Route 15 North of Leesburg: A Closer Look at the Effects of Widening

Prepared by Norman Marshall, President
Smart Mobility, Inc.
September 2018

Route 15 North of Leesburg:
A Closer Look at the Effects of Widening

By Norman Marshall, President
Smart Mobility, Inc.

Executive Summary

In the traffic modeling work that Loudoun County has done to date as part of the Route 15 Safety and Operations study, the county has evaluated traffic conditions under two different improvement "concepts" – Modified Concept A and Modified Concept B.

The main components included in Modified Concept A are:

- Widening Route 15 to four lanes between White's Ferry Road and Montresor Road, with median and turn lanes along this stretch;
- Implementing controlled access (right-in-right-out access at driveways) along Route 15 between Montresor Road and Saint Clair Lane; and
- Building a two-lane, controlled access bypass around Lucketts, while keeping Route 15 through Lucketts to two lanes and maintaining current access.

The main components included in Modified Concept B are:

- Widening Route 15 to four lanes between White's Ferry Road and Lucketts (south), and implementing controlled access (right-in-right-out access at driveways) along this stretch;
- Implementing controlled access (right-in-right-out access at driveways) along Route 15 between Lucketts (north) and Saint Clair Lane; and
- Building a controlled access bypass around Lucketts, part of which would be four lanes, and part of which would be two lanes.

As part of developing its traffic analyses, the county has projected future (year 2040) traffic volumes for the two concepts. For the Modified Concept A scenario, the county has projected a linear traffic growth rate of 0.75% per year (which equates to an overall growth rate of 17% by 2040 as compared to current volumes). For Modified Concept B, the county has projected a linear traffic growth rate of 1.25% per year (which amounts to a 29% increase in 2040 as compared to 2017 volumes). Although the county's use of a higher traffic growth rate for Concept B is an acknowledgment that the more extensive widening proposed in Modified Concept B would attract more traffic – or "induced travel" – to Route 15 than the shorter stretch of widening proposed in Modified Concept A, the county's traffic evaluations of the two concepts fail to adequately capture just how significantly widening in both concepts would induce new travel along Route 15 and therefore create new backups outside of the widened portions. The result is that the county's analysis significantly exaggerates the benefits of widening Route 15 and underestimates the new traffic problems it would generate.

In order to get a more reliable picture of the effects of widening, I determined it was necessary to employ a travel demand model that more adequately captures key aspects of induced travel and improves other aspects of the travel demand models that are at the county's disposal. I therefore created an enhanced travel demand model that properly accounts for the induced travel that Modified Concepts A and B would generate. I also added a third alternative that does not include widening and serves as a loose proxy for a traffic-calming and roundabout approach so that I could compare traffic congestion under that approach to Modified Concepts A and B.

The results from the enhanced model show that traffic will not grow nearly as much along Route 15—and particularly along the congested portions—if the highway is not widened. Further, the enhanced model shows the extent to which the additional capacity constructed in the two widening scenarios would attract more traffic—and especially regional trips—to the corridor. When the full extent of induced travel is taken into account, it is clear that while the additional capacity from widening may appear to help address existing bottlenecks on Route 15, it simply shifts them upstream of the widened portions.

Even setting my enhanced model aside, the same "bottleneck-shifting" effects of widening Route 15 are also apparent in the modeling outputs generated by the county's own analysis, albeit to a lesser extent since the traffic forecasts the county used for its analyses do not adequately account for induced travel.

To address the safety issues that would result from having to turn left onto a four-lane Route 15 at the many unsignalized intersections along the roadway, access from driveways and many side streets is shown as being limited to right-in-right-out movements in Modified Concepts A and B. This would greatly inconvenience those accessing Route 15 from those streets: In order to turn left, they would need to turn right and then make a U-turn at one of the widely-spaced roundabouts shown in the diagrams for Modified Concepts A and B.

Decision-makers, business owners, and residents alike would be wise to engage in the debate over widening Route 15 with their eyes wide open. Once one portion is widened to four lanes, the new bottlenecks it generates upstream will generate pressure to widen the next segment. This pushes the county into a wasteful and repetitive cycle of successive and expensive widening projects that yield unsatisfactory results. Route 15 becomes a larger and more dangerous highway primarily designed for regional travelers, while the historic character of the corridor is destroyed, local access is limited, and congestion remains. It is best to stop this cycle before it gets started. The far more prudent and responsible approach is to forego the widening alternatives, and instead intentionally manage traffic flow on Route 15 with traffic-calming improvements and roundabouts.

Route 15 North of Leesburg:
A Closer Look at the Effects of Widening

By Norman Marshall, President
Smart Mobility, Inc.

Introduction

In the traffic modeling work that Loudoun County has done to date as part of the Route 15 Safety and Operations study, the county has evaluated traffic conditions under two different improvement “concepts” – Modified Concept A and Modified Concept B.

The main components included in Modified Concept A are:

- Widening Route 15 to four lanes between White’s Ferry Road and Montresor Road, with median and turn lanes along this stretch;
- Implementing controlled access (right-in-right-out access at driveways) along Route 15 between Montresor Road and Saint Clair Lane; and
- Building a two-lane, controlled access bypass around Lucketts, while keeping Route 15 through Lucketts to two lanes and maintaining current access.

The main components included in Modified Concept B are:

- Widening Route 15 to four lanes between White’s Ferry Road and Lucketts (south), and implementing controlled access (right-in-right-out access at driveways) along this stretch;
- Implementing controlled access (right-in-right-out access at driveways) along Route 15 between Lucketts (north) and Saint Clair Lane; and
- Building a controlled access bypass around Lucketts, part of which would be four lanes, and part of which would be two lanes.

As part of developing its traffic analyses, the county has projected future (year 2040) traffic volumes for the two concepts. For the Modified Concept A scenario, the county has projected a linear traffic growth rate of 0.75% per year (which equates to an overall growth rate of 17% by 2040 as compared to current volumes). For Modified Concept B, the county has projected a linear traffic growth rate of 1.25% per year (which amounts to a 29% increase in 2040 as compared to 2017 volumes). Although the county’s use of a higher traffic growth rate for Concept B is an acknowledgment that the more extensive widening proposed in Modified Concept B would attract more traffic to Route 15 than the shorter stretch of widening proposed in Modified Concept A, the county’s traffic evaluations of the two concepts fail to adequately capture just how significantly widening in both concepts would induce new travel along Route 15 and therefore create new backups outside of the widened portions. The result is that the county’s analysis grossly exaggerates the benefits of widening Route 15 and underestimates the new traffic problems it would generate.

In order to get a more reliable picture of the effects of widening, I determined it was necessary to employ a travel demand model that more adequately captures key aspects of induced travel and improves other aspects of the travel demand models that are at the county's disposal. I therefore created an enhanced travel demand model that properly accounts for the induced travel that Modified Concepts A and B would generate. I also added a third alternative that does not include widening and serves as a loose proxy for a traffic-calming and roundabout approach so that I could compare traffic congestion under that approach to Modified Concepts A and B.

As discussed below, the results from the enhanced model show that traffic will not grow nearly as much along Route 15—and particularly along the congested portions—if the highway is not widened. Further, the enhanced model shows the extent to which the additional capacity constructed in the two widening scenarios would attract more traffic—and especially regional trips—to the corridor. When the full extent of induced travel is taken into account, it is clear that while the additional capacity from widening may appear to help address existing bottlenecks on Route 15, it simply shifts them upstream of the widened portions, creating new congestion that must then be addressed with new widening projects.

