Central Vermont Regional Planning Commission
Town of Orange
Intersection Design Feasibility Study

Alternatives

Submitted by:

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In conjunction with

Broadreach Planning & Design

Heritage Landscapes LLC

University of Vermont Consulting Archaeology Program

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This report has been formatted for double-sided printing.
Blank pages are intentional, so that the beginning of the report and the appendices can start on an odd numbered, right-side page.

A. INTRODUCTION

1. OVERVIEW

This study is examining the most appropriate ways to increase safety for motorist, as well as for bicyclists and walkers, on Reservoir Road at the intersection with Lords Road in the Town of Orange, Vermont. The project is being funded and supported by the Central Vermont Regional Planning Commission.

To begin the project, the Town of Orange created a steering Committee, which included a representative from the Central Vermont Regional Planning Commission (CVRPC), the Selectboard, local volunteers, and Town Staff. Working with their consultant, Lamoureux & Dickinson, assisted by Broadreach Planning & Design, Heritage Landscapes, and the University of Vermont Consulting Archaeology Program (the L&D Team), they examined the existing conditions around the intersection and developed the summary report of existing conditions in the Study Area.

2. PURPOSE AND NEED

The purpose of the intersection improvement project examined in this study is to improve conditions on the roadway that will safely slow motorists moving through the intersection; create longer sight lines for each approach to the intersection, and provide improved facilities for walkers and bicyclists as possible.

Needs for the improvements include:

- Excessive speeds of motor vehicles coming from the north as they pass through curve in Reservoir Road at the intersection.
- The uphill approach of Lords Road to Reservoir Road combined with the super-elevation of Reservoir Road and the small crest in Reservoir Road north of the intersection that limit sight lines for southbound and eastbound travelers.
- The number of incidents of motorists driving off the road reported by local residents and Town staff that have occurred at the intersection.

3. ALTERNATIVE DEVELOPMENT

Following an examination of the updated existing conditions, the L&D team and Steering Committee conducted a work session to identify as many alternative ways of addressing the purpose and need of this project as possible. The group also worked together to do an initial analysis of alternatives to refine or eliminate those that did not provide significant improvement to the needs or were otherwise unsuitable. The L&D Team then refined the descriptions; added a few links or additional segments as appropriate, including the No-Action Alternative; did further analysis; eliminated additional alternatives that did not appear to work or meet the purpose of the project; and developed a concise viable set of alternatives. After the L&D Team review, they joined the Steering Committee to review the final list of alternatives and analysis in preparation for a second public work session.

Table B-1 at the end of the text shows all of the alternatives that the L&D Team and the Steering Committee initially developed; it also highlights whether these initial alternatives were kept as part of the refined set of alternatives or eliminated prior to the public work session, or combined with other alternatives to create a new option. If the L&D Team and advisory committee decided to eliminate an alternative, **Table B-1** explains the basis for the elimination. **Figure B-1** shows the final set of Reservoir Road and Lords Road alternatives that remained after the initial review process. **Table B-2** provides an analysis of the remaining alternatives, including the No-Action Alternatives. The refined set of alternatives is meant for public review and consideration.

4. USE OF THIS REPORT & NEXT STEPS

This report is meant to serve as a guide to the alternatives under consideration for improving driving, walking, and bicycling conditions at and near the intersection of Reservoir Road and Lords Road. It presents this information for public review. **Figure B-1** in this report presents all of the alternatives that are currently under consideration on one map so that they can be examined and evaluated together. **Figure B-1** does not imply that all of the alternatives are meant to be developed. None of the alternatives are recommended at this point in the project.

The alternatives will be considered at a public work session on October 16, 2017, during which the attendees will have a chance to express their opinions on which alternative, or group of alternatives, would make the most sense to pursue first. By the end of the public work session, the L&D Team and Steering Committee hope that consensus on the preferred alternative(s) will emerge.

