CCRPC Active Transportation Plan Evaluation

September 13, 2021

Prepared by:

Dr. Gregory Rowangould and Eliana Fox
University of Vermont Transportation Research Center
25 Colchester Avenue, Burlington, VT 05405
www.uvm.edu/cems/trc

Prepared for:

Chittenden County Regional Planning Commission
10 West Canal Street, Suite 202
Winooski, Vermont 05404

THE UNIVERSITY OF VERMONT
TRANSPORTATION
RESEARCH CENTER

CONTENTS

1 Introduction 3

2 Implementation Status 4

2.1 Recommended Active Transportation Network 4

2.2 Other Infrastructure Recommendations 8

2.2.1 Short Term/Immediate Recommendations 8

2.2.2 Long-Term Recommendations 10

2.3 Engineering 13

2.4 Non-Infrastructure 17

3 Evaluating the Planning and Prioritization Process 23

3.1 Proposed ATP Network 23

3.1.1 Developing the Proposed ATP Network 23

3.1.2 Prioritizing ATP Network Projects 25

3.2 Other Recommendations 27

3.3 Performance Measures 27

4 Recommendations 28

4.1 Use an Accessibility Focused Framework to Prioritize Infrastructure Projects 29

4.2 Evaluate and Prioritize Other Infrastructure, Policy and Programmatic Recommendations 32

4.3 Use Consistent, Outcome Focused, Performance Measures 34

4.4 Provide More Detailed Information to Guide Implementation of Specific Recommendations 35

4.5 Additional Recommendations 36

5 References Cited 37

Appendix A – Infrastructure Project Status 39

TABLES

Table 1 Short Term Recommendations 9

Table 2 Long Term Recommendations 11

Table 3 Engineering Recommendations 14

Table 4 Education Recommendations 18

Table 5 Encouragement Recommendations 19

Table 6 Enforcement Recommendations 20

Table 7 Evaluation Recommendations 21

1 INTRODUCTION

The UVM Transportation Research Center ("TRC") evaluated the Chittenden County Regional Planning Commission ("CCRPC") 2017 Active Transportation Plan ("ATP") to determine the current implementation status of the plan's recommendations and develop a strategy for implementing and prioritizing the ATP's remaining projects and recommendations.

We evaluated the implementation of each ATP recommendation through a combination of methods including, visual inspection of roadway infrastructure through aerial imagery and field studies, a search of records and policies on each municipality's website, evaluation of recent Transportation Improvement Program (TIP) projects, contacting municipal staff, conducting an electronic survey sent to planning and/or public works staff in each municipality, and our research team's local knowledge of the region. Determining the implementation status of each ATP recommendation was extremely challenging and not always possible. The ATP provides a wide range of recommendations including a proposed active travel network ("ATP network") along with many design, planning and policy recommendations. A particular challenge in determining the implementation status of the proposed ATP network is the lack of detail in what needs to be built. While the ATP identifies network links that lack sufficient bicycle infrastructure, it does not include recommendations on what changes are required. Evaluating the implementation status of the other ATP recommendations was even more difficult. Many recommendations were described as "encouraging" or "assisting with" the implementation of a specific recommendation and it was often unclear who was responsible for providing encouragement and assistance or how encouragement and assistance should be provided. In many instances we were able to identify municipalities that have adopted various recommendations, but we were often unable to determine if their adoption was in response to the ATP or specific encouragement or assistance activities.

After evaluating the implementation status of the recommendations in the plan, we considered how the remaining ATP recommendations could be implemented and prioritized. We began by evaluating the data and analytical methods used to generate and prioritize the current recommendations in the ATP. Our review identified a number of limitations in the original planning and prioritization process that are likely to limit the implementation of the ATP's recommendations. One significant limitation is the lack of an integrated and consistent accessibility-based framework for evaluating and prioritizing infrastructure projects, including those making up the proposed ATP network. The main purpose of transportation infrastructure, including bicycle and pedestrian infrastructure which are the focus of the ATP, is access to destinations where people engage in various activities such as work and education and obtain goods and services (Handy, 2020). Development and expansion of the region's ATP network should therefore aim to increase accessibility for pedestrians and bicyclists. Equity is also an important consideration and can also be evaluated using an accessibility framework by quantifying how projects increase accessibility for different communities or population groups (Kent & Karner, 2019).

Despite the challenges in evaluating the implementation status of the ATP's recommendations and the limitations we identify in some of the planning and prioritization methods, our evaluation finds that many of the plan's recommendations have been implemented and many of the region's municipalities do consult the plan. In short, we find that the plan is likely to be effective in guiding the region towards the wider adoption of active travel infrastructure and supportive plans and polices; however, there are opportunities to improve the plan, revisit some of the recommendations and develop a more strategic project prioritization process. It will also be important to develop a more robust, outcome focused, set

of performance measures to ultimately determine if the plan is likely to achieve its goals. The remainder of this report catalogs the implementation status of each recommendation to the extent we could determine, identifies limitations in the planning and prioritization process that may limit the implementation and performance of the ATP, and concludes with a series of recommendations to address these shortcomings.

2 IMPLEMENTATION STATUS

2.1 Recommended Active Transportation Network

One of the main features of the ATP is a proposed regional active transportation network[1]. The ATP network identifies network links that could be improved to create a regional *bicycle* travel network. Walking is assumed to be a more localized, short distance, activity that is facilitated by local infrastructure and therefore was not explicitly considered in the creation of the ATP network. We evaluated each segment of the proposed ATP network to determine implementation status. We considered the presence of any bicycle infrastructure on a proposed network segment to be an indication that the proposed ATP network had been implemented there. Proposed ATP network segments that currently lack bicycle infrastructure were recorded as not being implemented.

Implementation status was evaluated through the review of aerial imagery (e.g., google maps), archived street level images (e.g., google street view) and site visits. We first reviewed imagery that was available through online resources and noted segments of the active transportation network corridors where bicycle specific infrastructure exists. We then evaluated the remaining active transportation network corridors with site visits. Site visits were made by driving the network corridors in spring and early summer of 2021 and recording the presence and type of bicycle infrastructure. We did not systematically evaluate the quality or dimensions of infrastructure.

Our evaluation of the implementation status of the proposed ATP network has several important limitations. Determining the implementation status of the proposed ATP network was challenging and not always possible. A significant challenge was that the ATP provides very little information about existing conditions of the proposed ATP network and what changes are needed to improve existing conditions. While the ATP states that the lack of project detail was intentional because specific design considerations depend on a range of local factors that were beyond the scope of a regional planning exercise, the absence of these details makes it difficult to understand what, if anything, has changed along a proposed ATP network segment and if changes were in response to the ATP and in line with the ATP's overall goals and objectives.

Rural roads and highways were particularly difficult to evaluate because the ATP suggests that facilities in rural areas may not require any specific infrastructure[2] or that a paved shoulder[3] could be sufficient. It is unclear, for example, what changes may be needed to rural, low volume, roads like Duxbury Road in Bolton or Barber Farm Road in Jericho which are both part of the proposed ATP network and currently have no bicycle infrastructure. Many rural roads and highways have a shoulder, but widths are often variable. It is unclear if roadways in the proposed ATP network that currently have a shoulder were upgraded in response to the ATP, if the shoulders were pre-existing, or if the current shoulders are wide

[1] See figure 18 on page 58 of the ATP.
[2] Discussion of shared roads on page 36 of the ATP.
[3] Discussion of paved shoulders on page 35 of the ATP.

enough to satisfy the intent of the ATP. Most of the roadways we surveyed have shoulders and many appeared to have widths between 3ft to 5ft[4]. Some shoulders were much narrower and a few were wider for short lengths. A minimum 4ft shoulder width is a common design recommendation[5], with greater widths recommended for higher volume roads with greater truck traffic and higher speed facilities. These guidelines are largely based on the minimum distance required to safely separate bicyclists from moving traffic, rather than providing a low stress environment that is likely to promote greater levels of bicycling in a community (Mekuria et al., 2017). Given these limitations and uncertainties, in most cases we did not consider paved shoulders as bicycle infrastructure even though shoulders may have been implemented as a response to the ATP. In a few cases where shoulders were consistently wide throughout the corridor and in good condition (free of surface defects and well-marked) we noted them but were not able to determine if they were constructed in response to the ATP. All rural roads without any bicycle infrastructure or shoulders were recorded as not implemented.

We encountered similar challenges in urban areas. While we could observe current conditions, including the presence of bicycle facilities such as bicycle lanes and shared use paths, we were not able to determine if current facilities were implemented in response to the ATP or if the ATP envisioned improved bicycle facilities. For example, a bicycle lane could be upgraded to a buffered bicycle lane (e.g., as recently implemented on portions of North Avenue in Burlington) or a separated shared use path could also be provided (e.g., as was recently built on Colchester Avenue in Burlington). State Route 2 from the UVM campus in Burlington to Dorset Street in South Burlington has a bicycle lane or shared use path, but is also identified as a major barrier. While this roadway segment is clearly not a low stress facility, what level of improvement would satisfy the intent of the ATP is also unclear. Given these limitations and uncertainties, we recorded any roadway segment that currently has bicycle infrastructure as being implemented. We did not consider shared use lane markings ("sharrows") or signs indicating bicycle routes as bicycle infrastructure since there is little evidence of their effectiveness at increasing bicycling or traffic reducing stress levels (Mekuria et al., 2017).

Figure 1 Faded Bicycle Lane on Kellogg Road, Essex

The condition of bicycle facilities was also observed to be highly variable. We observed many instances of bicycle lane markings that had completely worn away (see Figure 1 for an example). The surface condition of most bicycle lanes outside of Burlington was generally good. Pavement conditions in Burlington were highly variable, in some cases causing complete failure of bicycle infrastructure (Figure 2). Many flex posts were missing from the protected bicycle lane on Union Street in Burlington which we marked as a buffered bicycle

[4] We did not measure and inventory the width of all bicycle infrastructure. This estimate is based on the measurement of a few spot locations and estimation based on observations while driving proposed ATP network segments.

[5] This includes guidelines in the Vermont Agency of Transportation's Pedestrian and Bicycle Design Manual: https://vtrans.vermont.gov/sites/aot/files/highway/documents/publications/PedestrianandBicycleFacilityDesignManual.pdf

Figure 2 Unmaintained Bicycle Lane on College Street, Burlington

lane rather than separated. The design of bicycle infrastructure was also highly variable. The width of bicycle lanes varied substantially, sometimes within the span of a single block. While we did not measure the width of bicycle lanes, some were clearly less than what is generally recommended in most guidelines (4 ft to 5 ft). Some roadways only have bicycle lanes on one side of two-way streets. Shared use paths were sometimes marked with a center dividing line, sometimes signed as a shared used path, and sometimes were indistinguishable from sidewalks. We marked bicycle facilities as present regardless of their condition and design.

We did not conduct an inventory of intersection treatments nor did we consider intersections when evaluating the implementation status of the recommended ATP network because the ATP had very little information about existing intersection facilities and few design recommendations. We observed that many on-road bicycles facilities lacked treatments at major intersections. The most common treatment was including a bicycle lane for through movements at intersections that did not have right turn lanes. Very few intersections had infrastructure to protect bicyclists from right turning traffic or accommodated left turns. A few intersections in Burlington have bicycle boxes which address some of these issues, but even in Burlington most do not. Some intersection treatments, such as the intersection of College St. and Prospect St. in Burlington create dangerous conditions for bicyclists (green right turn arrow into a bicycle lane that allows through and left bicycle movement). Most intersections do not have markings that indicate that the traffic control system detects bicyclists and where the bicyclist should stop to activate the signal. The lack of comprehensive (allowing turning movements) low stress accommodations for bicyclists at intersections is likely a major deterrent to increasing the amount of bicycling along many routes included in the ATP.

Overall, we observed that 20% (50.2 mi) of the proposed ATP network has been implemented (considering the limitations discussed above). Figure 3 provides an overview of the proposed ATP network implementation status, indicating that most of the implementation has been in more urbanized areas. This may be partially a result of our decision to designate rural roads and highways with shoulders as not being implemented, even though existing shoulders may have been in response to the ATP. Appendix A provides a detailed table of roadway segment implementation status, including the type of bicycle infrastructure provided and notes from our field study. UVM has also created a geospatial database with this information to facilitate mapping and future updates.