This points the county down a wasteful path of successive and expensive widening projects that result in a larger and more dangerous highway designed for regional travelers, in which the historic character of the corridor is destroyed, local access is limited, but congestion remains. It is best to stop this cycle before it gets started. The far more prudent and responsible approach is to forego the widening alternatives, and instead develop a strategy for intentionally managing traffic flow on Route 15 with traffic-calming improvements and roundabouts.

The Loudoun County Traffic Analyses Fail to Sufficiently Account for Induced Travel.

Induced travel is an important and well-established dynamic that explains why roadway widening projects in congested regions cause traffic volumes to grow and quickly fill the new capacity the widening project created. Anthony Downs is a prominent economist at the Brookings Institution who was one of the first to observe and explain this phenomenon:

> *Nearly every vehicle driver normally searches for the quickest route, one that is shorter or less encumbered by obstacles (such as traffic signals or cross-streets) than most other routes. These direct routes are usually limited-access roads (freeways, expressways, or beltways) that are faster than local streets if they are not congested. Since most drivers know this, they converge on such "best" routes from many points of origin.*
>
> *The problem is that during the peak travel hours on weekdays, so many drivers converge on these "best routes" that they become overloaded, particularly in metropolitan areas. Traffic on them eventually slows to the point where they have no advantage over the alternative*

routes. That is a rough equilibrium is reached, which means that many drivers can get to their destinations just as fast on other roads.[1]

Downs coined the term "triple convergence" to describe how peak period traffic congestion is inevitable because drivers will compensate for capacity increases by (a) shifting routes; (b) shifting travel time of travel; and (c) shifting travel mode. Due to these shifts, the new equilibrium after capacity will be just as congested as the old equilibrium.[2]

The first two effects listed by Downs (route shifts and time-of-day shifts) are already present in the Route 15 corridor today and can be seen in the traffic count data. However, as discussed below, they are not adequately captured in the traffic growth forecasts that Loudoun County used for the Route 15 Safety & Operations Study. The county then input those flawed traffic growth forecasts into the VISSIM microsimulation software package that models individual cars and driver behavior to develop the various measures of congestion (e.g., traffic queues, average delay at intersections, level of service) that are discussed in the county's Route 15 traffic analyses. Because the traffic growth forecasts were developed in a flawed manner that failed to properly account for induced travel, the VISSIM microsimulation results based on those forecasts are also flawed, as discussed below.

Route Shifts

Currently, a significant amount of traffic diverts from Route 15 in the morning peak period to avoid the backups south of the traffic signal in Lucketts. The county's traffic count data bears this out. There were 773 right turns from Montresor Road onto Route 15 counted in the three peak morning hours, but only a third as many vehicles (263) counted in the three peak afternoon hours turning left onto Montresor Road. This discrepancy strongly indicates that a large percentage of the vehicles turning right onto Route 15 from Montresor Road in the morning are not people who live in the neighborhoods accessed by Montresor Road, but rather are drivers using the Stumptown Road/Montresor Road route as an informal "bypass" in the morning to avoid congestion in the morning rush hour. (Elsewhere in the corridor, the returning afternoon three-hour traffic volumes are only slightly lower than the morning three-hour volumes.) The Loudoun County traffic forecasts assume that the same utilization of the informal Stumptown/Montresor Road "bypass" would occur with or without the Lucketts Bypass in place. However, if Route 15 is widened, many of the vehicles using this route as an informal bypass would shift back to Route 15 to take advantage of the added capacity. As a result, future traffic volumes would be higher on Route 15 in the morning peak period than the Loudoun County

---

[1] Downs, Anthony. *Stuck in Traffic: Coping with Peak-Hour Traffic Congestion*, p. 27. Brookings Institution and Lincoln Institute of Land Policy, 1992.

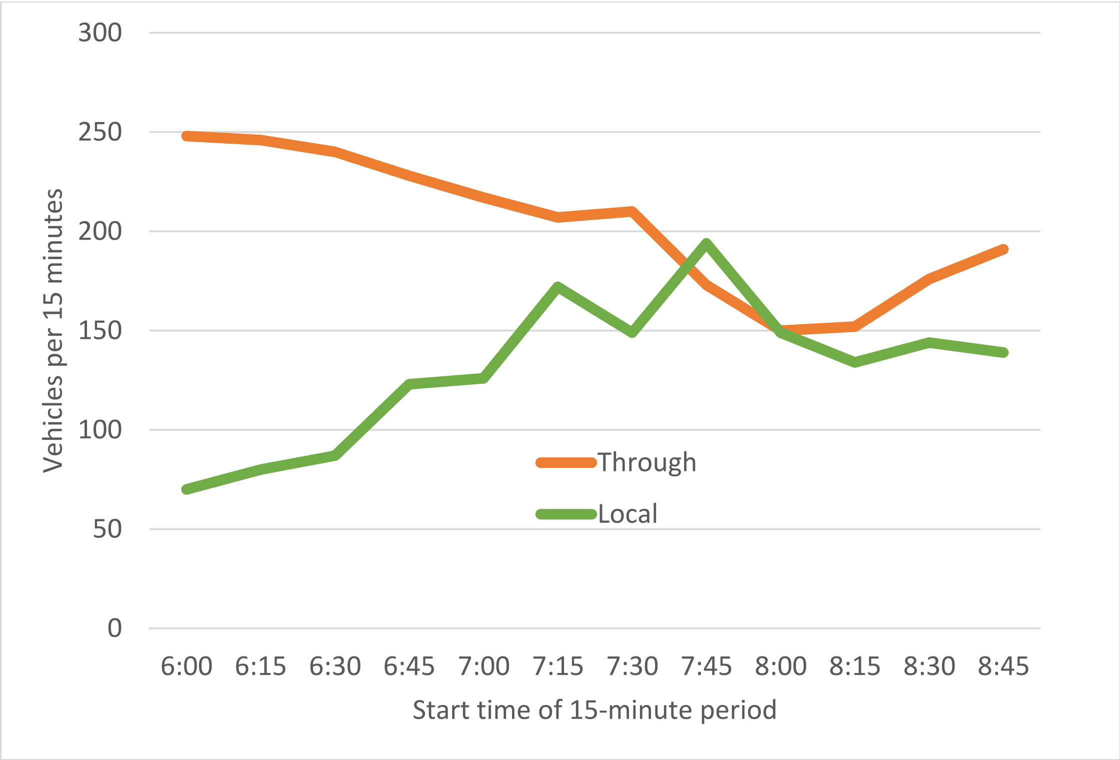
[2] The term "induced travel" has been used to include the three triple convergence effects discussed above, plus shifts in destinations, and longer-term shifts in land use. Induced travel has been studied in dozens of research efforts. A recent review of induced travel research concluded that induced travel is real and that the magnitude is sufficient to prevent capacity expansion from reducing congestion. Handy, S. and M. G. Boarnet; *Impact of Highway Capacity and Induced Travel on Passenger Vehicle Use and Greenhouse Gas Emissions: Policy Brief prepared for California Air Resources Board*; September 30, 2014. See also Litman, Todd; *Generated Traffic and Induced Travel – Implications for Transport Planning*; April 24 2018, *available at* http://www.vtpi.org/gentraf.pdf.

analyses assume. Therefore, the traffic forecasts for Route 15 used in the county's VISSIM analyses on the road segments that are now "bypassed" with the Stumptown Road/Montresor Road route are too low and render the performance measure results unrealistic.

