

Memorandum on the Traffic Performance of the Circ-Williston Transportation Project Alternatives Relative to the Section 404 Basic Project Purpose and Practicability

1.0 Introduction

This memorandum is written as follow-up to the June 30th interagency meetings on the Circ-Williston Transportation Project. The purpose of the memorandum is to document a summary of the results of the analyses of traffic operational performance of the alternatives. The results reflect analyses documented in the Draft Environmental Impact Statement (DEIS) and its Appendix O – Transportation Technical Report, as well as analyses conducted to support responses to comments on the DEIS.

Based on these analyses, clear conclusions can be made regarding which of the alternatives fulfill the basic project purpose and which do not. Logically, an alternative that fulfills the basic project purpose is practicable under the Section 404(b)(1) guidelines which state that an alternative is practicable if it is available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purposes. Conversely, an alternative that does not fulfill the basic project purpose is not practicable under the Section 404(b)(1) guidelines.

The traffic performance of alternatives relates to the existing technology (or technical aspects of alternatives as noted in the Corps New England District *Highway Methodology Workbook*), as well as the logistics aspects of the practicability definition.

1.1 What is the basic project purpose?

The purpose of the Circ-Williston Transportation Project is to improve access to, from, and within the project area and remedy existing and projected deficiencies including congestion, safety, and mobility issues (including the movement of both people and goods).

Key aspects of the basic project purpose are as follow:

1. Geographic scope – a project area encompassing Williston, Essex and Essex Junction;
2. Purpose – improve access to from and within the project area; and,
3. Purpose – remedy existing and projected deficiencies including congestion, safety, and mobility issues (including the movement of both people and goods).

Figure 1 shows the project area boundaries and regionally significant business centers in relation to the roadway network. These business centers include a major shopping center and airport-related commercial businesses around the Marshall Avenue/Maple Tree Place intersection with VT 2A, Burlington International Airport, the Champlain Valley Expo (a location used for major events) off of VT 15 in Essex, and IBM facilities in Essex Junction and Williston (the largest private sector employer in Vermont). VT 2A is the only north-south State Truck Route in the project area that provides access to local businesses, and provides direct access to I-89. A portion of VT 2A is designated by the

U.S. Department of Transportation as part of the National Highway System because it links I-89 with Burlington International Airport.

1.1.1 Project Area Transportation Problems

Population and employment in the project area have grown rapidly in the past three decades. This growth has led to corresponding increases in automobile and truck travel and traffic congestion. Chittenden County has been the fastest growing county in Vermont, adding 48,000 persons and 70,000 jobs between 1970 and 2000. Population and employment growth has dispersed beyond the traditional urban core of Burlington, South Burlington, and Winooski. Williston was the fastest growing municipality in Chittenden County between 1990 and 2000, growing from 4,900 to 7,700 residents and 4,600 to 9,700 jobs.

The project area is expected to continue to be one the fastest growing areas in Chittenden County over the next 20 years. Williston is expected to add over 2,900 residents and 10,500 jobs between 2000 and 2030. A large portion of the growth expected in Williston is planned for a high density zoning district at Taft Corners (VT 2A and US 2). Future population and employment growth will exacerbate existing transportation systems deficiencies, creating unacceptable levels of congestion, safety problems, and reduced mobility of people and goods.

Congestion

Under the No Build Alternative three signalized intersections along VT 2A will have unacceptable level of service (LOS) F during the AM and PM peak hours in 2030. In addition, several segments of VT 2A will experience severe congestion. Because of these congested conditions on VT 2A, many drivers will seek other, parallel routes. The nearest alternate route to VT 2A in the project area is North Williston Road, a collector route in an area designated by the Chittenden County Regional Planning Commission as rural. Traffic volumes and congestion are expected to increase substantially on North Williston Road, inconsistent with its functional classification and roadway design.

Safety

The majority of VT 2A roadway segments and intersections, including Marshall Avenue/Maple Tree Place, Industrial Avenue/Mountain View Road, and Five Corners are designated by VTrans as high crash locations because they exceed the statewide crash rates. As traffic volumes increase on VT 2A, the number of accidents occurring in these locations is expected to continue to increase. VT 2A serves both as an arterial for north-south travel between Williston, Essex and Essex Junction, but also as a collector for numerous business and residential access. Local residents have noted that it is becoming increasingly difficult to find a safe gap in the VT 2A traffic flow for vehicles coming from the numerous side streets and driveways along the corridor.

Movement of People and Goods

Future growth and traffic congestion will reduce the mobility of people and goods to, from, and within in the project area. For example, the duration of the average trip from Williston to Essex will increase by 6 minutes between 2005 and 2030, from 21 minutes to 27 minutes during the PM peak hour. Increased travel times will result increased costs for individuals and businesses, as result of lost time and fuel consumption.

1.2 What are the alternatives under consideration?

This section provides a summary overview of the alternatives evaluated in the DEIS: the No Build Alternative, the VT 2A Alternatives, Circ A/B Alternatives, and Hybrid Alternatives. For information regarding other alternatives that were considered, but rejected during the alternatives screening process, refer to Chapter 3 of the DEIS and the Alternatives Screening Technical Report.

1.2.1 No Build Alternative

The future condition without the proposed project is called the No Build Alternative. Analysis of the No Build Alternative and is used as a baseline for the evaluation of the effects of the Build Alternatives. A future No Build year of 2030 was used for all transportation analyses because it coincides with the next scheduled update of the Chittenden County Metropolitan Planning Organization's *2025 Metropolitan Transportation Plan* (MTP). The No Build Alternative includes most of the expected improvements in the VT 2A and Circ A/B corridors, as well as other transportation and non-transportation projects in Chittenden County.

1.2.2 VT 2A Alternatives

Existing Roadway Layout of VT 2A

In order to understand the VT 2A alternatives, it is helpful to understand the current roadway layout of VT 2A. From I-89 to US 2 in Williston, VT 2A is generally four-lanes, with additional turning lanes at intersections. The remainder of VT 2A from US 2 to Five Corners in Essex Junction is generally two-lanes, with additional turning lanes at intersections. All major intersections on VT 2A are signalized intersections. VT 2A crosses the Winooski River on a two-lane bridge structure north of James Brown Drive in Williston.

