identified by 1) public input, 2) origin-destination pairs, and 3) previous plans and studies are combined in Figure 16. This preliminary network is then refined to separate low stress connections from the proposed connections and to focus on regional connections (Figure 17).



Figure 16: Proposed segments based on public input, origin-destination pairs, and previous plans and studies

In addition to this analysis, the crash data indicated that special attention will need to be paid to Winooski, Five Corners in Essex Junction, US 2/Williston Road in South Burlington, US 7/Shelburne Road in South Burlington, and sections of Burlington.



Figure 17: Proposed and existing networks

This page is left blank intentionally.

CHAPTER 6: RECOMMENDATIONS

INFRASTRUCTURE AND ENGINEERING

Recommendations for improving regional connectivity (summarized below in Figure 18 and in Appendix F) were developed based on identified gaps in the network, land use, demand, and public input. It should be reiterated that walking recommendations are largely policy and program-based rather than infrastructure specific, as individual crosswalk and sidewalk projects are more local and site specific than is reasonable to address on a regional scale. Moreover, for regional trips, people are more likely to travel by bicycle or transit than to walk long distances. Additionally, the local walking infrastructure and networks for shorter trips is already quite strong in Chittenden County compared with the bicycle infrastructure.

Furthermore, while segments and corridors are identified for the purposes of addressing regional connectivity and gaps, facility types (that is, shared use path versus on-road bike lane, etc.) are not specified. This again is due to each segment having specific local needs that require a level of planning attention that is not considered on a regional scale. As mentioned previously, the facility type depends largely on context: in rural areas, a shared use path or a shared street will serve both walkers and bicyclists, but in urban areas that may be more congested, it will be important to give different users their own space (pedestrians/sidewalks, bicyclists/bike lanes). Additionally, facilities that offer the greatest degree of separation from traffic (that is, separated bike lanes, shared use paths) should be pursued whenever possible in order to attain a low-stress network that will be usable by the greatest number of people.

Finally, it should be noted that there are constraints which limit the usability of some facilities. For example, some municipal departments of public works remove snow from sidewalks and shared use paths, but others do not. In addition, some paths are lit, facilitating travel at night, where others are not. Therefore, the effective usability of the existing network is more limited than what is shown in Figure 18.











6.1.1 SHORT-TERM/IMMEDIATE TO <5 YEARS

- Start developing a wayfinding plan now, so that as network segments are built, signs showing connections can be put into place.
- Upgrade existing bike lanes to separated bike lanes by adding flexposts (need 5' bike lane + 1' buffer) where possible.
- Develop contraflow bike lanes on one-way streets, and include flexposts as possible to provide separation from traffic.
- Identify a segment on which to pilot an advisory lane. The candidate should be a road where there is limited width for bicycle facilities and the average daily traffic (ADT) is less than 6,000 vehicles. South Road in Williston is an example of an appropriate candidate for an advisory lane demonstration. Advisory lanes will require significant driver education and a shift in behavior, so begin with pilot/demonstration projects and education initiatives prior to implementing on a wide scale.
- Work with GMT to ensure that all new or updated bus stops include bike racks, sidewalk connections, crosswalks, and ADA ramps.
- Ensure that bike lanes are continued through intersections rather than ended at the approach. Include such designs in intersection improvement studies and plans. Consult the VTrans Highway Safety & Design Engineering Instructions (HSDEI) 16-100-Bicycle Facility Design Guidance and VTrans Highway Safety & Design Detail 646.02.
- Include bike detection at signalized intersections, and encourage Departments of Public Works to check that bike detection systems are functioning properly when doing routine maintenance.











Some locations are major barriers and will require significant capital investment to address. Figure 19 indicates the five most frequently noted locations in the wikimap:

- The Exit 14 ramps on US2/Williston Road in South Burlington
- The Jughandle west of the Exit 14 ramps on US2/Williston Road in Burlington/South Burlington
- The Winooski-Burlington Bridge
- The Winooski Circulator
- The Exit 16 ramps on US7 in Colchester

Not surprisingly, these locations are noted as barriers because they are in areas with multi-lane roads, high volumes of vehicles, and complex traffic patterns. General ideas for approaching these barriers are noted below.

- Focus on separated facilities (separated bike lanes, shared use paths) to attract the greatest number of potential users.
- Consider alternate designs for the Exit 14 interchange, such as a bike-ped bridge (as of summer 2016, there is a bike-ped bridge scoping study being conducted for this area).
- Develop separated bike lanes through the Jughandle west of Exit 14 at East Avenue, Spear Street, and East Terrace.
- Rebuild the Main Street bridge over the Winooski River between Burlington and Winooski with separated bike lanes, or build a separate bike-ped bridge (as of summer 2016, there is a feasibility study of a separate bike-ped bridge, and a scoping study of the existing Winooski-Burlington bridge will be conducted in spring 2017).
- Implement the walking and biking improvements identified in the Winooski Transportation Plan around the Winooski Circulator on Winooski Falls Way, Cascade Way, East and West Allen Streets, Weaver Street, and Abenaki Way.
- Integrate high quality, low stress bicycle and pedestrian improvements into the proposed design for the Colchester Exit 16 interchange. The proposed Diverging Diamond Interchange includes sidewalks on the East and West sides to the intersection, with a shared use path on both sides through the intersection.
- Consider developing a recreation path along the Circ Highway right-of-way. Although a segment was not recommended in this network because better transportation connectivity is provided by parallel alignments, interest was expressed in charrette discussions in developing such a path.
- Use LTS analysis to inform decision-making about project prioritization and design selection.





Figure 19: Active transportation barriers that need addressing in Chittenden County



6.1.3 ENGINEERING

Test out new concepts with pilot projects to evaluate before and after data and demonstrate new configurations to the public.