Time-of-Day Shifts

Similarly, the Loudoun traffic forecasts fail to account for the induced travel that would manifest in regional drivers shifting the time of day that they use Route 15. Current Route 15 traffic counts show very different time profiles for "local" traffic versus "through" (or "regional") traffic in the morning peak period, and it is evident that regional traffic is suppressed by local traffic volumes at peak travel times.[3] As shown in Figure 1 below, the "through" traffic peaks in the very first 15-minute time period (6:00 – 6:15 a.m.), as through travelers adjust their time of travel to avoid congestion. In sharp contrast, the "local" traffic peaks almost two hours later around 8 a.m. The "through" traffic drops at exactly the time that the "local" traffic peaks, and then increases again afterward.

Figure 1: Temporal Distribution of Route 15 Morning Peak Period: "Local" versus "Through" Traffic



If Route 15 is widened, some of the regional traffic that is avoiding the peak travel times would shift into the peak period due to the additional capacity, and the peak period travel flow

[3] Traffic counts alone do not categorize vehicles as "local" versus "regional"/"through" traffic. However, it is safe to assume that a substantial portion of the southbound traffic crossing into Virginia from Maryland in the morning is regional traffic using Route 15 as a "through" route, and that a substantial portion of the traffic turning onto southbound Route 15 from side roads is "local." Therefore, for purposes of this analysis, I labeled the former as "through" trips and the latter as "local" trips.

would increase significantly as a result. However, the Loudoun County forecast fails to capture this induced travel because it incorrectly assumes that the exact same pattern of time shifting would continue regardless of the capacity of Route 15. As with the failure to account for route shifting, the failure to account for time-of-day shifting renders the Loudoun traffic forecasts unjustifiably low and unreliable and thereby undermines the county's VISSIM results.

An Enhanced Travel Demand Model that Adequately Captures Induced Travel Demonstrates the Futility of a Widening Approach.

For my review, I determined it was necessary to employ a travel demand model that more adequately captures these and other aspects of induced travel. I therefore updated the Loudoun County Travel Demand Model with a much more sophisticated Dynamic Traffic Assignment (DTA) algorithm.[4] For more information on the enhanced model, please see the Technical Appendix to this report.

I then used the enhanced model to evaluate Modified Concepts A and B in order to get a more accurate sense of how the two scenarios of proposed widening, combined with a bypass around Lucketts, would impact traffic volumes and congestion on Route 15. I also added a third alternative that does not include widening and serves as a loose proxy for a traffic-calming and roundabout approach so that we could compare traffic congestion under that approach to Modified Concepts A and B. This third alternative is described herein as the "Traffic-Calming" alternative.

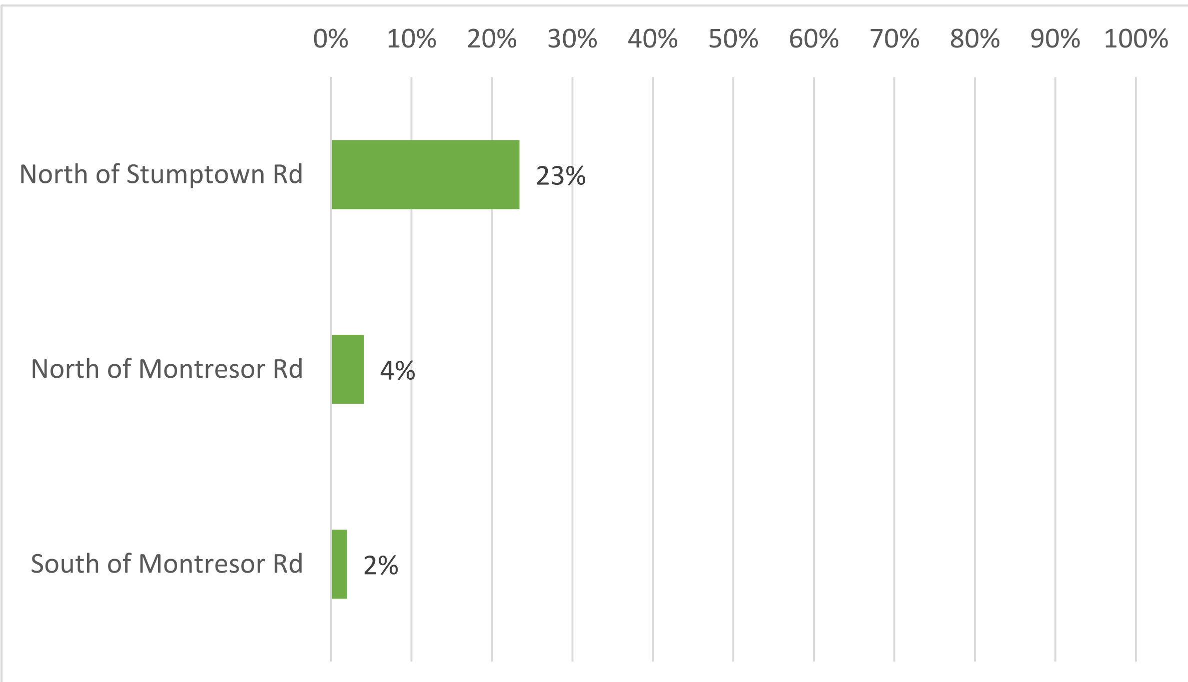
[4] I intentionally chose to enhance the Loudoun County travel demand model rather than the Metropolitan Washington Council of Governments' (MWCOG) travel demand model because it covers the full geographic area covered by the MWCOG model but provides more geographic detail in Loudoun County. It also includes commuting throughout Virginia, to and from Maryland, to and from the District Columbia, and to and from a portion of West Virginia.

2040 Traffic Forecasts from the Enhanced Model:

1) Traffic-Calming Alternative

The Traffic-Calming alternative includes no widening and no bypass around Lucketts. As shown in Figure 2, the enhanced model is forecasting only modest southbound traffic growth in the three-hour morning peak period under the Traffic-Calming alternative, with especially low growth at the congested southern end. As will be seen below, the enhanced model shows that the projected traffic growth on Route 15 under the Traffic-Calming alternative is far less than the traffic growth that would occur under Modified Concepts A and B.

