

Final Report

Intersection Improvements

Route 7A and Route 313/Church Street Arlington



Route 11/30 and East Manchester Road Manchester



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September, 2001

Executive Summary

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Engineered Solutions, Inc. and North Woods Engineering were contracted by the Bennington County Regional Commission to provide preliminary engineering, alternatives analysis and public involvement for improvements to the intersections of Vermont 7A and 313 West in Arlington and Vermont 11/30 and East Manchester Road in Manchester.

Both of the intersections involved in this project are relatively high profile locations, frequented by not only local vehicular traffic, but also by tourists, bicyclists and pedestrians. Therefore, during the development of this project we attempted to balance the needs of the local communities to efficiently convey vehicular traffic with the needs of the non-vehicular and tourist users for a safe and predictable intersection.

Design Approach

The designs of public highway intersections often need to balance a wide variety of divergent goals. The following Intersection Design Goals were considered: A) Reduction of conflict points; B) Reduction of the severity of potential conflicts; C) User comfort; D) User convenience/efficiency and E) Consistency with the surrounding land uses. Four Design Element categories are combined and balanced to ensure that the intersection best serves the needs of the public and address the Intersection Design Goals: A) Human Factors; B) Traffic Volumes; C) Physical Limitations; D) Economics.

Arlington

The intersection of Vermont 313 West with Vermont 7A in Arlington plays an important role in both the transportation system of the region and character of the Village. Although the adjacent intersection of Church Street and the central island contribute to the character of the intersection and Village they also deter from its general functionality and safety for the public at large.

By addressing the flow within the intersection of Vermont 7A and 313 West and improving the function of the adjacent intersection of Church Street, long-term safety, reliability and aesthetic character can be maintained or even improved. A variety of alternatives were developed to address the alignment of the intersection and accessory alternatives were developed to address peripheral, but significant issues such as access to Church Street, pedestrians, etc.

Of these alternatives, Alternative C in combination with Accessory B provide a predictable traffic flow through the area and generate a large expanse of green space that can be utilized for public gardens or other community use such the character of the area can be preserved.



Manchester

The intersection of East Manchester Road and Vermont 11/30 was significantly modified in the early 1940's when Vermont 11/30 was realigned to establish the existing curve. After this improvement, the entrance to East Manchester Road and the intersection Rootville Road were left more or less in their pre-existing locations. Based on the traffic volumes of that day, this was a reasonable approach.

However, Manchester and the surrounding area are now significant generators of traffic and the deficiencies in the function of this intersection are becoming evident. Between the unnecessary number of conflict point, the sight distance limitations and the traffic volume expecting to utilize East Manchester Road, the safety at the intersection has been compromised.

As with Arlington, a variety of alternatives were developed. Of these, Alternative C effectively addresses the noted functional deficiencies of the intersection and also improves the character of the immediate area. Again, the amount of green space created by this design is significant providing the opportunity for public use as well as provide screening from adjacent residential properties.



Although the most costly alternative, the total cost is relatively modest with respect to the significance of the improvement garnered. Thus, Alternative C represents the best value of all of the alternatives investigated.

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Appendix A	Arlington Design Alternatives Alternative Drawings Evaluation Matrix Cost Estimates Traffic Analysis
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1.0 Introduction

Engineered Solutions, Inc. (ESI) and North Woods Engineering (NWE) were contracted by the Bennington County Regional Commission (BCRC) to provide preliminary engineering, alternatives analysis and public involvement for improvements to the intersections of Vermont 7A and 313 West in Arlington and Vermont 11/30 and East Manchester Road in Manchester. The following report summarizes the approach, analysis and conclusions of this project.

Both of the intersections involved in this project are relatively high profile locations, frequented by not only local vehicular traffic, but also by tourists, bicyclists and pedestrians. Therefore, during the development of this project we attempted to balance the needs of the local communities to efficiently convey vehicular traffic with the needs of the non-vehicular and tourist users for a safe and predictable intersection.

2.0 General Design Philosophy

To provide an explanation of the approach taken in the development of this project the following sections describe the diverse goals of the design process. The designs of public highway intersections often need to balance a wide variety of divergent goals. These goals are referred to as Intersection Design Goals by the American Association of State Highway Transportation Officials (AASHTO) and are categorized as follows:

- A) Reduction of conflict points;
- B) Reduction of the severity of potential conflicts;
- C) User comfort;
- D) User convenience/efficiency and
- E) Consistency with the surrounding land uses.

To address these goals, various Design Elements are considered, compared and balanced to ensure that the intersection best serves the needs of the public. Four Design Element categories effectively combine to address the Intersection Design Goals:

- A) Human Factors
- B) Traffic Volumes
- C) Physical Limitations
- D) Economics

Sections 2.1 - 2.4 describe how the Design Elements address the Design Goals. These general principles were used in the analysis and design of the intersections in Arlington and Manchester. Section 2.5 describes the approach taken during the execution of this project to obtain input from the local and regional community. Information gathered from the public served to guide and direct the alternatives analysis towards reasonable solutions to real user concerns.

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2.1 Human Factors

The most important function of an intersection is to provide a safe and efficient interchange between its various users (cars, busses, trucks, bicycles, pedestrians, etc). Because each of these users approaches the intersection independently, appropriate design considerations need to be made to ensure that the intersection is predictable such that each user can accurately anticipate the behavior of the others in the intersection. Traffic flow and control must be standard and simple, thus minimizing user decision-making and maximizing the amount of attention paid to negotiating the interchange.

Intersections of transportation systems also serve as defining points of a community. In fact, many communities exist solely due to the fact that they are (or have been) crossroads of transportation systems (ports, railroad junctions, etc.) Therefore, they must not only provide efficient traffic flow but also complement the character of the area and/or region. Appropriate incorporation of the transportation system into the landscape is critical in providing long-term transportation solutions.

2.2 Traffic Volumes

Intersection design typically begins with an analysis of motorized vehicular traffic volumes handled by an intersection. These traffic volumes and directional distributions indicate the number of lanes, the need for tuning lanes or even the need for signalization. The State of Vermont Agency of Transportation (VTrans) provides comprehensive traffic data collection and analysis. Data provided by VTrans were used to develop the alternatives for the intersections involved in this project.

2.3 Physical Limitations

There are often physical site constraints that control the design of an intersection. Whether natural or manmade, these constraints often dictate the layout of the intersection due to the cost associated with relocating or removing the feature, or social/regulatory limitations. Features such as existing grades, property lines, historic sites, buildings, cemeteries, etc often provide such limitations on design.

2.4 Economics

Economic considerations are incorporated in the design of the intersections to minimize both the initial construction costs and the long-term maintenance and operational costs. Maintenance associated with snow plowing, landscaping, signs and striping, etc all contribute to the ongoing costs of a highway intersection. If the maintenance costs of a design are too great, maintenance operations will be delayed or abandoned and thus the safety of the intersection may be jeopardized. Often, investment in upfront engineering and construction costs results in a more durable intersection, thus minimizing maintenance costs and providing a dependable, long lasting and safe intersection.

