



Future of Rural Transit: Combined School and Public Transportation Feasibility Study

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Acknowledgements

The project team would like to thank the Future of Rural Transit Advisory Committee and Steering Committee for their help completing this feasibility study. In addition, we would like to thank project partners at Mount Mansfield Unified Union School District, Orange East Supervisory Union, Green Mountain Transit, Tri-Valley Transit, and Chittenden County Regional Planning Commission.



Project Goals and Background

The goal of the Future of Rural Transit project is to expand clean transportation options for rural communities by offering combined bus services to schools and community members using electric buses. The project was launched in 2020 with the formation of an Energy Action Network Team to explore the feasibility of combining school and public transportation, engage state and local stakeholders to identify barriers and potential solutions to combined service, and research existing models of combined service in Vermont.

This report presents findings of feasibility studies conducted in two Vermont school districts to assess the concept of combining school and public transportation to meet (or enhance) student travel needs while also increasing the public's access to transit. A key question of this study is whether the overall efficiency of our transportation system can be improved through this consolidation, reducing cost, vehicle miles traveled, and greenhouse gas emissions, while improving the level of service provided. VEIC led the feasibility study with support and input from a Steering Committee of organizations: Vermont Clean Cities Coalition, Vermont Agency of Transportation, Vermont Energy Education Program, Green Mountain Transit and the Energy Action Network.

One of the first steps in the feasibility study was to identify partner school districts interested in exploring and piloting the combined school and public transportation. The project Steering Committee led a competitive process and selected Mount Mansfield Union Unified School District (MMUUSD) and Orange East Supervisory Union (OESU) to participate in the study.

VEIC worked with stakeholders and the two partner school districts to identify potential routes that would serve as the focus of the feasibility study and could be piloted through this project. We made a strategic decision to focus on the potential for transit to provide school transportation (rather than school buses serving the general public). Currently, we are evaluating the potential for transit to provide service that is supplemental to existing school bus service (e.g., additional after school service). We have not yet considered the opportunities to eliminate or reduce school bus routes.

Chittenden County Regional Planning Commission (CCRPC) staff have surveyed residents in Underhill and Jericho looking at demand for and awareness of transit; they did not find much evidence of either.¹ **Transit focused on serving students could find more success.** For example, we have learned that school routes in Burlington are among the most successful routes in Green Mountain Transit's service territory.

Initially, the project had hoped to quantify the following for each route that combined public and school transportation:

¹ Tri-Town Study led by Stedman Hill Consulting, presented to CCRP in April 2021.

- if the route can be served by electric buses and identifying charging needed to support operations (on-route or depot)
- potential cost-savings from fleet consolidation and electric vehicle (EV) adoption
- savings to Medicaid (or Elderly and Disabled?)
- reductions in energy use from fleet consolidation and EV adoption
- reductions in greenhouse gas (GHG) and other air pollutants that harm human health from fleet consolidation & EV adoption
- assessing labor impacts (drivers, maintenance, fleet managers)
- quantify increased access to rides among public

However, because the routes under consideration in both partner school districts are additional to existing service, there are no quantifiable savings as initially envisioned. We have included estimates of operational cost and maintenance savings and emissions reductions of new routes provided by electric buses, compared to diesel buses.

Benefits of Electrification

In addition to considering combining school and public transportation, this project is also considering the viability of operating these routes with electric buses. It's well-known that Vermont's transportation sector is highly dependent on fossil fuels. The future of rural transit must provide Vermonters with mobility without fossil fuels. The benefits of transportation electrification are numerous:

1. **GHG reductions:** reductions in GHG emissions relative to a diesel bus are particularly pronounced in Vermont where the grid is particularly clean. The Vermont Agency of Natural Resources (ANR) estimates that electric buses currently operating in the state will have annual GHG emissions 97% lower than diesel buses.
2. **Improved air quality:** electric buses have no tailpipe emissions, dramatically reducing not just GHGs but emissions of particulate matter, carbon monoxide, volatile organic compounds, and nitrogen oxides, all federally regulated criteria pollutants. These are known carcinogens that also aggravate respiratory conditions such as asthma and COPD and can cause cognitive delays in children.
3. **Cost savings from fuel and maintenance:** diesel buses are notoriously expensive and difficult to maintain. Although more expensive to purchase, electric buses can be substantially cheaper to both maintain and fuel. ANR estimates that operational savings will be as much \$36,000 over the lifetime of Vermont's electric buses.

4. **Price stability:** In addition to being cheaper than diesel, electricity prices are much more stable, increasing only 1.37¢ in Vermont over the past five years, according to the Energy Information Administration.
5. **Reliance on a local source of energy:** Nearly three quarters of the money spent on petroleum leaves the state. According to the Energy Action Network, this adds up to \$1.5 billion leaving Vermont annually. In contrast, an estimated 70% of spending on electricity remains to circulate within Vermont.
6. **Potential to use buses as a resiliency measure:** the large battery packs in electric buses can serve as a distributed energy resource, increasing the resiliency of the local grid and a back-up power source during emergencies. Although still in the early stages of development, electric bus batteries also have potential to generate revenue for schools (or utilities, depending on the ownership structure) through vehicle-to-grid (V2G).

