

INTERCHANGE MODIFICATION REPORT

FOR

**INTERSTATE 81 AND ROUTE 37 INTERCHANGE
FREDERICK COUNTY, VIRGINIA
MILEPOST 310**

**PREPARED BY:
VIRGINIA DEPARTMENT OF TRANSPORTATION
STAUNTON DISTRICT**

**DECEMBER 13, 2006
Revised: February 16, 2007**

PURPOSE AND NEED

Plans have been submitted to the Virginia Department of Transportation (VDOT) by a developer proposing the commercial and residential development of the eastern quadrants of the I-81 and Route 37 (Exit 310) interchange. As part of a proffer package, Frederick County has made the approval of these development plans contingent on the acceptance of the interchange modifications by VDOT and FHWA.

In addition, continued development in the Winchester area and with the proposal to extend Route 37 to complete a loop bypass around Winchester, the existing interchange will need to be improved to provide an acceptable Level of Service.

PROJECT LOCATION AND DESCRIPTION

The proposed project is located south of Winchester on Interstate 81 at milepost 310. This project consists of modifications to an existing interchange servicing Route 37 north to Winchester and continued access to Route 11. Improvements to Route 37 and Route 11 will be included in the modifications to the interchange.

The existing interchange at Route 37 is a conventional rural diamond interchange for servicing local roads or streets. All four ramps have similar geometry and length. The ramps have a straight alignment with a flat curve transition to the mainline and have a length of 1600 feet including the acceleration and deceleration lengths. On Route 37 the northbound and southbound ramp intersections are signalized and are spaced less than 200 feet east and west of the interstate mainline.

The interchanges on Interstate 81 in Frederick County have a spacing of approximately three miles which is standard spacing for rural areas. The interchange with Route 50 is almost three and a half miles north of the Route 37 interchange and is a four leg interchange with a partial cloverleaf. The interchange with Route 277 is three miles south of the Route 37 interchange and is a conventional rural diamond interchange.

On Route 37 the adjacent intersections and interchanges are in close proximity to the existing interchange. The intersection with Tasker Road is less than 200 feet from the northbound ramp termini on the east side of the interchange. One thousand feet west of the interchange, Route 11 runs parallel to the interstate. The terminus for the westbound ramp onto Route 11 is less than 100 feet from the terminus of the southbound interstate ramp. The ramp from Route 11 to eastbound Route 37 has no separation from the southbound entrance ramp for the interstate.

The existing interchange has an interchange Level of Service C for the current traffic volume. Accident data for the entire interchange for the last three years shows a total of sixty-one (61) crashes with one fatality on Interstate 81. The fatality was a rear end collision in the northbound lane three hundred feet (300') north of the overpass of Route 37 and was due to driver inattention. As shown in the chart below, forty-one percent (41%) of the crashes involved injuries to one or more persons.

	DVMT	Total Crashes	Injury Crashes	Fatal Crashes
Interstate 81 N	22,064	25	8	1
Interstate 81 S	22,402	13	9	0
Route 37	1,904	23	8	0

RELATIONSHIP TO OTHER HIGHWAY IMPROVEMENTS

The WinFred MPO Long Range Plan (See Attachment A) identifies many significant regional roadway improvements. Some projects that are underway or in active planning stages include:

- The extension of Route 37 east to Warrior Drive (Route 719), Route 522, and beyond.
- The extension of Warrior Drive north to the new Tevis Street Bridge across I-81.
- The extension of Warrior Drive south to Route 277.
- The relocation of the I-81 / Rte 277 interchange about ½ mile south, with existing interchange bridge remaining as a bridge connection without access to I-81/
- A MPO planning study is underway to evaluate a new Route 37 interchange at or near Shady Elm Drive (Route 651).
- Construction of the “Stephens City Bypass” west of town connecting I-81 and Route 37 at the above two new / relocated interchanges.
- East of I-81, relocated Route 277 will connect to existing Route 277 corridor and connect with Warrior Drive, providing a similar “bypass” connecting I-81 with Route 37 east of I-81.

Completion of these roadway improvements will greatly enhance regional travel options in this area and provide congestion relief for the I-81 / Route 37 interchange.

2035 REASONABLE ALTERNATIVES

Two proposed interchange designs have been reviewed for the improvements to the Route 37 interchange. Both alternatives have been assessed on the basis of traffic volumes, capacity and cost.