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2.5 Public Involvement

Due to the inherent public nature of these projects, involvement of the local community is critical to ensure that the needs the intersection's users are met. During the course of this project there were four meetings involving the local communities:

Kick Off Meeting

Staff from ESI and BCRC met with interested parties on the sites of each intersection to discuss the details and nuances of the function of each intersection. This provided a foundation for the development of alternative designs. (June 12, 2001)

Project Status Meeting

A presentation of multiple alternative designs for both intersections was given at a special meeting of the Transportation Advisory Council. Feedback received at this meeting provided valuable guidance for refinement of the alternatives to better reflect the needs of the communities. (August 23, 2001)

Final Presentation

Arlington - a special public meeting was held to present the final alternatives developed. The issues surrounding the intersection were discussed and the preferred alternative was presented. Additional input gathered from this meeting was incorporated into this report. (September 24, 2001)
Manchester - the final alternatives and preferred alternative were presented to Town officials for their consideration and input. Presentation materials were left with the BCRC so that an additional public meeting could be held to discuss the alternatives if the project is funded and moves forward. (October 4, 2001)

All of the documents, presentation materials, maps and plans generated during this project have also been developed for digital distribution. This information is public and may be freely distributed to all concerned with this project, with appropriate acknowledgement of the source. Appendix C contains a CD-ROM that contains all such data. Please contact ESI if assistance is needed in accessing this data.

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3.0 Arlington

The following sections describe the existing conditions, traffic data, alternative designs, and recommendations for improvements to the intersection of Vermont Route 7A with Vermont Route 313 West in Arlington.

3.1 Existing Conditions

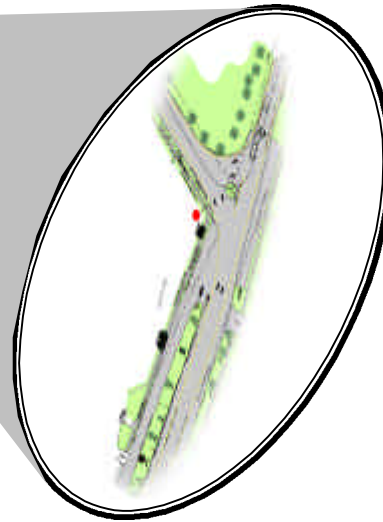
The intersection of Vermont Route 7A and Vermont 313 West is located in the Village of Arlington and the area is characterized by businesses, residences and historic homes and buildings. There are marble sidewalks on both sides of Vermont Route 7A and on



USGS Mapping

the south side of Vermont 313. Two churches, an inn, a bank, a convenience store and the Town Hall are located in the immediate vicinity of the intersection. Beyond that, there is a school to the south and a recreation center to the north. These two destinations are well known generators of pedestrian traffic in Village.

Arlington, Vermont
Vermont 7A and Vermont 313 West



The intersection geometry is currently defined by a central median on Vermont 313 creating a “Y” intersection that divides the turning movements causing a confusing and somewhat unpredictable traffic flow. Further complicating the site is the proximity of the entrance to Church Street. Although the recent conversion of

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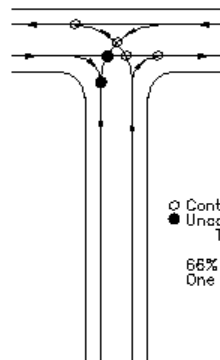
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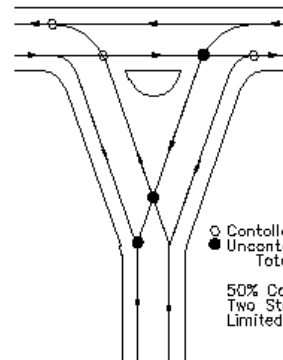
Church Street to a one-way street has significantly improved the situation, the lack of definition of the entrance continues to create an unsightly and confusing intersection.

The following diagrams represent the flow of a typical “T” intersection and a typical “Y” intersection. Each dot represents a point of potential vehicular conflict. Note that although both scenarios create 6 points of vehicular conflict, the “T” intersection has 4 controlled by a single Stop Sign, whereas the “Y” intersection is only 3 controlled by *two* Stop Signs.



○ Controlled Conflict Points = 4
● Uncontrolled Conflict Points = 2
Total Conflict Points = 6
66% Controlled
One Stop Signs

“T” Intersection



○ Controlled Conflict Points = 3
● Uncontrolled Conflict Points = 3
Total Conflict Points = 6
50% Controlled
Two Stop Signs
Limited Left Turn Storage

“Y” Intersection with Island

Additionally, the “Y” limits left turn storage and creates non-coincident conflict points. In other words, the left turning movement from the minor leg of a “T” intersection crosses three conflict points, all within the defined intersection and with only two opposing vehicle movements. Whereas, in the “Y” intersection these conflict points are separated, creating a conflict point at the base of the “Y” with a third opposing vehicle movement.

In addition to vehicular deficiencies, the broad nature of the intersection and the separation of conflict points, pedestrian flow through the “Y” intersection is much more difficult to define and control than with the “T.”

Beyond the inherent complications of the “Y” intersection at Vermont 7A and 313 West, the configuration of the intersection makes truck-turning movements from Vermont 7A south to Vermont 313 West difficult. There is evidence that the rear wheel path of the turning trailer often leaves the paved surface and that the truck encroaches on the oncoming Vermont 313 traffic.

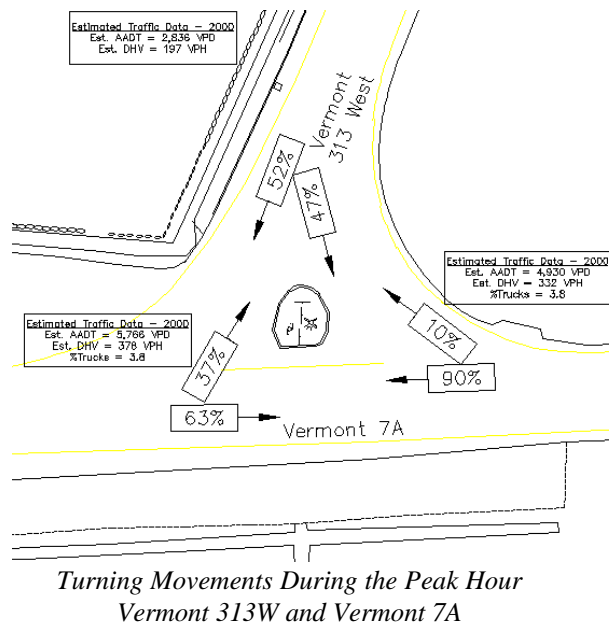
Despite the inherent poor performance of the “Y” intersection as a traffic control feature, VTrans has not recorded any accidents at this intersection. VTrans, however, only records “serious” accidents as reported by the State Police with a significant amount of damage or injury. There is anecdotal evidence of fender-

benders, other minor accidents and close calls, all situations typical of a low speed intersection.

The island at the center of the “Y” plays an important role in defining the character of the Village of Arlington. The gardens are maintained by a local volunteer organization and community members post notices on the telephone pole located in the island.

3.2 Traffic Volumes

A variety of existing traffic data, estimates and projections are available through the VTrans web site at www.aot.state.vt.us. For the purposes of this analysis, daily traffic (AADT) volumes from 1998 and turning movements from 2000 were used as base data. The data were then factored and projected to develop Design Hour Volume (DHV) traffic volumes for 2005 and 2020 for each movement in the intersection. The data and technical analysis are presented in Appendix A.