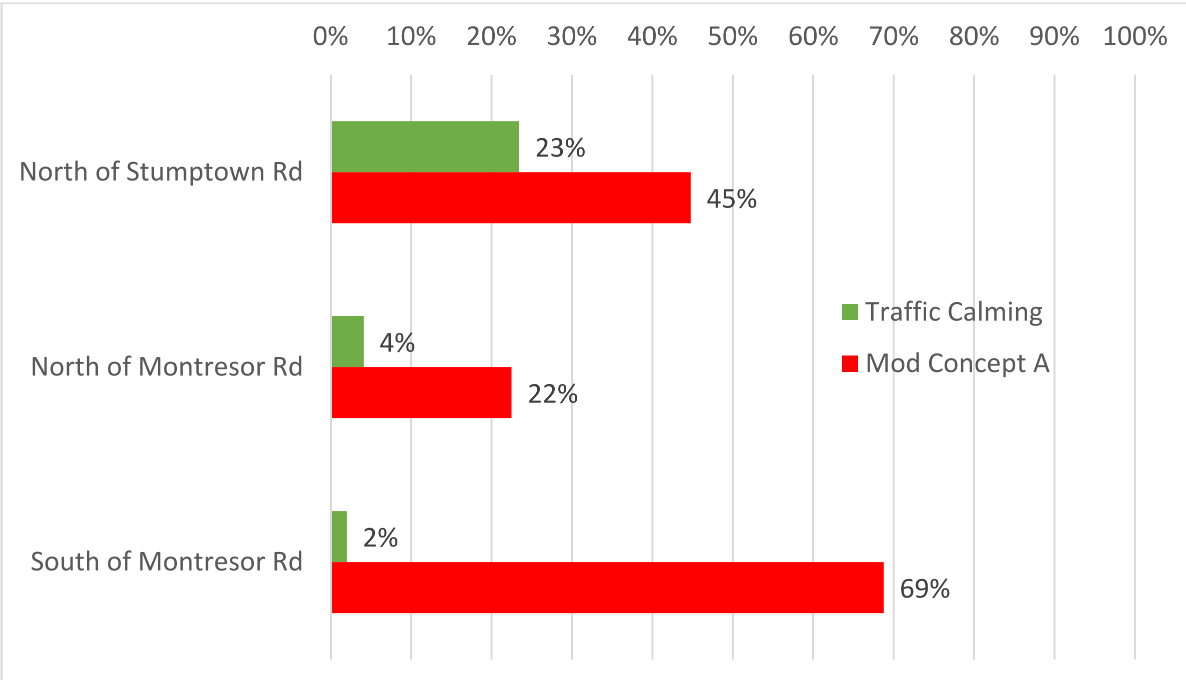
Figure 2. 2040 Southbound Morning Peak Period Traffic Growth from 2016: Traffic-Calming Alternative



2) Modified Concept A

As stated in the introduction to this report, the main components of Loudoun's Modified Concept A alternative include widening Route 15 north to Montresor Road to four lanes, plus constructing the Lucketts Bypass. As shown in Figure 3 below, the enhanced model forecasts large increases in southbound three-hour morning peak period traffic as compared to the Traffic-Calming alternative:

Figure 3. 2040 Southbound Morning Peak Period Traffic Growth from 2016: Modified Concept A versus Traffic-Calming Alternative

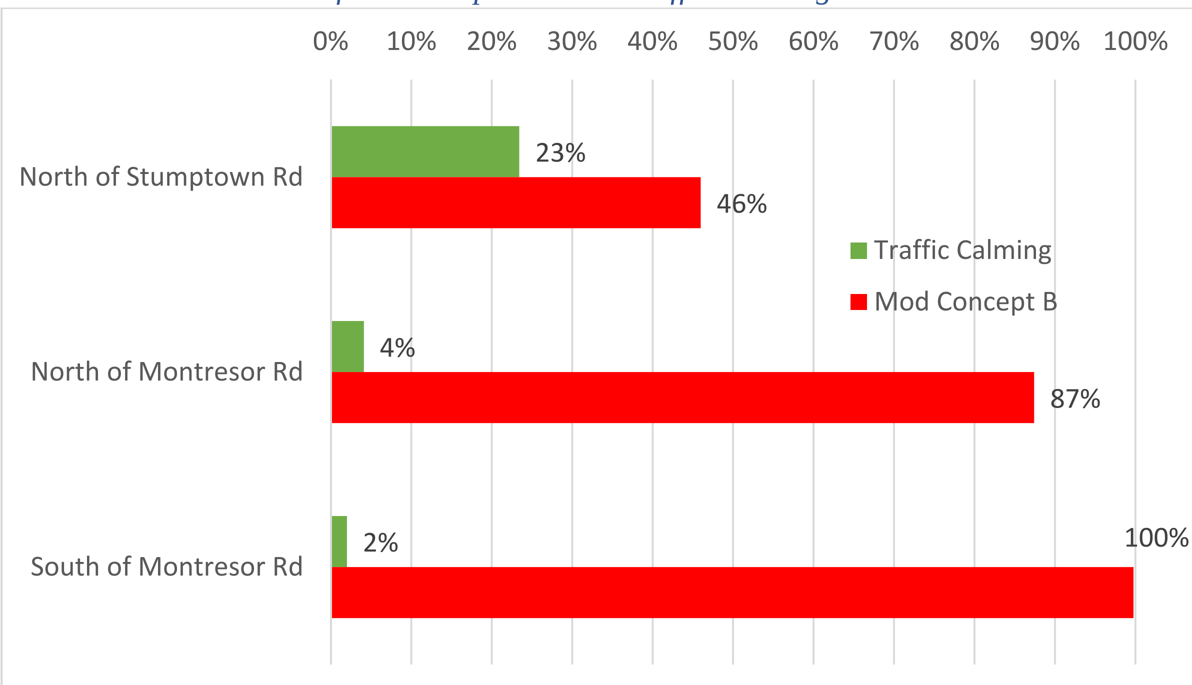


These forecasted increases for Modified Concept A (45%, 22%, and 69%) are much higher than the 17% assumed in the Loudoun County traffic analyses, and they are far above the increases that would occur with the Traffic-Calming alternative. This additional traffic is largely composed of the induced regional traffic discussed above that would shift to using Route 15 during peak hours to take advantage of the additional capacity south of Montresor Road. Most notably, Figure 3 above shows that although Modified Concept A generates additional capacity south of Montresor Road by widening the road to four lanes, it also induces significantly more traffic volume along all three portions of Route 15 than would occur without widening. As a result, the portions of Route 15 north of Montresor Road would be significantly more congested under Scenario A than they would be with a Traffic-Calming alternative. South of Montresor Road, much of the new capacity generated by the widening would be consumed by the induced travel the widening would spur. As such, although Modified Concept A would help alleviate some of the congestion south of Montresor Road during the AM peak period, it would simply shift congestion to the north of Montresor Road, creating conditions significantly more congested than they would be under the Traffic-Calming alternative.

3) Modified Concept B

As explained above, the main components of the county's Modified Concept B alternative include widening Route 15 to four lanes north to the approach to Lucketts, and constructing the Lucketts Bypass. As shown in Figure 4 below, the enhanced model forecasts large increases in southbound morning peak period traffic in all three roadway segments shown as compared to the Traffic-Calming alternative.

Figure 4: 2040 Southbound Morning Peak Period Traffic Growth from 2016: Modified Concept B versus Traffic-Calming Alternative



Similar to Modified Concept A, the increases in traffic volumes the enhanced model forecasts for Modified Concept B are much higher than the 29% assumed in the Loudoun County traffic analyses, and they are generally orders of magnitude higher than what the enhanced model forecasts for a Traffic-Calming alternative. As with Modified Concept A discussed above, the additional traffic growth the enhanced model forecasts on all three stretches of Route 15 is primarily the induced regional traffic that would make route shifts or time-of-day shifts to take advantage of the additional capacity south of Lucketts. Notably, the portion of Route 15 north of Lucketts Road that would remain two lanes under Modified Concept B would be significantly more congested than it would be under the Traffic-Calming alternative. South of Lucketts Road, much of the new capacity generated by the widening would be consumed by the induced travel the widening would spur. Indeed, the 100% increase in traffic volumes south of Montresor indicates this stretch would have the same density of vehicles per lane across two southbound travel lanes as there is in the single southbound travel lane today. In effect, the new southbound lane that widening creates quickly attracts new traffic, and the congestion that appears to have been resolved by the widening is shifted to the north in the form of new bottlenecks.

The County's Own Traffic Analyses Point to the Same Outcomes.