Mount Mansfield Union Unified School District (MMUUSD)

MMUUSD spends over \$2 million annually on school transportation. MMUUSD owns and operates their school buses: a fleet of 32 diesel buses that serve 26 regular routes. The fleet transports about 1,036 students daily, resulting in an estimated 368,916 student-trips over the course of the school year. Four of the buses are kept at drivers’ homes overnight. School buses provide some service during the summer as well as extracurricular late buses during the school year. Extracurricular buses leave Mount Mansfield Union High School (MMU) at 4:30. MMUUSD also operates a 24-passenger bus for out-of-district schools under the special education services program.

Table 1. MMUUSD Transportation 2019 Baseline Data.

Annual Mileage	422,325
Diesel Costs	\$ 159,375
Maintenance Costs	\$ 117,682

Based on input from MMUUSD, the project Steering Committee focused route development on service connecting Cambridge/Jeffersonville, Underhill/Jericho, and Richmond/Bolton to Mount Mansfield Union High School (MMU) and potentially other destinations, such as the Richmond Park and Ride, and Taft Corners. Broadly we considered: a north-south connection via Browns Trace or Rt. 15 and/or an east-west connection via Rt. 2 (shown in Figure 1).

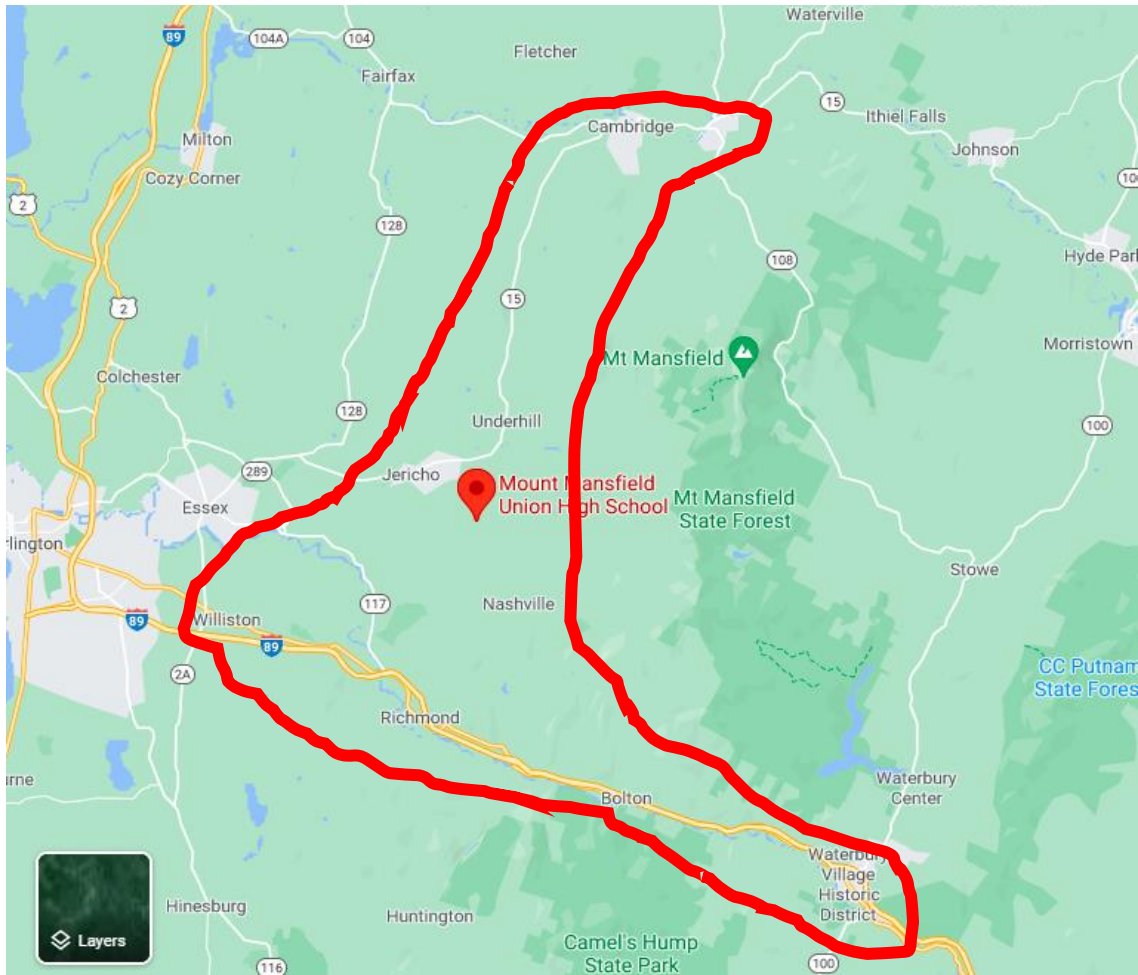


Figure 1. Region considered for public transit routes.