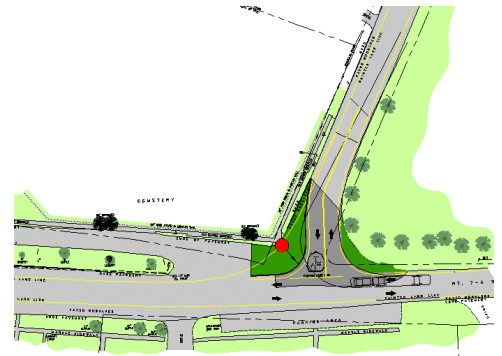
3.3 Alternatives Analysis

The following sections outline alternatives for traffic movement through the intersection - beginning with the simplest and progressing to more complex solutions. Additionally, “accessory alternatives” are presented to address access to Church Street and potential pedestrian movements. Each alternative attempts to reduce the number of uncontrolled conflict points as well as maintain or even enhance the character of the Village of Arlington in concert with the Design Goals outlined in Section 2.0. How each alternative addresses these Design Goals is summarized in the Evaluation Matrix in Appendix A. Cost estimates for each alternative are also in Appendix C and larger versions of the plans are located in Appendix A.

All of the proposed alternatives will require the relocation of existing overhead utilities as well as a fire hydrant that currently exists in the island at the center of the “Y” intersection. Additionally, the highway Right of Way at the intersection is not well defined. The alternatives developed remained generally within the existing roadway and shoulder limits. Prior to implementation of the any improvement, the Right of Way will need to be reviewed and/or established.

3.3.1 Alternative A - \$13,000

Alternative A represents the simplest approach to addressing the uncontrolled and undefined nature of the intersection. The basic components involve creating a “T” intersection and modifying the “313 entrance” to Church Street (definition of the access to Church Street is addressed by the Accessory Alternatives).

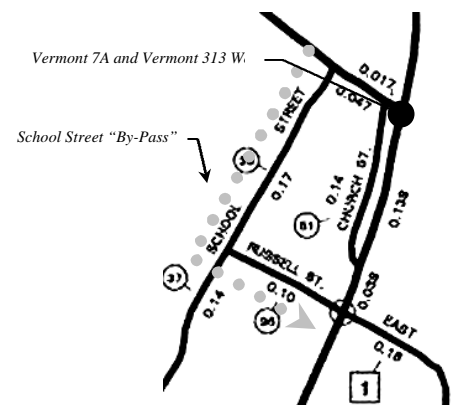


Alternative A

Although the intersection is improved in some respects, there are significant drawbacks to the alternative. The turning movement from Route 7A to 313 would be constricted causing large trucks to encroach in the oncoming Vermont 313 lane to negotiate the turn. This alternative also does not address the left and right turning movements from Vermont 313 onto Vermont 7A.

The general performance of intersections is determined by their “Level of Service,” an A-F scale based on traffic delay. The traffic analysis of this intersection shows that it performs at an estimated Level of Service of A and/or B for both existing and projected volumes. This indicates that delays of up to 12 seconds may be experienced within a 20-year design horizon. This is not typically considered a significant delay and many intersections are designed to meet this standard. However, at an intersection where there are currently defacto turning lanes and subsequently very little delay, this imposed delay may be unacceptable to local users.

Based on input from the local residents it was learned that School Street is regularly used as a “bypass” of this intersection. Neither the structure of School Street nor its residential nature is compatible with such through traffic. Redefining this intersection and “creating delay” by removing the

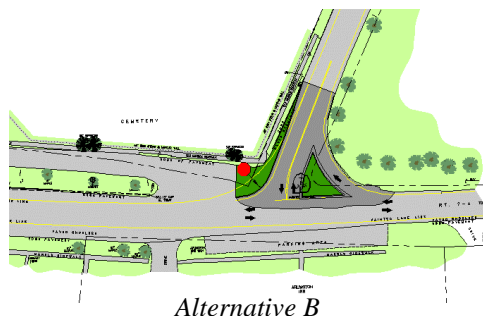


Downtown Arlington, School Street By-Pass

turning lanes may generate additional traffic on School Street. This could be mitigated by changing School Street to one-way northbound, however, the delays at the intersection of Vermont 7A and Vermont 313 West may still be unacceptable. This may generate frustration and poor decision making while negotiating the intersection.

3.3.2 Alternative B \$18,000

Alternative B is similar to Alternative A in that it creates a “T” intersection. However, it addresses the right hand turning issue by creating a slip lane with a raised/curbed island for right hand turns from Vermont 7A to Vermont 313 West. This ramp not only accommodates the turning movement of large trucks but also moves one of the conflict points away from the intersection. Additionally, an island is created which can be landscaped such that the existing aesthetic of the intersection is maintained.

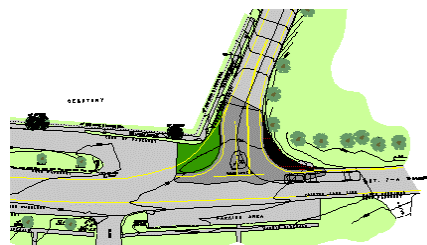


Alternative B

Although the island creating the slip ramp provides definition and the opportunity for aesthetic improvement, it comes with notable drawbacks. Roadway maintenance and snow removal become more difficult whenever a structure is placed in the roadway. Alternative treatments such as a painted or textured island help to address the maintenance issue but are much less durable than a curbed island and offer little guidance to drivers in the winter.

3.3.3 Alternative C - \$\$17,000

Alternative C attempts to address the deficiencies of Alternatives A and B. By creating dedicated left and right turn lanes on the 313 approach, delays will be minimized providing an improved and defined version of the existing use of the intersection. To better accommodate truck-turning movements a mountable curb is proposed. This will provide definition to the intersection for the common user yet allows access by large trucks.



Alternative C

As with the island of Alternative B, the construction of the mountable curb involves both additional construction expense and potential for future maintenance. However, the effect gained by reducing the amount of paved surface within the intersection improves the definition and thus safety.

3.4 Accessory Analysis

The following Accessory Alternatives can be added onto the base alternatives to address peripheral intersection issues.

3.4.1 Accessory A - \$7,000

Accessory Alternative A attempts to separate the intersection of 313 with 7A and the entrance to Church Street. Although the location of this alternative maximizes the distance between 313 and Church Street, it also reduces the available parking on Church Street by removing approximately 6 spaces. Additionally, this alternative would require extensive curbing and landscaping and is not conveniently aligned with any opposing intersection.



Accessory A

3.4.2 Accessory B - \$4,000

Accessory Alternative B also effectively separates the entrance of Church Street from 313. Although it also requires curbing and landscaping an additional two to three parking spaces are maintained. Additionally, it places the entrance directly opposite from the entrance to the Arlington Inn Drive, thus minimizing the points of conflict along Route 7A.



Accessory B

3.4.3 Accessory C - \$8,000

Accessory Alternative C addresses pedestrian movements through the intersection. Although pedestrian movement through the intersection is not currently a priority, the possibility of a future crossing needs to be considered to ensure that the solutions implemented do not preclude the construction of pedestrian facilities.



Accessory C

The presence of a cross walk at this location could provide a very effective gateway effect. This visual effect can result in slower traffic speeds making drivers more aware of their environment, thus creating a safer village setting.

3.4.4 Accessory D - \$1,000

The traffic analysis for the intersection shows that a left turn lane from Vermont 7A onto Vermont 313 W is warranted based on the volume of traffic on Vermont 7A and the percent turning onto Vermont 313 W. Accessory D



Accessory D

involves the restriping of Vermont 7A to accommodate a left hand turn lane. However, construction of such a turning lane would consume the entire paved roadway width and significantly change the appearance of the entrance to the Village of Arlington.

Based on the types of accidents that occur at the intersection, speeds through the intersection are low, installation of such a turning lane would encourage higher speeds through intersection and increase the risk of each conflict point.

3.5 Preferred Alternative

The most critical issue at this intersection is the lack of definition. This is evident in the broad and undefined entrance to Church Street and the poorly signed and confusing island.