Common Elements with the VT 2A Alternatives

The defining characteristic of the VT 2A alternatives is that they involve improvements to VT 2A between I-89 Exit 12 in Williston and Five Corners in Essex Junction. They all involve varying degrees of roadway widening, as well as intersection improvements.

The VT 2A alternatives would all require full reconstruction of VT 2A, including the removal of existing pavement, the placement of gravel base materials, and new pavement for the full length of the roadway. The VT 2A alternatives include completion of a continuous path along VT 2A. The existing portions of the path that have already been constructed would be maintained or relocated. The VT 2A alternatives would also include a commitment to improvements to bus waiting areas, such as better signing and the installation of benches or shelters.

Differences Between the VT 2A Alternatives

Alternative 2 would widen VT 2A to four travel lanes, with additional turning lanes and the installation of new traffic signal systems at intersections. Alternative 3 would also widen VT 2A to four travel lanes, but instead of turning lanes and new traffic signals, roundabouts would be installed at key intersections. Alternative 22 would involve tapered widening of VT 2A, with four travel lanes at the southern part of the corridor,

three lanes (two travel lanes with a continuous two-way left turn lane) in the middle segment and two travel lanes (unchanged from the existing layout) in the northernmost part of the corridor from James Brown Drive to Five Corners in Essex Junction. Alternative 22 would also involve the installation of roundabouts at six intersections, while Alternative 3 would have roundabouts at nine intersections.

Alternatives 2 and 3 would include the construction of a new pedestrian crossing structure over the Winooski River, while pedestrians would be accommodated on the existing VT 2A bridge under Alternative 22.

Alternatives 2 and 3 would eliminate approximately fifty-eight on-street parking spaces in Essex Junction. Alternative 22 would not affect parking in Essex Junction.

1.2.3 Circ A/B Alternatives

Common Elements with the Circ A/B Alternatives

The defining characteristic of the Circ A/B alternatives is the construction of a new roadway connecting I-89 in Williston to VT 289 in Essex, in the existing Circ A/B right-of-way. The Circ A/B alternatives would require the construction of a new bridge over the Winooski River and interchange ramps to connect the new roadway to the existing interchange of VT 289 and VT 117. The Circ A/B alternatives would also involve intersection improvements on VT 2A, but less extensive than the improvements proposed for the VT 2A Alternatives. These improvements are called “spot improvements”.

The Williston Alternative Transportation Path (WATP) near the Allen Brook School would be reconstructed to cross over the proposed Circ A/B roadway. Additional multi-use paths are proposed on the west side of Redmond Road and on the south side of Mountain View Road. The Circ A/B alternatives would also include a commitment to improvements to bus waiting areas, such as better signing and the installation of benches or shelters.

Differences Between the Circ A/B Alternatives

Alternative 16 is a four-lane limited access highway with grade separated interchanges, while Alternative 17 is a four-lane boulevard-type street with at grade intersections.

There are three different combinations of interchange options being evaluated for Alternative 16, referred to as Alternatives 16a, 16b and 16c, respectively. These options were evaluated to investigate the effects of including an interchange at US 2, and a different interchange design in the area of Mountain View Road and Redmond Road designed to reduce wetland impacts.

Alternative 16a would have a trumpet interchange with I-89 and with Redmond Road, but would have no connection to US 2. Alternative 16b would have the same trumpet interchanges as 16a at I-89 and Redmond Road, but it would also have a partial cloverleaf interchange at US 2. Alternative 16c would have a trumpet interchange with I-89, no connection to US 2, and a diamond interchange with Mountain View Road.

Alternative 17 (Circ A/B Boulevard) would have a diamond interchange with roundabouts at I-89, and at-grade signalized intersections with US 2 and Mountain View Road.

1.2.4 Hybrid Alternatives

Common Elements with the Hybrid Alternatives

The defining characteristic of the Hybrid Alternatives is that they combine widening and intersection improvements on VT 2A with a boulevard-type roadway in the existing Circ A right-of-way, from I-89 to Mountain View Road. This roadway in the Circ A corridor is called the “Circ Street”.

The Circ Street would have a diamond interchange with roundabouts at I-89, and at-grade intersections with US 2 and Mountain View Road. These at-grade intersections could be either signalized or roundabout intersections. The Circ Street would have four lanes with a landscaped median from I-89 to US 2, and two travel lanes from US 2 to Mountain View Road. The Circ Street would have a multi-use path on the east side of the roadway, separated by a landscaped buffer, from US 2 to Mountain View Road. The existing Williston Alternative Transportation Path (WATP) near the Allen Brook School would cross the Circ Street at-grade. The Circ Street terminates at Mountain View Road and has the same design in Alternatives 18, 19 and 23.

Differences Between the Hybrid Alternatives

In addition to a common Circ Street, Alternatives 18, 19 and 23 would involve different types of widening and intersection improvements on VT 2A. The improvements on VT 2A would be identical to those described for Alternatives 2, 3 and 22 in Section 1.2.2.

- Alternative 18 (Alternative 2 VT 2A Improvements plus Circ Street)
- Alternative 19 (Alternative 3 VT 2A Improvements plus Circ Street)
- Alternative 23 (Alternative 22 VT 2A Improvements plus Circ Street)

1.3 How do the alternatives perform in meeting the basic project purpose?

The basic project purpose includes the phrase “remedy existing and projected deficiencies including congestion, safety, and mobility issues (including the movement of both people and goods).” A remedy is “something that corrects or counteracts” (Webster’s Ninth New Collegiate Dictionary, 1991). To fulfill the basic project purpose, an alternative should serve as a remedy for (or correct or counteract) existing and projected deficiencies. Therefore, the appropriate measure of fulfilling this aspect of the basic project purpose is whether or not an alternative corrects or counteracts the identified deficiency (ies). Alternatives that correct or counteract the project area transportation deficiencies related to congestion and mobility will result in improvements in access to, from, and within the project.

1.3.1 Congestion

Intersection Congestion

One of the measures related to congestion - level-of-service (LOS) - is an Agency of Transportation Design Standard, with LOS E or better considered the standard for urban

areas. As shown in Table 1, Alternatives 2, 22, 16b, and 18 do not correct or counteract a deficient LOS condition at an intersection while the other alternatives do.¹

Operational issues with the roundabouts included as part of Alternatives 3, 22, 19, and 23 result in congested conditions that would degrade access to VT 2A from the project area business centers. These issues do not occur for the other alternatives that use signalized intersections at these locations.