The Steering Committee decided that the most promising route was one that travels from the Richmond Park and Ride to MMU via Richmond Village and Camel's Hump Middle School. This route (shown in Figure 2) would link the Park and Ride to the Village and hopefully have high ridership among MMU students. This route could also extend north past MMU to Rt. 15.

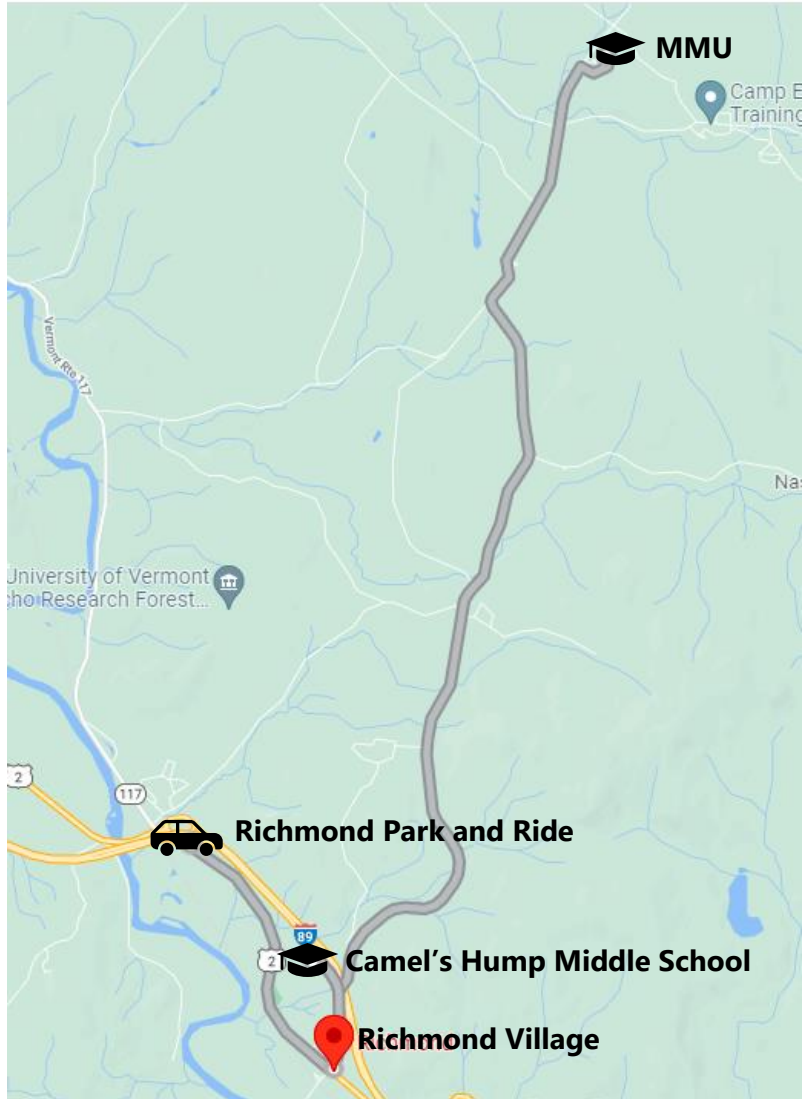


Figure 2. Proposed route for combined school and public transportation in MMUUSD.

Potential routes were discussed with local stakeholders, in addition to MMUUSD. These route ideas were validated as of interest. Other route ideas that were identified by stakeholders and by the project Steering Committee included:

- Route connecting town centers along VT-15 to US-2 in Richmond: Jeffersonville, Cambridge Underhill (MMU), Jericho, Richmond and Williston Village.
- Route running north-south along Brown's Trace: Jericho-MMU-Richmond, with a stop at Camel's Hump Middle School; this route could start in Jeffersonville
- Route connecting MMU to Bolton along the Rt. 2 corridor

All of these routes are still under consideration, especially if engagement with the MMUUSD community suggests that there is demand for service to Cambridge or Bolton. However, the feasibility analysis for this project focused on the route shown in Figure 2 above.

Survey of MMUUSD Stakeholders and Communities

VEIC created an online survey to better understand demand for combined school and public transit in the MMUUSD area. The survey focused on after school service (between 4:30 and 6) along the route in Figure 2. The survey was distributed through the MMUUSD monthly newsletter and posted on Front Porch Forums in Richmond and Jericho.

We received 175 responses from residents of Bolton, Huntington, Jericho, Richmond, and Underhill (see Appendix 1 for a full copy of the survey and Appendix 2 for detailed survey results). Most respondents reported living in Richmond (71) and Jericho (45). The majority of respondents were parents (98) of MMUUSD students. Approximately a quarter of respondents (47) were not affiliated with MMUUSD (neither students, staff, nor parents).