The only alternative that effectively addresses these two issues while maintaining the existing performance of the intersection is Alternative C. Accessory B should also be included to complete the definition of the entrance to Church Street. Accessory B represents the lowest cost and least disruptive approach to improving this entrance. The green space created by the combination of these two alternatives provides a convenient location for public gardens, information boards, etc. as well as a utility pole relocated from the existing island. The local water commissioner has indicated that the existing fire hydrant in the island can be relocated to a point adjacent to the access drive to the Arlington Inn on the east side of Route 7A. The total estimate construction cost of the preferred alternatives is \$21,000.



Preferred Alternative

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4.0 Manchester

The following sections describe the existing conditions, traffic data, alternative designs and recommendations for improvement to the intersection of Vermont 11/30 and East Manchester Road in Manchester.

4.1 Existing Conditions

The intersection of Vermont 11/30 and East Manchester Road is located on Vermont 11/30 east of the Route 7 overpass and Manchester Village. There are a variety of restaurants, motels and tourist destinations located in the immediate vicinity of the intersection. These businesses are widely spaced



Vermont 11/30 and
East Manchester Road

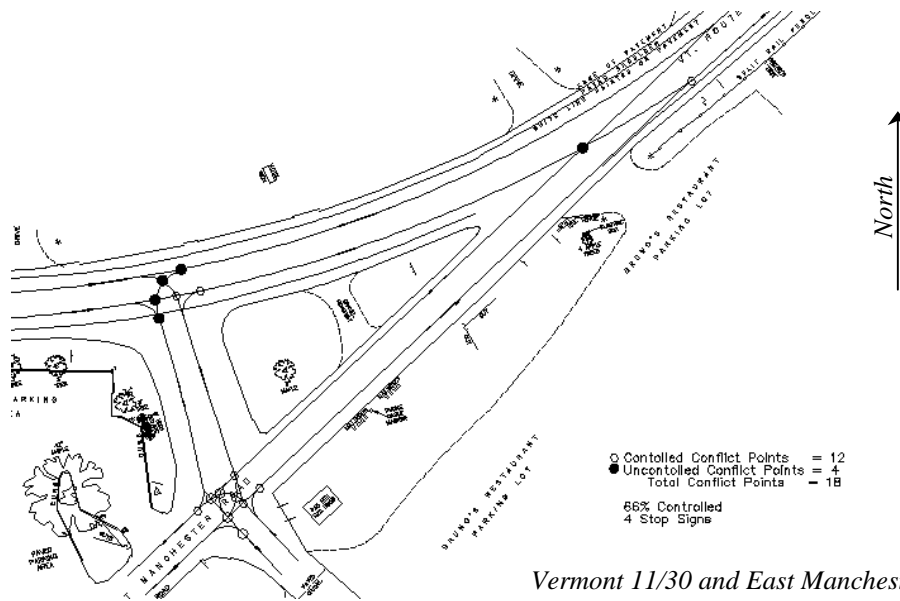
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and provide a transition from the village setting of Manchester, to the rural character of the surrounding region. This is the main route between Manchester and local ski areas, and is a popular tourist and recreation route.



Currently, East Manchester Road intersects with Vermont 11/30 at two official/paved locations and one unofficial/unpaved location. These multiple access points create unnecessary conflict points and cause driver confusion while negotiating the intersection. Additionally, Rootville Road intersects with East Manchester Road such that it is functionally connected East Manchester Roads intersection with Vermont 11/30. The following diagram locates the conflict

points that currently exist at the intersections of Vermont 11/30 and East Manchester Road; and East Manchester Road and Rootville Road.



Vermont 11/30 and East Manchester Road Intersection Conflict Points

There are 18 conflict points in the current paved intersection alignment assuming that the movements at the eastern intersection are limited to the “straight through” movements, as shown in the diagram. The reality is, however, that the eastern intersection offers all turning movements. If all of the turning movements at the eastern intersection plus the unofficial/unpaved intersection are included, an additional 16 potential conflict points are generated. Therefore, there are a total of 34 *potential* conflict points at this intersection, compared to 6 in a typical “T” intersection. In addition to the conflict points associated with this intersection, there are numerous private business drives creating additional conflict points in the immediate vicinity.

The westerly intersection is a typical “T” type intersection and supports predictable traffic movements. The easterly intersection, however, creates a confusing and potentially dangerous traffic movement from Vermont 11/30 onto East Manchester Road. Westbound traffic on Vermont 11/30 exiting onto East Manchester Road is presented with the choice of exiting at the easterly intersection or continuing on to the westerly intersection. This creates a complex decision-making process for westbound Vermont 11/30 traffic that is dependant on oncoming Vermont 11/30 traffic. The westbound driver on Vermont 11/30 has three general options for negotiating the intersection: speed up to cross in front of oncoming traffic at the easterly intersection, stop and wait at the easterly intersection or continue on to the westerly intersection of East Manchester Road. From casual observation of the function of the intersection and discussions with local users, it appears that the first option (accelerating through the intersection) is frequently chosen. This creates an

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unsafe traffic movement on Vermont 11/30 and results in a vehicle traveling onto East Manchester Road at a high rate of speed.

The geometry of East Manchester Road lends itself to this high-speed maneuver for the first 200 feet, until the intersection with Rootville Road. This allows drivers to carry 40 to 50 mph speeds from Vermont 11/30 onto East Manchester Road and through the intersection with Rootville Road. After this point the roadway becomes narrow and rural in nature and is not capable of handling such speeds safely.

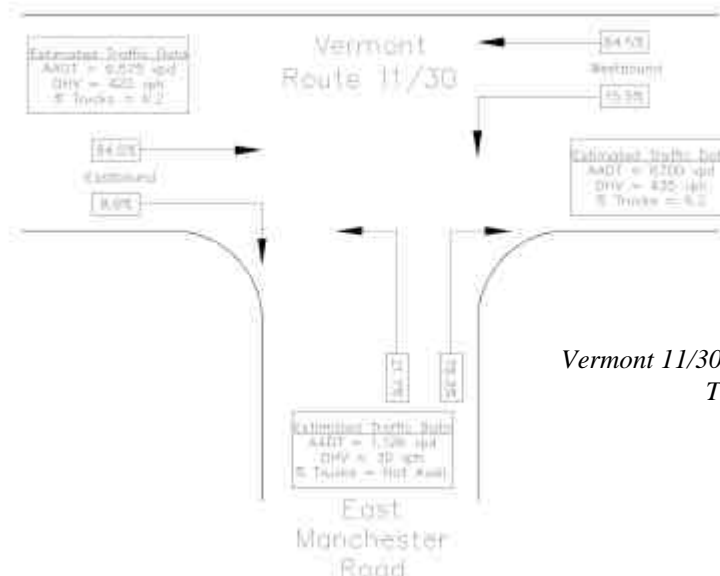
VTrans recorded 7 accidents at this location from 1995 through 1999. Four of which were recorded as “rear end” collisions and one as a broadside collision. The remaining two involved a single vehicle leaving the roadway due to weather or excessive speed. This type of accident history is consistent with the limitations on sight distance and confusion on behalf of the drivers attempting to negotiate this stretch of highway.

There are currently no pedestrian movements defined at the intersection and it does not appear that there are any significant pedestrian destinations in the immediate vicinity. Improvement of the intersection alignment would not preclude future pedestrian features and would allow for future installation of pedestrian or bicycle facilities.

4.2 Traffic Volumes

As in Arlington, existing VTrans Data were used to analyze the performance of this intersection. Daily traffic volumes from 1996 and turning movements from 2000 were used as base data. The data were then factored and projected to develop Design Hour Volume traffic volumes for 2000, 2005 and 2020 for each movement in the intersection. The data and technical analysis are presented in Appendix B.