The capacity of each entry of a roundabout is the maximum number of vehicles that can reasonably be expected to enter the roundabout from an approach during a given time period. The commonly accepted performance measure for roundabouts is a volume to capacity ratio of 0.85 or less for the critical approach (FHWA Roundabouts: An Informational Guide). If the critical approach becomes congested, the function of the roundabout will degrade, even though the overall or “average” level of service of the entire roundabout may appear to be acceptable. As shown in Tables 2 and 3, several of the roundabouts in Alternatives 3, 22, 19, and 23 have critical approaches with volume to capacity ratios substantially greater than 0.85. This problem is particularly severe for Alternatives 3 and 19. Under Alternatives 3 and 19 in the PM peak period, volume to capacity ratios substantially exceed 0.85 at the following locations that are vital to the accessibility of project area business centers:

- **VT 2A and Marshall Avenue/Maple Tree Place-** access to regional shopping center and other commercial areas.
- **VT 2A and Industrial Avenue/Mountain View Road-** access to commercial and industrial areas west of VT 2A
- **VT 2A and South Street/River Street-** access to IBM
- **VT 2A and Five Corners-** access to Essex Junction businesses and Champlain Valley Expo

Roadway Segment Congestion

Another measure related to congestion - volume-to-capacity (v/c) ratio - is used to assess congestion on roadway segments between intersections. It has been determined that a v/c ratio of 1.32 indicates a severely congested roadway segment in Chittenden County based on data from the Chittenden County Metropolitan Planning Organization’s travel demand model (approximates the LOS E-F threshold) and field observations. As shown in Tables 4 and 5, Alternatives 2, 22 and 23 do not correct or counteract one or more a severely congested roadway segments while the other alternatives do.

Because of congestion on the primary north-south road in the project area - VT 2A - traffic seeks other routes including town roads such as North Williston Road. In the No Build Condition, North Williston Road would experience restricted flow, but not severely

¹ Note that Table 1 shows LOS for the intersections as a whole, which is essentially an average of the delay at each approach to the intersection. For roundabouts, this indicator may mask the unacceptable performance of one or more approaches where capacity is exceeded. For this reason NCHRP Report 572: Roundabouts in the United States recommends that LOS should not be defined for the intersection as a whole at roundabouts. Tables 2 and 3 provide information on roundabout critical approach delays that needs to be considered in evaluating the ability of the alternatives to remedy congested conditions. Alternatives 3 and 19 in particular have approach delay issues that are not reflected in the overall intersection LOS results.

congested flow. Under Alternative 23, congestion on North Williston Road would deteriorate to severely congested conditions and, therefore, would create a deficient condition (See Table 6).

VT 2A Side Street Delays

Access to VT 2A from side streets and driveways is an existing congestion problem that is very important to local residents. One of the consequences of alternatives that increase capacity and traffic volumes on VT 2A is that it becomes much more difficult for drivers from the numerous side streets and driveways along VT 2A to find safe gaps in the traffic flow. The Circ A/B Alternatives generally reduce side street delays by reducing traffic volumes on VT 2A. Alternative 16b would reduce delays at all of the analyzed VT 2A side streets (See Tables 7 and 8). Alternative 16a and 17 would increase delay at one side street in the PM peak. Alternative 16c would increase delay at one side street in the AM peak and one side street in the PM peak. Considering the totality of the results and the isolated and minor nature of these increases (36 percent or less change in delay), Alternatives 16a, 16c, and 17 do meaningfully remedy the problem. Alternatives 2, 3, 22, 18, 19, and 23 cause increases in delays at two to four side streets in the AM peak and three to six side streets in the PM peak. The increases in delay under some of these alternatives are substantial, 200 to 300 plus percent increases under Alternatives 2, 3, 18, and 19 in some locations as the result of large increases in VT 2A traffic volumes with the provision of four travel lanes throughout the VT 2A corridor. The extent and magnitude of problems associated with Alternatives 2, 3, 22, 18, 19, and 23 leads to the conclusion that these alternatives do not remedy the problem of VT 2A side street congestion.

1.3.2 Safety

Safety was measured in the DEIS by estimates of the number of crashes. As shown in Table 9, Alternative 17 does not counteract the number of crashes in the project area. Alternative 17 reduces crashes at high crash locations along VT 2A, but results in a net increase of one crash over the No Build Alternative for the project area as a whole because it creates two new signalized intersections (US 2 and Mountain View Road). This situation could be corrected by installing a diamond interchange instead of signalized intersection at Mountain View Road (as in Alternative 16c).

The extensive VT 2A side street delays created by the VT 2A and Hybrid Alternatives discussed in Section 1.3.1 contribute to a safety problem not accounted for in the quantitative crash analysis methodology. This is because increased delays is likely to result in drivers taking greater risks to turn onto VT 2A. There is no reliable quantitative method available to estimate the number of crashes attributable to increased side street delays; however the issue does need to be qualitatively considered in evaluating the safety performance of the alternatives. The potential safety risk is greatest under Alternatives 2, 3, 18 and 19 which have the highest VT 2A traffic volumes and longest side street delays. According to the 2000 Highway Capacity Manual chapter on unsignalized intersections:

“LOS F occurs when there are not enough gaps of a suitable size to allow a minor street demand to safely cross through traffic on the major street. This is typically evident from extremely long control delays experienced by minor-street traffic and queuing on the minor approaches.....LOS F may also may also appear in the form of drivers on the

minor street selecting smaller than usual gaps. In such cases, safety may be a problem, and some disruption to the major traffic stream may result.” (page 17-26).

1.3.3 Movement of People and Goods

Travel Times

The movement of people and goods within the project area is measured by estimates of travel times and speeds between the project area communities. The movement of people and goods is negatively affected by roadway congestion. As noted in the FHWA publication *Trends and Advanced Strategies for Congestion Mitigation* (2005), “One of the key principles that the FHWA has promoted is that the measures used to track congestion should be based on the travel time experienced by users of the highway system. While the transportation profession has used many other types of measures to track congestion (such as “level of service”), travel time is a more direct measure of how congestion affects users.”