In short, the enhanced model correctly matches the triple convergence framework to produce a more reliable forecast of traffic volumes that result from the three different alternatives discussed above. And it demonstrates that widening Route 15 will be followed by induced travel (primarily in the form of route shifts and time-of-day shifts) that causes a shifting of bottlenecks from the widened sections to other sections.

However, even if we set my enhanced model aside and focus on the modeling outputs generated by the county's own VISSIM analyses, the same result is apparent (albeit it to a lesser extent since, as discussed above, the traffic forecasts the county used for its VISSIM analyses do not adequately account for induced travel).

This is illustrated by comparing the county's VISSIM outputs for 2040 Modified Concept A with the outputs for Modified Concept B for the second of the two afternoon peak hours modeled, as done in Figure 5 below.[5] Such a comparison shows the traffic problems at intersections along the northern part of the Route 15 corridor that are created by the proposed widening to the south.

As evident from the Figure 5, the county's VISSIM analyses show much more average delay and a far greater amount of failing service levels in the northern part of the corridor in Modified Concept B than in Modified Concept A. This is primarily due to the higher traffic volumes the county is assuming for Modified Concept B relative to Modified Concept A as part of the county's (insufficient) attempt to account for induced travel from the more extensive widening in Modified Concept B. As discussed above, these results from the county's modeling actually understate the amount of induced travel and the resulting increases in traffic volumes from widening, but they nevertheless show that decreases in traffic congestion in the widened sections to the south would be accompanied by increased traffic congestion in the unwidened portions of the corridor to the north.

[5] Figure 5 is copied from pages 5 and 10 of the county's VISSIM traffic data modified concepts A and B.pdf, dated July 2018.

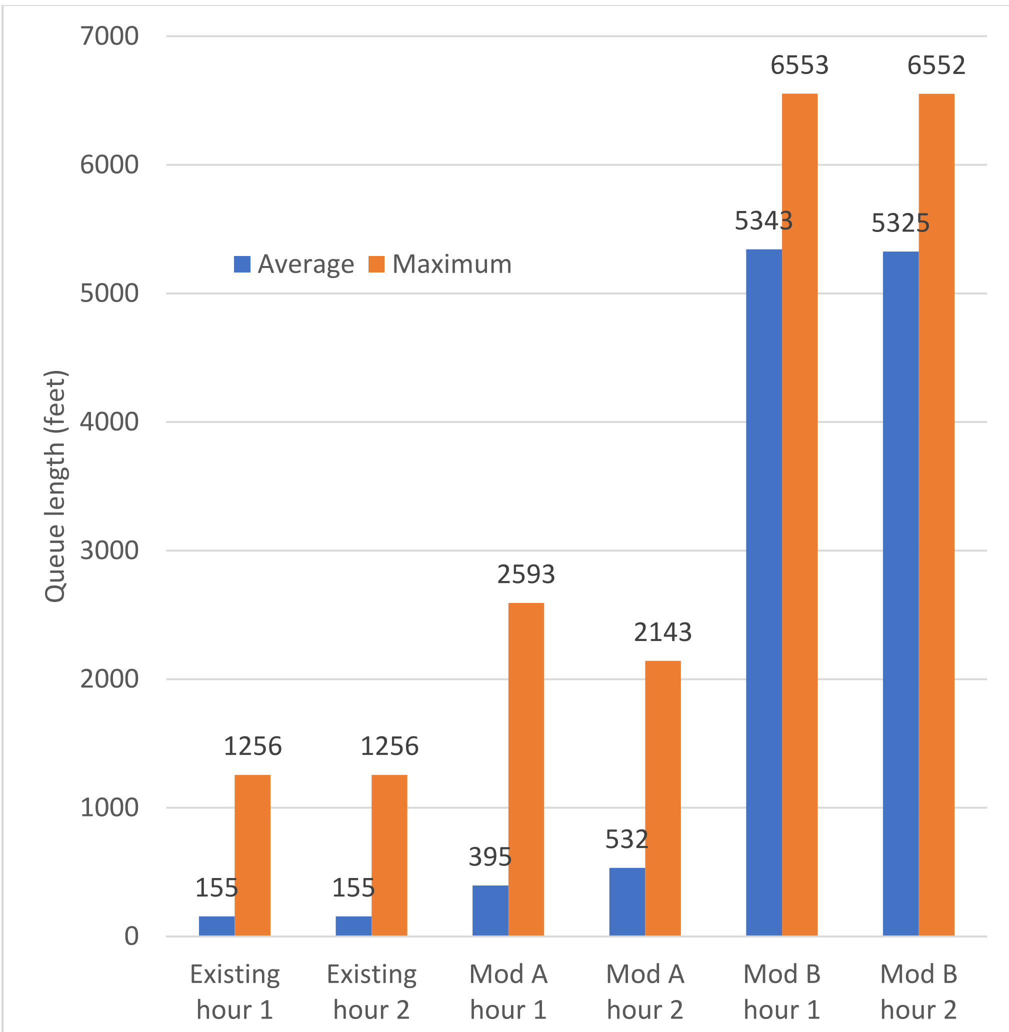
Figure 5: VISSIM Outputs for Second Afternoon Peak Hour

Intersection	Approach	Movement	Mod A Average Delay (sec/veh)		Mod B Average Delay (sec/veh)	
Route 15 and Lovettsville Rd	NB	LT	45.7	40.6	195.5	195.3
		TH	40.5		195.3	
	SB	TH	5.2	5.1	6.4	6.2
		RT	4.4		5.3	
	EB	LT	72.1	63.5	92.1	79.9
		RT	41.8		47.5	
	Intersection		27.2		114.9	
Route 15 and Potomac Overlook Lane/Wilt Store Rd	NB	LT	5.5	3.3	177.5	182.8
		TH	3.3		182.8	
		RT	3.2		167.7	
	SB	LT	0.0	2.0	0.0	1.9
		TH	2.0		1.9	
		RT	2.2		2.0	
	EB	LT	0.0	6.8	0.0	7.5
		TH	0.0		0.0	
		RT	6.8		7.5	
	WB	LT	0.0	0.0	0.0	0.0
		TH	0.0		0.0	
		RT	0.0		0.0	
	Intersection		2.6		111.6	
Route 15 and St. Clair Lane/ Chestnut Hill Lane	NB	LT	7.9	3.1	188.5	204.3
		TH	3.1		204.3	
		RT	2.6		212.6	
	SB	LT	8.2	2.4	29.3	3.2
		TH	2.3		2.2	
		RT	2.3		2.8	
	EB	LT	0.0	0.0	0.0	0.0
		TH	0.0		0.0	
		RT	0.0		0.0	
	WB	LT	8.7	10.2	24.9	64.4
		RT	10.3		65.9	
	Intersection		3.0		123.3	
Lucketts Bypass - North	NB	LT	0.0	19.5	0.0	637.9
		RT	19.5		637.9	
	SB	LT	22.6	6.9	39.3	7.0
		TH	4.0		3.2	
	EB	TH	1.8	1.8	92.1	92.1
		RT	0.0		0.0	
	Intersection		4.7		77.9	
Lucketts Bypass Roundabout - Stumptown Road	NB	LT	13.1	12.9	197.0	187.2
		TH	12.9		187.5	
		RT	11.1		150.0	
	SB	LT	7.5	5.9	28.1	2.8
		TH	5.9		2.5	
		RT	5.8		2.0	
	EB	LT	8.0	7.5	37.5	30.0
		TH	7.1		26.8	
		RT	6.7		3.0	
	WB	LT	35.3	35.1	1418.9	1406.9
		TH	33.7		1275.7	
		RT	0.0		0.0	
	Intersection		11.4		129.0	
Route 15 and Lucketts Road/ Stumptown Road	NB	LT	3.5	3.7	537.6	76.3
		TH	5.0		172.0	
		RT	2.4		3.6	
	SB	LT	2.1	5.1	8.2	24.4
		TH	5.1		24.7	
		RT	0.0		0.0	
	EB	LT	17.0	14.7	87.3	53.8
		TH	14.9		49.2	
		RT	5.9		43.5	
	WB	LT	17.4	14.8	560.3	538.9
		TH	15.5		547.2	
		RT	6.2		451.2	
	Intersection		6.2		135.6	