The following diagram summarizes the directional flow and volume of traffic through this intersection, assuming it functions as a simple “T” intersection:



Vermont 11/30 and East Manchester Road
Traffic Volumes

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4.3 Alternatives Analysis

The following alternatives attempt to reduce the number of vehicular conflict points as well as reduce the possible severity of conflicts and maintain or even enhance the character of the area. All of the alternatives involve the closure of the eastern intersection of East Manchester Road as well as the closure of the unpaved/unofficial intersection at a minimum. These two features both minimize the number of conflict points and slow traffic on East Manchester Road.

All of the alternatives will also require landscaping and signs to ensure that the new intersection alignment is clear and well defined to prevent accidental use of the old easterly intersection of East Manchester Road. The cost estimate developed for each alternative allows for approximately \$5,000 worth of landscaping to define the new edge of Vermont 11/30 with mature trees and vegetation.

4.3.1 Alternative A - \$7,420

Alternative A represents a minimum amount of effort to achieve improved traffic flow definition and safety.

This alternative solely involves the closure of the eastern intersection of East Manchester Road and the unpaved intersection and directing all traffic through the existing western intersection. This reduces the number of conflict points from a potential of 34 controlled with 4 stop signs, down to 12 conflict points using 2 stop signs. One sign

would be located at Vermont 11/30 and East Manchester Road and the other at Rootville Road and East Manchester Road. The intersection of Rootville Road with East Manchester Road would become a poorly oriented “T” intersection.



Alternative A

However, this alternative centralizes the turning traffic flow to a location (the western intersection) which has limited stopping sight distances, both horizontal and vertical. Based on traffic volumes, a left hand turning lane is warranted from Vermont 11/30 westbound to East Manchester Road. Thus, it can be expected that left turning vehicles from Vermont 11/30 would be stopped in the travel way waiting to turn onto East Manchester Road. Although there is adequate shoulder to accommodate a right hand pass by advancing westbound traffic, relying on driver reaction and decision-making at a location with a known sight distance limitation may not be appropriate.

This alternative would also not clearly and definitively address the geometry of the Rootville Road intersection with East Manchester Road. Although “stop

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controlled,” the intersection would be located on the curve of East Manchester Road and the driver right of way could be confusing.

4.3.2 Alternative B - \$ 16,500

Alternative B is an improved version of Alternative A. By moving the intersection of East Manchester Road to the east, sight distances along Vermont 11/30 to the intersection are improved and the intersection of Rootville Road with East Manchester Road is better defined. The intersection of Rootville Road would be changed from a 4-way intersection to a “T” intersection with East Manchester Road.

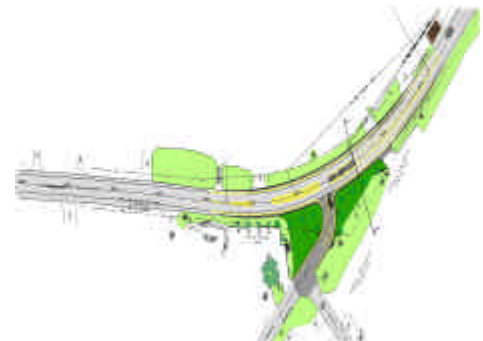


Alternative B

Although this alternative significantly improves the definition and performance of the general roadway system, it does not address the warranted turning movement from Vermont 11/30 onto East Manchester Road. The improvement of the sight distance to the intersection will improve the safety of the queuing left turning vehicle, but they will still be standing in the travel way vulnerable to advancing traffic.

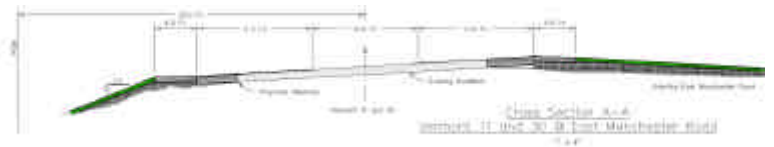
4.3.3 Alternative C - \$ 21,560

Alternative C is similar to Alternative B, with the exception of the addition of a left hand turning lane on Vermont 11/30 westbound to accommodate left hand turning movements from Vermont 11/30 to East Manchester Road. Thus, this alternative addresses all of the noted deficiencies at the intersection.



Alternative C

The current paved roadway surface is 32’ wide, including 4’ paved shoulders. By re-striping, three lanes (11’-10’-11’) could be installed on the existing paved surface at the intersection of East Manchester Road. The only new full depth paving required would be in the shoulder area and the new approach to East Manchester Road.



Construction of this alternative will, however slightly, modify the existing traffic path of vehicles on Vermont 11/30. The curve traveled by westbound traffic would become larger and the eastbound would become smaller. Proper consideration of the super-elevation in the curve, protection of drainage structures and patterns, smooth grade transitions, etc. will be necessary to ensure that the flow of traffic on Vermont 11/30 is not adversely affected.

4.4 Preferred Alternative

Although the most costly alternative, Alternative C most completely addresses the noted deficiencies at the intersection and creates a more predictable, protected and safer traffic flow. Despite being the most costly of the alternatives investigated, the cost of construction is modest considering the typical cost of highway improvements and the significance of the improvements rendered.

5.0 Conclusions

5.1 Arlington

The intersection of Vermont 313 West with Vermont 7A in Arlington plays an important role in both the transportation system of the region and character of the Village. Although the adjacent intersection of Church Street and the central island contribute to the character of the intersection and Village they also deter from its general functionality and safety for the public at large.

By addressing the flow within the intersection of Vermont 7A and 313 West and improving the function of the adjacent intersection of Church Street, long-term safety, reliability and aesthetic character can be maintained or even improved. Alternative C in combination with Accessory B provide a predictable traffic flow through the area and generate a large expanse of green space that can be utilized for public gardens or other community use.

5.2 Manchester

The intersection of East Manchester Road and Vermont 11/30 was significantly modified in the early 1940's when Vermont 11/30 was realigned to establish the existing curve. After this improvement to Vermont 11/30, the entrance to East Manchester Road and the intersection Rootville Road were left more or less in their pre-existing locations. Based on the traffic volumes of that day, this was a reasonable approach.

However, Manchester and the surrounding area are now significant generators of traffic and the deficiencies in the function of this intersection are becoming evident. Between the unnecessary number of conflict point, the sight distance limitations and the traffic volume expecting to utilize East Manchester Road, the safety at the intersection has been compromised.

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Alternative C effectively addresses the noted functional deficiencies of the intersection and also improves the character of the immediate area. As with the Arlington intersection, the amount of green space created by this design is significant. The planting of mature trees and other landscaping features serve to define the curve as well as provide screening from adjacent residential properties.

Although the most costly alternative, the total cost is relatively modest with respect to the significance of the improvement garnered. Thus, Alternative C represents the best value of all of the alternatives investigated.