The Steering Committee will review the results of the public work session and will make a draft set of final recommendations in a draft final report for one final public review before the study is finished. The draft final report will outline the preferred alternative(s). Afterwards, the Steering Committee and L&D Team will refine the draft final report for the project as needed. It will include both the *Existing Conditions* report and this *Alternatives* report.

B. ALTERNATIVES

1. OVERVIEW

In order to easily analyze and compare the various alternatives, the Steering Committee divided them into three categories:

- Reservoir Road Modifications;
- Reservoir Road Enhancements; and
- Lords Road Modifications and Enhancements.

This categorization is reflected in Table B-1. Once the analysis was completed, the Steering Committee decided that the categorization was not needed for the presentation of the list of final alternatives presented in this report.

The following text provides a brief description of each of the final alternatives. In addition to those potential improvements identified by the Steering Committee, taking no action also remains as one of the potential alternatives. The NO ACTION alternative is included in each of the tables for comparison purposes.

2. DESCRIPTIONS

a. Rework Reservoir Road In Its Current Alignment

This alternative would reconstruct Reservoir Road near the Lords Road intersection to correct some of the issues that contribute to the issues identified in the purpose and need of the project.

The reconstruction would lower the vertical crest on the road north of the intersection with Lords Road, in order to increase sight distances from Lords Road and to reduce the grade to the south. It would also provide uniform

superelevation (the tilting of the road from one side to the other on a curve) together with the recommended superelevation runoff distances (the transition area from a typical road cross section to a superelevated one). As noted in existing conditions, the existing curve is superelevated; but not uniformly. The superelevation exists only in the middle of the curve where Lords Rd intersects Reservoir Rd. The current superelevation ends abruptly, resulting in the outer sections (both north and south of Lords Rd) of the curve not being superelevated.

Alternative a. would also add two feet of paved shoulder on both sides of Reservoir Road and the clear zone would be extended outward by at least two feet. The Vermont State Design Standards recommend seven-feet wide clear zones on rural collector roads having an average daily traffic (ADT) volume less than 750 vehicles per day (vpd) and a design speed of 45 mph or less. At a 50 mph design speed, the recommended clear zones increase to 12 feet on fill slopes (the outside of the curve) and 8 ft on cut slopes (the inside of the curve). Clear zones would be graded at maximum 1:3 slopes (1:4 is preferred) and cleared of fixed objects.

The reconstruction work would also include the installation of curve signs and roadway delineators, as recommended in the 2013 VTrans High Risk Rural Roads report for Reservoir Road. The recommended sign package would be augmented by the installation of additional chevron signs on Reservoir Road on both sides of the intersection in both directions to provide additional warning and guidance to motorists of the curve in the road

The regrading of the Reservoir Road would lower its elevation at the intersection with Lords Road. This would allow the creation of a level area on Lords Road at the intersection, creating improved conditions for motorists turning north or south from Lords Road onto Reservoir Road. The new level area would also be paved.

b. Reroute Reservoir Road East Of The Current Alignment

This alternative would create a new alignment for Reservoir Road to the east of the existing alignment near Reservoir Road that would allow the road to have a larger curve radius. The new curve radius and corresponding roadway relocation would be largely determined by the selected design speed. The following table illustrates recommended curve radii at different design speeds using 6 percent as the maximum superelevation.

Speed	Centerline Radius	Lateral Shift[a]
35 mph	340 FT[b]	0 FT
40 mph	485 FT	10 FT
45 mph	643 FT	28 FT
50 mph[c]	833 FT	50 FT

[a] maximum shift in the middle of curve

[b] 340 FT is also the existing curve radius

[c] existing speed limit

Alternative b. would provide recommended superelevation runoff distances. The new road would be 24 feet wide, with two ten-foot travel lanes along with two feet of paved shoulder on both sides. The clear zones along the sides of the road would meet the Vermont State Design Standards, which recommend seven-foot wide clear zones on rural collector roads having an average daily traffic (ADT) volume less than 750 vehicles per day (vpd) and a design speed of 45 mph or less. At a 50 mph design speed, the recommended clear zones increase to 12 feet on fill slopes (the outside of the curve) and 8 ft on cut slopes (the inside of the curve). The clear zones would be graded at maximum 1:3 slopes (1:4 is preferred) and cleared of fixed objects.