- Encourage municipalities to request pedestrian easements and connections between developments during site review (where applicable).
- Encourage municipalities (where applicable) to assume responsibility for clearing snow from sidewalks and paths (if they don't already).
- Review municipal ordinances related to bicycle registration and parking. Ordinances should encourage bicycling and
 protect bicycles and bicyclists rather than discourage use. New developments should be encouraged or required to
 provide bicycle parking, including parking for cargo bikes, on-site. Refer to the Association of Pedestrian and Bicycle
 Professionals (APBP) Essentials of Bicycle Parking.
- Continue to provide funding programs like the VTrans Bicycle and Pedestrian Program to support construction of local bicycle and pedestrian infrastructure. VTrans Transportation Alternatives Program (TAP) funding also supports bicycle and pedestrian infrastructure.
- Review posted speed limits regularly. Traditionally, speed limits have been set according to the 85th percentile speed at which traffic travels. However, speed limits can and should be set according to the specific set of conditions experienced on that roadway, and using engineering judgement. When conducting safety or infrastructure improvement studies, planners and engineers should refer to http://safety.fhwa.dot.gov/uslimits/ to determine whether a road's speed limit is set appropriately.
- Coordinate with GMT to improve active transportation access to transit stops. Improvements may include upgrading signage, installing shelters or seating, lighting, route maps, and schedules.
- Develop a rural walking toolkit. Walking infrastructure might look different in rural areas compared with urban areas. Sidewalks sometimes seem out of place in rural areas, but that doesn't mean that opportunities for walking shouldn't be provided. A toolkit that describes how to advance rural walking alternatives like meandering soft surface paths would likely help towns in Chittenden County.
- Inventory curb ramps and assess their condition, including locations where they are missing. Curb ramps are an essential part of the pedestrian network to ensure accessibility for all.
- Develop a pedestrian maintenance toolkit for local Public Works Departments. Most municipalities in Chittenden County already do an excellent job at maintaining sidewalks, crosswalks, and curb ramps. Still, providing checklists and documenting innovative approaches to maintenance and facilities may assist them in planning budgets and allocating resources.
- Encourage local businesses to provide portable ramps to accommodate wheelchairs over raised/inaccessible doorways. Portable ramps are a low-cost way to provide wheelchair access to businesses with a step or small barrier to entry.
- Organize volunteer path maintenance events. Maintenance might include trash pickup, sweeping, cleaning of vandalism, and reporting areas in need of more serious maintenance.





- Encourage municipalities to require countdown timers and leading pedestrian intervals (where applicable) at all crosswalks.
- Work with municipalities to require installation of wheel guards on fleet trucks. Wheel guards prevent pedestrians and bicyclists from being pulled under the wheels of heavy vehicles in a crash. Municipalities can retrofit fleet vehicles operated by or under contract with the municipality, such as waste removal, construction or maintenance vehicles.
- Support the installation of public bike maintenance stations. Public maintenance stations allow bicyclists to fill tires with air and complete minor repairs. These stations offer convenience to bicyclists and increase the visibility of bicycling in the community.
- Consult the VTrans Highway Safety & Design Engineering Instructions (HSDEI) for guidance on proper design applications: HSDEI 12-001-Complete Streets Guidance, HSDEI 15-100-Guidelines for Pedestrian Crossing Treatments, and HSDEI 16-100-Bicycle Facility Design Guidance.
- Consider modern roundabouts in appropriate contexts (usually urban areas) as effective ways to calm traffic and improve safety, particularly for people who are walking and bicycling.



6.2 NON-INFRASTRUCTURE

The non-infrastructure recommendations are organized by the non-infrastructure Es: Education, Encouragement, Enforcement, and Evaluation.



- Work with the Vermont Department of Motor Vehicles to ensure that driver education includes a significant component on interaction with bicyclists and pedestrians. Focus on the importance of appropriate speeds and attentive driving.
- Promote Local Motion's "Everyday Bicycling" course. This course will help adult bicyclists learn bicycle safety, etiquette and the rules of the road.
- Provide educational materials on bicycle and pedestrian rules, safety and etiquette to drivers, bicyclists, and pedestrians. VTrans and Local Motion have printed materials that municipalities and other agencies can distribute.
- Educational materials can be targeted at students in schools and colleges with information about rights and responsibilities as well as safety.
- Launch a public awareness campaign focusing on yielding to pedestrians at crosswalks and driving slowly. Local media and public service announcements can be used to implement the campaign.
- Offer workshops and training courses to local staff and elected officials to communicate the importance of walking, pedestrian safety, and how design can impact both.



6.2.2 ENCOURAGEMENT

Promote aesthetics and attractive designs. Landscaping, streetscaping, and appropriate building scales make for pleasant environments in which people want to walk.

- Encourage healthcare providers, in collaboration with insurers, to prescribe active transportation where appropriate. Providers can write prescriptions for 20 minutes of daily walking or discounted bicycle helmets to encourage patients to walk and bicycle for health.
- Encourage municipalities to renew or apply for Walk- and Bike- Friendly Community designations from the League of American Bicyclists and the Pedestrian and Bicyclist Information Center.
- Continue to promote transportation demand management (TDM) strategies and participation in organizations such as the Chittenden Area Transportation Management Association (CATMA).
- Support schools in making walking and biking part of everyday school culture. Safe Routes to School participation can take the form of organizing annual walk events (such as International Walk to School Day), data collection, walking school buses, bike trains, walking and biking curricula, and monthly walk to school events.
- Consider a bike share pilot program in Chittenden County. Local Motion's 2012 feasibility study notes that bike share may be feasible in Burlington and Winooski. Planning for a pilot bike share system is underway by CATMA, UVM and Champlain College for launch in 2017.
- Promote the Bicycle Benefits program to local businesses and their patrons. The Bicycle Benefits program offers shoppers who bike to participating merchants a discount on their purchases.
- Encourage municipalities to develop a pedestrian advisory committee if appropriate and/or if they do not already have one.
- Encourage municipalities (where applicable) to adopt Vision Zero to prioritize safety for vulnerable users.
- Participate in PARK(ing) Day (the third Friday in September) on a county-wide basis. On PARK(ing) Day, parking spaces are transformed into parklets to convey the importance of open space and public art, and reinforce the importance of people over parking.