Level of Service Color Scale						
LOS	A	B	C	D	E	F
Signalized (Sec of Delay)	≤10	10 - 20	20-35	35-55	55-80	>80
Unsignalized (Sec of Delay)	≤10	10 - 15	15-25	25-35	35-50	>50

Another example of how the modeling outputs generated by the county's own VISSIM analyses demonstrate that widening Route 15 will be followed by induced travel and shift bottlenecks from the widened sections to other sections can be found by homing in on the results at the Route 15/Lovettsville Road intersection in the northern portion of the corridor. Figure 6 below shows the traffic queues (length of vehicle backups) that the county's VISSIM analysis computes at that intersection during the afternoon peak two hours. Notably, the analysis projects that the maximum backup under Modified Concept A – widening up to Montresor Road – will be about twice what it is under current conditions, and roughly ½-mile long. Under Modified Concept B – widening up to Lucketts Road – the county's VISSIM analysis projects that the *average* queue would be over a mile, while the maximum queue would be 1.25-miles long.

Figure 6: Year 2040 Afternoon Peak Queues Calculated by County's VISSIM Model: Route 15 at Lovettsville Road



In other words, widening does not solve delay – it simply transfers delay and congestion from the southern portion of the corridor to the northern portion. Widening may help address particular bottlenecks existing today, but peak period through traffic will increase, other bottlenecks will get worse, and new bottlenecks will be created.

Local Traffic Loses Out on Access with a Widened Route 15.

Further, to address the safety issues that would result from having to turn left from a side street or driveway onto a four-lane Route 15 at the many unsignalized intersections along the corridor, access from driveways and many side streets is shown as being limited (right-in- right-out only) in Modified Concepts A and B. In Concept B, this treatment extends all the way north to St. Clair Lane. This effort to address the potential safety problems on a widened Route 15 by eliminating left turns would greatly inconvenience those accessing Route 15 via driveways and several side streets. These travelers would instead need to make U-turns at the widely-spaced roundabouts shown in the diagrams for Modified Concepts A and B.

Conclusion

As evident from the results of my enhanced model, and even to a lesser but still significant extent in the modeling outputs generated by the county's own analyses, the widening scenarios for Route 15 do not solve congestion or delay – they simply transfer it upstream. Widening may help address particular bottlenecks existing today, but it will result in peak period through traffic increasing, other bottlenecks getting worse, and new bottlenecks being created.

Decision-makers, business owners, and residents alike would be wise to engage in the debate over widening Route 15 with their eyes wide open. Once one portion is widened to four lanes, the new bottlenecks it generates upstream will generate pressure to widen the next segment. This pushes the county into a wasteful and repetitive cycle of successive and expensive widening projects that yield unsatisfactory results. Route 15 becomes a larger and more dangerous highway primarily designed for regional travelers, while the historic character of the corridor is destroyed, local access is limited, and congestion remains. It is best to stop this cycle before it gets started. The far more prudent and responsible approach is to forego the widening alternatives, and instead intentionally manage traffic flow on Route 15 with traffic-calming improvements and roundabouts.

Technical Appendix

I updated the Loudoun County Travel Demand Model with a sophistical Dynamic Traffic Assignment (DTA) algorithm. I selected the Loudoun County model as the basis rather than the MWCOG model because it covers the full geographic area covered by the MWCOG model but has more geographic detail in Loudoun County than in the rest of the region. It includes commuting throughout Virginia, to and from Maryland, to and from the District Columbia, and to and from a portion of West Virginia. The enhanced model:

1) accounts for capacity constraints;
2) accounts for trips resulting from local land use growth; and
3) accounts for induced travel that will result widening.

In addition to implementing DTA in the model, I also addressed other model deficiencies in order to improve the model forecasts. These changes are documented below.

Dynamic Traffic Assignment

Both the Loudoun County Travel Demand Model ("Loudoun TDM") and the Metropolitan Washington Council of Governments ("MWCOG") model that the Loudoun TDM is based on rely on an outdated 40-year-old Static Traffic Assignment (STA) algorithm. National modeling guidance describes "capacity" as the "maximum volume that should be assigned to a link [road segment] by the forecasting model."[6] STA models do not constrain traffic forecasts to roadway capacity, so that model volumes often exceed roadway capacity, especially in future year forecasts. This introduces model errors for the roadway segments that are incorrectly assigned a volume of traffic that exceeds their capacity. Further, because those incorrect volumes carry over in the model to all roadway segments located upstream and downstream of the over-capacity segments, the volumes on those upstream and downstream segments are also erroneous. As a result, in the very congested Washington DC metro region, the horizon year forecasts the STA-reliant models generate are impossibly high for every important roadway segment.

The Dynamic Traffic Assignment (DTA) I incorporated into the enhanced model addresses these issues. It has not been widely adopted yet because it is relatively new and requires more computer resources. I have demonstrated that DTA is a practical alternative to STA for regional modeling for regions up to about 1 million population.[7] The Loudoun TDM includes the full extent of the metropolitan area included in the MWCOG model. Because DTA is still impractical to run on most computers for a region this size, I applied a hybrid approach