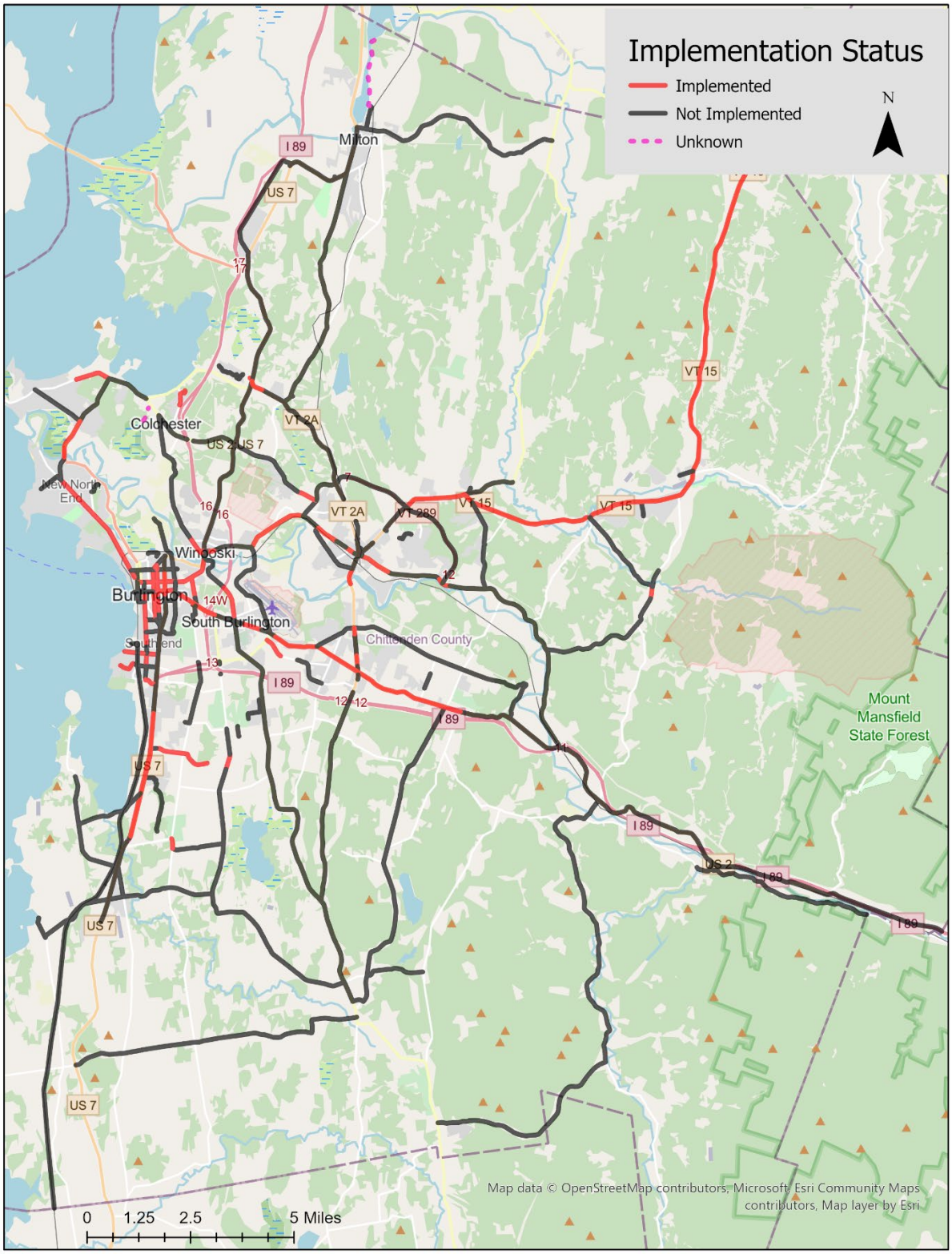

Figure 3 ATP Network Implementation Status as of 2021

2.2 Other Infrastructure Recommendations

In addition to the active transportation network, the ATP provides a list of various other infrastructure-related recommendations organized into three categories: short-term, long-term and engineering. The large number of recommendations which were often not directed at specific municipalities or corridors made evaluating their implementation status challenging. We evaluated these by distributing an online survey to planning and/or public works staff in each municipality, our knowledge (including observations from our network inventory) and by consulting with CCRPC staff. The electronic survey attempted to collect information about recommendations that would be difficult or impossible to determine from evaluating infrastructure or reviewing publicly available documents. The response rate was modest, with just 8 municipalities out of 18 incorporated municipalities responding. However, the responses did cover a range of municipality types from urban to suburban to rural and included Bolton, Burlington, Charlotte, Milton, South Burlington, Underhill, Westford, Williston.

2.2.1 Short Term/Immediate Recommendations

Seven short term recommendations were provided and are summarized in Table 1. Most recommendations were at least partially implemented. Full implementation would be difficult to achieve or determine in most cases given the lack of detail provided in most of the recommendations. For example, one recommendation is to upgrade bike lanes to separated facilities *where possible* and another is to develop contraflow bicycle lanes on one-way roads *as possible*. It is unclear where conversion to separated bicycle lanes and contraflow bicycle lanes are possible and also where it would be particularly beneficial. Without an understanding of where recommendations may be possible to implement it is not possible to understand how widely recommendations have been implemented. A second challenge is that many of the recommendations are not directed at a specific municipality or agency and therefore it is unclear who is supposed to implement the recommendation. For example, one recommendation is to "Work with GMT to ensure..." that all new bus stops include bicycle and pedestrian facilities and another recommendation is to "Start developing a wayfinding plan...". In these examples, it is unclear who is supposed to work with GMT or who is supposed to develop the wayfinding plan. Without knowledge of who was supposed to implement the recommendation it is difficult to determine its implementation status. The lack of assigning clear responsibility for implementation of each recommendation and criteria for where recommended projects should be considered is likely to limit implementation.

Table 1 Short Term Recommendations

Recommendation	Description	Implementation Status	Notes
Develop wayfinding plan	Start developing a wayfinding plan now, so that as network segments are built, signs showing connections can be put into place.	Not Implemented	Wayfinding exists in the region; however, there does not appear to be any formal plan. Recommendation doesn't specify which entity should lead this effort.
Update bike lanes to separate facilities	Upgrade existing bike lanes to separated bike lanes by adding flex posts (need 5' bike lane + 1' buffer) where possible.	Limited Implementation	1.0 mi in Burlington, although most flex posts are now missing. Recommendation unclear as to where this is possible.
Contraflow bike lanes	Develop contraflow bike lanes on one-way streets, and include flex posts as possible to provide separation from traffic.	Limited Implementation	0.15 mi in Burlington. Recommendation unclear as to where this is possible.
Pilot advisory bicycle lane	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. 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.	Implemented	Advisory bike line striped on Flynn Avenue in Burlington. Unclear if any data collected or if there are plans for further implementation.
Active travel infrastructure at GMT stops	Work with GMT to ensure that all new or updated bus stops include bike racks, sidewalk connections, crosswalks, and ADA ramps.	Partially Implemented	GMT reports that 9% of stops have bicycle parking and that 93% have a sidewalk connection. No information on ADA compliance and crosswalks was provided by GMT. Unclear if CCRPC or other municipalities have worked with GMT on implementation.
Bike lane continuity	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.	Partially Implemented	Implemented at most intersections in Burlington, many in Williston, partial implementation elsewhere. Less continuity at intersections with turning lanes. A few intersections in Burlington have bike boxes, but otherwise little accommodation for left turning bicycle traffic.
Install bike detection at signalized intersections	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.	Limited Implementation	Implementation appears limited to a small set of Burlington intersections that are on designated bicycle routes.

2.2.2 Long-Term Recommendations

Eight longer term infrastructure recommendations were also provided and are described in Table 2. Most of the recommendations are directed at five major barriers identified during the ATP development process, although a few are more general. Since most of the recommendations in this section targeted specific locations and contained more detailed design recommendations, evaluating implementation status was relatively straight forward. Most of the recommendations focused on the five major barriers that are being considered in project scoping and design plans as noted in Table 2. It was difficult to determine the extent to which the recommendation to "focus on separated facilities" has been implemented given the general nature of this recommendation; however, there are many instances of separated shared use facilities within Chittenden County which suggests this recommendation has been at least partially implemented.

The recommendation to consider using level of traffic stress (LTS) to guide planning and design considerations appears misplaced in this section about long term infrastructure projects. Furthermore, it is unclear who is supposed to use LTS, how LTS is estimated[6], and how LTS is supposed to be used to prioritize and guide the design of projects (we provide recommendations on how to do this in section 4 of this report). Without more specific guidance on how to implement and use an LTS-based prioritization and design process, it is unlikely to be widely implemented.

[6] Various versions of LTS have been proposed and used (Wang et al., 2016). The most common approach contains four LTS levels and are described in a research report produced by the Minta Transportation Institute (Mekuria et al., 2017). The ATP references the Minta report but only contains 3 LTS levels.

Table 2 Long Term Recommendations

Recommendation	Description	Implementation Status	Notes
Focus on separated bicycle facilities	Focus on separated facilities (separated bike lanes, shared use paths) to attract the greatest number of potential users.	Partial Implementation	Similar to short term recommendation of converting bike lanes to separated bicycle lanes. Separated facilities, mostly shared use paths, have been constructed in many places around Chittenden County but do not yet create a well-connected network.
Alternate designs for Exit 14 interchange	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).	Under Consideration	Shared use paths and other separated facilities are included in the I-89 2050 Study Exit 14 alternatives and the I-89 Exit 14 Alternative Transportation Crossing Study. In June 2021 the City of South Burlington applied to the federal RAISE program for funding to design/construct a separate bike-ped bridge near Exit 14.
Separated bike lanes thru the Jughandle at East Ave, Spear St, and East Terr	Develop separated bike lanes through the Jughandle west of Exit 14 at East Avenue, Spear Street, and East Terrace.	Under Consideration	Shared use paths and other separated facilities are included in the I-89 2050 Study Exit 14 alternatives and the I-89 Exit 14 Alternative Transportation Crossing Study.
Rebuild Main St. bridge over Winooski River	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).	Under Consideration	The 2019 Bridge Scoping Report includes separated, shared use paths, in each alterative. Unclear how bicycle travel is accommodated at intersections on either side of the proposed bridge project, but the 2019 Colchester/Riverside/ Barrett/Mill scoping study identified walk/bike treatments on the Burlington side of the bridge
Implement bicycle and pedestrian improvements in Winooski Transportation Master Plan	Add shared use lane markings along Winooski Falls Way east of the Circulator	Not Implemented	
	Add shared use lane markings along Cascade Way north of Winooski Falls Way	Not Implemented	
	Eliminate merge lane on eastbound East Allen Street east of Cascade Way and replace with striped bicycle lane from Cascade Way east for half a block to tie into the existing bike lane prior to Abenaki Way.	Not Implemented	East Allen Street Gateway Enhancements Scoping Study provides additional walk/bike improvements in this area.
	Install bike facilities as part of Weaver St connection from Tigan St to W Allen St	Not Implemented	
	Construct new bicycle facility (protected bicycle lanes or striped bicycle lanes) on Weaver Street with connections to Main St at Tigan St and West Allen St.	Not Implemented	Bike lane connection exists on West Allen St.
	Add shared use lane markings on Abenaki Way north of Winooski Falls Way	Not Implemented	

Integrate bike/ped improvements to proposed design for Exit 16	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.	Planned for Implementation	Shared use paths are included in the proposed DDI intersection; however, it is unclear if they will achieve a high quality and low stress environment given high traffic volumes and multiple at-grade ramp and intersection crossings. Unclear if bicycle facilities approaching the DDI will be improved. Unclear if current design alterative meets the intent of this ATP recommendation. http://www.exit16ddi.vtransprojects.vermont.gov/
Consider developing a recreation path along the Circ Highway right-of-way	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.	Not Implemented	Unclear why this recommendation is included here when it was determined that it should not be included in the proposed ATP network.
Level of Traffic Stress Analysis	Use LTS analysis to inform decision-making about project prioritization and design selection.	Unknown	Unclear who is supposed to use LTS, how LTS is estimated, and how LTS is to be used in prioritization and to inform design.