Alternative A

A VDOT improvement study for a nineteen (19) mile section, from milepost 305 to 324, of Interstate 81 was completed in 1998 by Hayes, Seay, Mattern & Mattern, Inc. Included in this study was a conceptual design (See Attachment B) for improving the interchange at milepost 310 for the future Route 37 Winchester loop. The study proposed a design for a four leg interchange with a full cloverleaf and collector distributor roads on both Interstate 81 and Route 37 (future loop). As a result of discussions between the FHWA and VDOT, the collector distributor lanes on Route 37 were eliminated (See Attachment C).

Due to the proximity of the Route 37/11 interchange, possible operational problems were identified. Major modification/relocation of this interchange to reduce/eliminate weave and other operational problems would be desirable. The ultimate solution to the

location/relocation of this interchange is not being addressed at this time in this interchange modification request.

Based on 2035 forecasts, this interchange configuration will provide Levels of Service ranging from A to F for weaving and merging sections. This interchange design has an estimated construction cost of \$52.7 million, not including required right of way or utility relocation.

Alternative B

The second alternate considered was a three level semi-directional interchange (See Attachment D). The area impacted by this alternative is larger than the full cloverleaf on the northwest quadrant of the interchange due to the improvements to interchange for Route 11, but is smaller on the southwest and northwest quadrants. This interchange configuration provides a Level of Service C or better at all weaving sections and has an estimated construction cost of \$74.4 million. The construction cost does not include the required right of way or utility relocation.

Alternative B improves the Level of Service at the interchange, but the construction cost is almost \$22 million more than for Alternative A. Due to the developing nature of surrounding land uses and significant regional roadway improvements underway, it is difficult to presently determine whether this additional cost (40 % higher) will be justified. Therefore, we recommend the following:

- Both Alternatives A and B be considered as viable alternatives,
- ROW obtained during Phase 1 should be adequate to accommodate both ultimate 2035 alternatives,
- After Phase 1 is constructed and fully operational, a future request from VDOT for approval of Phase 2 improvements at this I-81 / Route 37 interchange will include another evaluation of 2035 system interchange alternatives for Phase 3.

BASIS OF PROPOSAL

VDOT is confronted with several issues in the development and improvement of this interchange. First is the dynamic development of the adjacent area. The commercial and residential development near this site and the numerous roadway projects in the adjacent area make traffic forecasting a challenge for the existing interchange.

Second, the developer has agreed to proffer right of way in the eastern quadrants of the interchange and proffer construction of several roadway elements to expedite the improvements to the interchange and fulfill the agreement with Frederick County. VDOT is anxious to finalize these proffers and obtain the necessary right of way for future improvements.

A project is included in the FY2007-2012 SYIP (UPC 75881) for “SAFETY/TRAFFIC OPERS/TSM” for \$3,278,000 at this interchange. It is the District’s intention to use these funds, in addition to supplemental private/State/Federal funds (yet unobligated) to construct the Phase I project. There are, as of now, no projects in the SYIP for completion of any of the Phase II or III work.

In order to utilize the findings and conclusions from the planning studies, be proactive in adjusting to the future growth of the area, improve the operation and safety of the interchange, and leverage the opportunities to secure right of way and roadway improvements, VDOT is proposing that the new interchange configuration be achieved in three (3) design and construction phases.

PHASES OF DESIGN AND CONSTRUCTION

Individual elements from the conceptual Alternate A design (full cloverleaf, see Attachment C) have been selected and staged for the interchange as the development of the region progresses.

Phase I

VDOT is proposing that the outer ramps or spread diamond of the concept design utilizing a design year of 2012 be considered as Phase I (See Attachment E). This phase will utilize the existing bridges over Interstate 81 and the majority of existing pavement on Route 37. Modifications to the Interstate 81 interchange are limited to the relocation and improvement of the entrance and exit ramps and the extension of the acceleration and deceleration lanes for a 50 mph ramp design speed. Modifications to Route 37 will include new turn lanes at the existing interchange and at the interchange for Route 11, an extension of Route 37 to the east and the realignment of Tasker Road. Traffic studies will be used to determine the start of the Phase II design and construction. These studies will begin with the completion of Phase I construction and continue at two year intervals. VDOT will evaluate the safety conditions and level of service of this interchange as it relates to all the interchanges within the district. The priority of safety and level of service issues for this interchange in combination with the availability of funding will be the decisive factors used to trigger the start of Phase II. VDOT will continue to coordinate with the FHWA to ensure the safety of the traveling public within the District.