Lords Road would be extended eastward as needed to intersect the newly aligned road. The extension would include a level paved area for vehicles on Lords Road turning north or south onto Reservoir Road.

The old Reservoir Road roadbed would be removed and the land returned to natural vegetation. The right-of-way of the old road would be swapped with the City of Barre for the new right-of-way for realigned Reservoir Road and the extension of Lords Road.

c. Enhancements

i. *Install curve warning signs on Reservoir Road, and add chevrons at the curve itself*. This alternative would include just the installation of curve signs and roadway delineators, as recommended in the 2013 VTrans High Risk Rural Roads report for Reservoir Road. It would also include the installation of additional chevron signs on Reservoir Road on both sides of the intersection in both directions to provide additional warning and guidance to motorists of the sharp curve in the road

ii. *Install guardrail on outside of curve on Reservoir Road*. This alternative would add guardrails along the outside of the curve on the west side of Reservoir Road south of Lords Road. The guardrails would be used in locations where adequate clear zones could not be provided.

iii. *Add center line and outside edge rumble strips through the curve on Reservoir Road*. This alternative would add a linear rumble strip along the centerline and outside edge of the curve on Reservoir Road to alert motorists if they drift out of their lane.

iv. *Provide greater tree clearing at the southwest corner of the intersection*. Alternative c.iv would remove several of the evergreen trees in the southwest corner of the intersection to increase the clear zone and reduce the amount of shade on the intersection in the winter.

C. ANALYSIS

1. OVERVIEW

Table B-2 provides additional data on how each of the alternatives might address the purpose and need for this project, impact identified resources, or benefit users or the community.

The Steering Committee used the following points as the means of providing a comparison between the different alternatives. Not all of the criteria are listed in each of the tables. Those that showed the same impacts for each of the alternatives were sometimes eliminated to make the tables easier to understand. For instance, if each of the alternatives for enhancements to Reservoir Road showed that there would be no impacts to adjacent trees, then the line discussing this impact was removed. Similarly, descriptive elements, described in Section 2 below, were also removed if that particular element was not relevant to all of the alternatives being compared in the table, such as the discussion of superelevation for Lords Road.

2. PROJECT DESCRIPTION

- Amount of Land Swapped with the Barre City
- Additional Right-of-Way Needed from Private Land Owners
- Amount of New Paving Installed
- Amount of Pavement Removed
- Number of New Signs Installed
- Number of Permanent Easements Needed
- Number of Construction Easements Needed
- Change in Grade of Reservoir Road
- Change in Grade of Lords Road
- Level Approach Created for Lords Road
- Change in Superelevation of Reservoir Road
- Significant Physical Constraints
- Amount of Area Restored to a Natural Condition

3. ATTRIBUTES

- Addresses Purpose and Need
- Creates Longer Sight Distances
- Benefits Motorists, Bicyclists, and Pedestrians
- Reduces Crash Potential
- Induces Higher Travel Speeds
- Encourages Lower Travel Speed
- Promotes Fewer Land Departures
- Order of Magnitude Cost (For Comparison Purposes Only)

4. ENVIRONMENTAL AND CULTURAL IMPACTS

- Tree Removal
- Tree Replacement
- Steep Slope Disturbance
- Ledge Removal
- Adverse Historic Resource Impacts
- Utility Pole Disturbance
- Stormwater System Disturbance
- Stormwater Impacts
- Other Potential Impacts