Travel times for project area communities have increased in recent years as measured by the U.S. Census Bureau Journey to Work statistics. Between 1990 and 2000, for example, the mean journey to work for Essex residents (including Essex Junction) increased 2 minutes, while for Williston residents the increase was 3.9 minutes. The Census Bureau data suggests that a 2-4 minute reduction in travel time is necessary for an alternative to counteract deterioration in the movement of people and goods. As indicated by Tables 10 and 11, Alternatives 22 and 23 do not counteract the deterioration in the movement of people and goods while the other alternatives do.

It is important to note that the mobility analysis is based on the weighted average travel times for all trips with origins or destinations in Essex, Essex Junction, or Williston. While a savings of two to four minutes may not sound large, when this savings is multiplied by thousands of trips over many years, the time and vehicle operating cost savings are substantial. For example, Alternative 17 would result in a travel time savings of 3.67 minutes over the No Build Alternative for trips from Essex to Williston in the AM peak hour. Approximately 480 trips originating in Essex with a destination in Williston occur each day during the 2030 AM peak hour, so the total time savings per day is 1,761.6 minutes or 29.36 hours. Assuming approximately 260 weekdays in a year, the total AM peak hour travel time savings over one year would be 7,633.6 vehicle operating hours. This does not include PM peak hour travel time savings, off-peak travel time savings, and travel time savings for other trips through the project area that do not have an origin in Essex and a destination in Williston. In evaluating the mobility analysis results, it is also important to consider the length of distance of the weighted average trip. For the Essex to Williston AM peak hour, the weighted average trip distance is 6.6 to 7 miles, depending on the alternative. The relatively short distance of the typical trip further supports the conclusion that a savings of 2 to 4 minutes is a substantial change.

Other Roadways (VT 15 and VT 117)

The VT 15 corridor is a key east-west regional highway for the movement of people and goods between residential areas in Essex and Jericho and the major employment centers in the project area. The importance of the VT 15 corridor is highlighted by the Chittenden County Metropolitan Planning Organization’s VT 15 Corridor Study, which identifies the segment of VT 15 immediately east of Five Corners as one of the most congested areas of the entire corridor. As shown in Table 12, Alternatives 2, 3, 22, 18,

19 and 23 would worsen congestion and increase traffic volumes on portions of VT 15 in Essex Junction, while the other alternatives would reduce congestion and traffic volumes in these areas.

The VT 117 corridor is an important route for access to, from, and within the project area between I-89 Exit 11 and Five Corners, particularly for residents of Richmond, Jericho, and Essex. VT 117 runs parallel to the Winooski River, and intersects with the two crossings of the Winooski River in the project area- VT 2A and North Williston Road. As shown in Table 13, Alternatives 2, 3, 22, 18, 19 and 23 would worsen congestion and increase traffic volumes on portions of VT 117 in Essex Junction, Essex, and Jericho, while the other alternatives would reduce congestion and traffic volumes in these areas.

1.3.4 Conclusions Regarding the Ability of Alternatives to Meet the Basic Project Purpose

Based on the above summary and accompanying tables, the following alternatives do not remedy one or more existing and projected deficiencies because they do not correct or counteract an unacceptable condition: No Build, 2, 3, 22, 16b, 17, 18, 19, and 23. Because these alternatives do not remedy the deficiencies, they are not practicable under the 404(b) (1) guidelines.

The remaining alternatives (Alternatives 16a and 16c) do correct or counteract all of the identified deficiencies and improve access to, from and within the project area.

1.4 What design issues affect the practicability of the alternatives?

In addition to the transportation performance assessment, design issues need to be considered in the practicability determination. Two key design issues are the feasibility of a five-legged roundabout at Five Corners and a two-way left-turn lane on VT 2A.

1.4.1 Five Corners Roundabout

Alternatives 3, 22, 19, and 23 include a two-lane, five-legged roundabout at the Five Corners intersection in Essex Junction. According to the FHWA roundabout guide, it is not desirable for double-lane roundabouts to have more than four legs or entries different from 90 degrees: "Double-lane roundabouts with legs aligned at approximately 90-degree angles allow motorists to determine the appropriate lane choice for their path through the roundabout in a relatively easy manner. Double-lane roundabouts with more than four legs and/or with legs aligned at angles significantly different from 90 degrees make driver decisions more complicated. This occurs because it can be difficult on some legs to determine which movements are left, through, and right. For this reason, it is desirable that multilane roundabouts be limited to a maximum of four legs, with legs aligned at approximately 90-degree angles. If this is not possible, special advance guide signs showing appropriate lane choice should be considered."

1.4.2 VT 2A Two-Way Left Turn Lane

Alternatives 22 and 23 would add a two-way left turn lane to VT 2A between Blair Park Road at a point immediately north of James Brown Drive in Williston. Among other considerations, two-way left turn lanes are effective and appropriate for urban arterials with commercial development, low to moderate through volumes, and high left-turn volumes (See NCHRP Report 282: Multilane Design Alternatives for Improving Existing Highways, and NCHRP Report 395: Capacity and Operational Effects of Mid-Block Left-Turn Lanes). The traffic conditions in this segment do not warrant a two-way left turn lane because the proportion of through traffic on this section is high (e.g. approximately 95 percent at River Cove Road and James Brown Drive), and left-turn volumes low (approximately 5 percent at these two intersections).

1.4.3 Conclusions Regarding Design Issues


The design issues related to a roundabout at Five Corners under Alternative 3, 22, 19, and 23 potentially could be mitigated with special measures (e.g. guide signs on lane choice, pavement markings, and/or mountable curbs between lanes), but still present a real logistical problem for these alternatives that is avoided by other alternatives. The design assessment also shows that the two-way left turn lane component of Alternatives 22 and 23 is not appropriate from a technical perspective.

1.5 Conclusion

Table 14 summarizes the transportation assessment conclusions discussed in Sections 3.2 and 3.3. Alternatives 16a and 16c are the only alternatives that remedy existing and projected deficiencies and improve access to, from, and within the project area. Therefore, Alternatives 16a and 16c are the only alternatives that are practicable in terms of technical aspects and logistics in light of the overall project purpose. The other alternatives either do not remedy congestion, safety or movement of people and goods deficiencies and/or worsen access to, from, and within the project area. Alternatives 3, 22, 19, and 23 have design issues related to having a roundabout at Five Corners and/or a two-way left turn lane on VT 2A that further support the conclusion of the transportation assessment that these alternatives are not practicable. From a transportation corridor planning perspective, Alternatives 2, 3, 22, 16b, 17, 18, 19, and 23 have traffic operational problems that render them ineffective in fulfilling the basic project purpose of the Circ-Williston Transportation Project and, hence, they are not practicable.

