STATE OF VERMONT
AGENCY OF TRANPORTATION

Alternatives Discussion

FOR

Montgomery BHO 1448(27)

TH 10, BRIDGE 36 OVER THE BLACK FALLS BROOK

May 2, 2012

I. PURPOSE AND NEED STATEMENT

Purpose
The purpose of this project is to provide the traveling public with a safe and efficient crossing over Black Falls Brook.

Need
The existing structure is a timber deck on rolled beams that are rusted. On February 3, 2011, Vermont Agency of Transportation wrote a letter to the town of Montgomery, instructing them to post the bridge for 3 tons. This posting is not capable of carrying the anticipated loads for this bridge.

There is no approach railing or adequate bridge railing. There is a substantial drop from the roadbed to the streambed. The existing abutments/wingwalls are laid up stone w/ concrete facing.

The vertical alignment does not meet the required "K" value for the design speed and needs improvement.

II. SITE INFORMATION

The site is located at Bridge 36 on TH 10, over Black Falls Brook. Bridge 36 is approximately 0.3 miles east of the intersection of TH 10 and TH 6. The bridge site is in a remote part of town that is heavily wooded. The bridge is 28'-6" long (face to face of abutments) and has a roadway width of 14'-0". The clear height from the streambed to the bottom of beams is approximately 8'-2".

The existing handrail is comprised of slender angle iron fascia mounted brackets with tubular steel pipe rail. There is no approach railing and the bridge railing is not sufficient to prevent errant vehicles from exiting the bridge.

Environmental Resources
The following is a summary of the environmental resources at the project site as detailed by the VTrans environmental section.

1. *Agricultural*: There are no prime agricultural soils within the project area.

2. *Archeological*: There are potential archaeological resources in the project area as shown on the Layout Sheet.

3. *Biological*:

   a.) Wetlands: Black Falls Brook is a high gradient watercourse confined with steep banks, and therefore, wetlands and flood plains are not present within the project area.

   b.) Aquatic Habitat: Black Falls Brook is a habitat for trout. Therefore, any removal of vegetation within the riparian zone should be minimized. Timing of construction, water handling techniques, and properly designed and maintained erosion controls should be developed such that impacts to this resource be minimized to the maximum extent practicable. Both a *Stream Alteration Permit* and *COE 404 Permit* application will address this resource.

   c.) Wildlife Habitat: There are no species or habitats of special concern located at the project site.

4. *Forestry*: The project area is best described as mixed forest. This remote part of town is located to the northeast of Montgomery, VT. As with other remote areas throughout Vermont, logging operations have taken place throughout the 1900's. It is probable that logging operations will continue in the future, further justifying the need for a sufficient bridge crossing.

5. *Hazardous Materials*: According to the Vermont Agency of Natural Resources (VANR) *Vermont Hazardous Site List*, there are no known hazardous materials in the project area.

6. *Historic*: The Bridge is not eligible for the National Register of Historic Places.

Hydraulics

The VTrans Hydraulics Unit performed a preliminary hydraulic analysis of the site in July 1999. Their report states that the existing single span bridge has a total clear span perpendicular to the channel of 25'-3". The distance face to face of abutments, measured along the roadway, is 28'-7". The structure is more than adequate hydraulically. If a new superstructure is to be placed on the existing abutments, the bottom of the beams should be no lower than elevation 1140.42 feet on the low end. This elevation will provide 1'-0" of freeboard during a 100 year rainfall event (Q100).

For a complete replacement, a new single span bridge is recommended. The clear span length, measured perpendicular to the channel should be the same as the existing bridge. That will result in a minimum distance of 28'-7" from face to face of existing abutments measured along the roadway. Abutments should be aligned with the channel. No fill material should be placed in front of the abutments, so as to constrict the waterway opening.

Right-of-Way

The Town is responsible for determining the width of the existing right-of-way. VTrans will assist with obtaining any temporary and/or permanent construction easements. A 3-rod right of way has been assumed and is shown on the layout.

Structural Condition

The 2011 inspection report states that the rating (based on a score of 9) of the deck was a 7, the superstructure scored a 4, and substructure a 6.

Deck: The deck, which was replaced in 2001, consists of 3"x10" sawn lumber transverse-members with 2" thick runner planks.

Superstructure: Four rolled I-beams and two light duty channel members support the deck. The beams have areas of heavy rust scale with some moderate pitting and section loss and are not of adequate size for safely supporting modern design loads. The beams throughout are weakening slowly and steadily due to ongoing corrosion activity. Several beams throughout have scattered areas with 50% section loss. The ends of the beams rest directly on the concrete abutments.

Substructure: Abutment #1 was originally laid-up stone and has since been faced with concrete. The concrete facing appears to be in fairly good condition except for the lower downstream corner which has spalled and exposes the original stone. The downstream wingwall consists of laid up stone which needs repointing and the upstream wingwall is in poor condition above the knee wall and should be replaced. Abutment #2 is a concrete abutment in good condition. There is a large void off the end of the upstream wingwall where the embankment has washed out. This also needs to be addressed with the rehabilitation work.