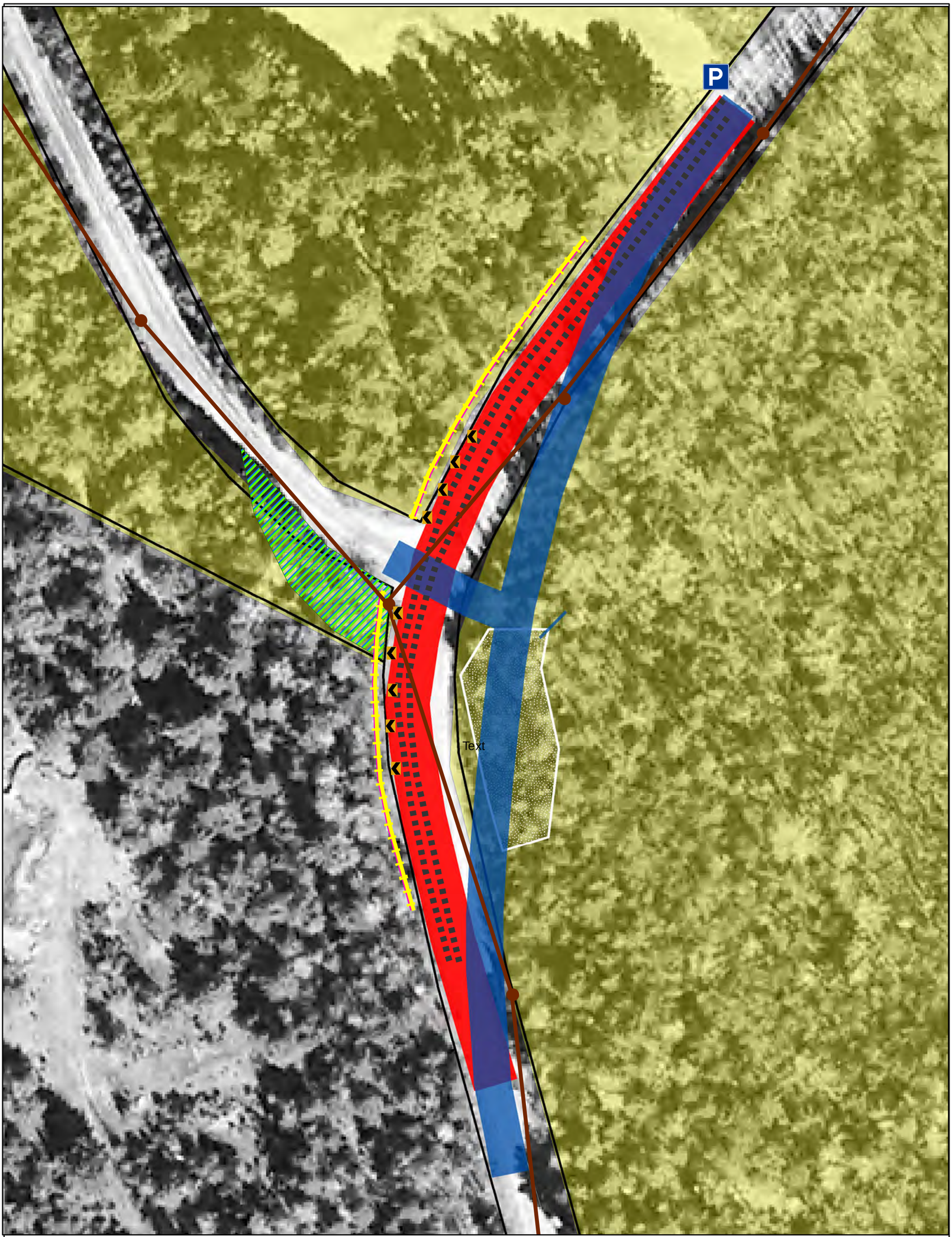
TABLE B-1 Initial Alternatives Analysis

ALTERNATIVE	DESCRIPTION	DISPOSITION	FINAL DESIGNATION
No Action	Retain existing conditions, modified only by the potential installation of new signs based on the HRRR recommendations	Kept	**No Action**
RESERVOIR ROAD MODIFICATIONS			
A: Reduce grade on Reservoir Road north of the intersection to lower the vertical crest	Remove the hightpoint on Reservoir Road so that motorists heading north and south on Reservoir Road and exiting Lords Road have longer sight distances	Kept	**Alt 2a**
B: Reroute Reservoir Road to the east to create a larger radius curve.	Create a new road east of the current road alignment, remove the old road, extend Lords Road to the new roadway, and restore the old road alignment to a natural condition with new meadow seeding and tree plantings	Kept	**Alt 2b**
C: Increase curve superelevation on Reservoir Road	Increase the superelevation of the Reservoir Road curve to provide uniform recommended super-elevation in the curve for the existing radius and to add runoff distance on both ends.	**Deleted** - This modification would remove one of the conditions that keep motorists moving slowly through the intersection, even though it might make it less likely that they would leave the road.	
D: Extend curve superelevation on Reservoir Road as needed to c	Reconstruct the curve to provide uniform six percent superelevation and to add superelevaton runoff distances on both ends	Kept	**Alt 2c**
E: Widen road, provide paved shoulders, and increase the clear zone on Reservoir Road	Improve sight distances and provide wider vehicle recovery areas by widiening the road, removing existing vegetation along Reservoir Rd within the recommended clear zone, and cutting or filling the existing side slopes	Kept	**Alt 2d**
F: Introduce an "S" curve to bring Reservoir Road further west north of the intersection with Lords Road	Make a larger radius curve by pushing Reservoir Road to the west close to Lords Road, which would require a short s turn north of the intersection to bring the road back to its existing alignment close to the parking for the recreation area.	**Deleted** - This alternative would require the removal of the parking spaces and part of the recreation area to be constructed according to State Design Standards and would also shorten the sight distance for motorists existing from Lords Road.	