2.3 Engineering

Sixteen engineering recommendations were provided, although many had little to do with engineering or even infrastructure. For example, this section contained recommendations about snow clearing, bicycle registration, bicycle infrastructure funding programs, volunteer path "maintenance" events (i.e. trash and vandalism clean up), and the installation of bicycle maintenance stations. Engineering guidance should focus on facility design, maintenance and construction issues, such as ensuring that municipal roadway and intersection design standards address the needs of pedestrians and bicyclists and incorporate the latest design guidance from state and federal agencies, professional engineering organizations and other reputable sources. Engineering recommendations could also address maintenance issues that affect pedestrian and bicyclist infrastructure, geometric design considerations, and suitable materials and methods for facility construction (i.e., geotechnical engineering).

There were also numerous challenges to determining the implementation status of recommendations in this section. Similar to the challenges discussed previously, many recommendations lacked sufficient information about *where* recommendations should be implemented and almost all recommendations failed to identify *who* should be responsible for their implementation. For example, count down timers should be encouraged *where applicable* – but no guidance is provided about where they are applicable nor is it clear who is to perform the encouragement, what encouragement means, or if financial or technical assistance is available. We considered recommendations implemented or partially implemented (most cases) if we could identify examples of their implementation in Chittenden County although we were unable to determine if implementation was in response to the ATP or pre-dated the ATP.

Table 3 Engineering Recommendations

Recommendation	Description	Implementation Status	Notes
Pedestrian easements	Encourage municipalities to request pedestrian easements and connections between developments during site review (where applicable).	Partial Implementation	Unable to determine if encouragement was provided. However, several municipalities indicated in our survey that they sometimes request easements, 1 always requests easements and 3 were unsure or stated that they did not.
Snow clearing	Encourage municipalities (where applicable) to assume responsibility for clearing snow from sidewalks and paths (if they don't already).	Partial Implementation	Unable to determine if encouragement was provided. Most municipalities that have public sidewalks clear them according to our review of municipal policies and survey responses. A few do not clear snow and some only clear snow on select sidewalks. Burlington does not clear all shared use paths to allow for winter recreation.
Bicycle registration and parking	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.	Partial Implementation	Unable to determine who is responsible for reviewing and if a review was completed. According to our survey, some municipalities have bicycle parking requirements. Burlington has an entire chapter dedicated to bicycle ordinances. We did not review municipal policies to identify ordinances that encourage or discourage bicycle use.
Fund VTrans Bike-Ped programs	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.	Implemented	This recommendation is for continuing existing state and federal funding programs.
Regularly review posted speed limits	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.	Partial Implementation	Most municipalities responding to our survey stated that they review speed limits based on a variety of considerations. Frequency of review is variable. It is unclear if current practice has changed in response to the ATP or since its publication. We did not evaluate if municipalities us the FHWA speed limit tool.
Active transportation access to transit	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.	Partial Implementation	Unclear who is supposed to coordinate with GMT. This recommendation generally overlaps with a similar recommendation in the short-term recommendations. Some of these items have been implemented at various stops but its unclear/unlikely that they are all appropriate at all stops.

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.	Not Implemented	Unclear who should develop the toolkit and what the toolkit would consist of. Is new research required or can existing FHWA and other existing design guidance be referred to? Soft surface paths may not be useful during winter and spring (mud season).
Inventory curb ramps and assess condition	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.	Partial Implementation	Unclear who is to perform the inventory. Only Burlington stated this as a regular practice in our survey. The focus on curb ramps only addresses one aspect of ADA standards (one that is specifically required by DOJ/DOT when roadways are improved). For sidewalks to be accessible to people with disabilities, they also must be wide enough, free of obstacles, be relatively level, provide a durable surface free from significant defects (e.g., cracks, holes and raised slabs) and buttons to active signals should be accessible as well. See https://www.fhwa.dot.gov/environment/bicycle_pedestrian/publications/sidewalks/chap4a.cfm, http://www.bikewalk.org/pdfs/sopada_fhwa.pdf, and https://www.access-board.gov/guidelines-and-standards/buildings-and-sites/about-the-ada-standards/ada-standards/chapter-4-accessible-routes for more information on ADA design guidelines and standards applicable to sidewalks.
Develop a pedestrian maintenance toolkit for local DPWs	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.	Not Implemented	Unclear who should develop the toolkit and what the toolkit would consist of. While we did not evaluate the quality and condition of bicycle and pedestrian infrastructure as part of this project, we did observe many instances of poorly maintained pedestrian and bicycle facilities. Many on-road bicycles facilities had faded or missing lane markings when we inventoried them in late spring and early summer. Some bicycle facilities, particularly in Burlington, had very poor pavement conditions. A large number of sidewalks in Burlington were observed to be in poor condition.
Portable ramps for local businesses	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.	Unknown	Unable to determine if encouragement was provided. Unclear who would be responsible for encouraging this and how encouragement would be provided.
Volunteer path maintenance events	Maintenance might include trash pickup, sweeping, cleaning of vandalism, and reporting areas in need of more serious maintenance.	Unknown	Unclear who is responsible for implementing this and if it occurs. It is also unclear why volunteers should be expected to perform what is typically (and currently) a municipal function.
Countdown timers & leading ped intervals at crosswalks	Encourage municipalities to require countdown timers and leading pedestrian intervals (where applicable) at all crosswalks.	Partial Implementation	Unable to determine if encouragement was provided. Unclear who is responsible for encouragement and how encouragement would be provided. Unclear where countdown timers and LPIs are/are not applicable. Both strategies have been implemented in multiple municipalities across Chittenden County to various degrees based on responses to our survey. Implemented at most intersections in Burlington.

Require installation of wheel guards on fleet trucks	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.	Not Implemented	Unclear who is responsible for working with municipalities on this recommendation. No municipalities acknowledged adopting this in our survey. There may be some merit to this recommendation but this does not appear to be a widely implemented safety countermeasure and therefore will likely require significant outreach and education.
Public bike maintenance stations (fix-it stations)	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.	Partial Implementation	Unclear who is responsible for supporting this and what the support consists of? Financial support? Some stations exist in the county at a mix of public and private business locations: https://www.localmotion.org/bike_repair_stations.
Seek state guidance on proper design applications	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.	Unknown	Unable to determine to what extent municipalities consult these guidelines or if their consultation of guidelines has changed in response to the ATP.
Consider modern roundabouts	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.	Partial Implementation	Several municipalities responded to our survey that roundabouts are considered. CCRPC also provides some design guidance: https://www.ccrpcvt.org/our-work/transportation/transportation-resources/roundabouts/.

2.4 Non-Infrastructure

The non-infrastructure recommendations were organized into four categories: education, encouragement, enforcement, and evaluation. We evaluated the implementation status of each recommendation by searching the websites of local, regional and state government agencies and organizations that partner with CCRPC to identify documents and policies indicating implementation of each recommendation. We also collected information through an electronic survey distributed to each municipality's planning and public works staff. Evaluating the implementation status of the non-infrastructure recommendations was challenging because of the very large number and diversity of these recommendations combined with little information about who should be implementing them. The recommendations and their implementation status are summarized in Tables 4 - 7.

Table 4 Education Recommendations

Recommendation	Description	Implementation Status	Notes
Motorist Education	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.	Partially Implemented	Unclear who is responsible for implementing this and if outreach to DMV occurred. VT Driver's Manual (2019) has a section on sharing the road with bicycles. Other vulnerable users that drivers should look for are frequently mentioned in the manual: https://dmv.vermont.gov/sites/dmv/files/documents/VN-007-Drivers_Manual.pdf Driver's Manual Interactive training also includes components on bike/ped interactions: https://dmv.vermont.gov/driver-training
Local Motion Every-day Bicycling Project (EBP) Classes	Promote Local Motion's "Everyday Bicycling" course. This course will help adult bicyclists learn bicycle safety, etiquette and the rules of the road.	Implemented	Unclear who is to promote this beyond Local Motion? CCRPC provides funding to support Local Motion's bicycle advocacy and education efforts.
Provide educational materials on bike/ped rules	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.	Implemented	Unclear if the intent was to distribute materials beyond what is currently done by Local Motion? CCRPC provides funding to support Local Motion's bicycle advocacy and education efforts. https://www.localmotion.org/rules_of_the_road
Targeted outreach and education to schools and colleges	Educational materials can be targeted at students in schools and colleges with information about rights and responsibilities as well as safety.	Unknown	Unclear who is responsible for providing these materials and outreach to schools.
Launch pedestrian awareness campaign	Launch a public awareness campaign focusing on yielding to pedestrians at crosswalks and driving slowly. Local media and public service announcement can be used to implement the campaign	Not Implemented	Unclear who is responsible for producing the campaign? We are unaware of any campaigns.
Workshops, training for local officials	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.	Unknown	Unclear who is responsible for creating and providing workshops and training.

Table 5 Encouragement Recommendations

Recommendation	Description	Implementation Status	Notes
Encourage healthcare providers and insurers to prescribe active transportation, as appropriate	Providers can write prescriptions for 20 minutes of daily walking or discounted bicycle helmets to encourage patients to walk and bicycle for health.	Not Implemented	Unclear who would implement this. Presumably providers would need to determine appropriate level of physical activity for patients depending on their health condition. Unclear who would be funding or creating a program for discounted bicycle helmets. Unclear that bicycle helmet availability is a barrier to bicycling.
Walk- and Bike- Friendly Communities designations	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	Partially Implemented	Unclear who is to provide encouragement and if this has occurred; however, Local Motion has previously helped communities apply. Burlington and Essex Junction are designated. According to survey responses, some municipalities are interested in designation but it appears that outreach has not occurred recently.
Promote TDM strategies	Continue to promote transportation demand management (TDM) strategies and participation in organizations such as the Chittenden Area Transportation Management Association (CATMA).	Implemented	CCRPC is a CATMA member and provides funding to CATMA. CCRPC's other TDM partners are listed here: https://www.ccrpcvt.org/our-work/transportation/transportation-demand-management-park-ride/#tdm-partners. The City of Burlington also has TDM requirements in city ordinances: https://www.codepublishing.com/VT/Burlington/#!/html/BurlingtonAxA/BurlingtonAxA08.html
Support schools in making walking and biking part of everyday	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.	Implemented	VTrans funds the program as part of its Bicycle and Pedestrian Program and Local Motion runs it. The program will be "re-launched" this year. https://saferoutes.vermont.gov/ Way to Go! Has also recently focused on walking, biking and rolling to schools. www.waytogovt.org
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.	Implemented	E-bike share implemented in summer 2021, replacing prior version that used conventional bicycles. http://greenridebikeshare.com/
Promote the Bicycle Benefits program	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.	Implemented	This program exists. Unclear who promotes it. https://www.facebook.com/BicycleBenefitsVermont & http://bicyclebenefits.org/cities/15 & https://www.localmotion.org/bicycle_benefits
Municipal pedestrian advisory committees	Encourage municipalities to develop a pedestrian advisory committee if appropriate and/or if they do not already have one.	Partially Implemented	Unclear who is responsible for encouragement, if encouragement has occurred, and where this would *not* be appropriate. Seven municipalities have bike/ped or alternative transportation or mobility committees. Five municipalities have energy, trails or recreation committees that work on sustainable transportation issues. Five municipalities don't have any relevant committees (Buel's Gore not included). Local Motion also does a lot of work with municipal bike/ped committees.
Adopt Vision Zero strategy	Encourage municipalities (where applicable) to adopt Vision Zero to prioritize safety for vulnerable users.	Limited Implementation	Unclear who is responsible for encouragement and if encouragement has occurred. Where is it not applicable? No communities have adopted this. Burlington is only community to respond to the survey indicating they are considering this.

Participate in PARK(ing) Day	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.	Not Implemented	Unclear who is responsible for coordinating this. Some municipalities have piloted transforming parking spaces into parklets and outdoor dining.

Table 6 Enforcement Recommendations

Recommendation	Description	Implementation Status	Notes
Bicycle and Pedestrian Training courses	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: https://www.youtube.com/embed/hhkEb0ie7Cg/	Unknown	Unclear who is responsible for implementation and if promotion has occurred.
Develop speed reduction program	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.	Partially Implemented	Unclear who is responsible for implementing this program. Many communities are using speed feedback signs/trailers based on responses to our survey. Unclear if this has been in response to the ATP and if other measures have been taken.
Positive reinforcement	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.	Not Implemented	Unclear who is responsible for implementing this program. Appears aimed at local police departments but its unclear if they are at all aware of this recommendation. Unclear how police would provide positive reinforcement to people who are driving? Local Motion used to provide incentives to (free ice cream coupons) to courteous drivers (e.g., yielding to pedestrians at crosswalks).
Municipal ordinance review of town-wide speed limits	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.	Not Implemented	Unclear who is to conduct this review and what criteria would be used to determine when a town-wide speed limit or reduction is warranted. Only Burlington has a town wide speed limit that we are aware of.
Public safety & enforcement campaigns	Work with local police on public safety and enforcement campaigns (where applicable).	Unknown	Unclear who is to work with police and what the relationship involves? Unclear where a public safety and enforcement campaign would/would not be applicable?
Enforce pedestrian right-of-way	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.	Unknown	Unclear who is to work with police and what the relationship involves?