Traffic Data

Since this project has a low traffic volume (<40 vehicles), and the following traffic data will be used:

ADT<40
DHV<10
ESAL's<50,000

Design Criteria

The design standards for this bridge project are the Vermont State Standards, dated October 22, 1997.

Design Criteria	Source	Existing Condition	Minimum Standard	Comment
Approach Lane and Shoulder Widths	VSS Table 6.3	7'/0' (14')	7'/0' (14')	
Bridge Lane and Shoulder Widths	VSS Table 6.3	13.5'/0' (13.5') One way bridge	8'/0' (16')	Substandard
Clear Zone Distance	VSS Table 6.5		7' fill / 7' cut	
Banking			6% (max)	
Speed		25 mph (Posted)	25 mph (Design)	
Horizontal Alignment	AASHTO Green Book Exhibit 3-26	R=80'/50' , Bridge located on straight middle segment of an S-curve	R_{min}=144'	Substandard
Vertical Grade	VSS Table 6.6	Bridge located in transition from (-)2.82% grade to (+)14.55% grade	15% (max) for mountainous terrain	
K Values for Vertical Curves	VSS Table 6.1	Bridge located on sag (K = 7)	20 crest / 30 sag	Substandard
Vertical Clearance Issues	VSS Section 6.6	None noted	14'-0" (min)	
Horizontal Stopping Sight Distance	VSS Table 6.1	64'	150'	Substandard
Bicycle/Pedestrian Criteria	VSS Table 6.7		No provisions	
Bridge Railing	Bridge Manual Section 13	fascia mounted brackets with tubular steel pipe rail	TL-2	Substandard

III. MAINTAINENCE OF TRAFFIC

One-way Temporary Bridge

Initial investigations indicate that any temporary bridge should be located upstream of the existing structure. This placement would have significantly less impacts to the archeological resources than a downstream structure. The upstream alignment would require a phase I archeological study. Additionally, a temporary bridge would require easements from affected property owners.

Advantages: This alternative would have the smallest impact to traffic on TH 10. Access to properties on both sides of the bridge would be maintained at all times during construction.

Disadvantages: The temporary bridge will have additional construction impacts to archeological sensitive areas and will require Right-of-Way acquisition resulting in a longer time before construction can begin. This will increase the cost of the preliminary engineering phase of the project. Construction of the temporary bridge will also add time and increase the cost of the construction phase of the project.

Rapid Construction

This traffic alternative would require closing the bridge for the duration of the bridge erection period. This is a dead end road providing access to one residence, so it does not have high traffic volumes. Thus, closing the bridge for one to two days would have minimal impacts to traffic.

Advantages: This alternative would eliminate the need for a temporary bridge, which would significantly reduce the cost and time of construction. Additionally, this option would not require Right-of-Way acquisition from the town for a temporary bridge and would minimize impacts to archeologically sensitive areas.

Disadvantages: This alternative would have the greatest impacts to local traffic on TH 10.

Realignment of Bridge with Traffic Maintained on Existing Bridge

A realignment of the bridge will not be considered. With realignment, the existing abutments would not be able to be used for soil retention. This option would require new abutments to be poured, which would be both costly and time consuming. Additionally, there are archeological resources on the upstream and downstream sides of the existing bridge. A new alignment would have impacts to these resources. Also, a realignment would require the acquisition of permanent Right-of-Way, which would be both time consuming and costly.

Phased Construction

Phased construction will not be considered. The existing bridge only has one lane, which supports one-way traffic. This existing width of the bridge would make it extremely difficult to construct the bridge in segments.

IV. ALTERNATIVES

The proposed alignment and superstructure alternatives were selected to minimize environmental impacts, construction costs, and for comparison, to identify which most nearly satisfies the goals, and addresses the deficiencies stated in the *Purpose and Need Statement*, as well as which best serves the needs and desires of the Town.

The new superstructure will utilize the existing abutments for soil retention. The construction of new conventional footings and abutments will not be considered. The existing abutments are in good condition and would be able to handle the loading of the backfill and a new superstructure. The bridge is located on a dead end road, and during a portion of the rapid bridge construction, there will be no access to the one residence located on the other side of the bridge. Constructing the bridge utilizing the existing substructure will significantly reduce the time of construction, and is the best option. The downstream wingwalls will need to be repaired; this work can be done with the bridge open to traffic.

On Existing Alignment
Reconstruction of the bridge on the existing alignment was considered in the scoping process and is selected as the recommended alternative. Remaining on alignment will reduce impacts to archaeologically sensitive areas, provide lower construction costs, reuse portions of the existing structure, and maintain the character of the existing site. Additionally, the road will be raised approximately one foot for hydraulics and an improved vertical alignment.