Phase II

The particular Phase II geometric design will be determined at the start of this phase of the project. Updated traffic counts and improvements in the adjacent developed areas will be incorporated into the traffic model. Presently, three options are being considered for this phase. All options under consideration will incorporate the spread diamond interchange as proposed in Phase I.

Option A (See Attachment F) and Option B (See Attachment G) consist of a partial clover loop ramp design to eliminate the left turn movements for motorists when entering the interstate from Route 37 or exiting the Interstate onto Route 37. Option A will add the entrance loop ramps while Option B will add the exit loop ramps. Although the length of the existing Route 37 bridges over Interstate 81 may allow for the additional lanes needed for acceleration or deceleration, these two options may involve extensive and complex widening of Interstate 81 to the median. A disadvantage of both Option A and Option B is that the proposed loop ramps could not be reused in Phase III.

Option C (See Attachment H) will replace the Route 37 bridges over Interstate 81 to provide a divided six lane typical section on Route 37 and to accommodate the future width of Interstate 81. The new bridges will provide storage for the left turn movements

at the signalized ramp intersections. The advantage of this option is that the bridges will be utilized in the development of Phase III and will not be considered throw away construction as are the first two options.

Phase III

Phase III (See Attachment I) will complete the full reconstruction of the interchange and be comparable to the conclusions reached by the 1998 Interstate 81 improvement study as mentioned above. Phase III will also include the continuation of the Route 37 widening and will grade separate the intersection at Route 37 and Tasker Road. Since Route 37 is proposed to be a limited access roadway this intersection will be improved to a system grade separated interchange. The right of way acquired for Phase I, accommodates the right of way footprint of this system interchange.

OPERATIONAL ANALYSIS OF DESIGN ALTERNATIVE

Traffic volumes utilized for the analysis were for the 2012 full build-out from the Route 37/I-81 Interchange Analysis (PHRA, June 1, 2006). The PM Peak hour was selected for this study since the PM peak had higher volumes than the AM peak at every intersection. VDOT has amended the PM peak count for westbound Route 37 slip ramp to Route 11 northbound after the submission of the report from PHRA.

While only the PM peak is evaluated at this conceptual stage, AM & PM peak volumes will be evaluated during the preliminary engineering stages of Phase I and Phase II development projects.

SYNCHRO was utilized to develop the cycle lengths for the coordinated signal timing for the three Route 37 intersections (southbound ramps, northbound ramps, realigned Tasker Road) and the Route 11 intersection. These cycle lengths were optimized using HCS software to estimate individual intersection Levels of Service (LOS) & 95% Back of Queue (BOQ). The table in Attachment I shows 2012 full build-out PM Peak hour LOS and 95% BOQ for every movement at these four signalized intersections for Phase I and also for the three options considered in Phase II.

Phase I

The spread diamond as proposed in Phase I will achieve an overall LOS C at the ramp intersections, but will result in LOS D for some approaches and LOS D/E for some left turn movements at the interstate ramps, (See Attachment J). As development continues in the area and additional routes are made available, these movements and LOS may change. VDOT requests concurrence for the LOS from the FHWA for this phase.

With Phase I, the 95% BOQ and required stopping sight distance can be accommodated within turn lane storage on I-81 northbound & southbound off ramps, and on the Route 37 approaches on the bridge structure inside the ramps at the interchange. In addition, at the Route 37 and Route 11 interchange, the 95% BOQ and required stopping distance can be accommodated within turn lane storage along Route 37 off-ramp at Route 11, and along eastbound Route 37 at Tasker Road.

However, the 95% BOQ will exceed available storage along eastbound Route 37 at the southbound ramp and also along westbound Route 37 at the northbound ramp

intersections due to close proximity of the existing Route 11 interchange and the future Tasker Road intersection. Other regional improvements in the area will change the traffic patterns and may reduce the future traffic volumes at these intersections. If congestion and major queuing should become a factor, these intersections can be reevaluated as part of the Phase II interchange improvements. With the completion of Phase III, these issues will be eliminated since the intersection of Tasker Road and Route 37 will be grade separated and the Interstate 81 ramps will be free flow directional ramps.