6.2.3 ENFORCEMENT

- Promote the Bicycle and Pedestrian Training course offered by the Vermont Police Academy and Local Motion. This course aims to help law enforcement officers understand the rights and responsibilities of bicyclists and pedestrians. Chittenden County may also consider creating new educational materials, such as Massachusetts Bicycle Coalition's bike safety video, which works collaboratively with police officers on bicycle issues: <a href="https://www.youtube.com/embed/hhttps://www.youtube.com/embed/hhttps://www.youtube.com/embed/hhttps://www.youtube.com/embed/hhttps://www.youtube.com/embed/kttps://www.youtube.com/embed/kttps://wwww.youtube.com/embed/kttps://www.youtube.com/emb
- Develop a speed reduction program to strengthen enforcement and assure that vehicle speeds are safe for Complete Streets and vulnerable users such as bicyclists and pedestrians. A comprehensive speed reduction program may include speed feedback trailers.
- Focus on positive reinforcement, such as recognition for safe and slow driving, yielding to pedestrians, bicyclists who signal their turns, and looking both ways before crossing the street. Police in some communities hand out coupons for free coffee to people who are observed practicing safe behavior.
- Review municipal ordinances to determine if a town-wide speed limit or a reduction in the town-wide speed limit would be appropriate. In 2011, Burlington reduced its city-wide speed limit from 30 mph to 25 mph. Reducing the speed limit not only improves safety, but provides officers with a stronger basis for enforcement.
- Work with local police on public safety and enforcement campaigns (where applicable).
- Work with local police and code enforcement to enforce pedestrian right-of-way obstructions, such as blocking a sidewalk with a parked car or a sandwich board







6.2.4 EVALUATION

Develop a robust bicycle and pedestrian count program. Bicycle and pedestrian data collection is important to:

- Evaluate long-term trends.
- Forecast bike/ped volumes that a particular facility type might attract.
- Separate bicycle and pedestrian volumes in traffic models.
- Identify network gaps.
- Help define a hierarchal network (for example, functionally classify bike facilities and corridors).
- Acquire data to support performance measures that inform project selection and close data gaps.
- Measure the return on investment of new facilities.
- Develop a better understanding of how weather affects active transportation.
- Advance projects that are recommended in this regional plan in VTrans Transportation Alternatives and Bicycle-Pedestrian Programs. That is, projects that are being considered for funding should rank higher if they are consistent with regional planning initiatives.
- Develop a smartphone app for reporting maintenance or safety issues. Communities have streamlined public works operations and customer service by enabling users to report potholes, broken pedestrian signal buttons, and other hazards through their mobile devices.
- Develop local walking plans for each community in Chittenden County. Not only would documenting this ubiquitous mode raise its visibility and help residents to understand its importance, but formalizing a town's walking network will help to identify gaps, maintenance issues, and opportunities for improvement.
- Conduct walking audits annually. A walking audit is a method to determine if neighborhoods or specific routes meet walkability criteria, such as safety, connectivity, accessibility, comfort, cleanliness, and maintenance. Walk audits should be completed near schools or other high demand locations.
- Create walking maps for towns to promote walking. This recommendation could be completed concurrently with the local walking audits described above.
- Survey pedestrians periodically to identify both barriers and gaps in walkability.
- Enhance the CCRPC bike-walk count program. The 2013 FHWA Traffic Monitoring Guide notes that a program that combines both short- and long-term counts is best to gather spatial and volume information. For short-term counts, volunteers can count bicyclists and pedestrians an hour or two at a time, while permanent, automated counters can collect volumes continuously throughout the year. From these data, regional long-term trends can be identified and hourly, daily, and seasonal adjustment factors developed. Adjustment factors are then used to calibrate or extrapolate short-term counts performed at a wider variety of locations.

Count locations should include:

- Locations for which historic bike/ped count data exist
- Bridges
- A mix of rural, suburban, and urban locations



CHAPTER 7: IMPLEMENTATION

To organize the proposed network for implementation, the segments were aggregated into projects or corridors based on existing project extents, continuity of character, and physical or jurisdictional considerations. Each project/corridor was then scored for both priority and feasibility based on a high-level assessment of physical, operational, and demographic factors. It should be noted that regional priorities may not always match local priorities.

This section summarizes the priority and feasibility assessment, presents next steps for implementation, and provides an overview of anticipated maintenance costs. A full description of the recommendations is included in Appendix F.

7.1 NEXT STEPS FOR SHORT-TERM/IMMEDIATE TO <5 YEARS PROJECT

- Develop a wayfinding plan, including a recognizable network brand and logo, major origins and destinations and decision points, and an online/electronic distribution strategy.
- Reach out to local departments of public works to encourage the addition of flexposts to existing bike lanes where possible.
- Work with towns and cities to identify local one-way streets that could include contraflow bike lanes.
- Identify a candidate road segment for piloting an advisory lane; upcoming Transportation Improvement Program (TIP) projects or repaving projects might include an appropriate setting.
- Coordinate with GMT to identify funding opportunities and a plan for updating bus stops to include bike racks, sidewalk connections, crosswalks, and ADA ramps.
- Work with local departments of public works to make sure that VTrans HSDEI 16-100-Bicycle Facility Design Guidance and VTrans Highway Safety & Design Detail 646.02 are used in intersection improvement designs.
- Include bike detection at signalized intersections, and encourage Departments of Public Works to check that bike detection systems are functioning properly when doing routine maintenance

LONG TERM PROJECT PRIORITY AND FEASIBILITY

The methodology for assessing priority and feasibility is described in detail in Appendix G. As shown in Figure 20, projects that had a combination of both high priority and high feasibility were ranked most highly.

The proposed regional active transportation network based on the prioritization methodology is shown in Figure 21. High priority/ high feasibility segments and next steps for implementing them are described below. This serves as a long-term plan, so that after high-high projects are completed, medium priority/high feasibility, high priority/medium feasibility, and medium priority/medium feasibility projects can be pursued.



Figure 20: Priority-feasibility matrix




7.3 IMPLEMENTATION PRIORITIES

The segments identified as having both high priority and high feasibility are shown in Figure 22 and Table 3. All of the ATP segments that are on state highways are identified by the *VTrans On-Road Bicycle Plan* as "high priority" as well. Nearly all of the segments are on the FY17-20 Chittenden County Transportation Improvement Program (TIP), meaning that there are funded projects (planning, design, or construction) scheduled to take place on those corridors in the next four years. The potential to improve the active transportation network by coordinating with these planned projects is discussed below.

Several projects are identified as "Circ Alternatives Projects;" in May 2011, Governor Shumlin announced that the Circumferential Highway ("the Circ") would not be built, but that projects which would support mobility, congestion, transportation demand, safety, livability, and economic development (the original purpose and need of the Circ) would be pursued instead. The CCRPC has identified these projects and VTrans will help in advancing them.