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Appendix A

Arlington

Alternative Drawings

Evaluation Matrix

Cost Estimates

Traffic Analysis

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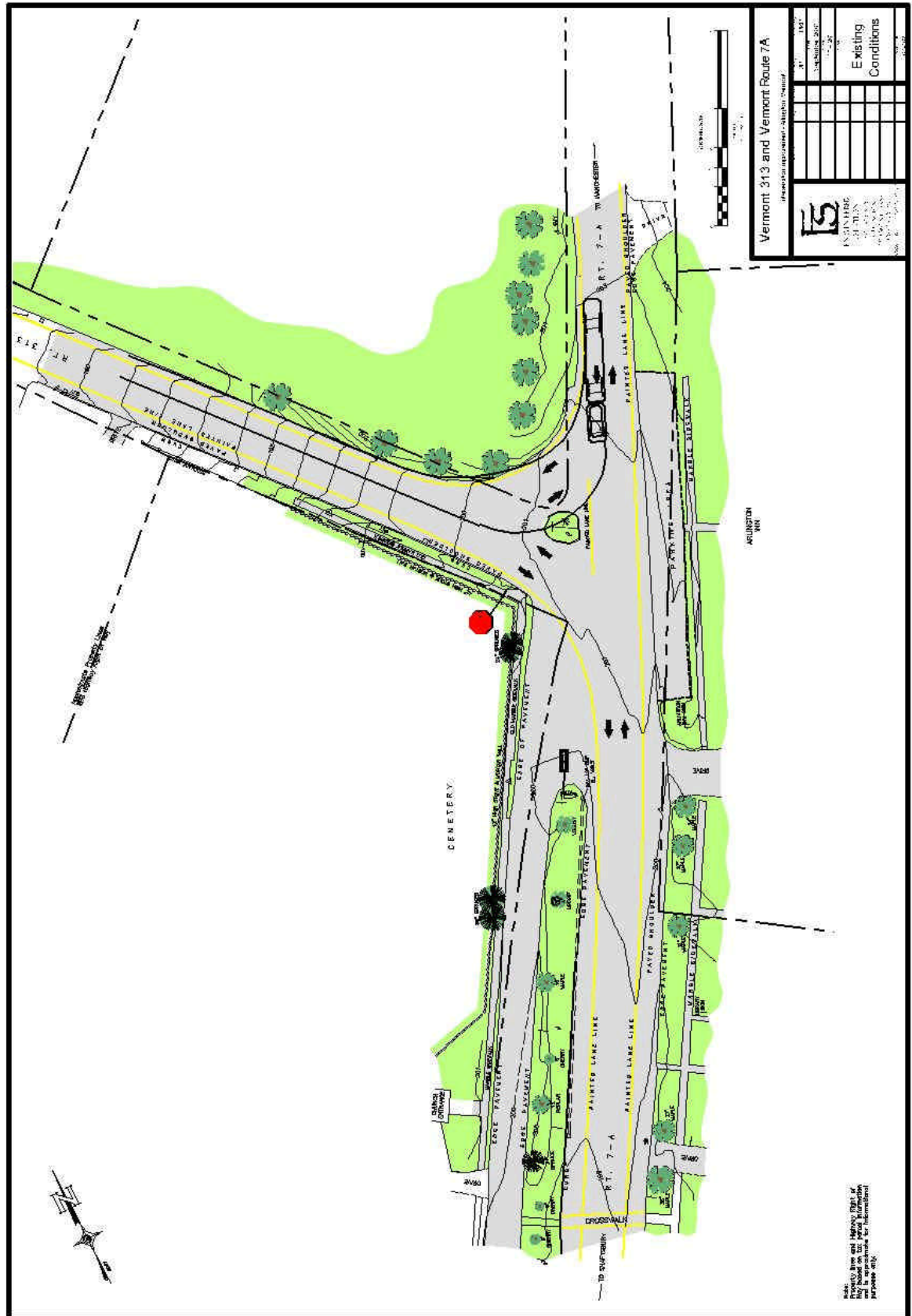
Existing Conditions

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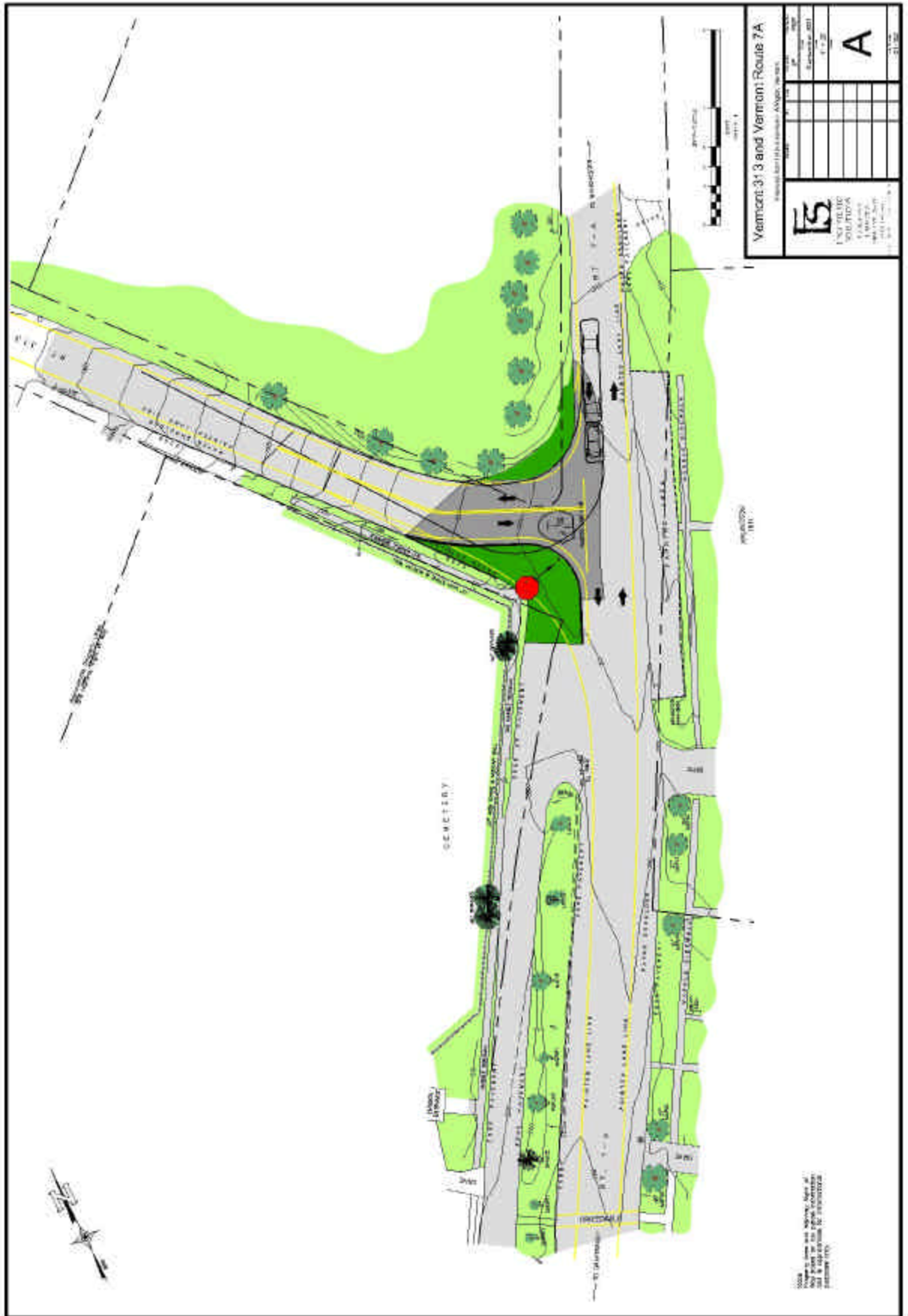
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ENGINEERING SOLUTIONS
1000 W. 10th Street
Burlington, VT 05401
Phone: 802-249-1111

PROJECT: Vermont 313 and Vermont Route 7A
DATE: 9/20/01
SCALE: 1" = 20'