Table 7 Evaluation Recommendations

Recommendation	Description	Implementation Status	Notes
Develop a robust bicycle and pedestrian count program.	Evaluate long-term trends	Under Consideration	CCRPC is working with the University of Vermont Transportation Research Center to improve its bicycle count program to address this recommendation.
	Forecast bike/ped volumes of a particular facility	Not Implemented	Would require updating the regional travel demand model or implementing another forecasting method. There are a wide range of demand forecasting methods; however, most are either too simplistic to be useful or would require significant data collection and statistical and/or spatial analysis work. An overview of methods is provided in this report: https://www.pedbikeinfo.org/cms/downloads/PBIC_WhitePaper_Forecasting.pdf
	Separate bicycle and pedestrian in traffic models	Not Implemented	Would require a significant update to the regional travel demand model.
	Identify network gaps	Partially Implemented	CCRPC is working with the University of Vermont Transportation Research Center to improve its bicycle count program. Part of this work is identifying gaps in bicycle count data. Pedestrian count data are not the focus of the UVM study.
	Help define a hierarchal network (for example, functionally classify bike facilities and corridors)	Under Consideration	CCRPC is working with the University of Vermont Transportation Research Center to improve its bicycle count program to address this recommendation.
	Acquire data to support performance measures that inform project selection and close data gaps	Under Consideration	CCRPC is working with the University of Vermont Transportation Research Center to improve its bicycle count program to address this recommendation.
	Measure the return on investment of new facilities	Not Implemented	Improved bicycle count program could help implement this.
	Develop a better understanding of how weather affects active transportation	Not Implemented	Improved bicycle count program could help implement this.
Advance projects recommended in this regional plan in VTrans Transportation Alternatives & Bike-Ped Programs	That is, projects that are being considered for funding should rank higher if they are consistent with regional planning initiatives.	Implemented	Guidance for 2021 TAP applicants states that projects score higher if they are part of an existing plan (although not necessarily a regional plan): https://vtrans.vermont.gov/sites/aot/files/highway/documents/ltf/TA%20Program%20Summary-Application%20Guide%20SFY%202021.pdf. Guidance for VTrans small-scale bicycle and pedestrian grants awards more points if projects complete a gap in a bicycle or pedestrian network or are demonstrated as a high need via an existing planning document: https://vtrans.vermont.gov/sites/aot/files/highway/documents/ltf/2021%20Small-scale%20BikePed%20Grant%20Guide.pdf
Develop a smart phone app for reporting issues	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.	Partially Implemented	Unclear who is supposed to develop this? CCRPC or municipalities? Several communities have apps and websites to report issues.

Develop local walking plans	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.	Partially Implemented	Six municipalities have plans that at least include walking. Other municipalities either have plans in development or do not have plans.
Conduct annual walking audits	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.	Unknown	Unclear who is responsible for implementing this.
Create walking maps	Create walking maps for towns to promote walking. This recommendation could be completed concurrently with the local walking audits described above.	Not Implemented	Unclear who is responsible for implementing this.
Pedestrian surveys	Survey pedestrians periodically to identify both barriers and gaps in walkability.	Not Implemented	Likely happens as part of specific projects, but not in general. Unclear why bicyclists are excluded from this recommendation?
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.	Under Consideration	Similar to first recommendation, develop a robust count program. CCRPC is working with the University of Vermont Transportation Research Center to improve its bicycle count program to address this recommendation.

3 EVALUATING THE PLANNING AND PRIORITIZATION PROCESS

In addition to evaluating the implementation status of each ATP recommendation, we were charged with developing a strategy to prioritize and implement the remaining ATP recommendations. To accomplish this task, we began by evaluating the data and methods used to develop and prioritize the ATP's recommendations. We read the current plan and reviewed its appendices, both of which were provided to us by CCRPC (the main active travel plan document is also available on CCRPC's website[7]). We focused on identifying the data and other sources of information used to develop the plan, the methodology used to translate these data and other information into a set of prioritized recommendations and information on how the plan's outcomes will be evaluated. We evaluated this information to identify opportunities to improve the prioritization process and a strategy to implement the plan's remaining recommendations. Since our evaluation uncovered concerns regarding both the methods and data used to develop the ATP recommendations in addition to the prioritization process (ideally the two are closely connected), some of our recommendations extend beyond improving just the project prioritization process and implementation strategy and focus more broadly on the ATP planning process. Some of these recommendations are provided to help inform future iterations to the region's ATP.

3.1 Proposed ATP Network

The proposed ATP network is the most significant product of the ATP planning process. The proposed ATP network identifies travel corridors consisting of streets, highways and paths that could be improved to create a regional bicycle network. The ATP uses separate methods and data to identify the proposed ATP network and rank the priority and feasibility of each segment. Our review revealed important limitations in both the ATP planning and prioritization process.

3.1.1 Developing the Proposed ATP Network

The proposed ATP network was identified using a 3-step process[8].

1. Barriers: Network segments were drawn through locations identified by the public as being a barrier to walking or bicycling. Public input was collected through an on-line wiki map and a series of charrettes.
2. Origin-Destination Density: The density of origins (residential addresses) and destinations (non-residential addresses) were used to identify additional network segments. Segments were drawn through high origin-destination density areas that did not include existing low-stress facilities. Low stress routes were identified using a level of traffic stress (LTS) model[9].
3. Segments Included in Prior Plans and Studies: Segments included in prior plans were gathered together and then "refined" to focus on low-stress and regional connections.

The primary purpose of a transportation system is to provide people access to destinations where they engage in various activities and obtain goods and services. The transportation system is also used by businesses to move goods and provide services. The design of transportation systems should therefore

[7] Chittenden County Active Transportation Plan (2017): https://www.ccrpcvt.org/wp-content/uploads/2016/01/OFFICIAL_CCRPC_REVISED-4_13.pdf

[8] See section 5.2 of the ATP.

[9] The LTS analysis is described in ATP report section 5.1; however, the sources of data and calculation methods are not described or referenced. Since the Mineta Transportation Institute first proposed the LTS methodology, multiple versions of the process have been developed and used.

generally focus on providing or increasing accessibility. Ensuring more equitable access for all population groups to destinations has also become a greater planning priority. Performance measures are used in transportation planning to evaluate current conditions and to what extent proposed transportation plans may improve them. Performance measures should include those that measure accessibility and often include other important outcomes including environmental impacts, safety and those related to motor vehicle mobility (e.g., congestion levels, average speed, travel times). Bicycle and pedestrian plans should also be designed to increase accessibility and ensure equitable outcomes. People may also engage in bicycling, walking and other types of active travel solely for recreation or exercise. Purely non-transportation bicycle and walking trips do not necessarily require access to destinations, but access to infrastructure that supports these activities should be considered. In most cases, active travel infrastructure that provides greater accessibility also provides more opportunities for recreation and exercise.

Accessibility can be measured in many ways, but most methods are focused on quantifying the network distance between where people live to various destinations (often a set of frequently accessed or important destinations like employment, schools, grocery stores, and public services). When evaluating accessibility for vulnerable roadway users such as pedestrians and bicyclists, it is also important to consider additional factors that may limit accessibility such as the lack of appropriate infrastructure and vehicle traffic conditions. Since some roadways may be less favorable for walking and bicycling, the accessibility provided by a roadway network may be different for people traveling by different modes. LTS has become a popular method for evaluating which network links are more favorable to bicycling than others (Mekuria et al., 2017; Wang et al., 2016) and can be used in the calculation of bicycle accessibility (Kent & Karner, 2019).

The data and methods used to develop the proposed ATP network consider some aspects of accessibility, but there are significant gaps.

In the first step of the process, the identification of barriers to active travel along routes used by cyclists and pedestrians provides information that can be useful for improving accessibility. Barriers to walking or bicycling were collected from the public through a wiki-map and a series of charrettes. However, these data should be used with caution and in a limited capacity. While no information was provided about how participants were recruited to the wiki-map or charrettes, it is very likely that participants opting to provide information through these forums are more likely to be frequently engaged in active travel than the general population. People with greater experience and confidence in walking and bicycling may have different infrastructure preferences and opinions about what constitutes a significant barrier to active travel. While the barriers identified through the public process may be important deterrents to bicycling and walking for all, participants in these forums may not have identified barriers that currently deter most people from engaging in active travel. Additionally, it is unclear how representative the data collected through the public process is. While some wiki map participant data was collected, including age, gender and home zip code, these data are insufficient for understanding how representative the participants were of current and potential network users or the general population. This raises questions about how well the data collected reflects the barriers facing diverse populations including households with young children, households without access to vehicles, workers, students, BIPOC, lower income households and communities in various geographic areas if the region.

Residential and non-residential addresses were used in step 2 of the ATP network development process to determine where additional low stress infrastructure is required. While very little explanation is provided in the ATP about how address data were used in this step, it appears[10] that they were a used to create an address density map. New active travel network links were then drawn within high density areas that did not have low stress routes or to connect various high-density areas together that currently lacked low stress connections – or possibly both of these objectives. At best, this process prioritized locating new ATP network links in higher population density areas which has some relationship to accessibility. However, the use of non-residential addresses for identifying trip attractions is inappropriate because there is extreme variability in the number of trips attracted to different non-residential addresses. For example, the University of Vermont or Global Foundries attract thousands of daily commute trips while other businesses may only attract a handful. While placing additional infrastructure within or between higher population density areas can improve accessibility, it does not explicitly evaluate how improvements change the distances people must travel to reach important destinations from their homes using active transportation infrastructure. High population density areas may not have many important destinations (e.g., suburban housing developments) while low population density areas may contain important destinations (e.g., major employers, medical services or government institutions located in industrial parks or urban cores that lack residential land-use). The address density approach used in the ATP also fails to consider the patterns of trip making that people make in the region and the portion of trips that fall within a distance range generally considered walkable or bikeable.

3.1.2 Prioritizing ATP Network Projects

Proposed ATP network links were ranked along two dimensions: priority and feasibility. Priority was evaluated based on three criteria[11]:

1. Serves a Population in Need: Serving a population in need is defined as a project being located in an area of very low to moderate opportunity[12] ***or*** within 100ft of a bus stop ***or*** within half a mile of a school (including colleges).
2. Addresses Bicycle and Pedestrian Crash Locations: A project that addresses a high bicycle or pedestrian crash location is defined as intersecting a location where more than one bicycle or pedestrian crash occurred between 2008 and 2012.
3. Closes a Bicycle and Pedestrian Gap: This criterion is met if the project addresses a previously proposed sidewalk ***or*** is in a walkable area that currently has no existing pedestrian infrastructure ***and*** is in a location with no existing bicycle facilities (bicycle facilities include paved shoulders, bike lanes and off-street paths).

Projects were assigned priority scores of low, medium or high based on if they met one, two or all three of the above criteria, respectively.

Feasibility was evaluated separately for rural and urban areas and assigned scores of low, medium and high. Rural feasibility depends on right-of-way availability and "topographical constraints". It is unclear what defines a topographical constraint and its various levels. Projects where there is no available right-

[10] Based on Figure 15 in the ATP.
[11] Defined in Appendix G of the ATP.
[12] Using HUD opportunity index at the Census Tract level which accounts for the poverty rate, school proficiency, homeownership rate, unemployment rate, and job access.

of-way or many topographical constraints are scored as low feasibility while those with fewer topographical constraints and available right-of-way are scored as medium or high feasibility. Feasibility in urban areas was scored based on the amount of "operational change" required. Greater operational change is generally defined in the ATP as a project that requires reallocating more space to active travel or requiring more construction.

The current prioritization criteria consider safety and some aspects of accessibility and equity.