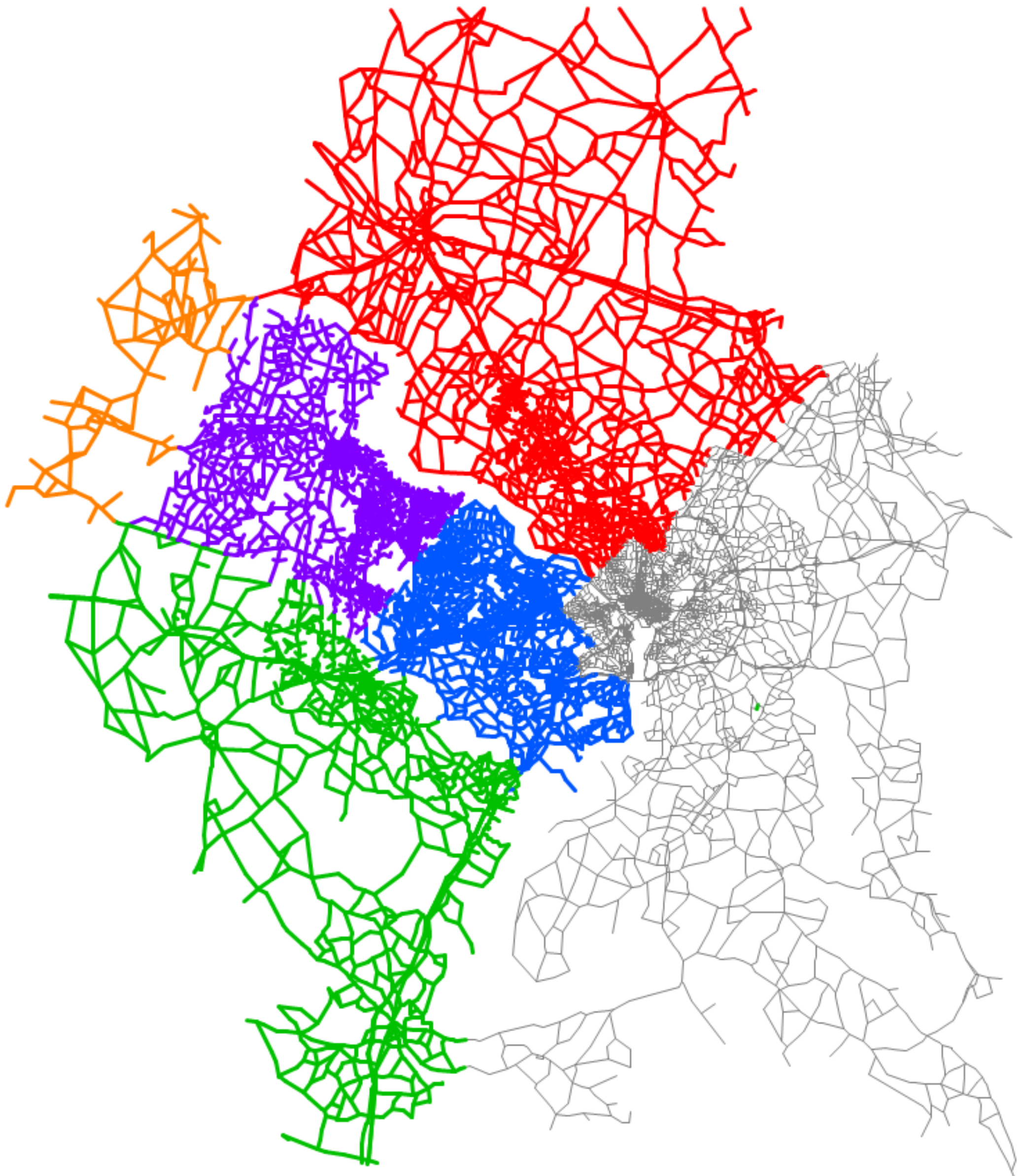
[6] Cambridge Systematics (2012). Cambridge Systematics, Vanassse Hangen Brustlin, Gallop, Bhat, C.R., Shapiro Transportation Consulting and Martin/Alexious/Bryson. *Travel Demand Forecasting: Parameters and Techniques*, National Cooperative Highway Research Program Report 716, 2012.

[7] Marshall, N.L. *Forecasting the impossible: The status quo of estimating traffic flows with static traffic assignment and the future of dynamic traffic assignment*. Research in Transportation Business & Management (2018), https://doi.org/10.1016/j.rtbm.2018.06.002.

using DTA for Loudoun County and trips that might pass through Loudoun County, while keeping STA for the rest of the travel in the region. The DTA model uses the open source program DTALite.[8]

Figure A1 shows the trips that are modeled with DTA:

Figure A1: DTA Model Area



[8] Zhou and Taylor (2014). X. Zhou and J. Taylor. DTALite: A queue-based mesoscopic traffic simulator for fast model evaluation and calibration. *Cogent Engineering* (2014), 1: 961345.

The trips included in the subarea DTA model are:

- Loudoun County VA (purple): to and from everywhere (including internal trips)
- Clarke County VA and Jefferson County WV (orange): to and from everywhere except within the two counties
- Northwestern MD (Carroll, Frederick, Howard and Montgomery Counties in red): to and from all the colored areas except for trips internal to the red counties
- Fairfax County VA (blue): to and from all the colored areas except for trips internal to Fairfax County
- Southwestern VA (Fauquier, Fredericksburg, Prince William, Spotsylvania and Stafford Counties in green): to and from all the colored areas except for trips internal to the green counties.

Time Periods and Feedback

In addition to implementing DTA, it was critical to fix the way that congestion feedback is done in the Loudoun County model. Otherwise, the route and time-of-day shifts discussed in the main report would not be captured properly in the model.

The enhanced model uses the same four time periods as the Loudoun County model:

- AM peak: 6 - 9 a.m.
- Midday: 9 a.m. - 3 p.m.
- PM peak: 3 - 7 p.m.
- Overnight: 7 p.m. - 6 a.m.

All good travel demand models employ a feedback process so that the destinations chosen are sensitive to congested travel time. The Loudoun model feeds back congested travel time from the morning peak period, but only to work trips. This is a problem because the model exaggerates the number of non-work travelers crossing the Potomac River during peak travel periods. The model assumes that these travelers will face no delays. In fact, non-work travelers likely are more sensitive to congestion delays than work travelers. While workers have limited choice about whether to cross the river or not, many non-work trips are discretionary. Shoppers could, for example, choose destinations on the same side of the river instead. The timing of many non-work trips could be shifted considerably. The purpose of introducing DTA into the model is to constrain travel forecasts so that they do not exceed capacity. This cannot be accomplished unless all travel destinations are also impacted by congestion in the model.

In my enhanced model, I addressed these problems with the Loudoun model by feeding back congested travel times to all trips – not only work trips. In addition, I used an average of morning and afternoon peak travel times because the afternoon congestion is more severe in many areas than the morning congestion, and also is less directional. In addition, I added more feedback iterations to my enhanced model in order to achieve a higher level of convergence – particularly in the 2040 forecasts.

Eliminating Unnecessary and Counter-Productive Calibration Factors

Finally, it was also necessary to remove a set of model adjustments that were introduced into the Loudoun County model to better match base year traffic counts, but that make the model less sensitive to future congestion and less accurate in forecasting induced travel.

In general, travel demand models should replicate travel behavior based on a set of general coefficients. Some modelers apply many adjustment factors in order to force the model to better match a set of base-year travel accounts. For the most part, this amounts to "papering over" model flaws. Even more problematic, it makes the model less sensitive to differences in land use forecasts and transportation networks. The developers of the Loudoun model employed an unusually extensive set of adjustment factors as summarized below in Table A1.

Table A1: Calibration Factors in the Loudoun County Model

Person trip calibration adjustments by jurisdiction	Table 6-8, p. 43[9]	Examples: work trips multiplied by 105% in Loudoun County, 70% in Jefferson County, and 150% in St. Mary's County
Person trip calibration adjustments by area type	Table 6-8, p. 44	Examples: trip rates in CBD multiplied by 130%, trip rates in rural areas multiplied by 60%
K Factors	Table 7-4, p. 53	Examples: work trips from Loudoun County to Loudoun County factored by 0.58, and work trips by Loudoun County to D.C. factored by factored by 0.19
Adjustments at the level of zone-to-zone to better match traffic counts	p. 74-75	Very large matrix tables (211 MB) of adjustment data for zone by zone by trip type

In my enhanced model, all of the calibration factors listed in Table A1 were eliminated except for the K-Factors, which I replaced with more realistic factors. Considering Virginia/West Virginia, Maryland, and D.C. as three "states", the replacement K-factors adjust interstate trips down to 85% of the base level applied within a single state.

Eliminating and improving the calibration factors required that the gravity model parameters (F factors) be replaced with coefficients that work properly without all of the calibration adjustments.