Key survey findings include:

- Most MMUUSD students who participate in after school activities are picked-up after school by a parent.
- The proposed Green Mountain Transit (GMT) route would increase the likelihood to participate in afterschool activities for 36% of respondents.
- The majority of respondents were residents of Richmond and were not affiliated with MMUUSD.
- Respondents expressed the greatest interest in stops in Richmond Village and the Richmond Park and Ride; there was minimal interest in stops at MMU or Camel's Hump Middle School.

Although not exhaustive, the survey helped us understand where demand does and does not exist within MMUUSD territory. We saw little evidence of demand for service to Bolton, Cambridge, or Route 15, and clear interest in a route connecting Richmond Village to the Richmond Park and Ride. Although flexible, moving forward, we will focus on a route with stops at: Richmond Park and Ride, Richmond Village, Camel's Hump Middle School, and MMU. We will continue to engage with the Tri-Town and communities MMUUSD families and staff, adjusting the proposed route as needed.

Feedback from Green Mountain Transit

GMT worked with the project Steering Committee and met with VEIC to discuss the proposed route. GMT identified two key barriers:

1. Long 'deadhead' trip from the GMT bus depot in Burlington to the route's start at the Richmond Park and Ride.

Solutions to consider:

- The bus spends the night at Camel's Hump Middle School (or some other nearby location). Camel's Hump MS is of particular interest because of the school's solar array and possible pairing with an electric transit bus.
- The outgoing trip to Richmond is not a deadhead route but carries passengers from Burlington.

2. Driver shortage, especially during peak hours: it may be difficult to staff a route during peak hours. GMT is already experiencing driver shortages with existing routes.

Solutions to consider:

- MMUUSD school bus drivers are recruited to drive the route. Both school districts and transit are struggling nationally to recruit and retain drivers. In fact, the driver shortage builds a stronger case for a consolidated transportation system requiring fewer drivers and buses.

An additional barrier to providing new service to MMUUSD is that none of towns that would potentially be served by the new service are members of GMT. There are two ways that communities, who are not currently members of GMT, can be provided with service:

- Join GMT as a member community in which there is an annual tax assessment and the community gains a seat on the GMT Board.
- Pay a member fee to provide service in the community. For example, Jericho, Underhill and Cambridge are each paying a fee for a commuter bus along Route 15 that provides transit access to each community.

In either scenario, communities interested in service would need to contribute funding to support the proposed route, or other routes under consideration.

Cost

Cost of service

GMT provided the project team with a cost per hour, inclusive of labor, benefits, overhead, fuel and maintenance: \$90. Including time to get to and from the Richmond Park and Ride from the Burlington bus depot, we estimate that this route would cost approximately \$400 per day to run two full circuits (one at 4:30 and one at 5:30). If the route was to run for 175 school days, the cost would be \$70,000 over the course of the school year.

Cost to towns

Route start-up costs would be covered by the towns and negotiated with GMT, and most likely include a capital contribution (we were not able to obtain an estimate of start-up costs for this route, nor expected capital contribution per town).

Electrification

The proposed route is between 18 miles (without service to Rt. 15) to 23 miles (with service to Rt. 15) roundtrip and could be served with an electric transit bus. As noted previously, the survey indicated little demand for service to Route 15. Bus range depends on battery size and varies from 70 miles to over 300, with a median range around 150 miles (note that range declines between 20 and 50% in sub-freezing temperatures). We anticipate the bus serving this route three times each afternoon, in approximately 45-minute increments between approximately 4:30 and 6:30. The route could be served by either a full-sized 35-40 foot transit bus or a smaller, cutaway bus or van depending on anticipated demand and ridership. A number of schools in the district have large solar arrays and we will explore the possibility of parking the bus at one of these locations and powering the buses with solar or using solar as a back-up source of energy.

As the project continues, we will also explore the possibility of the bus battery providing grid services and storage capacity to the local utility. A successful vehicle-to-grid (V2G) demonstration project in White Plains New York has shown the potential for electric buses to both transport people and serve as a grid resource. It has also shown an innovative model of shared bus/battery ownership between a utility (ConEdison) and a local transportation provider (White Plains School District).²



A Green Mountain Transit Electric Bus.

Savings from Electrification

² See: https://www.youtube.com/watch?v=wAiFLP43_rA and <file:///C:/Users/jsears/Downloads/%7B472CDEF3-D4A6-43E2-B833-189766DCDC40%7D.pdf>

We estimate that operating the proposed 18-mile route twice a day for 175 days per year with a diesel bus would emit 28 tons of GHG annually. Running the route with an electric bus would emit less than 1 ton, annually. Fuel and maintenance savings will vary but would be in the range of \$2,400 annually in fuel savings and \$6,100 in maintenance savings.³

Broader Community Interest in Transit

The project team has also been in communication with the Tri-Town Transportation Committee, a group of residents in Jericho, Underhill, and Richmond, interested in expanding transit access in their towns. Specifically, this group is interested in new midday service connecting the Tri-Town area to commercial centers in Burlington and Williston. The Future of Rural Transit is focused on school transportation, most likely routes that would run in the morning and afternoon. However, we do see opportunity for collaboration and shared interest in bringing transit service to the MMUUSD communities. We are exploring the possibility of a bus serving both the community, at midday, and students in the afternoon.