Realignment
Reconstruction of the bridge on a new alignment was considered and is not discussed further in this report as building a new bridge on a new alignment would be much more costly, generate permanent changes to the natural character of the site, would potentially effect archaeological resources, and would not maintain the existing funds sharing as discussed with the town (Federal 80%, State 15%, Local 5%). Construction of a completely new bridge would increase the local share of the project cost to 10%.

Alternative-1: No Action

This alternative would leave Bridge 36 in its current condition. The bridge fails to provide a sufficient and reliable structure for logging trucks, emergency vehicles, and other heavy vehicles that utilize the crossing. Although the existing structure is not in imminent danger of collapse, the deteriorated beams will continue to worsen while the lack of an adequate guardrail system poses an ongoing hazard. In the bridge's present condition, there is the possibility of vehicles rolling off the bridge into Black Falls Brook.

Alternative-2: Replace Structure – Temporary Bridge

This alternative would utilize conventional bridge construction methods to replace the existing superstructure. In order to construct a temporary bridge, this option would require Right-of-Way acquisitions, as well as have impacts to archeologically sensitive areas. Substructure work for this alternative would consist of saw cutting the top portion of each abutment and pouring new bridge seats. Additionally, each wingwall on the upstream portion of the bridge would be completely replaced to provide for a 14'-0" wide superstructure which is slightly wider than the existing. Also, repointing of the laid-up stone wingwall at abutment #1 would be necessary. This option nearly doubles the cost of construction versus the rapid bridge option.

Advantages: This option allows traffic to be maintained during construction.

Disadvantages: The construction time for this option would be significantly greater than the rapid bridge option. Additionally, there would be impacts to the surrounding archeologically sensitive area. The cost of this option is nearly double than the cost of the rapid bridge option.

Alternative-3: Replace Structure – Rapid Bridge

This alternative utilizes rapid bridge construction methods to replace the existing superstructure with a new superstructure. Whichever superstructure type is chosen, a concrete bare deck is recommended. The substructure work for this alternative would consist of saw cutting the top portion of each abutment and placing precast footings behind each of the abutments for the superstructure to rest on. Additionally, the downstream wingwall at abutment #1 would need to be repaired.

Advantages: Using rapid bridge construction methods, closure time can be reduced to approximately 1 to 2 days. A temporary bridge would not be used, significantly reducing the timeline and cost of the project. By utilizing a bare deck, little time is needed for concrete to cure on site. A grout will be used for the shear keys, which has a cure time of 3 days; however, access could be maintained for the one residence while this is curing. Archeology studies and Right-of-Way approvals can be time-consuming/costly, and are not needed for the rapid construction alternative. Additionally, environmental impacts are reduced.

Disadvantages: For this alternative, the bridge would be closed during construction (approx. 1 to 2 days). During this time, there would be limited access to the one residence located on the southern side of the bridge.

A cost evaluation of each alternative is shown below:

Montgomery BHO 1448(27)		**Alternative 1**	**Alternative 2**	**Alternative 3**
		Do Nothing	New Bridge w/ Temporary Bridge	New Precast Superstructure - Rapid Construction
COST	Roadway			
	Earthworks, Pavement, Traffic Control	$0	$38,688	$38,688
	Temporary Bridge	$0	$120,000	$0
	Bridge			
	Superstructure	$0	$99,500	$99,500
	Substructure	$0	$39,200	$39,200
	Removal of Structure	$0	$10,000	$10,000
	Channel Work	$0	$5,000	$5,000
	Erosion Control	$0	$20,000	$20,000
	Prelim. Engineering (15%)	$0	$69,937	$45,187
	Right of Way Acquisition	$0	$50,000	$0
	C. E. + Contingencies	$0	$69,937	$22,593
	ROUNDED TOTALS =	**$ 0**	**$ 657,000.00**	**$ 370,000.00**
ENGINEERING				
	Typical Section - Roadway (feet)	14'	14'	14'
	Typical Section - Bridge (feet)	13.5'	14'	16'
	Traffic Safety	No Change	Improved	Improved
	Alignment Change	No	No	No
	Bicycle Access	No Change	No Change	No Change
	Hydraulic Performance	No Change	No Change	No Change
	Pedestrian Access	No Change	No Change	No Change
	Utility	No Change	No	No
OTHER	ROW Acquisition	No	Yes	No
	Road Closure	No	No	Yes

V. Conclusion

The recommended alternative is to close the bridge and replace the existing superstructure with a precast concrete superstructure with a bare deck, utilizing rapid bridge construction methods. This is a low volume road, which provides access to one residence. A temporary bridge is not needed for this alternative, significantly decreasing the overall cost and timeline of the project as well as impacts to surrounding resources. The rapid bridge alternative is approximately half the cost of the conventional bridge type. With this option, there would be no access to the one residence for approximately one day. The homeowner can be directly involved in choice of day to close the bridge. This option is not only the most cost efficient option, but also has minimized impacts to surrounding archeological and environmental resources and is thus the recommended alternative.

PICTURES

Western Downstream Approach

Eastern Upstream Approach

Looking Upstream

Looking Downstream

Abutment No. 1

Abutment No. 2