Table 1
Effect on VT 2A Intersections with Unacceptable Level of Service

	AM Peak Hour			PM Peak Hour		
	Industrial Avenue / Mountain View Road	South Street / River Street	Five Corners	Marshall Avenue / Maple Tree Place	Industrial Avenue / Mountain View Road	Five Corners
Existing (2005)	D	F	F	D	E	E
No Build (2030)	F-	F-	F-	F	F-	F
Alternative 2	E	D	F	D	D	F
Alternative 3	B	B	B	E	D	D
Alternative 22	B	E	B	F	B	B
Alternative 16a	E	D	E	D	E	E
Alternative 16b	D	C	E	D	D	F
Alternative 16c	D	D	E	D	D	E
Alternative 17	D	D	E	D	D	E
Alternative 18	D	D	F	D	D	E
Alternative 19	A	B	B	D	E	C
Alternative 23	A	E	B	E	B	B

 Does not remedy unacceptable Level of Service

Notes:

Per VTrans Design Standards, LOS E or better is acceptable for urban and village areas.

**Table 2
Roundabout Critical Approach Volume to Capacity (V/C) Ratios
AM Peak (2030)**

VT 2A Intersection	Alternative 3				Alternative 22				Alternative 19				Alternative 23			
	Movement	V/C	Delay (Minutes)	Back up (cars)*	Movement	V/C	Delay (Minutes)	Back up (cars)*	Movement	V/C	Delay (Minutes)	Back up (cars)*	Movement	V/C	Delay (Minutes)	Back up (cars)*
I-89 Exit 12 SB Ramps	Ramp EB Left	0.78	0.3	9	Ramp EB Left	0.81	0.3	10	Ramp EB Thru	1.00	0.3	19	Ramp EB Thru	0.75	0.2	6
I-89 Exit 12 NB Ramps	VT 2A NB Left	0.58	0.2	0	VT 2A NB Left	0.62	0.2	0	Ramp WB Left	0.56	0.3	4	Ramp WB Left	0.57	0.4	4
Marshall Avenue/Maple Tree Place	VT 2A SB Right	1.01	1.0	24	Maple Tree Place WB Left	1.06	1.4	18	VT 2A NB Left	0.83	0.3	14	VT 2A NB Left	0.86	0.3	16
Wright Street/Conner Way	VT 2A NB Left	0.39	0.2	3	N/A	N/A	N/A	N/A	VT 2A NB Left	0.33	0.2	2	N/A	N/A	N/A	N/A
US 2	VT 2A NB Left	0.94	0.7	14	US 2 WB Right	1.03	0.8	24	VT 2A SB Right	0.98	0.4	11	US 2 WB Right	0.84	0.3	10
Industrial Avenue/Mountain View Road	VT 2A SB Left	0.79	0.4	12	Mountain View Road WB Left	0.84	0.4	11	VT 2A SB Left	0.64	0.3	7	Mountain View Road WB Left	0.86	0.3	5
South Street/River Road	South Street EB Left	0.85	0.5	8	N/A	N/A	N/A	N/A	South Street EB Left	0.85	0.5	8	N/A	N/A	N/A	N/A
Five Corners	VT 15 Pearl Street EB Thru	0.87	0.5	12	VT 15 Pearl Street EB Thru	0.61	0.2	5	VT 15 Pearl Street EB Thru	0.88	0.6	12	VT 15 Pearl Street EB Thru	0.6	0.2	5

Notes:



V/C ratio exceeds 0.85.

Per FHWA's publication Roundabouts: An Informational Guide, the function of the roundabout begins to break down when the V/C ratio of the critical approach exceeds 0.85

NB= northbound

SB= southbound

EB=

eastbound

WB= westbound

Delay= Average delay per vehicle in minutes

*95th percentile queue length in passenger car equivalents (PCE). Average PCE = 25 feet

**Table 3
Roundabout Critical Approach Volume to Capacity (V/C) Ratios
PM Peak (2030)**

VT 2A Intersection	Alternative 3				Alternative 22				Alternative 19				Alternative 23			
	Movement	V/C	Delay (Minutes)	Back up (cars)*	Movement	V/C	Delay (Minutes)	Back up (cars)*	Movement	V/C	Delay (Minutes)	Back up (cars)*	Movement	V/C	Delay (Minutes)	Back up (cars)*
I-89 Exit 12 SB Ramps	Ramp EB Thru	0.67	0.2	5	Ramp EB Thru	0.67	0.2	5	VT 2A NB Right	0.85	0.9	15	VT 2A NB Right	0.61	0.4	6
I-89 Exit 12 NB Ramps	VT 2A SB Right	0.78	0.1	10	VT 2A SB Right	0.87	0.2	15	VT 2A SB Right	0.8	0.2	12	VT 2A SB Right	0.89	0.2	18
Marshall Avenue/Maple Tree Place	Marshall Avenue EB Right	1.37	3.1	72	Marshall Avenue EB Right	1.64	5.1	104	Marshall Avenue EB Right	1.24	2.1	62	Marshall Avenue EB Right	1.5	4.0	101
Wright Street/Conner Way	VT 2A SB Thru	0.51	0.1	4	N/A	N/A	N/A	N/A	VT 2A SB Left	0.39	0.2	3	N/A	N/A	N/A	N/A
US 2	US 2 WB Right	0.88	0.3	12	US 2 EB Left	0.94	0.6	15	US 2 EB Left	0.76	0.3	7	US 2 EB Left	0.82	0.3	9
Industrial Avenue/Mountain View Road	VT 2A NB Left	1.24	2.2	49	VT 2A NB Right	0.79	0.2	8	VT 2A NB Right	1.32	2.7	63	VT 2A NB Left	0.69	0.3	6
South Street/River Road	River Road WB Thru	1.37	3.3	52	N/A	N/A	N/A	N/A	River Road WB Left	1.21	2.3	35	N/A	N/A	N/A	N/A
Five Corners	VT 2A NB Left	1.1	1.2	43	VT 15 Pearl Street EB Thru	0.81	0.3	10	VT 2A NB Right	1.09	1.0	43	VT 15 Pearl Street EB Thru	0.82	0.3	10