The first criterion relates to equity and aims to prioritize projects for populations in need by focusing on disadvantaged communities, access to education, and access to transit. An important limitation in this part of the prioritization process is that projects are prioritized based on where they take place rather than on projects that most increase accessibility for populations in need. The location of disadvantaged communities or important destinations is not necessarily where the most beneficial network improvements are required to provide greater access to important destinations for these populations. For example, an important route from a low opportunity census tract to employment opportunities may pass through a mixture of low and high opportunity census tracts. If network improvements along the route are required in higher opportunity census tracts, they would not be prioritized, even if they represent the largest barrier to improving access for low opportunity zones. Similarly, access to transit requires safe and accessible pedestrian and low stress bicycle routes that extend from where people begin their trips to where they reach a transit stop. Only prioritizing projects within 100ft of a transit stop excludes most of the route a pedestrian or bicyclist would need to travel and may exclude important transit access barriers from being prioritized. Similar issues occur when prioritizing routes to education within half mile of schools. A second limitation of this part of the prioritization process is that it does not consider existing levels of accessibility or the magnitude of potential improvements. Some low opportunity census tracts may have much worse accessibility than others and some projects may improve accessibility for a larger population in need than others. A final concern with identifying disadvantaged communities using low opportunity census tracts is that the geographic extent of a census tract is relatively large and varies with population density. This may make it difficult to identify populations in need within lower density regions. Similarly, there is also the risk of prioritizing projects in high opportunity areas within lower opportunity zones.

The second criterion considers safety by prioritizing projects where pedestrian or bicycle crashes have previously occurred. Projects are prioritized if they pass through locations where more than one pedestrian or bicyclist crash has occurred during a four-year period. The use of crash data is appropriate, although it is important to consider some of the limitations in these data. Since relatively few people make bicycle trips or walk in most places in the region, the location of crashes that occurred over a four-year period is unlikely to identify all areas that pose significant crash risks. The probability of a crash in a particular location, even a dangerous location, is relatively small when there are few pedestrians or cyclists (e.g., exposure is low). Locations with more frequently observed crashes may be more dangerous (higher probability or *risk* of a crash) or they may be places with more pedestrians or cyclists. While prioritizing projects that address locations with frequent crashes is clearly important, it is also important to consider that high crash frequency locations may not be the only high crash risk locations. Between 20% to 90% of bicycle and pedestrian crashes are not reported (Elvik & Mysen, 1999; Sciortino et al., 2005; Shinar et al., 2018; Winters & Branion-Calles, 2017) and near misses are very common but little data is collected on them (Aldred, 2016; Aldred & Goodman, 2018; Medury et al., 2019; von Stülpnagel & Krukar, 2018). Furthermore, some recent research suggests that places with very few

crashes may be among the most dangerous since safety concerns keep most active travel users away from these locations, limiting exposure and therefore crashes (Ferenchak & Marshall, 2019). In addition to gaps in crash and near-miss data, evaluating pedestrian and bicyclist crash risk is also complicated by the need for exposure data which does not exist for most crash locations and time periods. Acting on the recommendations in the ATP to increase bicycle and pedestrian data collection could therefore also help better identify safety concerns.

The third prioritization criterion requires that projects address both pedestrian and bicycle barriers. Projects must take place in a location without any pedestrian AND bicycle infrastructure. The intent here appears focused on increasing accessibility in places with no current active travel infrastructure; however, the criterion is only weakly linked to accessibility since network connectivity and access to destinations are not considered. This is also a very limiting criteria, particularly in more urbanized municipalities and town centers where active travel opportunities are greatest – if high quality infrastructure are provided. For example, by this criterion, almost no project in Burlington could receive the highest priority since most streets have sidewalks. This is also a curious criterion since the ATP network is focused on bicycle transportation. Furthermore, the prioritization of projects does not appear to have followed this criterion, since most projects in Burlington received the highest priority ranking despite taking place along routes with sidewalks.[13]

The feasibility of gaining public acceptance and constructing a project is also an important and practical consideration. While the qualitative evaluation of potential project feasibility offers a reasonable high-level analysis, it is unclear how the feasibility rankings can or should be used when prioritizing or implementing the recommended projects. Should high feasibility projects precede low feasibility projects? To a large extent, feasibility is related to project complexity and cost. A complex and costly project may be worth prioritizing if the expected increase in accessibility is large enough. Conversely, high feasibility projects may be easy to implement but offer few if any improvements in accessibility. A cost benefit approach could be considered to combine priority and feasibility into a single criterion; however, this would require estimating project costs which would be difficult for a relatively high-level regional plan. Weighing feasibility against a measure of accessibility offers a simpler approach.

3.2 Other Recommendations

The data, methods and other information used in determining the ATP's other recommendations were not discussed (Tables 1 to 7) and they were not prioritized or evaluated for their feasibility. Since there are a very large number of additional recommendation (67 of them), screening the most important and potentially effective recommendations would likely accelerate their implementation and help further the ATP's goals. Providing additional information about the resources required to implement these recommendations could also help implementing agencies evaluate their feasibility.

3.3 Performance Measures

Performance measures can serve two roles in the ATP. They can be used to evaluate and prioritize potential projects and evaluate the plan's eventual outcomes. Therefore, performance measures are another way to evaluate the implementation of the ATP. Performance measures can evaluate inputs or outcomes, for example, the miles of bicycle lanes installed (input) or the change in bicycle volume (outcome). Best practice is to clearly link quantifiable performance measures to each planning goal or

[13] See the map in Figure 21 in the ATP.

objective and then use these to guide the development of the plan, prioritize projects, and then monitor progress. Generally, performance measures that consider outcomes are preferable to those that only consider inputs. The ATP lists 12 separate goals, with some of these containing multiple items, and 26 performance measures that represent a mix of inputs and outcomes. Our review identified many goals without defined performance measures and few instances of performance measures being used to guide the plan's recommendations or implementation priority. A robust evaluation plan with measurable and well-defined performance measures can help CCRPC understand if and when goals are met, and learn which strategies are most effective.

Six of the 12 ATP goals listed on page 5 of the ATP have corresponding performance measures listed on pages 82 and 83. Furthermore, the first goal is actually a collection of at least 7 other goals (the provision of accessible, safe, efficient, interconnected, secure, equitable, and sustainable mobility choices..." for which only 4 items have relevant performance measures defined. For the first goal, no performance measures are listed that address efficiency, security, or equity and the accessibility performance measures focus only on transit access rather than access to goods, services and activities. A second concern is that many of the performance measures address secondary or indirect ATP outcomes where changes would be very difficult to measure and attribute to the ATP, for example, the plan's impacts on air quality, GHG emissions, asthma, and combined housing and transportation costs. Many factors beyond changes in the amount of bicycling and walking affect these outcomes. While the ATP can have a positive effect on these outcomes, this occurs through the plan's direct impacts on the amount of active travel or substitution of vehicle trips with active travel trips. In most cases, indirect and secondary impacts can be estimated from direct impacts but not the other way around.

Another limitation is the lack of detailed information needed to calculate and track changes in the included performance measures. Most performance measures are only partially defined. For example, "particulate matter" contains no information about the quantity to be measured (mass or concentration), where and how data are obtained (models or measurements), the time period(s) and area(s) for averaging and baseline quantities that can be compared to later. The combined housing and transportation cost performance measure raises additional questions. Similar to the particulate matter performance measure, no information is provided on how to calculate combined housing and transportation cost, what data are required and what level of spatial detail it should be applied to (e.g., the region, a city, a census block). More importantly, it is unclear that a housing and transportation cost performance measure would be responsive to the ATP's outcomes. The ATP is unlikely to change housing costs, and while the ATP may expand opportunities for less costly active travel it is unclear how this would factor into a change in (average?) travel cost calculations. Other performance measures such as vehicle miles traveled or mode shares are widely used in transportation planning and have standard definitions; however, baseline quantities and information on where to obtain required data are still missing. Finally, none of the performance measures consider changes in accessibility which should be one of the overriding considerations of the active travel plan and for which much of the necessary data may already be available.

4 RECOMMENDATIONS

We were tasked with evaluating the implementation status of recommendations contained in the 2017 ATP and developing a strategy to prioritize and implement any remaining recommendations. Our evaluation finds that a majority of the ATP's recommendations have been at least partially

implemented, including many portions of the ATP network and those relating to various infrastructure designs, policies and programs. Many recommendations also remain to be implemented, but this should be expected given that it has only been four years since the plan was adopted. The relatively quick pace of implementation is partially explained by including previously planned or scoped projects in the ATP, which may indicate that the pace of implementation could slow in the coming years.

In many cases, we were not able to fully determine the implementation status of a particular recommendation. This occurred for a number of reasons. A common issue was a lack of baseline information and data that made it difficult to understand what infrastructure, programs and policies existed prior to the ATP's adoption and which have occurred since then. Another issue was the broad description of many of the recommendations. With the exception of the proposed ATP network, many recommendations were described as offering encouragement or assistance with various policies and programs rather than implementation of specific policies and programs. Furthermore, details on who was responsible for providing encouragement, who was responsible for implementation and what encouragement or assistance would look like was often absent. In other cases, recommendations were merely suggestions; for example, to convert regular bicycle lanes to separated bicycle lanes "where possible". In this example and others, *where* implementation may be possible was not discussed. It was beyond the scope of this review to further investigate implementation in these cases. In most of these cases, we considered any evidence that some aspect of the recommendation had been implemented (e.g., relevant infrastructure, policy or program implemented) in the region as partial implementation. A further challenge was that many recommendations require implementation by individual municipalities. In most cases there are some municipalities that have implemented a specific recommendation and others that have not. It was not always possible to evaluate implementation of each recommendation in each municipality.

Our evaluation also uncovered many opportunities to improve the planning, prioritization and evaluation process. While many of the ATP's recommendations appeared reasonable to us, we did not focus on judging the merits of individual recommendations in most cases. Instead, we focused on the data and methods that were used to design the plan, prioritize recommendations and measure performance in order identify opportunities to better prioritize the remaining recommendations. The main outcome of this review is the recommendation to use a more integrated and accessibility focused framework for prioritizing infrastructure projects. An accessibility framework can also be used to develop and evaluate proposed projects and measure performance. Our other recommendations are largely focus on providing more detailed information about recommendations and how they should be implemented.

4.1 Use an Accessibility Focused Framework to Prioritize Infrastructure Projects

The primary purpose of a transportation system is providing people and businesses with access to destinations where goods, services and activities occur (Handy, 2020). Focusing on accessibility is particularly important in developing transportation systems that support active transportation modes because feasible trip distances are much shorter and infrastructure is often more limited than it is for trips using motor vehicles. While some aspects of accessibility were considered in developing the current ATP and prioritization of ATP network links, the data and methods used were disjointed, failing to evaluate how the proposed infrastructure projects change accessibility by active modes of transportation.

Accessibility can be measured in various ways. For active travel, performance measures that consider the network distance to destinations are the most consistent with accessibility, but other measures such as proximity to active travel infrastructure or its extent are sometimes used because of their simplicity. Proximity to active transportation infrastructure can also be appropriate if the aim is to provide access to opportunities for recreation and exercise rather than transportation. A particular challenge for evaluating accessibility for active travel is that not all roadways and other infrastructure support active travel to the same degree. Some roadways cannot be used by pedestrians and bicyclists (e.g., limited access highways) while other roadways are missing necessary infrastructure such as sidewalks or safe crossings. Many other roadways that can be used for active travel are generally avoided by most people because of their real and perceived level of safety. This means that only a portion of the available roadway network actually provides access to most potential pedestrians and bicyclists. LTS offers a consistent approach for evaluating which network links are generally suitable for bicycling from those where traffic safety concerns would prevent most people from using them (Mekuria et al., 2017; Wang et al., 2016). A similar concept may also be useful for evaluating pedestrian access (LaJeunesse et al., 2021).