As Green Mountain Transit expands its service area beyond Greater Burlington, more rural communities, such as the Tri-Town area may be better served by a local bus depot or even just stationing a single bus locally. Distributing buses across GMT territory would reduce deadhead trips and may make service to rural towns more efficient and cost-effective.

Next Steps

- Continue to engage with all necessary stakeholders as routes are developed, including MMUUSD staff, parents, and students, GMT, VTrans, and community members.
- Consider funding mechanisms for combined school/public transportation.
- Consider funding mechanisms for an electrified route.
- If GMT decides to move forward with the route, they would need to submit an application for new service to VTrans.

Orange East Supervisory Union

Orange East Supervisory Union (OESU) serves a widespread area including the towns of Bradford, Wells River, Groton, Newbury, Thetford, and Ryegate. There are an estimated 1,400 students attending the district's six schools and technical center. Some bussing is contracted to Butler Bus. Butler Bus provided the project team with data from 2019. According to these data, Butler operated three buses within OESU and three bus routes. All three of these buses are taken home to bus drivers' homes at night. An estimated 160 students use the school buses each day. Butler does not provide additional or special transportation services (e.g., special education, summer camps, extra curriculums).

³ See <https://www.publicpower.org/periodical/article/electric-buses-mass-transit-seen-cost-effective>

Table 2. Orange East SU School Transportation 2019 Baseline Data.

Annual Mileage	43,046
Diesel Costs	\$19,370
Maintenance Cost	\$0.62 per Mile

In our conversations with the OESU Assistant Superintendent, we learned of demand for service at the two high schools (Blue Mountain Union School and Oxbow High School) at the end of the school day for transportation to/from after school activities and employment. Additionally, OESU noted that the Bradford Tech Center serves students from New Hampshire and expressed interest in a circular route, traveling south along Route 5 between Wells River and Bradford, and then north up Route 302 in New Hampshire.

The response from Tri-Valley Transit (TVT), the local transit provider, was encouraging: TVT may be able to provide this service, combining it with the existing River Route. The proposed additional stops would add less than 10 miles to the existing route. TVT maintains a bus depot in Bradford, making service to the high school and tech center convenient with limited ‘deadhead’ miles. TVT is actively exploring electrification of its fleet and has received funding from the Federal Transit Administration to procure two battery electric buses that will be housed at the Bradford depot.

The additional service to serve the two high schools would add to TVT’s costs. Because the proposed stops would be part of an existing route, TVT can submit an application for modified service through VTrans which would cover the cost of the expanded route. We expect the route will run once per day at the end of the school day. If there is demand for additional afternoon or morning service, we will continue to work with OESU and TVT to increase frequency of the combined service.

Savings from Electrification

As noted above, the proposed modification would add less than 10 miles to existing River Route. Along these additional miles, relative to a diesel bus baseline, GHG savings would be approximately 6-7 tons annually. Fuel and maintenance savings would be in the range of \$600 and \$1,500 annually, along the additional 10 miles of route. Along the entire River Route, all savings from electrification would be greater: 75-80 tons GHG annually, \$7,000 in fuel savings and over \$15,000 in maintenance savings.⁴ Further, we expect that an electric bus in the TVT fleet would be used for more than once daily combined service along the River Route, ultimately yielding much great savings all around.

⁴ See <https://www.publicpower.org/periodical/article/electric-buses-mass-transit-seen-cost-effective>