 V/C ratio exceeds 0.85

Notes:

Per FHWA's publication Roundabouts: An Informational Guide, the function of the roundabout begins to break down when the V/C ratio of the critical approach exceeds 0.85

NB= northbound
SB= southbound
EB= eastbound
WB= westbound

Delay= Average delay per vehicle in minutes
*95th percentile queue length in passenger car equivalents (PCE). Average PCE = 25 feet

Table 4
Effect on VT 2A Roadway Segments with Restricted Flow or Severe Congestion
AM Peak Hour


ALTERNATIVE	Northbound VT 2A				Southbound VT 2A			
	I-89 to Marshall Avenue / Maple Tree Place (0.35 miles)		Marshall Avenue / Maple Tree Place to US 2 (0.36 miles)		Five Corners to South Street / River Street (0.36 miles)		South Street / River Street to Industrial Avenue / Mountain View Road (1.49 miles)	
	V/C	Volumes	V/C	Volumes	V/C	Volumes	V/C	Volumes
Existing (2005)	0.74	1142	0.97	621	1.01	809	1.22	962
No Build (2030)	1.17	1704	1.01	781	1.16	1023	1.51	1354
Alternative 2	1.19	1740	0.72	1038	0.98	1560	1.21	1930
Alternative 3	1.14	1659	0.63	893	0.95	1511	1.18	1887
Alternative 22	1.04	1817	0.60	1016	1.17	1025	1.51	1354
Alternative 16A	1.12	1627	0.94	715	0.99	874	1.30	1157
Alternative 16B	1.05	1513	0.97	740	0.98	856	1.27	1137
Alternative 16C	1.10	1596	0.94	718	1.00	877	1.29	1149
Alternative 17	1.06	1527	0.97	745	0.99	870	1.29	1154
Alternative 18	1.08	1597	0.62	890	0.99	1579	1.21	1954
Alternative 19	1.04	1518	0.57	814	0.96	1528	1.19	1907
Alternative 23	0.94	1609	0.52	855	1.17	1033	1.52	1364
	Does not remedy severely congested segment conditions							

Notes:

A V/C ratio of 1.00 represents conditions where traffic flow becomes restricted and travel speed is reduced by increasing volumes based on data from the CCMPO travel demand model. A V/C ratio of 1.32 approximates conditions where traffic flow becomes unstable and severe congestion is experienced by motorists (roughly equivalent to LOS F).

**Table 5
Effect on VT 2A Roadway Segments Restricted Flow or Severe Congestion
PM Peak Hour**

	Northbound VT 2A						Southbound VT 2A			
	US 2 to Industrial Avenue / Mountain View Road (1.08 miles)		Industrial Avenue / Mountain View Road to South Street / River Street (1.49 miles)		South Street / River Street to Five Corners (0.36 miles)		South Street / River Street to Industrial Avenue / Mountain View Road (1.49 miles)		Marshall Avenue / Maple Tree Place to I-89 (0.35 miles)	
	V/C	Volumes	V/C	Volumes	V/C	Volumes	V/C	Volumes	V/C	Volumes
Existing (2005)	0.81	625	1.33	984	1.11	862	1.03	883	0.95	1330
No Build (2030)	1.06	913	1.61	1284	1.16	1036	1.07	950	1.32	1793
Alternative 2	0.84	1304	1.29	1906	1.06	1697	0.79	1261	1.36	1868
Alternative 3	0.81	1256	1.25	1843	1.01	1614	0.74	1181	1.31	1771
Alternative 22	1.05	903	1.61	1287	1.17	1046	1.09	967	1.19	1954
Alternative 16A	1.08	919	1.41	1097	1.03	901	0.93	820	1.26	1698
Alternative 16B	1.03	874	1.39	1081	1.04	906	0.90	789	1.22	1626
Alternative 16C	1.01	854	1.42	1111	1.06	922	0.90	784	1.28	1721
Alternative 17	1.02	869	1.43	1116	1.04	927	0.94	824	1.30	1747
Alternative 18	0.79	1223	1.30	1932	1.06	1701	0.80	1270	1.25	1693
Alternative 19	0.77	1177	1.27	1878	1.01	1619	0.75	1196	1.22	1633
Alternative 23	1.01	851	1.64	1304	1.17	1047	1.09	968	1.12	1812


 Does not remedy severely congested segment conditions

Notes:

A V/C ratio of 1.00 represents conditions where traffic flow becomes restricted and travel speed is reduced by increasing volumes based on data from the CCMPO travel demand model. A V/C ratio of 1.32 approximates conditions where traffic flow becomes unstable and severe congestion is experienced by motorists (roughly equivalent to LOS F).

Table 6
Effect on North Williston Road Segments Restricted Flow or Severe Congestion

	AM Peak		PM Peak	
	Southbound North Williston Road (VT 117 to Mountain View Road / Governor Chittenden Road) (2.13 miles)		Northbound North Williston Road (Mountain View Road / Governor Chittenden Road to VT 117) (2.13 miles)	
	V/C	Volumes	V/C	Volumes
Existing (2005)	0.90	583	0.88	497
No Build (2030)	1.24	820	1.26	754
Alternative 2	1.03	691	1.07	632
Alternative 3	1.05	703	1.07	635
Alternative 22	1.24	819	1.25	752
Alternative 16A	0.54	399	0.57	342
Alternative 16B	0.48	361	0.49	292
Alternative 16C	0.36	282	0.44	277
Alternative 17	0.44	346	0.40	251
Alternative 18	1.14	749	1.10	641
Alternative 19	1.15	755	1.10	644
Alternative 23	1.33	867	1.28	766

 Creates severely congested flow conditions

Notes:

A V/C ratio of 1.00 represents conditions where traffic flow becomes restricted and travel speed is reduced by increasing volumes based on data from the CCMPO travel demand model. A V/C ratio of 1.32 approximates conditions where traffic flow becomes unstable and severe congestion is experienced by motorists (roughly equivalent to LOS F).