NO.	DATE	DESCRIPTION
1	9/20/01	ISSUED FOR PERMIT
2		
3		
4		
5		
6		
7		
8		
9		
10		

A

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Drawn by: [Name]
Checked by: [Name]
Scale: 1" = 20'
Date: 9/20/01

Alternative B

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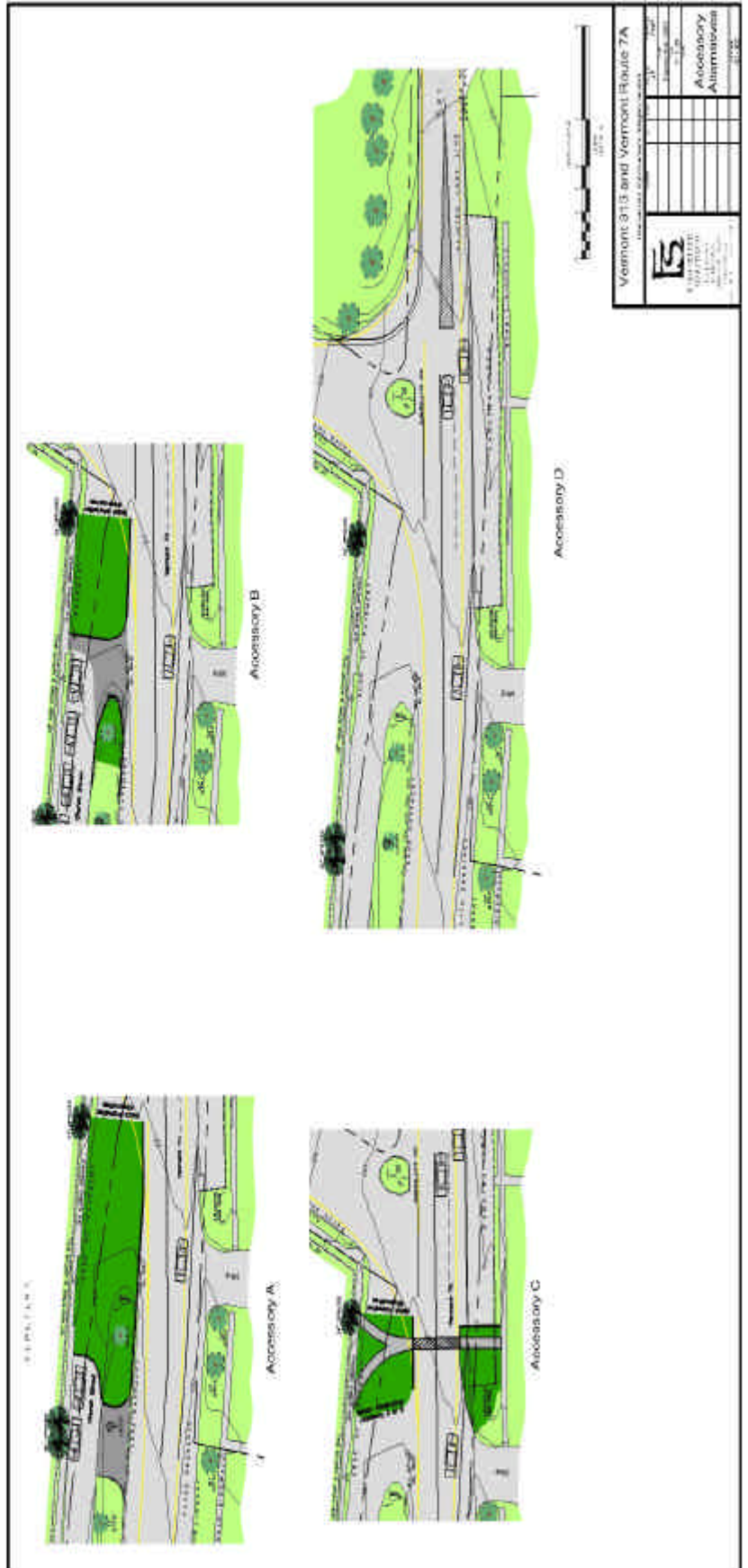
Accessories

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Evaluation Matrix - Intersection Alternatives
Vermont Route 7A and Vermont 313 West - Arlington, Vermont

Criteria	Alternative A	Alternative B	Alternative C
Reduction of Uncontrolled Conflict Points	Yes	Yes	Yes
Reduction of Severity of Conflict Points	Yes	Yes	Yes
User Comfort	Diminished	Diminished	Maintained
User Convenience	Diminished	Diminished	Maintained
Consistent with Land Uses	Yes	Yes	Yes
Utility Impact	Yes	Yes	Yes
Maintenance Cost	Minimal	Noticeable, plowing inconvenience	Minimal, more complex plowing
Construction Cost	\$13,000	\$18,000	\$17,000
Preferred Alternative			✓

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Evaluation Matrix - Accessory Items

Vermont Route 7A and Vermont 313 West - Arlington, Vermont

Criteria	Accessory A	Accessory B	Accessory C
Reduction of Uncontrolled Conflict Points	Yes - Best	Yes - Good	Yes
Reduction of Severity of Conflict Points	Yes	Yes	Yes
User Comfort	Maintained	Maintained	Maintained
User Convenience	Diminished	Diminished	Maintained
Consistent with Land Uses	Yes	Yes	Questionable
Utility Impact	No	No	No
Maintenance Cost	Minimal	Minimal	Minimal
Construction Cost	\$7,000	\$4,000	\$8,000
Preferred Alternative		✓	

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Engineer's Preliminary Quantity and Cost Estimate*

Vermont 7A and 313 West - Arlington, Vermont

Alternative A

Item	Unit	Quantity	Unit Cost	Cost
Bituminous Paving	SY	200	\$18	\$3,600
Concrete Curbing	LF	150	\$25	\$3,750
Earthwork	CY	125	\$28	\$3,500
Signing and Striping	Each	1	\$500	\$500
			sub total a	\$11,350
Landscaping		@3% sub total a		\$341
			sub total b	\$11,691
Mobilization		@5% sub total b		\$584.53
Contingency		@5% sub total b		\$584.53
			Total Estimated Cost	\$13,000

Alternative B

Item	Unit	Quantity	Unit Cost	Cost
Bituminous Paving	SY	300	\$18	\$5,400
Concrete Curbing	LF	300	\$25	\$7,500
Earthwork	CY	75	\$28	\$2,100
Signing and Striping	Each	1	\$500	\$500
			sub total a	\$15,500
Landscaping		@3% sub total a		\$465
			sub total b	\$15,965
Mobilization		@5% sub total b		\$798.25
Contingency		@5% sub total b		\$798.25
			Total Estimated Cost	\$18,000

Alternative C

Item	Unit	Quantity	Unit Cost	Cost
Bituminous Paving	SY	325	\$18	\$5,850
Concrete Curbing	LF	250	\$25	\$6,250
Earthwork	CY	100	\$28	\$2,800
Signing and Striping	Each	1	\$500	\$500
			sub total a	\$15,400
Landscaping		@3% sub total a		\$462
			sub total b	\$15,862
Mobilization		@5% sub total b		\$793.10
Contingency		@5% sub total b		\$793.10
			Total Estimated Cost	\$17,000

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Alternative B

Item	Unit	Quantity	Unit Cost	Cost
Bituminous Paving	SY	400	\$18	\$7,200
Earthwork	CY	100	\$28	\$2,800
Signing and Striping	Each	1	\$500	\$500
Landscaping - trees	Each	10	\$500	\$5,000
subtotal a				\$15,500
Mobilization		@5% subtotal a		\$780.00
Contingency		@5% subtotal a		\$780.00
Total Estimated Cost				\$17,000