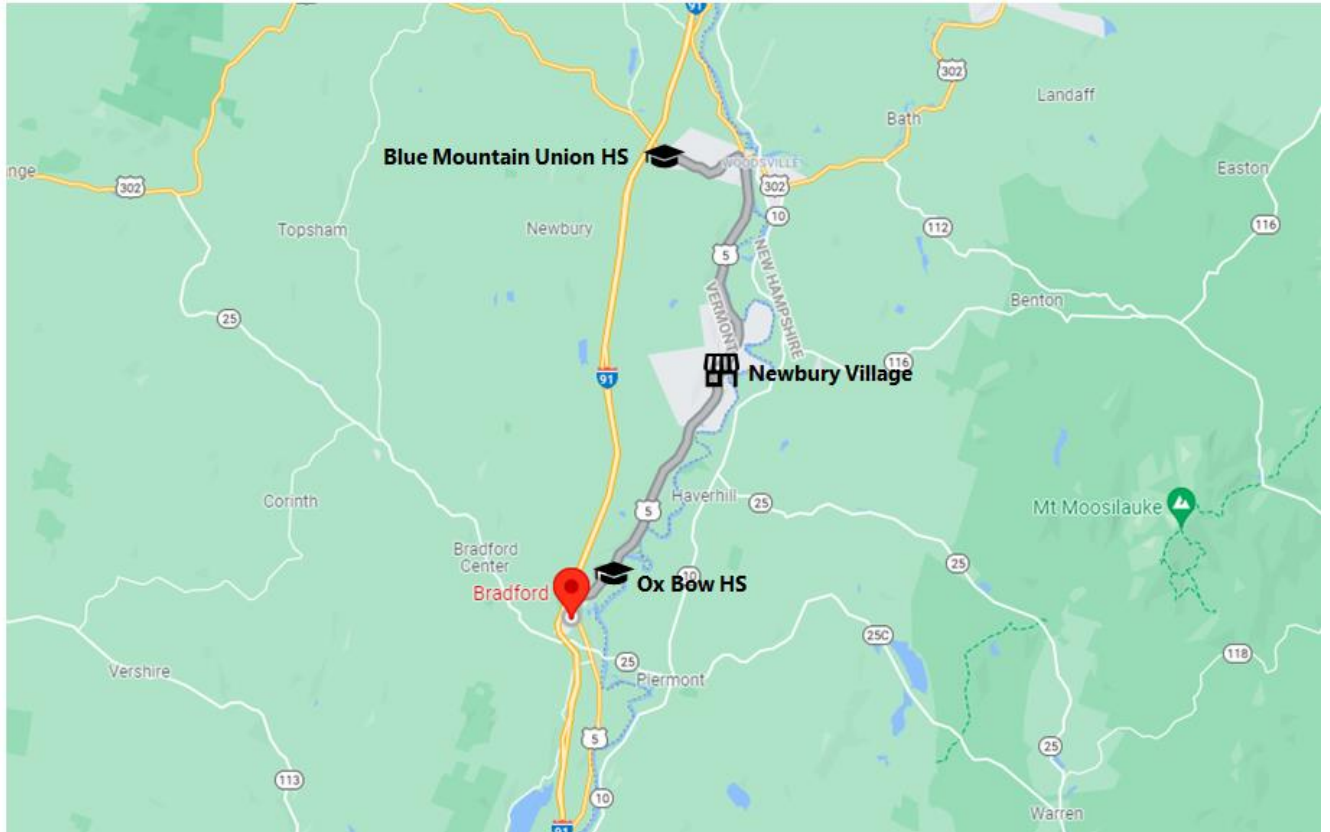


Figure 3. Proposed route for combined school and public transportation route in OESU.

Next Steps

1. Continue to facilitate conversations with OESU staff and TVT (service will most likely begin in the spring of 2022, after the application for modified service has been reviewed by VTrans).

Appendix 1- MMUUSD Survey

The MMUUSD Survey was administered online. The survey was advertised in the monthly MMUUSD newsletter and on Tri-Town Front Porch Forums. Below is a copy of the survey.

INTRO

Mount Mansfield Unified Union School District was one of two school districts and communities selected to participate in a feasibility study of the Future of Rural Transit Project. The Future of Rural Transit is a coalition of VTrans and other partners seeking to expand transportation options by combining school and public bus service. This survey will help the project team gather valuable feedback on potential routes. Your responses will be anonymous.

SURVEY

1. What town do you live in?
 - a. Bolton
 - b. Huntington
 - c. Jericho
 - d. Richmond
 - e. Underhill
 - f. Other (write-in)
2. Are you affiliated with MMUUSD?
 - a. YES (Select all that apply):
 - i. Parent
 - ii. staff [routed to 4]
 - iii. student
 - b. NO [if no routed to 4]
3. IF PARENT OR STUDENT, NOT IF STAFF: How do you/your child get home from after school activities?
 - a. I/my child does not participate in after school activities.
 - b. I/my child carools with others.
 - c. I/my child is picked up by a parent.
 - d. I/my child uses the school bus that leaves MMU at 4:30.
 - e. Other (please specify)
4. If a Green Mountain Transit bus provided service to and from the following locations between 4:30 and 6 PM, Monday through Friday, how often would you use each of the following stops?

	2x per week or more	Once a week	A few times a month	Rarely or Never
Richmond Park & Ride				
Richmond Village				

Camel's Hump Middle School				
Mount Mansfield Union HS				
Rt. 15 & Browns Trace Rd.				
Cambridge Park & Ride				
VYCC Barn on Rt. 2				
A stop in Bolton				

5. Are there other stops you would use in this area? (write-in)
6. IF PARENT OR STUDENT: Would Green Mountain Transit service like the route described above make it more likely for you/your child to participate in afterschool activities? y/N
Comments (write-in)
7. Additional comments:
8. Demographics (optional)
 - a. Age of child (write-in)
 - b. Race (write-in)
 - c. Income
 - i. Up to \$70,000 annually
 - ii. \$70,000 - \$100,000 annually
 - iii. More than \$100,000 annually