Table 7
Change in Delays on Side Streets at Intersections with VT 2A, AM Peak

		Helena Drive	Helena Drive	Knight Lane	Meadow Run Rd	Meadow Run Rd	Hickory Hill Rd	River Cove Rd	James Brown Dr	Cascade St
		EB	WB	WB	EB	WB	EB	EB	EB	EB
Existing (2005)	Delay (minutes)	0.8	1.5	0.4	0.3	0.4	0.4	0.5	0.9	0.9
	Volume	(9)	(33)	(35)	(18)	(27)	(10)	(11)	(14)	(22)
No Build (2030)	Delay (minutes)	1.1	2.5	0.7	1.1	1.6	1.1	4.3	2.4	3.1
	Volume	(10)	(37)	(48)	(22)	(52)	(15)	(18)	(15)	(27)
Alt 2	Change in Delay from No Build	-44%	-62%	-16%	-39%	-68%	-44%	299%	319%	389%
	Volume	(10)	(37)	(48)	(22)	(54)	(15)	(7)	(15)	(27)
Alt 3	Change in Delay from No Build	-56%	-74%	-25%	-37%	-57%	-47%	215%	285%	274%
	Volume	(10)	(37)	(46)	(24)	(53)	(15)	(9)	(15)	(27)
Alt 22	Change in Delay from No Build	-62%	-73%	7%	-51%	-63%	-51%	3%	2%	3%
	Volume	(10)	(37)	(48)	(22)	(52)	(15)	(18)	(15)	(27)
Alt 16a	Change in Delay from No Build	-38%	-57%	-30%	-5%	-49%	-24%	-47%	-49%	-62%
	Volume	(12)	(37)	(52)	(20)	(48)	(15)	(16)	(16)	(22)
Alt 16b	Change in Delay from No Build	-41%	-56%	-45%	-46%	-71%	-48%	-69%	-56%	-63%
	Volume	(10)	(37)	(48)	(22)	(49)	(17)	(7)	(15)	(28)
Alt 16c	Change in Delay from No Build	-41%	-56%	-26%	36%	-52%	-23%	-59%	-52%	-60%
	Volume	(10)	(37)	(48)	(22)	(42)	(15)	(13)	(15)	(27)
Alt 17	Change in Delay from No Build	-29%	-34%	-22%	3%	-29%	-23%	-64%	-52%	-58%
	Volume	(10)	(36)	(48)	(20)	(45)	(15)	(10)	(15)	(27)
Alt 18	Change in Delay from No Build	-50%	-66%	-27%	-40%	-82%	-40%	201%	261%	380%
	Volume	(10)	(37)	(50)	(19)	(54)	(15)	(6)	(11)	(27)
Alt 19	Change in Delay from No Build	-56%	-72%	-31%	-52%	-76%	-50%	142%	143%	302%
	Volume	(10)	(37)	(47)	(22)	(55)	(15)	(7)	(9)	(28)
Alt 23	Change in Delay from No Build	-65%	-76%	-13%	-55%	-73%	-56%	-9%	53%	13%
	Volume	(10)	(38)	(50)	(20)	(49)	(15)	(15)	(23)	(27)


 Does not remedy the deficiency.

Table 8
Change in Delays on Side Streets at Intersections with VT 2A, PM Peak

		Helena Drive	Helena Drive	Knight Lane	Meadow Run Rd	Meadow Run Rd	Hickory Hill Rd	River Cove Rd	James Brown Dr	Cascade St
		EB	WB	WB	EB	WB	EB	EB	EB	EB
Existing (2005)	Delay (minutes)	1.2	1.9	0.6	0.3	0.4	0.5	0.5	1.6	1.0
	Volume	(26)	(62)	(55)	(11)	(22)	(5)	(7)	(28)	(3)
No Build (2030)	Delay (minutes)	2.3	3.7	13.3	0.5	0.9	0.8	8.6	4.4	1.9
	Volume	(28)	(67)	(227)	(14)	(39)	(6)	(10)	(28)	(4)
Alt 2	Change in Delay from No Build	-71%	-76%	Err*	6%	6%	-50%	122%	74%	35%
	Volume	(28)	(67)	(228)	(11)	(37)	(6)	(12)	(28)	(4)
Alt 3	Change in Delay from No Build	-75%	-82%	16%	-15%	28%	-54%	72%	25%	54%
	Volume	(28)	(67)	(224)	(14)	(40)	(7)	(14)	(28)	(11)
Alt 22	Change in Delay from No Build	-77%	-87%	16%	5%	9%	-56%	20%	-4%	-6%
	Volume	(28)	(67)	(226)	(14)	(40)	(5)	(13)	(27)	(2)
Alt 16a	Change in Delay from No Build	-62%	-67%	-28%	14%	-20%	-10%	-49%	-55%	-40%
	Volume	(28)	(67)	(224)	(12)	(36)	(5)	(13)	(29)	(4)
Alt 16b	Change in Delay from No Build	-58%	-59%	-45%	-20%	-35%	-36%	-60%	-65%	-43%
	Volume	(28)	(67)	(224)	(13)	(37)	(6)	(10)	(23)	(6)
Alt 16c	Change in Delay from No Build	-66%	-72%	-30%	-19%	-25%	28%	-55%	-59%	-46%
	Volume	(28)	(67)	(224)	(11)	(36)	(9)	(12)	(28)	(1)
Alt 17	Change in Delay from No Build	-41%	-42%	-29%	-20%	-27%	-1%	-54%	-51%	-17%
	Volume	(28)	(67)	(226)	(11)	(38)	(7)	(11)	(30)	(14)
Alt 18	Change in Delay from No Build	-71%	-78%	11%	-21%	6%	123%	144%	86%	44%
	Volume	(28)	(67)	(224)	(14)	(41)	(5)	(12)	(28)	(4)
Alt 19	Change in Delay from No Build	-76%	-83%	-10%	-28%	-11%	-52%	84%	38%	17%
	Volume	(28)	(67)	(224)	(14)	(41)	(4)	(13)	(28)	(4)
Alt 23	Change in Delay from No Build	-75%	-87%	-10%	-7%	-11%	-51%	6%	11%	8%
	Volume	(28)	(68)	(228)	(14)	(40)	(6)	(10)	(28)	(4)


*Err= Delays and queue exceed software capability limits



Does not remedy the deficiency.