It is recommended that projects that are included in this ATP be considered more favorably in the Bicycle-Pedestrian Program application process. This would incentivize projects that support regional network connectivity. This recommendation should not be construed as nonsupport of facilities that link important local trip origins and destinations, and the CCRPC will continue endorsing such facilities seeking funding through VTrans programs.

ID	Municipality	Name
1	Burlington/Winooski/Colchester/Essex/ Essex Junction/Jericho	Colchester Ave, VT15 (E. Allen St/College Pkwy/Pearl St) and VT117 (River Rd)
2	South Burlington/Williston/Richmond/ Bolton	US2 (Williston Rd)
3	Williston	Governor Chittenden Rd/Mountain View Rd/ Industrial Ave
4	Essex	VT15 (Center Rd)
5	Milton	US7 (River St)
6	Shelburne	US7(Shelburne Rd), Bostwick Road to Teddy Bear Factory

 Table 3: High priority-high feasibility projects



PROJECT 1: COLCHESTER AVE, VT15 AND VT117 FROM BURLINGTON TO RICHMOND

Jurisdiction:

HP124B

- Colchester Ave is a Town Highway in Burlington
- VT15 is a State Highway in Colchester and Essex, and a Town Highway in Essex Junction
- VT117 is a Town Highway in Essex Junction and a State Highway for its remainder to US2

Are there TIP projects in this segment? Yes

2017 Construction

Colchester Ave



HP111 2017 Construction Circ Alternative Project: Pearl Street Improvements from Post Office Square to Five Corners

Paving VT15 and VT117 in Essex Jct

There are intermittent sidewalks and bike lanes (and a short shared use path) on VT15 between Winooski and Essex Junction.

Near term, the upcoming paving project in Essex Junction may be able to stripe bike lanes. Longer term, the Pearl Street Improvements from Post Office Square to Essex Junction will provide better facilities and will complement the road diet project between West Street Extension and CVE, and the shared use path planned between Lime Kiln Road and Susie Wilson Road.

VT117



7.3.2 PROJECT 2: US2 FROM SOUTH BURLINGTON TO BOLTON

Jurisdiction:

US2 is a Town Highway from the Burlington City line to Millham Court in South Burlington and a State Highway for its remainder

Are there TIP projects in this segment? Yes

US2 (Williston Road) between Kennedy Drive/Airport Drive (South Burlington) and Industrial Avenue (Williston)



US2 (Williston Road) from Taft Corners to Oak Hill Road



US2 in Bolton and Richmond

The section of US2 between VT117 in Richmond and approximately the Bolton Valley Access Road is a very popular biking route. Although there are currently no TIP projects in this segment, VTrans evaluates paving candidates each year and a future project is likely.

CCRPC conducted a <u>scoping study</u> in 2014 of bike-ped connections between the Exit 11 Park-and-Ride lot and Richmond Village. The scoping study made long, medium and short term recommendations. CCRPC should work with Richmond to implement the recommendations.

CHAPTER 7: IMPLEMENTATION

Jurisdiction: Town Highway

Are there TIP projects in this segment? Yes



PROJECT 4: VT 15 FROM OLD STAGE ROAD TO ESSEX WAY IN ESSEX

Jurisdiction: VT15 is a State Highway

Are there TIP projects in this segment? Yes



7.3.5 PROJECT 5: US7 FROM FORBES ROAD TO MAIN STREET IN MILTON

Jurisdiction: US7 is a State Highway

Are there TIP projects in this segment? No

There are relatively adequate sidewalk connections along this segment in Milton, but no facilities for people riding bicycles. Although there are currently no TIP or VTrans projects being considered in this area, a scoping study should be pursued as a follow up to the 2016 Milton US7 Corridor Study. This would be initiated by the Town of Milton with assistance from the CCRPC.

7.3.6 PROJECT 6: US7 (SHELBURNE ROAD FROM BOSTWICK ROAD TO TEDDY BEAR FACTORY (SHELBURNE)

Jurisdiction: US7 is a State Highway

Are there TIP projects in this segment? No

This segment of US7/Shelburne Road has very wide shoulders and connects to major employers in the region. Providing facilities for active transportation might encourage commuting by walking or biking. The CCRPC is currently working on the Southern Gateway project to improve bicycling and walking in this area. As a state highway, VTrans owns and maintains the roadway and would decide whether the wide shoulder could be striped as a bike lane or other facility to support walking and bicycling.

PROGRAMS FOR ADVANCING PRIORITY PROJECTS

FEDERAL AND STATE FUNDING SOURCES

VTrans Bicycle and Pedestrian Program

The intent of the VTrans Bicycle and Pedestrian Program is to improve access and safety for bicyclists and/or pedestrians through the planning, design and construction of infrastructure projects. The program is administered by the VTrans Municipal Assistance Bureau (MAB). The Bike/Ped Program provides funding for either the scoping or design/construction of:

- Bicycle lanes (on-road facility delineated with pavement markings and signs)
- Shoulders (generally a minimum of 3-feet wide to accommodate bicyclists)
- Sidewalks
- Pedestrian crossing improvements, including median pedestrian refuge islands and bulb outs
- Pedestrian or bicycle intersection signals
- Improvements that address requirements of the Americans with Disabilities Act
- Shared-use paths (designed for use by both bicyclists and pedestrians)
- Pedestrian-scale lighting (not likely to rank highly as a standalone project, but eligible as a project component)

Highway Safety Improvement Program (HSIP)

HSIP funds are available for safety projects aimed at reducing traffic fatalities and serious injuries. Bike lanes, roadway shoulders, crosswalks, intersection improvements, underpasses and signs are examples of eligible projects. Projects in high-crash locations are most likely to receive funding. States that have identified bicycle safety and pedestrian safety as Emphasis Areas are more likely to fund bicycle and pedestrian safety projects.

Transportation Investment Generating Economic Recovery (TIGER) Grant

TIGER grants fund a broad array of road, rail, transit, and bicycle and pedestrian projects. The program focuses on capital projects that generate economic development and improve access to reliable, safe, and affordable transportation especially for disadvantaged communities. The grant funds projects that have gone through preliminary design stages and prioritizes projects with broad stakeholder support. Applicants are required to demonstrate that project benefits outweigh the costs. Projects in urban areas must request at least \$10 million (with a 20% match) and projects in rural areas must request at least \$1 million (with no required match).