Appendix 2- MMUUSD Survey Results

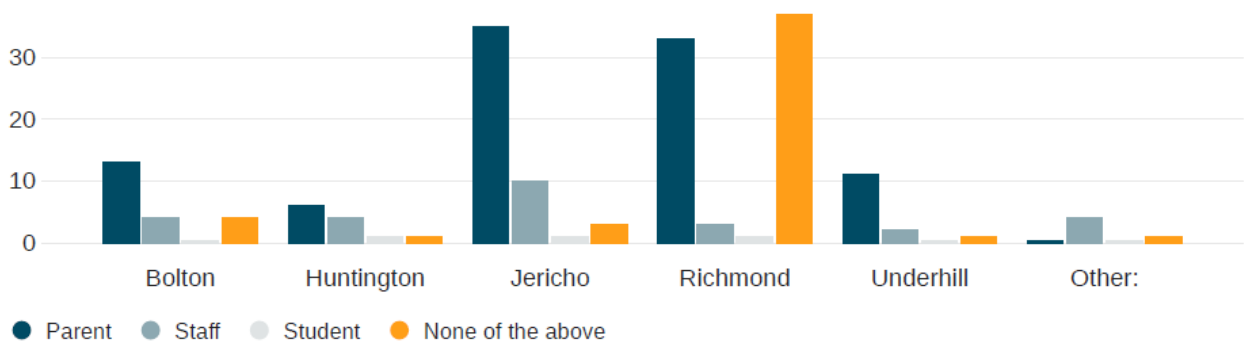
Response by Town

Field	Choice Count
Bolton	17
Huntington	9
Jericho	45
Richmond	71
Underhill	12
Other:	5
Total	159