LTS data can also form the basis of a robust accessibility-based active travel planning and project prioritization framework that considers factors likely to promote additional active travel and increase safety. A recent application of an LTS-based accessibility evaluation and project prioritization framework for the Baltimore, Maryland bicycle plan provides a comprehensive example (Kent & Karner, 2019). We outline the basic steps below in the process used by Kent and Karner (2019) in Baltimore and add a few additional notes on what would be required to extend the concept to pedestrian infrastructure:

1) Create a network dataset that includes bicycle and pedestrian infrastructure. The network dataset will need to be routable, meaning that it must contain the appropriate level of detail to know how individual network links connect (where links intersect, which turning movements are allowable), which directions traffic can flow (one-way and two-way streets), and which modes can use each link. The dataset will also need detail about the type(s) of bicycle infrastructure present, roadway characteristics including lane configuration, traffic volume, and traffic speeds, and information about intersection controls to estimate LTS.
2) Estimate LTS for each network link. Multiple definitions have been used for estimating LTS, though most are fairly similar (Wang et al., 2016). The LTS method used in the ATP is not described. The LTS approach should consider bicycle infrastructure type (on street bicycle lane versus a separated or off-street facility), the width of on street bicycle lanes and presence of parking, traffic speed, traffic volume, and characteristics of street intersections (e.g., signalized or not, possibly the type of bicycle infrastructure present). Dr. Peter Furth, Professor of Civil and Environmental Engineering at Northeastern University and one of the authors of the widely cited and used 2012 Mineta Transportation Institute report on LTS (Mekuria et al., 2012) provides information on the original and an updated scheme for classifying roadway network segments by LTS and examples on his university website[14].
3) Create bicycle and pedestrian networks. The bicycle network is created by selecting low LTS network links (generally LTS level 1 and 2 when using the standard 4-level LTS scheme). The pedestrian network may consist of streets with sidewalks and multi-use paths, although it may

[14] http://www.northeastern.edu/peter.furth/criteria-for-level-of-traffic-stress/

also be possible to extend the concept of LTS to pedestrian infrastructure (LaJeunesse et al., 2021).

4) Identify important destinations. There is a wide range of what can be considered important including employment opportunities, education, food and other retail, government services, entertainment, etc. Data are required on the location of these destinations. These data can be purchased from commercial data vendors, are available from the US Census, and may have been used in the current ATP (i.e., the address density data used in the ATP network development process).
5) Determine pedestrian and bicycle service areas. First, spatial analysis zones must be defined. These could be travel analysis zones used in the region's travel demand model, census blocks or block groups, or other neighborhood scale geography. The next step is determining trip distance thresholds for bicycle and pedestrian trips. A wide range of values have been used. Kent and Karner (2019) use 2 miles for bicycle trips while other studies have used thresholds in the range of one to three miles. A mile is likely a reasonable threshold for pedestrian trips. These thresholds are used to create bicycle and pedestrian service zones, by calculating the network distance from the centroid of each analysis zone outwards in all directions. The more extensive the bicycle or pedestrian network, the larger the service area will be.
6) Calculate accessibility metrics for each analysis zone. Each service area is intersected with the location of important destinations. Metrics can include the number and type of destinations that can be reached within each service area. It is also possible to estimate the average distance to destinations in each service area or consider the distance to destinations beyond the service area which has the advantage of not defining predetermined walking and bicycle distance thresholds but requires other choices[15].

The above framework can be used to evaluate how accessibility changes for people living in each zone if the entire ATP network were developed and also for individual projects. By evaluating each project independently, this framework makes it possible to rank each project based on how much it improves accessibility for the region's population. It is also possible to rank projects or prioritize them based on how much accessibility is increased for particular destinations, such as schools and transit stops. Furthermore, it is also possible to evaluate how accessibility is improved for different population subgroups (e.g., low income households or BIPOC) using data on the characteristics of each zone's population.

While an accessibility-based analysis and prioritization framework would take some resources to develop, CCRPC appears to have many of the necessary data including information about pedestrian and bicycle facilities, possibly the location of destinations (non-residential addresses), and an LTS model.

Additional Considerations:

- The LTS method used in the ATP should be reviewed for its accuracy:
    - LTS usually has 4 levels, with levels 1 and 2 being considered a low stress environment for adult bicyclists. Level 1 is generally considered appropriate for children. It is unclear why the ATP LTS analysis only has 3 levels and what those levels correspond to.

[15] Requires consideration of how many nearest destinations to consider. For example, the first employment opportunity or several? One grocery store or two?

    - LTS should also consider intersections and street crossings. Uncontrolled intersections of low and high stress links result in higher LTS as do intersections that fail to continue bicycle infrastructure through the intersection while avoiding conflicts with right turn lanes. LTS links are not particularly useful if there is no low stress way to navigate intersections.
    - Network links where traffic speeds are greater than 35 MPH are generally considered LTS 3 or greater regardless of bicycle infrastructure unless it is completely separated from the roadway. Many high-speed roadways have LTS 2 in the ATP.
    - Providing shoulders on high speed roadways does not improve LTS. They are always LTS 4.
    - LTS should consider the prevailing traffic speed rather than the speed limit in places where traffic speeds often exceed posted speed limits. While Burlington has a 25 MPH citywide speed limit (with some posted roadway exceptions), the prevailing speed on many roads likely exceeds this outside the immediate downtown area.
- The above accessibility framework is designed primarily to evaluate transportation trips. Recreational and exercise bicycle and walking trips do not necessarily have a destination. The same framework, however, can be used to evaluate the extent of the LTS network in each service area or access to certain types of pedestrian and bicycle infrastructure that may hold greater value for recreation such as shared use paths.
- Many accessibility metrics can be estimated in specialized travel demand modeling software and standalone geographic information systems (GIS) such as ESRI's ArcGIS ArcMap and ArcPro software. This means that an accessibility model can be created without new software or changes to the regional travel demand model.
- While an accessibility-based evaluation and prioritization framework can guide planning and implementation decisions, planners must still choose possible network links to evaluate. Accessibility metrics can be used to identify low accessibility zones where planning efforts could focus.

4.2 Evaluate and Prioritize Other Infrastructure, Policy and Programmatic Recommendations

Links making up the proposed ATP network were scored for their priority and feasibility. This is helpful for focusing implementation efforts on what's most important considering the limited budgets often available for active transportation projects. All other recommendations in the ATP, including other infrastructure recommendations, were not prioritized or evaluated for their feasibility. Given the large number of these other recommendations (we counted 67) implementation would likely benefit from also evaluating their feasibility and priority.

Some of the infrastructure recommendations should be considered with the proposed ATP network, where they can be evaluated and prioritized along with other infrastructure projects using a consistent framework. For example, recommendations to continue bicycle infrastructure through intersections. If infrastructure is not continued through an intersection, a low LTS is not achieved on the joining network links and the proposed ATP network should not be considered complete. Other, specific infrastructure recommendations, such as improvements around the City of Winooski traffic circulator should also be included in the ATP network rather than as separate recommendations.

The ATP also includes a number of general infrastructure engineering and design recommendations such as including bicycle detection at traffic signals, using roundabouts, and upgrading bicycle lanes to separated bicycle lanes. The ATP does not discuss *where* to implement these types of general infrastructure recommendations or provide any guidance on their relative importance. Most focus on either improving safety or encouraging active travel, and should be evaluated with respect to their likely contribution to improving one or both of these outcomes. Some of these other infrastructure recommendations are required by federal regulations or strongly encouraged, such as providing and maintaining accessible pedestrian infrastructure[16,17]. Therefore, recommendations related to building and maintaining accessible pedestrian infrastructure should be prioritized above most other recommendations. The ATP focuses on providing curb ramps, but the plan should consider other changes needed to make the entire pedestrian network accessible, such as ensuring that sidewalk surfaces are free of large cracks, holes and other obstructions, are wide enough to accommodate wheelchairs, provide sufficient and safe places to cross roadways, and that pedestrian crossing signals accommodate users with physical disabilities (e.g., placing signal activation buttons in accessible locations).

Other recommendations should be evaluated based on evidence of their effectiveness and costs. FHWA maintains a website of "proven" safety countermeasures that apply to pedestrians and bicyclists that have been evaluated for their effectiveness[18]. Evidence pertaining to the effectiveness of various pedestrian and bicycle infrastructure designs and treatments for increasing active travel participation is less clear than it is for safety owing to the relative difficulty of studying travel behavior change versus crashes (Aldred et al., 2021; Handy et al., 2014; Krizek et al., 2009). No single guidance document like FHWA's proven safety countermeasures exists; however, comprehensive design guidance does. Up to date design guides such as those produced by the National Association of City Transportation Officials (NACTO) provide guidance that generally reflects the latest research on what constitutes a safe and low stress bicycle and pedestrian environment. Other guidance, including that from American Association of State Highway and Transportation Officials (AASHTO), are not up to date although updated guidance is expected soon. Generally, research on bicycle facilities has converged on the importance of providing dedicated and preferably separated facilities to increase the amount of bicycling. Several meta-analysis provide some guidance that covers a range of infrastructure and policy interventions, but findings generally come with many caveats and limited evidence (Aldred, 2019; Mölenberg et al., 2019; Pucher et al., 2010; Scheepers et al., 2014). Wide shoulders, wide outer lanes, signed bicycle routes, and shared lane markings have little evidence of effectiveness at promoting more bicycling. Research on pedestrian facilities is much more limited beyond what is required to meet ADA standards. The quality of the pedestrian environment and surrounding area is thought to be important, including the proximity and speed of adjacent traffic, factors that affect a pedestrian's sense of security and safety such as lighting, crime rates, and surrounding land uses (Addy et al., 2004; Ariffin & Zahari, 2013; Jacobsen et al., 2009; Owen et al., 2004).

[16] FHWA guide on ADA standards and pedestrian infrastructure design guidance: http://www.bikewalk.org/pdfs/sopada_fhwa.pdf and https://www.fhwa.dot.gov/environment/bicycle_pedestrian/publications/sidewalks/chap4a.cfm

[17] ADA standards relevant to pedestrian infrastructure: https://www.access-board.gov/ada/#a4

[18] https://safety.fhwa.dot.gov/provencountermeasures/

The remaining recommendations can generally be classified as policies, programs and further guidance. Generally, the infrastructure recommendations in the ATP and land-use patterns that make it possible to reach destinations by walking and bicycling can be considered necessary for increasing the amount of active travel in the region and making it safer. Many of the other recommendations play a supporting role, further enhancing the opportunities provided by infrastructure investments and compatible development patterns or developing additional resources to guide future planning decisions. Therefore, where recommendations compete for resources, the plan's infrastructure recommendations should generally be prioritized. Where possible, recommendations should also be screened for evidence of their effectiveness and feasibility. Prioritizing and ranking them may not be feasible given the diversity of recommendations; however, focusing on a smaller, more parsimonious, set of recommendations would likely increase the odds that they are implemented and that implementation helps achieve goals. The inclusion of a very large, unprioritized, set of recommendations which includes some items that are known to be relatively effective and others that may have little impact or evidence obscures what's most important.

4.3 Use Consistent, Outcome Focused, Performance Measures

Performance measures are often used to evaluate transportation plans. Performance measures can be grouped into two general types: inputs and outcomes. Identifying which recommendations have been implemented is a type of input performance measure. Input performance measures are useful in the short term since the outcomes from a plan usually take time to manifest and measure. Ultimately, however, outcomes that work towards the achievement of the plan's goals is what matters most. We identified 12 goals (although some goals contained multiple goals), but only six had performance measures. The performance measures were a mixture of inputs and outcomes. We recommend developing outcome-based performance measures that relate to each of the plan's defined goals. Our review also identified several other limitations and concerns with performance measures. Our recommendations concerning these are outlined below:

- Performance measures should be clearly defined. Most were not. For outcome-based performance measures, information is required on how each performance measure is measured, modeled and/or calculated. This should include relevant information about where to collect data, which models to use and what would be required to operate them, and information about equations that may be required for certain calculations. Information about relevant spatial and temporal considerations is also needed. For example, are performance measures tracked at the municipal or county level? Are they tracked year by year?
- Outcome-based performance measures should be provided in the ATP for the base year. This is necessary for gauging progress towards goals overtime. It would also serve as an example of where to obtain or how to calculate each performance measure.
- CCRPC should consider defining performance targets. Although not necessary, defining targets can be helpful for gauging progress towards goal achievement and defining the success of the plan. Performance targets can be developed for goals and/or input and outcome-based performance measures. For example, goals could include targets for increased bicycle and pedestrian mode shares, crash reduction or the extent of the ATP network built.
- Include accessibility performance measures. Greater accessibility to important destinations by walking and bicycling should be an important outcome of the ATP. It is difficult to observe or

measure accessibility directly but it can be estimated using the same LTS and service area methods described in our project prioritization recommendations.

- Focus on primary outcomes rather than secondary or indirect outcomes when measuring performance. GHG reduction may be an appropriate goal, but the ATP affects GHG emissions to the extent it can increase active travel model share for transportation trips.

4.4 Provide More Detailed Information to Guide Implementation of Specific Recommendations

In general, our evaluation of the ATP found many recommendations lacked enough detail and guidance to facilitate full implementation and ultimately the achievement of the plan's goals. For example, while the ATP identified and prioritized network links to create a regional active travel network, very little guidance is provided on what new infrastructure or improvements to existing infrastructure are required on each link. For the other ATP recommendations, guidance on where the recommendation may apply, how the recommendation could be implemented and who is responsible for implementation was often not provided. While it is understandable that a regional plan must find balance between geographic scope and detail, in our assessment more detail as outlined below would greatly benefit implementation and goal achievement.