Bicycle and Pedestrian Funding Opportunities: US Department of Transportation, Federal Transit, and Federal Highway Funds

The Federal Highway Administration created a data-table to assist communities in understanding which Federal funding programs could be used for bicycle and pedestrian projects. The table provides an overview; specific program requirements must be met and eligibility must be determined on a case-by-case basis. For example: transit funds must provide access to transit and Congestion Mitigation and Air Quality Improvement (CMAQ) funds must benefit air quality in eligible areas.

Community Services Block Grant Program (CSBG)

The Community Services Block Grant provides funds to alleviate the causes and conditions of poverty in communities and includes transportation projects. Administered by the Department of Health and Human Services, funding is allocated to states who then make it available to local communities. Funded projects have included: commercial district streetscape improvements; sidewalk improvements; safe routes to school; and neighborhood-based bicycling and walking facilities that improve local transportation options or help revitalize neighborhoods.

Sustainable Communities Regional Planning Grants and the Partnership for Sustainable Communities

This grant program supports locally-led collaborative efforts that bring together diverse interests to determine how best to target housing, economic and workforce development, and infrastructure investments to create more jobs and regional economic activity. The Program places a priority on investing in partnerships, including non-traditional partnerships (e.g., arts and culture, recreation, public health, food systems, regional planning agencies and public education entities). The program is a key initiative of the Partnership for Sustainable Communities, in which HUD works with the U.S. Department of Transportation (DOT) and the U.S. Environmental Protection Agency (EPA) to coordinate and leverage programs and investments.

Partnerships to Improve Community Health (PICH)

The PICH program supports programs tailored to individual community needs, across various settings (community institutions/ organizations, health care facilities, schools, and worksites), to create greater access to healthier environments with the goal of reducing the prevalence of chronic diseases. Funding priorities include addressing physical inactivity and lack of access to places such as parks and schools.

National Implementation and Dissemination for Chronic Disease Prevention

This initiative supports national organizations and their local chapters/affiliates in building and strengthening community infrastructure to implement population-based strategies to improve community health.

Racial and Ethnic Approaches to Community Health

REACH is a national program administered by the Centers for Disease Control and Prevention (CDC) to reduce racial and ethnic health disparities. Through REACH, awardee partners plan and carry out local, culturally appropriate programs to address a wide range of health issues among African Americans, American Indians, Hispanics/Latinos, Asian Americans, Alaska Natives, and Pacific Islanders. REACH gives funds to state and local health departments, tribes, universities, and community-based organizations. Awardees use these funds to build strong partnerships to guide and support the program's work. Along with funding, CDC provides expert support to REACH awardees.

Section 405 National Priority Safety Programs

Section 405 grants provide funding on a competitive basis to states to improve highway safety in a number of areas including impaired driving, occupant protection, distracted driving and more. States are eligible to apply if they have met certain qualifications that pertain to each subgrant. Under this section, Nonmotorized Safety grants are eligible to states where pedestrian and bicyclist fatalities exceed 15 percent of the state's total annual crash fatalities. The funds may be used for law enforcement training, enforcement campaigns, and public education to improve pedestrian safety.

Section 402 State and Community Highway Safety Grant Program

The Section 402 program provides grants to states to improve driver behavior and reduce deaths and injuries from motor vehicle-related crashes. The program is jointly administered by the National Highway Traffic Safety Administration (NHTSA) and the Federal Highway Administration (FHWA) at the federal level and by State Highway Safety Offices at the state level. Funds may be used to reduce impaired driving, reduce speeding, improve pedestrian and bicycle safety, and reduce school bus deaths and injuries, among other activities. Child and adult bicycle safety education is eligible for funding.

Livable and Sustainable Communities

U.S. DOT's Livability Initiative focuses on enhancing the economic and social well-being of all Americans by creating and maintaining a safe, reliable, integrated and accessible transportation network that enhances choices for transportation users, provides easy access to employment opportunities and other destinations, and promotes positive effects on the surrounding community.

River, Trails, and Conservation Assistance Program

This program, administered by the National Park Service, helps to connect Americans to their parks, trails, rivers, and other places. When a community asks for assistance with a project, NPS staff provides free, on-location facilitation and planning expertise from conception to completion. Assistance can include visioning and planning, developing concept plans for trails, parks and natural areas, setting priorities and identifying funding sources.

Recreational Trails Program (RTP)

The RTP provides funds to States to develop and maintain trails and trail-related facilities. Projects can include: planning and design; land acquisition; maintenance and the purchase of maintenance equipment, and educational programming. Although under the FAST Act the program has been consolidated into the Surface Transportation Block Grant Set-Aside, each state administers it independently with funding set at 2009 levels.

Army National Guard

The Army National Guard is a great partner for community activities, such as trail building. Their desire to work in communities and their need for community-based work makes them excellent partners especially for trail building and clearing.

Bus and Bus Facilities Program, Ladders of Opportunity Initiative(5309)

The funds in this program may be used to modernize and expand transit bus service specifically for the purpose of connecting disadvantaged and low-income individuals, veterans, seniors, youths, and others with local workforce training, employment centers, health care, and other vital services.

New Freedom Program (5217)

The New Freedom grant program funds projects that help Americans with disabilities participate in the work force and in society. Lack of adequate transportation is a primary barrier to work for individuals with disabilities. The New Freedom program seeks to reduce barriers to transportation services and expand the transportation mobility options available to people with disabilities.

Surface Transportation block Grant Program Set-Aside (formerly Transportation Alternatives)

This set-aside, established in the 2015 transportation bill, Fixing America's Surface Transportation Act (FAST Act), replaces the Transportation Alternatives Program (TAP). Activities which were eligible under the Transportation Alternatives Program, which itself included the former Transportation Enhancements Program, the Safe Routes to School Program, and the Recreational Trails Program are now eligible under this set-aside. Larger Metropolitan Planning Organizations control a share of the funds to distribute locally through a competitive process.

Surface Transportation Block Grant

Under the FAST Act, the Surface Transportation Program (STP) was renamed the Surface Transportation Block Grant Program. Bicycle and pedestrian activities are broadly eligible under this large and flexible program.

Congestion Mitigation and Air Quality Improvement (CMAQ) Program

The CMAQ program supports surface transportation projects and other related efforts that contribute air quality improvements and provide congestion relief. Non-motorized projects can be funded through this program because of their link to air quality improvements. Projects must be located in areas that do not meet, or have recently not met, minimum air quality standards.