The base year for the Loudoun County model is 2010 which was chosen in part because it is a Census year with good county-to-county work trip data. My enhanced model (without the extensive calibration adjustments) fits the county-to-county Census data better than the Loudoun County model (correlation coefficient r=0.993 for the enhanced model vs. r=0.989 for the Loudoun County model). The combination of the better base-year model fit, the elimination of the calibration adjustments, and capacity-constrained DTA make my enhanced model a much more accurate and reliable model for forecasting inter-county travel, including Route 15 Potomac River crossings.

[9] References to URS in Association with WGA. *Loudoun County Travel Demand Model: Model Development and Validation Report*, prepared for Loudoun County, April 2014.

Resume

NORMAN L. MARSHALL, PRESIDENT

nmarshall@smartmobility.com

EDUCATION:

Master of Science in Engineering Sciences, Dartmouth College, Hanover, NH, 1982
Bachelor of Science in Mathematics, Worcester Polytechnic Institute, Worcester, MA, 1977

PROFESSIONAL EXPERIENCE: (30 Years, 15 at Smart Mobility, Inc.)

Norm Marshall helped found Smart Mobility, Inc. in 2001. Prior to this, he was at Resource Systems Group, Inc. for 14 years where he developed a national practice in travel demand modeling. He specializes in analyzing the relationships between the built environment and travel behavior, and doing planning that coordinates multi-modal transportation with land use and community needs.

Regional Land Use/Transportation Scenario Planning

Portland Area Comprehensive Transportation System (PACTS) – the Portland Maine Metropolitan Planning Organization. Updating regional travel demand model with new data (including AirSage), adding a truck model, and multiclass assignment including differentiation between cash toll and transponder payments.

Loudoun County Virginia Dynamic Traffic Assignment – Enhanced subarea travel demand model to include Dynamic Traffic Assignment (Cube). Model being used to better understand impacts of roadway expansion on induced travel.

Vermont Agency of Transportation-Enhanced statewide travel demand model to evaluate travel impacts of closures and delays resulting from severe storm events. Model uses innovate Monte Carlo simulations process to account for combinations of failures.

California Air Resources Board – Led team including the University of California in $250k project that reviewed the ability of the new generation of regional activity-based models and land use models to accurately account for greenhouse gas emissions from alternative scenarios including more compact walkable land use and roadway pricing. This work included hands-on testing of the most complex travel demand models in use in the U.S. today.

Climate Plan (California statewide) – Assisted large coalition of groups in reviewing and participating in the target setting process required by Senate Bill 375 and administered by the California Air Resources Board to reduce future greenhouse gas emissions through land use measures and other regional initiatives.

Chittenden County (2060 Land use and Transportation Vision Burlington Vermont region) – led extensive public visioning project as part of MPO's long-range transportation plan update.

Flagstaff Metropolitan Planning Organization – Implemented walk, transit and bike models within regional travel demand model. The bike model includes skimming bike networks including on-road and off-road bicycle facilities with a bike level of service established for each segment.

Chicago Metropolis Plan and Chicago Metropolis Freight Plan (6-county region)— developed alternative transportation scenarios, made enhancements in the regional travel demand model, and used the enhanced model to evaluate alternative scenarios including development of alternative regional transit concepts. Developed multi-class assignment model and used it to analyze freight alternatives including congestion pricing and other peak shifting strategies.

Municipal Planning

City of Grand Rapids – Michigan Street Corridor – developed peak period subarea model including non-motorized trips based on urban form. Model is being used to develop traffic volumes for several alternatives that are being additional analyzed using the City's Synchro model.

City of Omaha - Modified regional travel demand model to properly account for non-motorized trips, transit trips and shorter auto trips that would result from more compact mixed-use development. Scenarios with different roadway, transit, and land use alternatives were modeled.

City of Dublin (Columbus region) – Modified regional travel demand model to properly account for non-motorized trips and shorter auto trips that would result from more compact mixed-use development. The model was applied in analyses for a new downtown to be constructed in the Bridge Street corridor on both sides of an historic village center.

City of Portland, Maine – Implemented model improvements that better account for non-motorized trips and interactions between land use and transportation, and applied the enhanced model to two subarea studies.

City of Honolulu – Kaka'ako Transit Oriented Development (TOD) – applied regional travel demand model in estimating impacts of proposed TOD including estimating internal trip capture.

City of Burlington (Vermont) Transportation Plan – Led team that developing Transportation Plan focused on supporting increased population and employment without increases in traffic by focusing investments and policies on transit, walking, biking and Transportation Demand Management.

Transit Planning

Regional Transportation Authority (Chicago) and Chicago Metropolis 2020 – evaluated alternative 2020 and 2030 system-wide transit scenarios including deterioration and enhance/expand under alternative land use and energy pricing assumptions in support of initiatives for increased public funding.

Capital Metropolitan Transportation Authority (Austin, TX) Transit Vision – analyzed the regional effects of implementing the transit vision in concert with an aggressive transit-oriented development plan developed by Calthorpe Associates. Transit vision includes commuter rail and BRT.

Bus Rapid Transit for Northern Virginia HOT Lanes (Breakthrough Technologies, Inc and Environmental Defense.) – analyzed alternative Bus Rapid Transit (BRT) strategies for proposed privately-developing High Occupancy Toll lanes on I-95 and I-495 (Capital Beltway) including different service alternatives (point-to-point services, trunk lines intersecting connecting routes at in-line stations, and hybrid).

Roadway Corridor Planning

I-30 Little Rock Arkansas – Developed enhanced version of regional travel demand model that integrates TransCAD with open source Dynamic Traffic Assignment (DTA) software, and used to model I-30 alternatives. This model models freeway bottlenecks much more accurately than the base TransCAD model.

South Evacuation Lifeline (SELL) – In work for the South Carolina Coastal Conservation League, used Dynamic Travel Assignment (DTA) to estimate evaluation times with different transportation alternatives in coastal South Caroline including a new proposed freeway.

Hudson River Crossing Study (Capital District Transportation Committee and NYSDOT) – Analyzing long term capacity needs for Hudson River bridges which a special focus on the I-90 Patroon Island Bridge where a microsimulation VISSIM model was developed and applied.

PUBLICATIONS AND PRESENTATIONS (partial list)

Forecasting the Impossible: The Status Quo of Estimating Traffic Flows with Static Traffic Assignment and the Future of Dynamic Traffic Assignment. *Research in Transportation Business and Management* 2018.

Assessing Freeway Expansion Projects with Regional Dynamic Traffic Assignment. Presented at the August 2018 Transportation Research Board Tools of the Trade Conference on Transportation Planning for Small and Medium Sized Communities.

Vermont Statewide Resilience Modeling. With Joseph Segale, James Sullivan and Roy Schiff. Presented at the May 2017 Transportation Research Board Planning Applications Conference.

Assessing Freeway Expansion Projects with Regional Dynamic Traffic Assignment. Presented at the May 2017 Transportation Research Board Planning Applications Conference.

Pre-Destination Choice Walk Mode Choice Modeling. Presented at the May 2017 Transportation Research Board Planning Applications Conference.

A Statistical Model of Regional Traffic Congestion in the United States, presented at the 2016 Annual Meeting of the Transportation Research Board.

MEMBERSHIPS/AFFILIATIONS

Associate Member, Transportation Research Board (TRB)

Member and Co-Leader Project for Transportation Modeling Reform, Congress for the New Urbanism (CNU)