**Table 9
Annual Crash Analysis Results**

	VT 2A Corridor Only		Other Roadways (including the Circ A/B roadway, where applicable)		Total	
	# of Accidents	% Change (from No Build to Build)	# of Accidents	% Change (from No Build to Build)	# of Accidents	% Change (from No Build to Build)
Existing (2005)	130	-	288	-	418	-
No Build (2030)	156	-	324	-	480	-
Alt 2	135	-13.5%	328	1.2%	463	-3.5%
Alt 3	130	-16.7%	326	0.6%	456	-5.0%
Alt 22	116	-25.6%	325	0.3%	441	-8.1%
Alt 16A	135	-13.5%	330	1.9%	465	-3.1%
Alt 16B	130	-16.7%	332	2.5%	462	-3.8%
Alt 16C	134	-14.1%	329	1.5%	463	-3.5%
Alt 17	135	-13.5%	350	8.0%	485	1.0%
Alt 18	131	-16.0%	346	6.8%	477	-0.6%
Alt 19	126	-19.2%	339	4.6%	465	-3.1%
Alt 23	112	-28.2%	338	4.3%	450	-6.3%

 Does not remedy the deficiency.

**Table 10
Project Area Mobility AM Peak, Peak Direction (Southbound)**

ALTERNATIVE	Weighted Avg. Travel Time (Min.)		Change in Travel Time	
	Essex to Williston	Essex Jct to Williston	Essex to Williston	Essex Jct to Williston
Existing (2005)	18	13	-	-
No Build (2030)	22	16	-	-
Alt 2	20	14	-2 minutes	-2 minutes
Alt 3	20	14	-2 minutes	-2 minutes
Alt 22	22	16	-2 seconds	-1 second
Alt 16A	19	14	-3 minutes	-2 minutes
Alt 16B	18	14	-4 minutes	-2 minutes
Alt 16C	18	14	-4 minutes	-2 minutes
Alt 17	18	14	-4 minutes	-2 minutes
Alt 18	20	14	-2 minutes	-2 minutes
Alt 19	20	14	-2 minutes	-2 minutes
Alt 23	22	16	-4 seconds	-12 seconds
	Does not remedy the deficiency.			

Table 11
Project Area Mobility PM Peak, Peak Direction (Northbound)

ALTERNATIVE	Weighted Avg. Travel Time (Min.)		Change in Travel Time	
	Williston to Essex	Williston to Essex Jct	Williston to Essex	Williston to Essex Jct
Existing (2005)	21	15		
No Build (2030)	27	21		
Alt 2	24	17	-3 minutes	-4 minutes
Alt 3	24	17	-2 minutes	-3 minutes
Alt 22	26	21	-5 seconds	-5 seconds
Alt 16A	23	18	-4 minutes	-3 minutes
Alt 16B	22	17	-4 minutes	-4 minutes
Alt 16C	22.72	17.50	-4 minutes	-3 minutes
Alt 17	22.81	17.58	-4 minutes	-3 minutes
Alt 18	23.71	16.73	-3 minutes	-4 minutes
Alt 19	23.98	17.04	-3 minutes	-4 minutes
Alt 23	26.41	20.37	-9 seconds	-18 seconds
	Does not remedy the deficiency.			

Table 12
Effect on Congestion on VT 15

	AM Peak		PM Peak	
	VT 15 Westbound (Educational Drive to Five Corners)		VT 15 Eastbound (Five Corners to Educational Drive)	
	V/C	Volumes	V/C	Volumes
Existing (2005)	0.95	442	0.75	641
No Build (2030)	0.97	531	0.77	740
Alt 2	1.08	602	0.90	862
Alt 3	1.06	634	0.88	840
Alt 22	1.00	556	0.79	759
Alt 16a	0.84	340	0.71	702
Alt 16b	0.84	330	0.72	699
Alt 16c	0.86	343	0.73	706
Alt 17	0.84	357	0.72	691
Alt 18	1.08	662	0.90	863
Alt 19	1.06	637	0.88	846
Alt 23	0.98	539	0.80	768



 Does not improve access or creates a worsened condition.

Table 13
Effect on Congestion on VT 117

	AM Peak				PM Peak			
	VT 117 Westbound (East Street to Five Corners)		VT 117 Westbound (IBM Entrance to Valleyview Drive)		VT 117 Eastbound (East Street to Five Corners)		VT 117 Eastbound (IBM Entrance to Valleyview Drive)	
	V/C	Volumes	V/C	Volumes	V/C	Volumes	V/C	Volumes
Existing (2005)	0.79	502	0.82	769	0.82	385	0.84	618
No Build (2030)	0.96	614	0.90	847	1.00	492	0.93	679
Alt 2	1.09	725	0.95	886	1.08	559	0.91	660
Alt 3	1.07	707	0.94	880	1.06	541	0.93	676
Alt 22	0.97	627	0.91	852	1.00	492	0.93	676
Alt 16a	0.81	504	0.69	815	0.83	351	0.73	548
Alt 16b	0.82	503	0.72	716	0.83	400	0.74	564
Alt 16c	0.83	515	0.74	732	0.86	366	0.77	582
Alt 17	0.82	501	0.71	691	0.86	381	0.75	567
Alt 18	1.09	727	0.93	875	1.10	570	0.91	666
Alt 19	1.07	704	0.93	872	1.06	539	0.91	663
Alt 23	0.99	640	0.88	833	1.01	500	0.92	672

 Does not improve access or creates a worsened condition.

**Table 14
Traffic Performance of the Alternatives**

	Remedies Congestion?			Remedies Safety in Project Area?	Remedies Mobility between Essex and Williston?	Roundabout Critical Approach Substantially Exceeded?
	At VT 2A Intersections?	On VT 2A and North Williston Road Segments?	On VT 2A Side Streets?			
No Build (2030)	No	No	No	No	No	N/A
Alternative 2	No	Yes	No	Yes	Yes	N/A
Alternative 3	Yes	Yes	No	Yes	Yes	Yes
Alternative 22	No	No	No	Yes	No	Yes
Alternative 16a	Yes	Yes	Yes	Yes	Yes	N/A
Alternative 16b	No	Yes	Yes	Yes	Yes	N/A
Alternative 16c	Yes	Yes	Yes	Yes	Yes	N/A
Alternative 17	Yes	Yes	Yes	No	Yes	N/A
Alternative 18	No	Yes	No	Yes	Yes	N/A
Alternative 19	Yes	Yes	No	Yes	Yes	Yes
Alternative 23	Yes	No	No	Yes	No	Yes



Does not remedy the deficiency or improve access.