The on and off ramp details shown on Attachment E are preliminary only. During the preliminary design phase of PE, VDOT Traffic Engineering will evaluate the need and necessity of the number of lanes, turning movements, and signage for all movements. FHWA will review and approve of all modifications to the ramps. Turn lanes bays on Route 37 will be the full-width for the length of queue except where restricted by existing bridge widths. Dual left turn lane traffic onto I-81 entrance ramps will be reduced to one lane after a suitable distance (minimum 500' from point motorist realizes lane closure to point where markings for taper start) unless other operational factors require longer distances.

Phase II Option A

The spread diamond with the on loop ramps as proposed in Phase II, Option A will achieve an overall LOS B at the ramp intersections, but will result in LOS D for most of the approaches at the interstate ramps, (See Attachment J).

With Phase II, Option A the 95% BOQ and required stopping sight distance can be accommodated within turn lane storage on I-81 northbound & southbound off ramps similar to Phase I.

Phase II Option B

The spread diamond with the off loop ramps as proposed in Phase II, Option B will achieve an overall LOS C at the ramp intersections, but will result in LOS D/E for the off loop ramps at the interstate (See Attachment J).

With Phase II, Option B the 95% BOQ and required stopping sight distance can be accommodated within turn lane storage on I-81 northbound & southbound off ramps.

Phase II Option C

The spread diamond with the bridge replacements on Route 37 achieve an overall LOS B/C at the ramp intersections, but will result in LOS D for the southbound off ramp at the interstate (See Attachment J).

With Phase II, Option C the 95% BOQ and required stopping sight distance can be accommodated within turn lane storage on I-81 northbound & southbound off ramps similar to Phase I.

DESIGN EXCEPTIONS**Phase I**

The existing bridge on northbound Route 37 was constructed in 1964 and the width of the bridge does not meet current standards. A design exception will be required since no improvements are planned for this bridge in Phase I (See Attachment K). The proposed modifications to the Interstate Interchange as shown in Phase I are to be in compliance with the policies on geometric design as set forth by AASHTO and VDOT.

Phase II, Option A

The existing bridge on westbound Route 37 was constructed in 1964 and the width of the bridge does not meet current standards. A design exception will be required since no improvements are planned for this bridge in Phase IIA.

The length of the acceleration lanes for the entrance loop ramps are not standard for due to the proximity of the diamond entrance ramp onto Interstate 81. VDOT is anticipating that a design exception will be required for the reduced acceleration lane length.

In addition, if widening of Interstate 81 does not occur simultaneously the Phase II, Option A, the entrance loop ramp deceleration lanes will be located under the existing bridge structure and the shoulder width will be restricted. VDOT is anticipating that a design exception will be required for the reduced shoulder width.

Phase II, Option B

The existing bridge on westbound Route 37 was constructed in 1964 and the width of the bridge does not meet current standards. A design exception will be required since no improvements are planned for this bridge in Phase IIB.

If widening of Interstate 81 does not occur simultaneously the Phase II, Option B, the exit loop ramp deceleration lanes will be located under the existing bridge structure and the shoulder width will be restricted. VDOT is anticipating that a design exception will be required for the reduced shoulder width.

Phase II, Option C

The proposed modifications to the Interstate Interchange as shown in Phase II, Option C are to be in compliance with the policies on geometric design as set forth by AASHTO and VDOT. VDOT does not anticipate any design exceptions for this phase.

ESTIMATED PROJECT COSTS

The estimated project costs shown below are for Phases I and II and are based on an advertisement year of 2010. The estimated costs reflect only construction costs and do not include design, right of way acquisition in the western quadrants, utility relocation or construction management. The estimates for Phase II options show that this phase will be a feasible step toward the completion of the project.

	Phase I	Phase II		
		Option A	Option B	Option C
Construction Cost	\$16,500,000	\$13,600,000	\$12,600,000	\$12,800,000

CONCLUSION

With limited available financial resources and a developer willing to assist in the improvements of this interchange it makes good business sense to the Department to take advantage of the opportunity to accept proffers for right of way and roadway construction. The Department believes the phased approach to these improvements is a financially feasible plan.

VDOT is requesting approval of this phased approach for possible ultimate modification of this interchange. Specifically, VDOT is requesting FHWA approval/concurrence with the elements of the Phase I construction as contained in this report. This approval would be contingent on approval of the bridge design exception described herein. This approval would also be contingent on concurrence in the less than AASHTO standards for level of service and turn bay lengths as also outlined and described in this report.