RESERVOIR ROAD ENHANCEMENTS			
G: Reduced posted speed limit	Reduce posted speed limit on Reservoir Road	**Deleted** - Most motorits are not traveling the speed limit.	
H: Warning signs (per 2013 HRRR Report) and add chevrons	Install curve warning signs (per 2013 HRRR Report) on Reservoir Road, and add chevrons at the curve itself	Kept	**Alt 3a**
I: Guardrail on Reservoir Road	Install guardrail on outside of curve on Reservoir Road to help keep vehicles from leaving the roadway	Kept	**Alt 3b**
J: Rumble Strips	Add center line and outside edge rumble strips through the curve on Reservoir Road	Kept	**Alt 3c**
K: Increase clear zone along Reservoir Road (remove existing trees)	Create a wider clear area long the side of the road but without widening the road itself	**Deleted** - combined with Initial Alternative E	
L: Install flashing warning beacons	Use flashing warning signs to altert motorists of the upcoming curve and ingtersectiocn	**Deleted** - Warning signs loose their affectiveness	
M: Install speed feedback signs on Reservoir Road	Use a radar sign that tells motorists their speed in order to encourage lower speeds	**Deleted** - Most motorits are not traveling the speed limit.	
LORDS ROAD MODIFICATIONS & ENHANCEMENTS			
N: Raise and pave the Lords Road at the intersection to create a level approach area	Create a level paved area for motorists where they stop before entering Reservoir Road	Kept	**Alt 4a**
O: Relocate Lords Road approach to the south of the current intersection	Realign Lords Road to reduce the intersection approach grade, allow longer sight distances to the north, and create a level area for motorists at the intersection	Kept	**Alt 4b**
P: Relocate Lords Road approach to the north of the current intersection	Realign Lords Road to the north of the existing intersection to provide increased sight distance	**Deleted** - would increase the slope of the road and reduce sight distances to the south	
Q: Provide greater tree clearing at the southwest corner of the intersection to increase reduce shade on the road in winter	Remove trees southwest of the intersection to allow more sunlight to reach the road in the winter, reducing the amount of ice on the road	Kept	**Alt 4c**

TABLE B-2 Reservoir Road Alternatives
Town of Orange
Intersection Design Feasibility Study
October 11, 2017