People for Bikes Grant

People for Bikes Grants support bicycle infrastructure projects and advocacy initiatives that make it easier and safer for all people to ride. Most grant funds are awarded towards infrastructure projects such as bike paths, lanes, trails, and bridges, and end-of-trip facilities such as bike racks, bike parking, and bike storage.

Bike Shop Sponsorships

Trail and bicycle programs have a positive effect on the economy. Many of those who benefit would like to give back. Bike shops are often willing to donate a portion of their proceeds towards community events or the completion of a particular project.

Boy Scouts of America

The Boy Scouts of America is one of the nation's largest youth development organizations. The BSA provides a program for young people that builds character, trains them in the responsibilities of participating citizenship, and develops personal fitness. Many Scout troops embrace the opportunity to build or clear trails and small bridges, add benches, and address other transportation barriers.

Student Conservation Association (SCA)

SCA's mission is to build the next generation of conservation leaders and inspire lifelong stewardship of the environment and communities by engaging young people in hands-on service to the land. SCA teams are often looking for service projects, typically focused on trail building and maintenance, in which to get youth involved.

The Conservation Fund

The Conservation Fund provides loans for land acquisition to support the creation of bicycle and pedestrian facilities. Their loan program offers flexible financing as well as sustained and expert technical assistance to organizations aiming to protect key properties in their communities.

Crowdfunding

Crowdfunding focuses on raising money for projects through many small donations, typically via the internet. Websites, such as gofundme.com, ioby.com and indiegogo.com, allow fundraising campaigns to be easily established. In 2014, Memphis raised \$70,000 in this way to build a separated bicycle lane. In 2015, Denver launched a crowdfunding campaign focused on corporate donors for the planning and design of bicycle facilities.

National Recreation and Park Association (NRPA)

NRPA routinely partners with foundations to provide grants for projects in parks, such as the Walk With Ease Grant, which is a partnership between the NRPA and the Centers for Disease Control, or the NFL Play 60 After-School Kick Off Grant, a partnership with the NFL Network to fund fields, equipment and staff. Additional fundraising resources and strategies are also provided.

The Kresge Foundation

The Kresge Foundation provides grants to nonprofit organizations and government agencies seeking financial assistance for projects that contribute to improving health at the community level, including those that promote the use of new financial models to achieve cost-effective solutions. The goal of these grants is to create a comprehensive system that improves health outcomes, promotes health equity, reduces per-capita health costs, remove barriers to health and offers the greatest promise for adoption on a larger scale.

Robert Wood Johnson Foundation

The Robert Wood Johnson Foundation provides grants for projects that improve our community's health and the health care system with a focus on non-infrastructure projects. Most grants are awarded through calls for proposals (CFPs) available on their website. Brief proposals for projects that suggest new and creative approaches to solving health and health care problems can be submitted at any time.

AARP Vermont

As part of Livable BTV, AARP Vermont offers Community Action Grants for projects that support pedestrian infrastructure (sidewalks, amenities for walkers, public art, safe street crossings, navigation, etc.), public transit, and community accessibility for disabled residents. The grants are available to community groups or individuals and provide modest funding and technical support.



7.5 MAINTENANCE COSTS

Proper maintenance is imperative to support a usable and safe active transportation network. Local departments of public works should (if they haven't already) develop inspection programs to document facility condition and indicate needed repairs. Typical maintenance concerns for active transportation facilities can include the following:

- Potholes and other surface irregularities
- Debris near the right edge of the road
- Debris or surface irregularities on curves or at intersections
- Chip seal gravel
- Ridges or cracks
- Snow removal

Table 4 suggests annual maintenance costs for various facility types depending on the current condition; facilities in poor condition will require more maintenance in order to be usable. Additional information is provided in Appendix H.

Facility Condition		Good	Average	Poor
		Signage and pavement markings are in place and visible Crossings are well-maintained Surface is generally smooth with few if any cracks	Cracking in pavement/asphalt has been patched Pavement markings worn/ faded	Missing signs and/or pavement markings Pot holes, crumbling pavement
	On-Road Bicycle Facility	\$1,000	\$15,000	\$30,000
	Multi-Use Path	\$1,000	\$27,000	\$50,000
	Sidewalk	\$13,000	\$18,000	\$22,000

 Table 4: Anticipated yearly maintenance costs (per mile)

CHAPTER 8: PERFORMANCES MEASURES

This section summarizes the performance measures that CCRPC will use to evaluate progress towards the established Vision and Goals. The performance measures overlap largely with ECOS, the CCRPC's Long Range Plan, for ease of measurability and to ensure plan consistency.

Category/Goal	Performance Measure/Indicator				
Environmental Quality					
Goals: Conserve, protect and improve the health of native	Particulate Matter Ozone				
species habitats, water quality and quantity, and air quality.					
Reduce greenhouse gas (GHG) emissions contributing to climate change and adapt to become more resilient to a	Greenhouse gas emissions				
changing climate.					
	Adults with asthma (%)				
Public Health	Youth with asthma (%)				
Goal: All Chittenden County residents are healthy	Adults meeting physical activity guidelines (30 minutes/ day most days of the week) (%)				
	Adolescents in grades 9-12 meeting physical activity guidelines (60 minutes/day most days of the week) (%)				
	Annual crashes involving bicycles or pedestrian (#)				
Safety	Vehicle crashes resulting from high speeds (#)				
Goal: Improve the safety of the public including the loss of life	Written violations for drivers (when citation involves a bicyclist or pedestrian), bikes, peds (#)				
and property from natural and man-made hazards.	Sting operations (#)				
	Bicycle-pedestrian educational activities and events (#)				

Economic Development

Goal: Retain and support existing employers and job growth, grow target sector employers and entrepreneurs, and work to attract a greater diversity of employers and employees.

Housing + transportation costs for median income family

Category/Goal

Performance Measure/Indicator

Volume changes (% driving alone to work, bicycling and walking volumes at key count locations, biking and walking mode shares)

Miles of walking/biking infrastructure

Facilities installed (#)

GMT stops that have shelters (%)

GMT bus stops with bike racks (#)

Local Motion events (#)

GMT bus stops without sidewalk or bicycle access (#)

Vehicle miles travelled

Person miles travelled

Schools that are partners in Safe Routes to School (#)

Recommendations/ projects that are eligible for existing funding (#)

ATP recommended projects completed (%)

Transportation

Goal: Provide accessible, safe, efficient, interconnected, secure, equitable and sustainable mobility choices for our region's businesses, residents and visitors.

