A Minimum-Cost Solution to Wiehle and Hunter Mill Congestion

Report FAC/FCA-034

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Introduction: The traffic congestion near the intersection of the Dulles Toll Road and Hunter Mill Road is due to the six left turns in the immediate vicinity. That near the intersection of the Dulles Toll Road and Wiehle Avenue is due to nine left turns in the immediate vicinity. We will obtain data on traffic delays in the Fall; however, we have hearsay evidence that delays on Hunter Mill Road southbound are on the order of 10 minutes, and along Wiehle southbound, 15 minutes. The purpose of this report is to present two low-cost methods of eliminating these long delays.

Summary: Although tunnels and fly-overs could be used to eliminate the time delays associated with traffic signals and left turns, these are expensive. Two low-cost methods are available: (1) roundabouts and (2) one-way streets. The number of vehicles per hour that one-way streets can handle is much greater than with a roundabout; therefore, one-way streets appear to be a better solution for the Wiehle and Hunter Mill intersections with the Dulles Toll Road. The following streets would be made one-way (see Exhibit 1).

a. Sunset Hills, from Hunter Mill to Wiehle: one-way west
b. Wiehle, from Sunset Hills to Sunrise Valley: one-way south
c. Sunrise Valley, from Wiehle to Hunter Mill: one-way east
d. Hunter Mill, from Sunrise Valley to Sunset Hills: one-way north

These one-way streets form what is, in effect, a large traffic circle, having a perimeter of 2 miles. There would be no traffic lights anywhere along this route. A complete circling of the perimeter would require 4.7 minutes.

An attractive feature of the one-way solution is that it could be tried on a temporary basis. Traffic officers might be required during the trial period because some of the current intersections have islands that would otherwise confuse the drivers.

Most people who have offered an opinion on this scheme reject it at first, but become more convinced of its utility as they think about it more.

Discussion: Two low-cost methods of reducing delays due to left turns are available: (1) roundabouts and (2) one-way streets. A roundabout is defined in Wikipedia: “A roundabout is a type of circular junction in which road traffic must travel in one direction around a central island. Signs usually direct traffic entering the circle to slow down and give the right of way to drivers already in the circle.” Roundabouts are a new, improved version of the old traffic circle. They differ from traffic circles in three ways: (1) the island in the circle is smaller; (2) the perimeter of the island is rough but permits trucks to make the sharper turn required by the smaller circle; and (3) the entrance and exit ways are more gentle. The following exhibit shows a typical roundabout.

The Highway Design Manual gives the following equation for the capacity of a lane at its entrance into the roundabout:

$$Ca := Vc \cdot \frac{e^{-Vc \cdot tc}}{1 - e^{-Vc \cdot tf}}$$

where Ca is the lane capacity in vehicles per hour and Vc represents the vehicles per hour into which the cars in the lane must merge. The empirically determined critical gap, tc in hours, when expressed in seconds, is between 4.1 and 4.6; the empirically determined follow-up time, tf in hours, when expressed in seconds, is between 2.6 and 3.1. The critical gap is the time between cars on the main road at which the car on the side road would enter the main road. The follow-up time is the time after the side-road car leaves the side road and the next side-road car is ready to leave.

Consider the capacity for Hunter Mill Traffic traveling west, en route to the Toll Road. If Sunrise Valley eastbound has 1400 vph approaching the intersection with Hunter Mill Road and 100 vph continue straight while 1300 vph turn left toward the Toll Road, Vc would be 1300. If tc=4.3 seconds (0.0012 hrs) and tf=2.8 seconds (0.0008 hrs), Ca, the capacity for Hunter Mill traffic, would be 420 vph, as compared to the measured peak hour rate of 1070 vph[1].

We can compare this capacity with that with Hunter Mill Road being one way north, between its intersection with Sunrise Valley Drive and the Toll Road ramp. The traffic stream from Hunter Mill can take the right lane and the two-lane traffic streams from Sunrise Valley can take the left and center lanes of Hunter Mill so that there is no appreciable delay; therefore, Ca would be 1400 vph. The capacity of the Sunrise Valley traffic would be 1400 vph for each lane – a total of 2800 vph. Surely, the bottleneck will be at the toll booth or on the Toll Road itself.

According to the arrangement of one-way streets described in the Summary and in Exhibit 1, the perimeter would have two legs, each 0.8 miles long, and two legs, each 0.4 miles long. The longer legs might have a 35 mph speed limit. The shorter legs might have a 25 mph speed limit. The time required to travel the entire perimeter would be 4.7 minutes, which is well under the wait times for the current weekday congested flow. Speed limits of 40 mph and 30 mph would reduce this time to 4 minutes. For most morning drivers, the times would be much less because they would not need to traverse the entire perimeter. Less than 30% of the Hunter Mill ramp

[1] AADT_029_Fairfax_2009.xls (Link 401178)