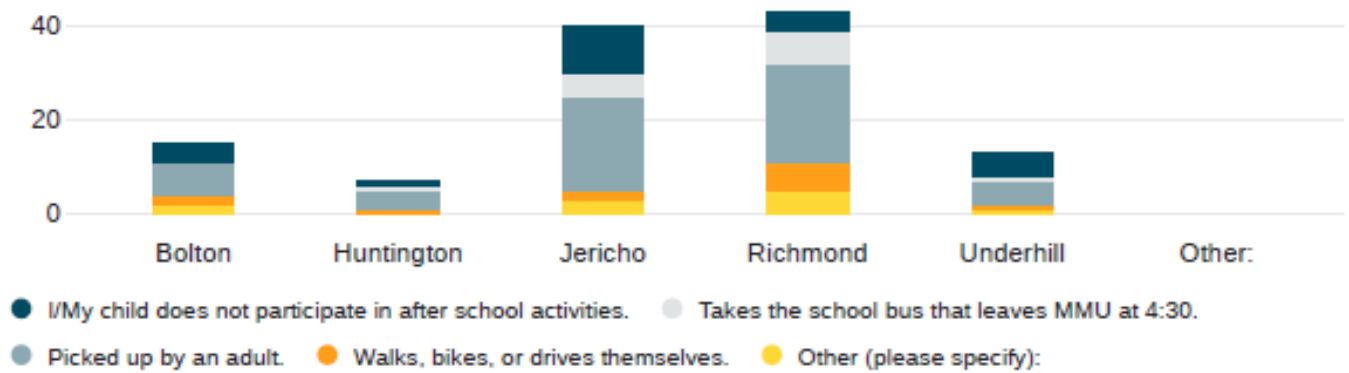
Affiliation with MMUUSD

Field	Choice Count
Parent	98
Staff	27
Student	3
None of the above	47
Total	175

Affiliation with MMUUSD by town

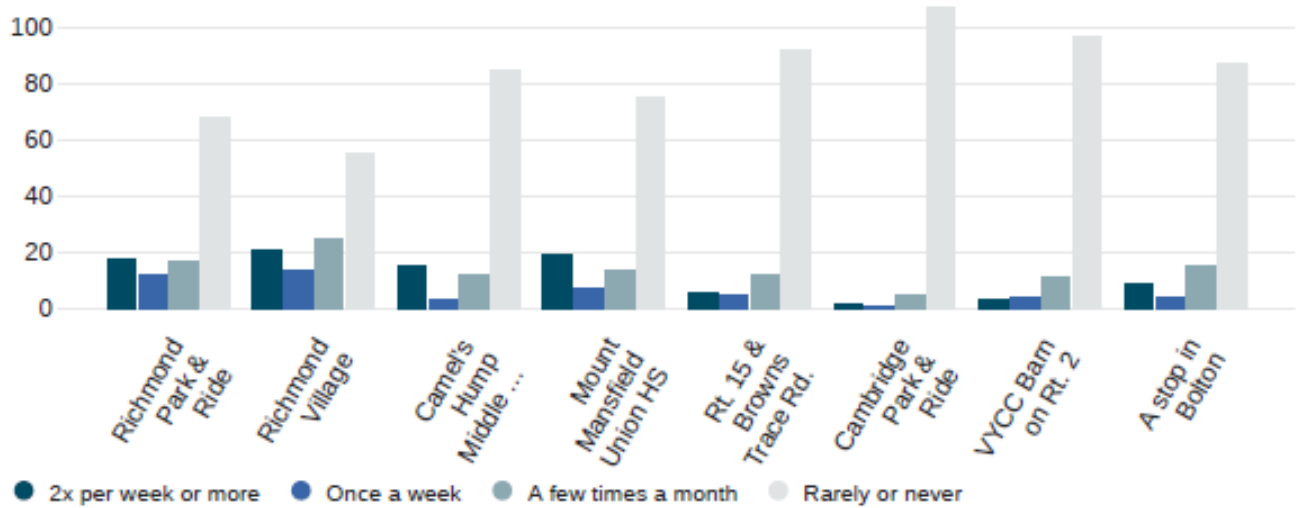


Travel choice to get home from after school activities



Field	Choice Count
Picked up by an adult.	57
Takes the school bus that leaves MMU at 4:30.	14
Walks, bikes, or drives themselves.	12
I/My child does not participate in after school activities.	24
Other (please specify):	11
Total	118

Usage frequency of proposed GMT stops



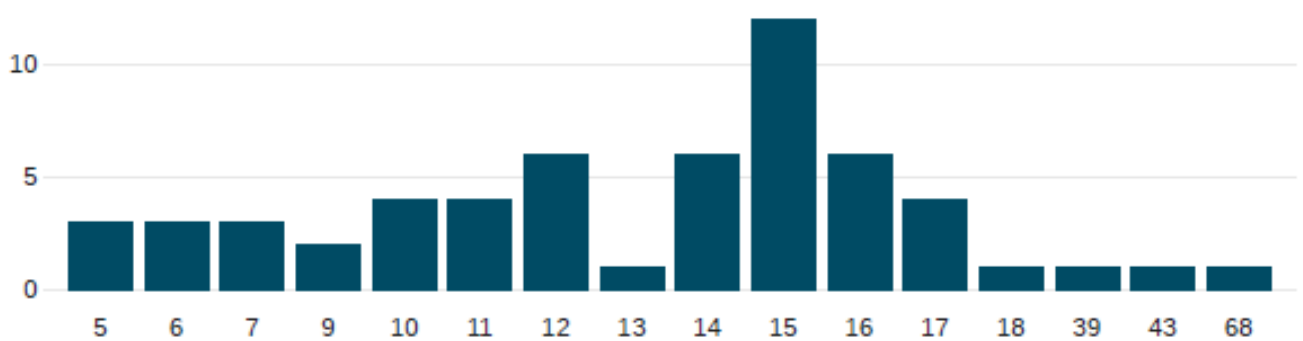
Field	2x per week or more	Once a week	A few times a month	Rarely or never
Richmond Park & Ride	18	12	17	68
Richmond Village	21	14	25	55
Camel's Hump Middle School	15	3	12	85
Mount Mansfield Union HS	19	7	14	75
Rt. 15 & Browns Trace Rd.	6	5	12	92
Cambridge Park & Ride	2	1	5	107
VYCC Barn on Rt. 2	3	4	11	97
A stop in Bolton	9	4	15	87

Would adding stops aid in after school activity participation?

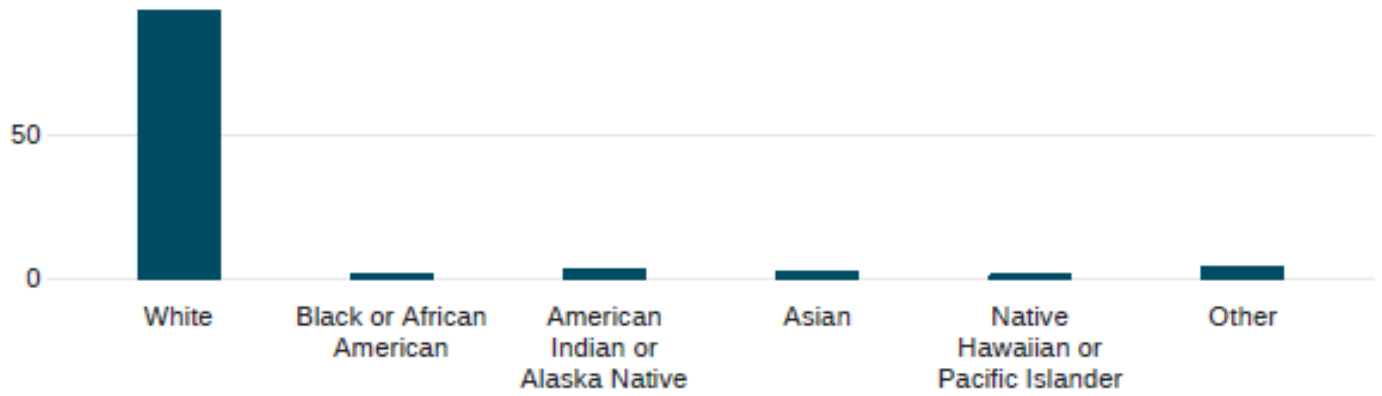
Field	Choice Count
Yes	25
No	44

Demographic Information

Count of respondents' age



Racial background



Count of income bracket