	No Action	a: Reconstructed Road - Current Alignment	b: New Road - Larger Curve Radius	c.i: Curve and Chevron Warning Signs	c.ii: New Guardrails	c.iii: Rumble Strips	c.iv: Southwest Corner Clearing
Project Description							
Amount of Land Swap with the City of Barre	0	0	0.52 AC	0	0	0	0
Additional ROW or Easement Needed	No	Yes	No	No	No	No	Yes
Amount of New Paving*	0	18,000 SF	18,500 SF	NA	NA	NA	NA
Amount of Removed Paving*	0	15,750 SF	16,800 SF	NA	NA	NA	NA
Number of New Signs	0	Variable	Variable	8 Minimum	0	2 Minimum	0
Construction Easements	No	Yes	Yes	No	No	No	Yes
Change in Grade	No Change	Yes	Yes	NA	NA	NA	NA
Change in Superelevation	No Change	Changed to include a complete 6.0% in new curve & correct runoff distances	Changed to include a complete 6.0% in new curve & correct runoff distances	NA	NA	NA	NA
Restored area	NA	0	1.0 AC	NA	NA	NA	NA
Significant Physical Constraints	None	Possible ledge removal required as grade is lowered	Ledge removal required	None	Side slope close to the edge of the road	None	Instability of newly exposed tall trees growing close together
Other Considerations		The addtional slope rights needed would accommodate the road elevation changes and new clear zones	0.52 acres of new right-of-way would need to be acquired from the City of Barre. In exchange, the existing right-of-way would be relinquished to the City upon completion			The installation of the rumble strips requires new pavement with a good foundation to be installed on Reservoir Road.	The additional easement woujld be for the aability to maintian the clearing over time
* Assumes that old pavement will be torn up and new pavement added when the new and old alignments overlap. New Paving is assumed to be 24-feet wide.							
Environmental/Cultural Constraints							
Tree Disturbance	No	Yes - Side slopes distrubed on each side to create clear zone	Yes - New alignment cleared for road	Possible - To locate signs proper distance from road and create good sight lines to signs	Possible - To create space for guardrail	No	Yes - 400 SF of forested area cleared
Tree Replacement		No	Yes	No	No		No
Side Slope Disturbance	No	Yes - Side slopes on both sides will be disturbed	Yes - Side slope on east side would need to be cut	Possibly - Side slope might need to be cut			No
Utility Disturbance	No	Possibly - Up to two utility poles might need to be relocated	Yes - Up to two utility poles would need to be relocated	No	No	No	No
Storm Sewer Disturbance	No	Yes - New drainage ditches would be needed on the east side and the culvert might need to be reset	Old culvert would need to be removed, a new culvert added, and drainage ditches provided on the sides of the new roadway	No	No	No	No
Stormwater Impacts	No	Minor increase in impervious surface - treatment not needed	Increased impervious surface - treatment would be needed	No	No	No	No - New meadow might provide better treatment than forest
Other Impacts	No		The				Clearing will provide more sunlight to reach the road, limiting ice build up in the winter and prevididng longer sight distance to the south from Lords Road
Attributes							
Addresses Purpose and Need	No	Yes	Yes	Yes	Yes	Yes	Yes
Creates Longer Sight Distances	No	Yes	Yes				Yes
Benefits All Users	No	Yes	Yes	Yes	Yes	No	Yes
Reduces Crash Potential	No	Yes	Yes	Yes	Yes	Yes	Yes
Induces Higher Speed	No	Yes	Yes	No	No	No	Yes
Encourages Lower Speed	No	No	No	Yes	Yes	Yes	No
Promotes Fewer Lane Dapartures	No	No	Yes	Yes	Yes	Yes	NA
Order of Magnitude Cost	$0						

Positive Considerations
Negative Considerations
Neutral



Intersection Design Feasibility Study

Orange, Vermont

Alternatives

Legend

- Alternative a
- Alternative b
- Alternative c.i
- Alternative c.ii
- Alternative c.iii
- Alternative c.iv
- Barre City Land
- Parking
- Utility Pole
- Overhead Utility Line
- Parcel Line
- Possible Ledge

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BROADREACH
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UVM CAP

N W E S

0 37.5 75 150 Feet

October 12, 2017

Figure B-1