CHAPTER 9: CONCLUSIONS AND NEXT STEPS

Through the process of developing the Chittenden County ATP, a number of important points and issues were identified:

- Active transportation has numerous benefits to people in Chittenden County. It is an important part of people's lives for transportation, recreation, and health. There are also economic, environmental, health, and quality of life benefits that affect the entire population, even those who do not walk or bike.
- Enforcement and education, in addition to engineering and infrastructure design, are important factors in improving safety and reducing crashes. This is particularly critical for people using active transportation, as they are more vulnerable to injuries and fatalities than people who are protected by a vehicle.
- Connecting bicycling and walking to other transportation modes such as transit and carsharing is critical for an effective and efficient system that supports quality of life in Chittenden County.
- The ATP presents recommendations for improving network connectivity for active transportation in Chittenden County, but does not specify facility type. By focusing on overall network gaps, context-sensitive solutions for individual projects can be developed later on.
 - Generally, walking infrastructure in village centers and urban areas is comprehensive. Individual infrastructure projects like sidewalk segments and crosswalks are municipal issues that are not addressed in this regional plan. The ATP recommends programs and policies that can support walking throughout Chittenden County.
 - Bicycling is a beneficial transportation option for regional trips. Therefore, the ATP recommends both non-infrastructure and infrastructure improvements for active transportation based on an analysis of bicycle network gaps.
- Proper maintenance is imperative to support a usable and safe active transportation network. Local
 departments of public works should (if they haven't already) develop inspection programs to document
 facility condition and indicate needed repairs.
- Lack of lighting and snow clearance can significantly limit usability of the active transportation network. Lighting should be included in path projects whenever possible. Responsibilities for snow and ice clearance (i.e., municipal or private abutter) should be clarified on a municipal level.
- In order to be fully accessible to everyone regardless of age or ability, the infrastructure recommendations need to incorporate universal design. Snow and ice removal is particularly important for accessibility.
- Many of the segments identified as high priority-high feasibility in the ATP are already on the Chittenden County TIP. Coordinating with these projects provides an excellent opportunity to begin implementing connections within the active transportation network.

¹ Physical Activity Guidelines Advisory Committee. PHYSICAL ACTIVITY GUIDELINES ADVISORY COMMITTEE REPORT, 2008. Washington, DC: U.S. Dept of Health and Human Services; 2008.

U.S. Department of Health and Human Services. 2008 PHYSICAL ACTIVITY GUIDELINES FOR AMERICANS. Washington, DC: U.S. Dept of Health and Human Services; 2008. <u>http://health.gov/paguidelines/pdf/paguide.pdf</u>

U.S. Health and Human Services Department's Physical Activity Guidelines for Americans

² Health Status of Vermonters, Vermont Department of Health, 2008.

³ "Step It Up! The Surgeon General's Call to Action to Promote Walking and Walkable Communities," Executive Summary <u>http://</u> <u>www.surgeongeneral.gov/library/calls/walking-and-walkable-com-</u> <u>munities/call-to-action-walking-and-walkable-communites.pdf</u>

⁴Gordon-Larsen P, Boone-Heinonen J, Sidney S, et al. Active commuting and cardiovascular disease risk: the CARDIA study. Arch Intern Med 2009;169:1216–23. <u>http://www.turner-white.com/memberfile.php?PubCode=jcom_oct09_walking.pdf</u>

⁵ "How to Increase Bicycling for Daily Travel," Active Living Research, Research Brief, May 2013 <u>http://activelivingresearch.org/</u> <u>files/ALR_Brief_DailyBikeTravel_May2013.pdf</u>

⁶ de Hartog JJ, Boogaard H, Nijland H, and Hoek G. "Do the Health Benefits of Cycling Outweigh the Risks?" Environ Health Perspect. 2010 Aug; 118(8): 1109–1116. <u>http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2920084/</u>

⁷ U.S. Department of Health and Human Services. 2008 PHYSICAL ACTIVITY GUIDELINES FOR AMERICANS. Washington, DC: U.S. Dept of Health and Human Services; 2008. http://health.gov/paguidelines/pdf/paguide.pdf

⁸ Centers for Disease Control and Prevention, Healthy Places, Mental Health <u>http://www.cdc.gov/healthyplaces/healthtopics/</u> mental.htm. December 2012.

⁹ Vermont Agency of Transportation, "Economic Impact of Bicycling and Walking in Vermont," Final Report July 6, 2012, prepared by Resource Systems Group, Inc., Economic and Policy Resources, Inc., and Local Motion. <u>http://vtransengineering.vermont.gov/sites/ aot_program_development/files/documents/ltf/BikePedFinal%20 Report%20Econ%20Impact%20Walking%20and%20Biking2012. pdf_</u>

¹⁰ Clifton, Kelly, Sara Morrissey, and Chloe Ritter, "Business Cycles: Catering to the Bicycling Market," & "Exploring the Relationship Between Consumer Behavior and Mode Choice," TR News 280 May–June, 2012. <u>http://kellyjclifton.com/Research/EconImpactsof-Bicycling/TRN_280_CliftonMorrissey&Ritter_pp26-32.pdf</u>

¹¹ Clean Air Partnership, "Bike Lanes, On-Street Parking and Business: A study of Bloor Street in Toronto's Annex Neighborhood," February 2009. <u>http://www.cleanairpartnership.org/</u> pdf/bike-lanesparking.pdf ¹² Popovich N., Handy S., "Bicyclists as Consumers: Mode Choice and Spending Behavior in Downtown Davis, California," <u>http://</u> <u>trrjournalonline.trb.org/doi/abs/10.3141/2468-06</u>

¹³ Drennen, Emily, "Economic Effects of Traffic Calming on Urban Small Businesses," San Francisco, CA. <u>http://www.bikewalk.</u> org/2004conference/sessions/28 Business calm/TrafficCalming summary.pdf

¹⁴ American Planning Association (APA), City Parks Forum Briefing Paper #03: How cities use parks for economic development, 2002.

¹⁵ APA, City Parks Forum Briefing Paper #05: How cities use parks for green infrastructure, 2002.