Engineer's Preliminary Quantity and Cost Estimate*

Vermont 11/30 and East Manchester Road - Manchester, Vermont

Alternative A

Item	Unit	Quantity	Unit Cost	Cost
Bituminous Paving	SY	0	\$18	\$0
Earthwork	CY	80	\$28	\$2,240
Signing and Striping	Each	1	\$500	\$500
Landscaping - trees	Each	8	\$500	\$4,000
sub total a				\$6,740
Mobilization		@5% subtotal a		\$340.00
Contingency		@5% subtotal a		\$340.00
Total Estimated Cost				\$7,000

Item	Unit	Quantity	Unit Cost	Cost
Bituminous Paving	SY	550	\$18	\$9,900
Earthwork	CY	150	\$28	\$4,200
Signing and Striping	Each	2	\$500	\$1,000
Landscaping - trees	Each	10	\$500	\$5,000
subtotal a				\$20,100
Mobilization		@5% subtotal a		\$1,010.00
Contingency		@5% subtotal a		\$1,010.00
Total Estimated Cost				\$22,000

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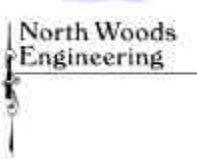
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Appendix B

Manchester

Alternative Drawings

Evaluation Matrix

Cost Estimates

Traffic Analysis

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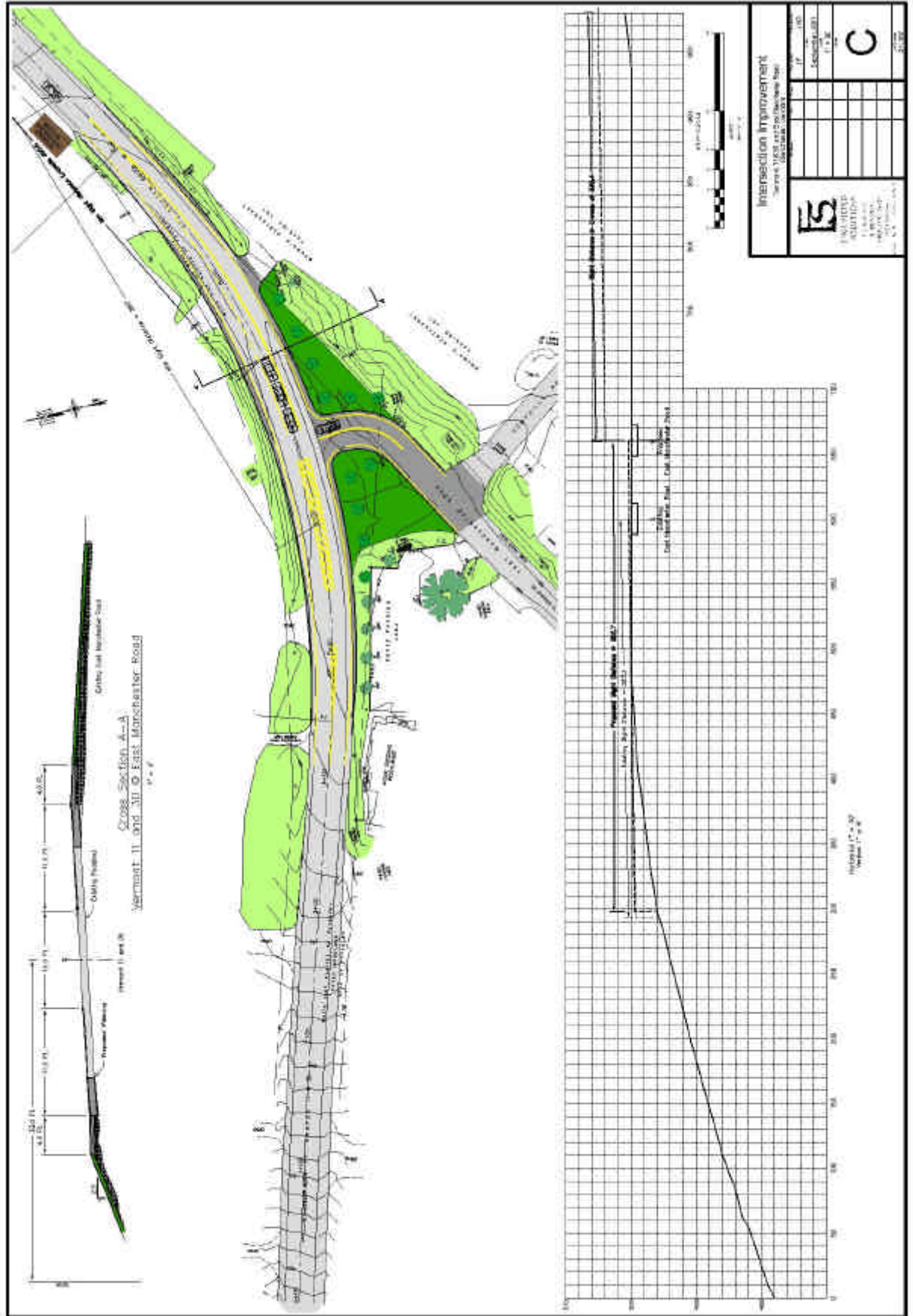
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Evaluation Matrix - Intersection Alternatives

Vermont Route 11/30 and East Manchester Road - Manchester, Vermont

Criteria	Alternative A	Alternative B	Alternative C
Reduction of Uncontrolled Conflict Points	Yes	Yes	Yes
Reduction of Severity of Conflict Points	Yes, Partial	Yes, Partial	Yes
User Comfort	Maintained	Maintained	Maintained
User Convenience	Diminished	Diminished	Diminished
Consistent with Land Uses	Yes	Yes	Yes
Utility Impact	Yes	Yes	Yes
Maintenance Cost	Improved	Improved	Improved
Construction Cost	\$7,000	\$17,000	\$22,000
Preferred Alternative			✓

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Engineer's Preliminary Quantity and Cost Estimate*

Vermont 11/30 and East Manchester Road - Manchester, Vermont

Alternative A

Item	Unit	Quantity	Unit Cost	Cost
Bituminous Paving	SY	0	\$18	\$0
Earthwork	CY	80	\$28	\$2,240
Signing and Striping	Each	1	\$500	\$500
Landscaping - trees	Each	8	\$500	\$4,000
sub total a				\$6,740
Mobilization		@5% subtotal a		\$340.00
Contingency		@5% subtotal a		\$340.00
Total Estimated Cost				\$7,000

Alternative B

Item	Unit	Quantity	Unit Cost	Cost
Bituminous Paving	SY	400	\$18	\$7,200
Earthwork	CY	100	\$28	\$2,800
Signing and Striping	Each	1	\$500	\$500
Landscaping - trees	Each	10	\$500	\$5,000
subtotal a				\$15,500
Mobilization		@5% subtotal a		\$780.00
Contingency		@5% subtotal a		\$780.00
Total Estimated Cost				\$17,000

Item	Unit	Quantity	Unit Cost	Cost
Bituminous Paving	SY	550	\$18	\$9,900
Earthwork	CY	150	\$28	\$4,200
Signing and Striping	Each	2	\$500	\$1,000
Landscaping - trees	Each	10	\$500	\$5,000
subtotal a				\$20,100
Mobilization		@5% subtotal a		\$1,010.00
Contingency		@5% subtotal a		\$1,010.00
Total Estimated Cost				\$22,000

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Appendix C

CD-ROM Digital Documents

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