- The proposed ATP network should clearly identify existing conditions and then provide a set of relevant design options that have been shown to lower the level of traffic stress or address a known safety concern. The plan could leave the selection of design options and the level of stress reduction up to the implementing municipality or agency. Design guidance should reference established guidelines such as those published by NACTO or AASHTO and include appropriate detail such as minimum bicycle lane and sidewalk widths. The Vermont Agency of Transportation Bicycle and Pedestrian Program also maintains a list of relevant design guidelines as well as state policies and design standards[19].
- Providing wider shoulders on rural roads and highways where traffic moves above 35MPH without other pedestrian or bicycle facilities will not reduce the level of traffic stress to a level that most people would find acceptable. In most cases, separated bicycle facilities would be required but are likely infeasible due to costs and available right of way. Wider shoulders may have some safety and other benefits to relatively experienced cyclists. Where wider shoulders are considered, guidance should include recommended widths that take into consideration traffic volume, speed and composition (e.g., truck traffic).
- Provide guidance on where other infrastructure and engineering recommendations apply. For example, the ATP recommends upgrading regular bicycle lanes to separated bicycle lanes "where possible" and to "focus on separated facilities". Without guidance on where recommendations may be possible or should be focused, its unlikely that they will be widely implemented.
- Identify resources available or needed to implement each recommendation. For example, detection of bicycles at intersections and pedestrian count down timers are recommended. Are there resources available to municipalities from CCRPC, VTrans or other places to pay for upgraded traffic signal equipment? Are there recommend strategies for implementation, such as performing upgrades during paving or reconstruction projects? A description of what is

[19] https://vtrans.vermont.gov/highway/local-projects/bike-ped/resources

generally required to implement the recommendation and resources available to aid the implementation is likely to increase implementation and identify potential barriers.

- Identity who is responsible for implementation. Some of the recommendations appear to be the responsibility of CCPRP while others fall on municipalities and other organizations. In other cases, it is unclear. For example, supporting the installation of bicycle maintenance stations and launching pedestrian awareness campaigns. These are activities that could be implemented by a wide range of organizations. Identifying who is primarily responsible for implementation would likely increase implementation and make it easier to track implementation status.

4.5 Additional Recommendations

- Land-use factors are also an important component of active travel (Ewing & Cervero, 2010), but are not considered in the ATP. Policies and programs that encourage greater density and diversity of land uses can be very effective strategies for increasing active travel. In many parts of the region, active travel for transportation is limited by low density, single use, development patterns. While land-use policy is considered in the regional long-range transportation plan[20], it seems appropriate to at least mention the importance of land-use planning for achieving the region's active travel goals. The ATP could also consider where new active travel infrastructure would benefit planned growth in the region.
- The public participation process which informed some aspects of the infrastructure recommendations is unlikely to have identified factors that prevent the vast majority of the region's population for biking and walking. The wiki map and charrettes appeared to focus on current users, rather than potential users (most everyone else). Understanding the barriers to potential users is what needs to be understood the most in order to cause significant change in active travel. Furthermore, collecting more socioeconomic data and information about past and current active travel level from public participation participants would provide useful information about who is providing data. These data are necessary for understanding how representative the views and information being provided are and can inform the design of future research and outreach methods.
- Maintenance needs were apparent during our evaluation of existing infrastructure. We did not inventory bicycle lane or sidewalk conditions, but faded bicycle lane markings were fairly common. Some bicycle lanes, particularly in Burlington, had very poor pavement conditions and debris. We also observed sidewalks in poor condition in many locations. While addressing a back log of deferred transportation infrastructure maintenance is a national challenge, the ATP could consider if and when preference for maintenance and reconstruction should focus active transportation infrastructure.

[20] 2018 Chittenden Count ECOS plan: http://www.ecosproject.com/2018-ecos-plan#final

5 REFERENCES CITED

Addy, C. L., Wilson, D. K., Kirtland, K. A., Ainsworth, B. E., Sharpe, P., & Kimsey, D. (2004). Associations of perceived social and physical environmental supports with physical activity and walking behavior. *American Journal of Public Health*, *94*(3), 440–443.

Aldred, R. (2016). Cycling near misses: Their frequency, impact, and prevention. *Transportation Research Part A: Policy and Practice*, *90*, 69–83. https://doi.org/10.1016/j.tra.2016.04.016

Aldred, R. (2019). Built Environment Interventions to Increase Active Travel: a Critical Review and Discussion. *Current Environmental Health Reports*, *6*(4), 309–315. https://doi.org/10.1007/s40572-019-00254-4

Aldred, R., & Goodman, A. (2018). Predictors of the frequency and subjective experience of cycling near misses: Findings from the first two years of the UK Near Miss Project. *Accident Analysis & Prevention*, *110*, 161–170. https://doi.org/10.1016/j.aap.2017.09.015

Aldred, R., Woodcock, J., & Goodman, A. (2021). Major investment in active travel in Outer London: Impacts on travel behaviour, physical activity, and health. *Journal of Transport & Health*, *20*, 100958. https://doi.org/10.1016/j.jth.2020.100958

Ariffin, R. N. R., & Zahari, R. K. (2013). Perceptions of the Urban Walking Environments. *Procedia - Social and Behavioral Sciences*, *105*, 589–597. https://doi.org/10.1016/j.sbspro.2013.11.062

Elvik, R., & Mysen, A. (1999). Incomplete Accident Reporting: Meta-Analysis of Studies Made in 13 Countries: *Transportation Research Record*. https://doi.org/10.3141/1665-18

Ewing, R., & Cervero, R. (2010). Travel and the built environment: A Meta-Analysis. *Journal of the American Planning Association*, *76*(3), 265–294. https://doi.org/DOI 10.1080/01944361003766766

Ferenchak, N. N., & Marshall, W. E. (2019). Suppressed child pedestrian and bicycle trips as an indicator of safety: Adopting a proactive safety approach. *Transportation Research Part A: Policy and Practice*, *124*, 128–144. https://doi.org/10.1016/j.tra.2019.03.010

Handy, S. (2020). Is accessibility an idea whose time has finally come? *Transportation Research Part D: Transport and Environment*, *83*, 102319. https://doi.org/10.1016/j.trd.2020.102319

Handy, S., Wee, B. van, & Kroesen, M. (2014). Promoting Cycling for Transport: Research Needs and Challenges. *Transport Reviews*, *34*(1), 4–24. https://doi.org/10.1080/01441647.2013.860204

Jacobsen, P. L., Racioppi, F., & Rutter, H. (2009). Who owns the roads? How motorised traffic discourages walking and bicycling. *Injury Prevention*, *15*(6), 369–373.

Kent, M., & Karner, A. (2019). Prioritizing low-stress and equitable bicycle networks using neighborhood-based accessibility measures. *International Journal of Sustainable Transportation*, *13*(2), 100–110. https://doi.org/10.1080/15568318.2018.1443177

Krizek, K. J., Handy, S. L., & Forsyth, A. (2009). Explaining changes in walking and bicycling behavior: challenges for transportation research. *Environment and Planning B: Planning and Design*, *36*(4), 725 – 740. https://doi.org/10.1068/b34023

LaJeunesse, S., Ryus, P., Kumfer, W., Kothuri, S., & Nordback, K. (2021). Measuring Pedestrian Level of Stress in Urban Environments: Naturalistic Walking Pilot Study. *Transportation Research Record*, 03611981211010183. https://doi.org/10.1177/03611981211010183

Medury, A., Grembek, O., Loukaitou-Sideris, A., & Shafizadeh, K. (2019). Investigating the underreporting of pedestrian and bicycle crashes in and around university campuses − a crowdsourcing approach. *Accident Analysis & Prevention*, *130*, 99–107. https://doi.org/10.1016/j.aap.2017.08.014

Mekuria, M. C., Appleyard, B. S., & Nixon, H. (2017). *Improving livability using green and active modes: A traffic stress level analysis of transit, bicycle, and pedestrian access and mobility*. Mineta Transportation Institute.

Mekuria, M. C., Furth, P. G., & Nixon, H. (2012). *Low-Stress Bicycling and Network Connectivity* (p. 86). Mineta Transportation Institute Publications.

Mölenberg, F. J. M., Panter, J., Burdorf, A., & van Lenthe, F. J. (2019). A systematic review of the effect of infrastructural interventions to promote cycling: strengthening causal inference from observational data. *International Journal of Behavioral Nutrition and Physical Activity*, *16*(1), 93. https://doi.org/10.1186/s12966-019-0850-1

Owen, N., Humpel, N., Leslie, E., Bauman, A., & Sallis, J. F. (2004). Understanding environmental influences on walking: Review and research agenda. *American Journal of Preventive Medicine*, *27*(1), 67–76. https://doi.org/10.1016/j.amepre.2004.03.006

Pucher, J., Dill, J., & Handy, S. (2010). Infrastructure, programs, and policies to increase bicycling: An international review. *Preventive Medicine*, *50, Supplement*, S106–S125. https://doi.org/10.1016/j.ypmed.2009.07.028

Scheepers, C. E., Wendel-Vos, G. C. W., den Broeder, J. M., van Kempen, E. E. M. M., van Wesemael, P. J. V., & Schuit, A. J. (2014). Shifting from car to active transport: A systematic review of the effectiveness of interventions. *Transportation Research Part A: Policy and Practice*, *70*, 264–280. https://doi.org/10.1016/j.tra.2014.10.015

Sciortino, S., Vassar, M., Radetsky, M., & Knudson, M. M. (2005). San Francisco pedestrian injury surveillance: Mapping, under-reporting, and injury severity in police and hospital records. *Accident Analysis & Prevention*, *37*(6), 1102–1113. https://doi.org/10.1016/j.aap.2005.06.010

Shinar, D., Valero-Mora, P., van Strijp-Houtenbos, M., Haworth, N., Schramm, A., De Bruyne, G., Cavallo, V., Chliaoutakis, J., Dias, J., Ferraro, O. E., Fyhri, A., Sajatovic, A. H., Kuklane, K., Ledesma, R., Mascarell, O., Morandi, A., Muser, M., Otte, D., Papadakaki, M., … Tzamalouka, G. (2018). Under-reporting bicycle accidents to police in the COST TU1101 international survey: Cross-country comparisons and associated factors. *Accident Analysis & Prevention*, *110*, 177–186. https://doi.org/10.1016/j.aap.2017.09.018

von Stülpnagel, R., & Krukar, J. (2018). Risk perception during urban cycling: An assessment of crowdsourced and authoritative data. *Accident Analysis & Prevention*, *121*, 109–117. https://doi.org/10.1016/j.aap.2018.09.009

Wang, H., Palm, M., Chen, C., Vogt, R., & Wang, Y. (2016). Does bicycle network level of traffic stress (LTS) explain bicycle travel behavior? Mixed results from an Oregon case study. *Journal of Transport Geography*, *57*, 8–18. https://doi.org/10.1016/j.jtrangeo.2016.08.016

Winters, M., & Branion-Calles, M. (2017). Cycling safety: Quantifying the under reporting of cycling incidents in Vancouver, British Columbia. *Journal of Transport & Health*, *7*, 48–53. https://doi.org/10.1016/j.jth.2017.02.010