¹⁶ "The National Bicycling and Walking Study: 15–Year Status Report" May 2010 <u>https://www.massdot.state.ma.us/portals/0/docs/</u> <u>bike/15-year_report.pdf</u>

¹⁷ Willis, D., Manaugh, K., & El-Geneidy, A. (2013). Uniquely satisfied: Exploring cyclists trip satisfaction. Transportation Research Part F: Traffic Psychology and Behaviour, 18, 136-147. <u>http://tram.mcgill.ca/Research/Publications/Cycling_Satisfaction_TRB.pdf</u>

¹⁸ Smith, O., Commute well-being among bicycle, car, and transit commuters in Portland, Oregon

http://bikeportland.org/wp-content/uploads/2013/01/TRB_ Osmith_55x44.pdf

¹⁹ Cohen L., Davis R., Lee V., and Valdovinos E. "Addressing the Intersection: Preventing Violence and Promoting Healthy Eating and Active Living." Prevention Institute, September 2010.

²⁰ Vermont Agency of Transportation, "Economic Impact of Bicycling and Walking in Vermont," Final Report July 6, 2012, prepared by Resource Systems Group, Inc., Economic and Policy Resources, Inc., and Local Motion. <u>http://vtransengineering.</u> <u>vermont.gov/sites/aot_program_development/files/documents/ Itf/BikePedFinal%20Report%20Econ%20Impact%20Walking%20 and%20Biking2012.pdf</u>

²¹ AAA, Your Driving Costs, 2015 <u>http://newsroom.aaa.</u> <u>com/2015/04/annual-cost-operate-vehicle-falls-8698-finds-aaa/</u>

²² Pedaling to Prosperity, <u>http://vault.sierraclub.org/pressroom/</u> <u>downloads/BikeMonth_Factsheet_0512.pdf;</u>

How Much Does It Cost To Commute By Bike? <u>http://www.treehugger.com/bikes/how-much-does-it-cost-to-commute-by-bike.html</u>

²³ NCHRP Report 770 "Estimating Bicycling and Walking for Planning and Project Development: A Guidebook" <u>http://onlinepubs.</u> <u>trb.org/onlinepubs/nchrp/nchrp_rpt_770.pdf</u>

²⁴ Transportation and Energy <u>http://vnrc.org/wp-content/uploads/2014/12/lssue-Transportation-and-Energy.pdf</u>

²⁵ Federal Highway Administration, National Bicycling and Walking Study, "Case Study No. 15 The Environmental Benefits Of Bicycling And Walking," 1993 <u>http://safety.fhwa.dot.gov/ped_bike/docs/</u> case15.pdf

²⁶ Rob McConnell et al., "Childhood Incident Asthma and Traffic-Related Air Pollution at Home and School," Environmental Health Perspectives 118 (July 2010): 1021–26, doi:10.1289/ ehp.0901232.

²⁷ Michael Jerrett et al., "A Cohort Study of Traffic-Related Air Pollution and Mortality in Toronto, Ontario, Canada," Environmental Health Perspectives 117 (May 2009): 772–77, doi:10.1289/ ehp.11533.

²⁸ Jennifer Parker et al., Linkage of the 1999–2008 National Health and Nutrition Examination Surveys to Traffic Indicators From the National Highway Planning Network, National Health Statistics Report (U.S. Department of Health and Human Services, Apr. 2, 2012).

²⁹ Nancy Tian, Jianping Xue, and Timothy M. Barzyk, "Evaluating Socioeconomic and Racial Differences in TrafficRelated Metrics in the United States Using a GIS Approach," Journal of Exposure Science and Environmental Epidemiology 23 (Mar. 2013): 215–22, doi:10.1038/jes.2012.83.

³⁰ Gregory M. Rowangould, "A Census of the US near-Roadway Population: Public Health and Environmental Justice Considerations," Transportation Research Part D Transport and Environment 25 (2013): 59–67, doi:10.1016/j.trd.2013.08.003.

³¹ Sarah Jarjour et al., "Cyclist Route Choice, Traffic-Related Air Pollution, and Lung Function: A Scripted Exposure Study," Environmental Health 12 (Feb. 7, 2013): 14, doi:10.1186/1476-069X-12-14.

³² Doug Brugge et al., "Developing Community-Level Policy and Practice to Reduce Traffic-Related Air Pollution Exposure," Environmental Justice (2015): Vol. 8, No. 3. DOI: 10.1089/ env.2015.0007

³³ Christin M. Kendrick et al., "Impact of Bicycle Lane Characteristics on Exposure of Bicyclists to Traffic-Related Particulate Matter," Transportation Research Record (2011): No. 2247, pp. 24-32. DOI: 10.3141/2247-04

³⁴ Available at <u>http://www.localmotion.org/documents/Chittenden</u> <u>County Bike Share Feasibility Study.pdf</u>

³⁵ Vermont Department of Health, Behavioral Risk Factor Surveillance System, 2000-2013. <u>http://healthvermont.gov/</u> <u>research/brfss/reports.aspx</u>

³⁶ Robert Wood Johnson Foundation, County Health Rankings & Roadmaps, Accessed 2015. <u>http://www.countyhealthrankings.org/</u>

³⁷ National Ambient Air Quality Standards (NAAQS), US Environmental Protection Agency, 2012. <u>https://www.epa.gov/crite-</u> <u>ria-air-pollutants/naaqs-table</u> ³⁸ Vermont Agency of Natural Resources, Air Pollution Division, Air Quality Index Report, 2012. <u>http://anr.vermont.gov/</u>

³⁹ Vermont Department of Health, Youth Risk Behavior Survey, 2013. <u>http://healthvermont.gov/research/yrbs.aspx</u>

⁴⁰ Dill, J., and N. McNeil. Four Types of Cyclists? Examination of Typology for Better Understanding of Bicycling Behavior and Potential. In Transportation Research Record: Journal of the Transportation Research Board, No. 2387, Transportation Research Board of the National Academies, Washington, D.C., 2013.

⁴¹ Maaza C. Mekuria, Peter G. Furth, and Hilary Nixon, "Low-Stress Bicycling and Network Connectivity," Mineta Transportation Institute (2012), Report 11-19.

⁴² FHWA, Traffic Monitoring Guide, 2013. <u>https://www.fhwa.dot.</u> <u>gov/policyinformation/tmguide/tmg_fhwa_pl_13_015.pdf</u>