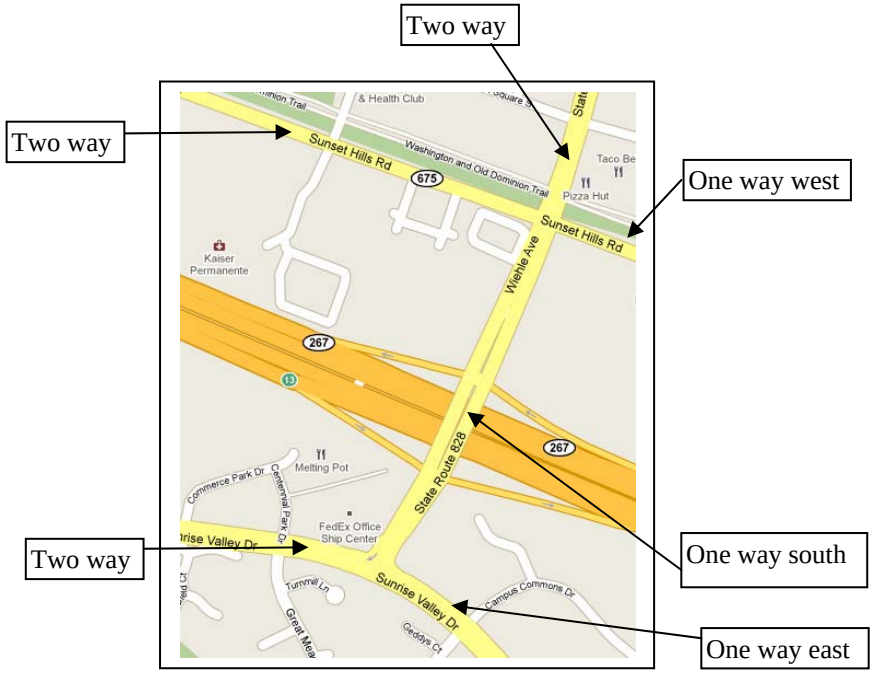
traffic, that coming south on Hunter Mill Road, would take half that time, because they would enter the toll road at Wiehle. The traffic on Sunrise Valley that currently takes the Wiehle ramp to the Toll Road would proceed to the Hunter Mill ramp, with almost no loss of time. Sunrise Valley drivers wanting to park at the Wiehle station can either travel almost the entire perimeter or can use Sunset Hills after crossing the Toll Road at Reston Parkway or at the new Soapstone bridge. In the evening hours, the Hunter Mill Road traffic would experience no time loss but those living down the east end of Hunter Mill Road, who had no delay in the morning, would exit the Toll Road at Wiehle and come back on Sunrise Valley, experiencing a 3-minute longer drive.

With Sunrise Valley and Sunset Hills being one way, and the possibility of all lanes being occupied, acceleration lanes may be needed from the side streets that enter these two roads.

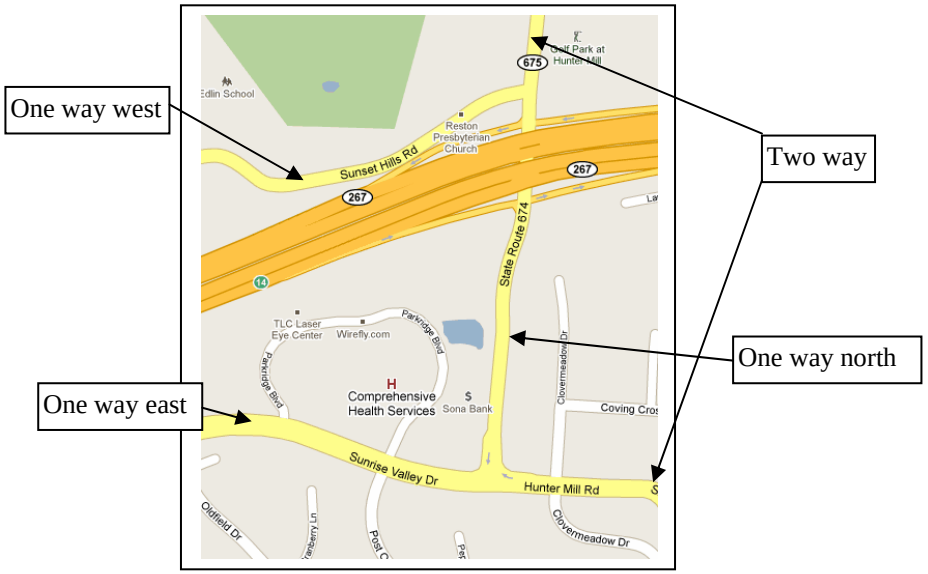
Appendix A: VDOT Data on Peak Traffic near the Hunter Mill Road Intersection

The following data was taken from AADT_029_Fairfax_2009.xls.

Along Hunter Mill Road, coming from the east toward Sunrise Valley:
18000 AAWDT * 0.097 * 0.6132 = 1070 vph
Along Hunter Mill Road, from Sunrise Valley north to the Toll Road:
22000 AAWDT * 0.1019 * 0.6219 = 1394 vph
Along Hunter Mill Road, coming south toward Sunset Hills Road:
13000 AAWDT * 0.1036 * 0.5721 = 716 vph
Along Sunrise Valley Drive, east toward Hunter Mill Road:
1394 – 716 = 687 vph
As compared to adding/subtracting flow streams from west = 595 vph



Wiehle Avenue Intersection



Hunter Mill Road Intersection

Exhibit 1: Diagrams Showing the Arrangement of the One-Way Streets