APPENDIX A – INFRASTRUCTURE PROJECT STATUS

PROJECT ID	CITY/TOWN	ROAD NAME	PRIORITY	FEASIBILITY	IMPLEMENTATION STATUS 2021	NOTES
1	Winooski	E Allen St/Main Street	high	low	Partially Implemented	Bike Lane
2	Winooski/Burlington	Main St/Colchester Ave	High	Low	Not Implemented	
3.01	Winooski	Winooski VT 15/College Pkwy/E Allen St	high	high	Partially Implemented	Bike Lane
3.02	Colchester/Essex	VT 15/College Pkwy/Pearl St	high	high	Shared Use Path	
3.03	Colchester/Essex	VT 15Pearl St	high	high	Partially Implemented	Bike Lane/Buffered Bike Lane
4.01	Essex Junction/Essex/Jericho/Richmond	Maple St/Railroad St	High	Low	Partially Implemented	Buffered Bike Lane
4.02	Essex Junction/Essex/Jericho/Richmond	VT 117/River Rd	High	High	Partially Implemented	Bike Lane
4.03	Essex Junction/Essex/Jericho/Richmond	VT 117/River Rd	High	High	Not Implemented	
4.04	Essex Junction/Essex/Jericho/Richmond	VT 117/River Rd	Low	High	Not Implemented	
5.01	Burlington/South Burlington/Williston/Richmond/ Bolton	US 2/Theodore Roosevelt Hwy	High	Medium	Not Implemented	
5.02	Burlington/South Burlington/Williston/Richmond/ Bolton	US 2/Theodore Roosevelt Hwy	High	High	Not Implemented	
5.03	Burlington/South Burlington/Williston/Richmond/ Bolton	US 2/Theodore Roosevelt Hwy	High	High	Not Implemented	
5.04	Burlington/South Burlington/Williston/Richmond/ Bolton	US 2/Theodore Roosevelt Hwy	low	low	Not Implemented	
5.05	Burlington/South Burlington/Williston/Richmond/ Bolton	US 2/Theodore Roosevelt Hwy	low	Medium	Not Implemented	
5.06	Burlington/South Burlington/Williston/Richmond/ Bolton	US 2/Theodore Roosevelt Hwy	High	High	Partially Implemented	Bike Lane, Missing a few segments
5.07	Burlington/South Burlington/Williston/Richmond/ Bolton	US 2/Theodore Roosevelt Hwy	High	High	Partially Implemented	Bike Lane, Missing near Airport Dr.
5.08	Burlington/South Burlington/Williston/Richmond/ Bolton	US 2/Theodore Roosevelt Hwy	High	Medium	Partially Implemented	Bike Lane

5.09	Burlington/South Burlington/Williston/Richmond/ Bolton	US 2/Theodore Roosevelt Hwy	High	Low	Not Implemented	Bike infrastructure exists but is poorly designed, ATP recommends new infrastructure that has not been implemented.
5.1	Burlington/South Burlington/Williston/Richmond/ Bolton	US 2/Theodore Roosevelt Hwy	High	Medium	Bike Lane	
5.11	Burlington/South Burlington/Williston/Richmond/ Bolton	US 2/Theodore Roosevelt Hwy	High	Medium	Shared Use Path, Bike Lane	
5.12	Burlington/South Burlington/Williston/Richmond/ Bolton	US 2/Theodore Roosevelt Hwy	High	Medium	Partially Implemented	Only a small segment of mostly one direction bike lane, dangerous intersection design at Prospect St.
6.01	Bolton	Cochran Road	Medium	Low	Not Implemented	Rural, low volume road
7	Williston	Mountain View Rd/Industrial Av/ Governor Chittenden Rd	High	High	Not Implemented	Part of this route is a seasonal dirt road
8	Williston	Old Stage Road	Medium	Medium	Not Implemented	
9	Colchester/Essex/Essex Junction	Essex Road	High	Medium	Partially Implemented	Shared Use Path
9.01	Colchester/Essex/Essex Junction	Lincoln St/Park St	Medium	Medium	Partially Implemented	
9.02	Colchester/Essex/Essex Junction	Main St/Colchester Rd	Medium	Low	Not Implemented	
9.03	Colchester/Essex/Essex Junction	Main St	Medium	Medium	Partially Implemented	Shared Use Path
10.01	Essex/Jericho	Susie Wilson Rd	Medium	High	Not Implemented	
10.02	Essex/Jericho	Upper Main St	High	Medium	Partially Implemented	Shared Use Path, Bike Lane
10.03	Essex/Jericho	Center Rd	High	High	Shared Use Path	
10.04	Essex/Jericho	Center Rd/BIxby Hill Rd/ Browns River Rd	High	Medium	Partially Implemented	
10.05	Essex/Jericho	VT 15/Jericho Rd	Medium	Medium	Bike Lane, Wide Shoulder (unclear if this is what the ATP envisioned)	
10.06	Essex/Jericho	VT 15	Medium	High	Partially Implemented	Wide Shoulder (unclear if this is what the ATP envisioned)
10.07	Essex/Jericho	VT 15	Medium	Medium	Partially Implemented	
11.01	Essex	Sand Hill Rd	Medium	Medium	Not Implemented	
11.02	Essex	Sand Hill Rd	Medium	High	Not Implemented	
12.01	Jericho	Browns Trace/Barber Farm Rd	low	low	Not Implemented	
12.02	Jericho	Lee River Rd	Medium	Medium	Not Implemented	
12.03	Jericho	Lee River Rd	Medium	Low	Not Implemented	
13.01	Milton/Colchester/Winooski	Main St/Maplewood Ave	Medium	High	Not Implemented	

13.02	MIlton/Colchester/Winooski	Us 7/ River St	High	High	Not Implemented	
13.04	Milton/Colchester/Winooski	US 7/ River St	High	Low	Not Implemented	
13.05	Milton/Colchester/Winooski	Roosevelt Hwy	Medium	Low	Partially Implemented	Shared Use Path, very short segment
13.06	Milton/Colchester/Winooski	Roosevelt Hwy	High	Medium	Not Implemented	
13.07	MIlton/Colchester/Winooski	Main St	High	Medium	Not Implemented	
14.01	Colchester/Essex	Severance Rd/Kellogg Rd	Medium	High	Partially Implemented	Bike Lane
14.02	Colchester/Essex	Severance Rd	Medium	High	Not Implemented	
14.03	Colchester/Essex	Blakely Rd	Medium	High	Not Implemented	
15.01	Colchester/Winooski	W Allen St/ W Center St/ Malletts Bay Av	High	Low	Bike Lane	
15.02	Colchester/Winooski	Malletts bay Av	Medium	Medium	Not Implemented	
16.01	Burlington	N Prospect St/ Intervale Road	High	Medium	Not Implemented	
16.02	Burlington	S Prospect St/Ledge Rd/ Locust St	High	Medium	Not Implemented	
17	South Burlington/Colchester	Airport Dr/Airport Pwky/Lime Kiln Rd	High	Medium	Not Implemented	Shoulder looks like a bike lane in some places
18.01	South Burlington/Winooski	Patchen Rd	High	Medium	Partially Implemented	Bike Lane
18.02	South Burlington/Winooski	Hinesburg Rd	High	Medium	Not Implemented	
18.03	South Burlington/Winooski	Hinesburg Rd	Medium	Medium	Not Implemented	
19.01	South Burlington/Shelburne	Dorset St	Low	Medium	Partially Implemented	Shared Use Path along north section.
19.02	South Burlington/Shelburne	Dorset Hts	Low	Low	Not Implemented	Unclear what would be required here (quiet dead end street)
19.03	South Burlington/Shelburne	Dorset St	Medium	Medium	Not Implemented	
20.01	Williston/St George/Hinesburg	Mechanicsville Rd	High	Medium	Partially Implemented	Shared Use Path, very short segment
20.02	Williston/St George/Hinesburg	Pond Rd/Oak Hill	Medium	Medium	Not Implemented	
21.01	Shelburne/Hinesburg	Shelburne Falls Rd	Medium	Medium	Not Implemented	
21.02	Shelburne/Hinesburg	Irish Hill Rd/Marsett Rd	Medium	Medium	Not Implemented	
22	Shelburne	Bishop Rd/Spear St	Low	Medium	Not Implemented	
23	Shelburne	Shelburne Bike Path/Hullcrest Rd/Pinehurst Dr	Medium	Medium	Not Implemented	
24	South Burlington	Allen Rd	Low	Medium	Implemented	Shared Use Path
25.01	Burlington	Harrison Av	Medium	High	Not Implemented	
26.01	Burlington/South Burlington/Shelburne	N Willard St/ S Willard St	High	Medium	Partially Implemented	Bike Lane (on one side only)

26.02	Burlington/South Burlington/Shelburne	Shelburne Road	High	Medium	Not Implemented	
26.03	Burlington/South Burlington/Shelburne	Shelburne Road	High	Medium	Partially Implemented	Bike Lane
26.04	Burlington/South Burlington/Shelburne	Shelburne Road	High	Medium	Not Implemented	Wide Shoulder not marked as Bike Lane
26.05	Burlington/South Burlington/Shelburne	Shelburne Road	High	High	Not Implemented	Wide Shoulder not marked as Bike Lane
27.01	Shelburne	Harbor Rd	Medium	Medium	Not Implemented	
27.02	Shelburne	Falls Rd	Medium	Medium	Not Implemented	
28	Shelburne	Bay Rd	Medium	Low	Not Implemented	
29	Shelburne	Bostwick Rd/Beach Rd	Low	Medium	Not Implemented	
30.01	Burlington	Starr Farm rd	Medium	Medium	Not Implemented	
30.02	Burlington	North Av	High	Medium	Bike Lane, Buffered Bike Lane, One Sided Bike Lane, Small portion missing from northern end of N. Ave.	
31	Colchester	Heineberg Dr/Prim Rd/Plattsburg Av	Medium	Medium	Not Implemented	
32	Colchester	Porters Point Rd	Medium	Low	Not Implemented	
33	Colchester	W Lakeshore Dr	Medium	High	Partially Implemented	Shared Use Path
34.01	Colchester	Hallow Creek Rd/Deer Ln/Shetland Ln/Morgan Dr	Medium	High	Partially Implemented	Shared Use Path, very short segment
34.02	Colchester	Williams Rd	low	high	Bike Lane	
35	Colchester	Colchester Bike Path Connector	Medium	Medium	Check	
36	Burlington	Manhattan Dr/Intervale Av	Medium	High	Not Implemented	
37	Burlington	Shelburne Rd/S Winooski Av/ N Winooski Ave/ St Paul St	High	Medium	Partially Implemented	Bike Lane
38	Burlington	N Union St/S Union St	High	Medium	Partially Implemented	Buffered Bike Lane
39	Burlington	North St	High	Medium	Not Implemented	
40.01	Burlington	Colchester Av	High	Medium	Bike Lane, One Direction Bike Lane	
40.02	Burlington	Colchester Av	High	High	Shared Use Path, Bike Lane	
40.03	Burlington	Pearl St	High	Medium	Bike Lane, One Direction Bike Lane	
41	Burlington	Battery St/Park St	High	Medium	Not Implemented	
42	Burlington	Pine St	High	Medium	Partially Implemented	Bike Lane/One Side Bike Lane
43	Burlington	Maple St	High	Low	Not Implemented	
44	Burlington	Howard St	Medium	Low	Not Implemented	

46	Burlington	Flynn Av	High	Low	Bike Lane/Advisory Bike Lane/One Sided Bike Lane	
47	Burlington	Home Av/Austin Dr	Medium	High	Partially Implemented	Bike Lane
48.01	South Burlington	East Av	High	Medium	One Direction Bike Lane	
48.02	South Burlington	East Av	Medium	Medium	Not Implemented	
48.03	South Burlington	Spear St	Low	Medium	Not Implemented	
48.04	South Burlington	Spear St	Low	Medium	Not Implemented	New Pavement & Relatively Wide Shoulder
49	Essex Junction	West St	High	Medium	Not Implemented	
50.01	Essex Junction	Beech St	Medium	High	Not Implemented	
50.02	Essex Junction	Main St	High	Medium	Not Implemented	
51	South Burlington/ Williston	Marshall Av/Kimball Av	Medium	Medium	Partially Implemented	Bike Lane on Kimball Ave
52	Richmond	Bridge St	Low	High	Not Implemented	
53	Milton/Westford	Westford-Milton Rd/Westford Rd/Main St	Medium	High	Not Implemented	
54	Charlotte/Hinesburg	Hinesburg Rd/Charlotte Rd/Church Hill Rd	Medium	Medium	Not Implemented	
55	Hinesburg/Huntington	Hinesburg Hollow Rd	Medium	High	Not Implemented	
56	Milton/Colchester	Middle Rd/East Rd	Medium	High	Not Implemented	
57	Underhill/Westford	VT 15	Low	Medium	Wide Shoulder (unclear if this is what the ATP envisioned)	
58	Richmond/Huntington	Main Rd/ Huntington Rd	Low	Medium	Not Implemented	
59	Williston/St George	VT 2A/ St George Rd	Low	Low	Not Implemented	
60	Shelburne/St George/Hinesburg	VT 116/Hinesburg Rd	Medium	Low	Not Implemented	
61.01	Hinesburg/Huntington	Richmond Rd	Medium	Low	Not Implemented	
62	Essex	I-289	High	Medium	Not Implemented	