

NATIONAL CAPITAL REGION  
TRANSPORTATION PLANNING BOARD

2010 PERFORMANCE OF  
HIGH-OCCUPANCY VEHICLE  
FACILITIES ON FREEWAYS IN THE  
WASHINGTON REGION

DRAFT

May 20, 2011

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ABSTRACT FORM

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<b>AGENCY:</b>	The Metropolitan Washington Council of Governments is the regional organization of the Washington area's major local governments and their governing officials. COG works towards solutions to such problems as growth, transportation, inadequate housing, air pollution, water supply, water quality, economic development and noise, and serves as the regional planning organization for Metropolitan Washington.
<b>REPORT ABSTRACT:</b>	This report contains a summary of data collected from high occupancy vehicle (HOV) facilities located along freeways in the Washington, D.C. metropolitan region.
<b>SUBJECT:</b>	2010 Performance of Regional High Occupancy Vehicle Facilities on Freeways in the Washington Region
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## EXECUTIVE SUMMARY

Presented in this report is information developed from data collected in spring 2010 along five operational high occupancy vehicle (HOV) corridors in the Washington region. Data were collected from 5 A.M. to 10 A.M. during the inbound peak flow direction and 3 P.M. to 8 P.M. during the outbound peak flow direction. HOV lanes are operational in the following corridors as of spring 2010:

- I-95/I-395 (Shirley Highway) in Arlington County, the City of Alexandria, Fairfax County, and Prince William County (fully barrier separated HOV lanes)
- I-66 inside I-495 (the Capital Beltway) in Fairfax and Arlington Counties (exclusive HOV facility in the peak commute direction during the peak commute period)
- I-66 outside the Beltway in Fairfax and Prince William Counties (concurrent flow HOV lanes)
- I-270 (and the I-270 Spur) in Montgomery County, Maryland (concurrent flow HOV lanes)
- VA 267 (Dulles Toll Road), in Fairfax County which has a concurrent flow HOV lane
- U.S. 50 (John Hanson Highway) in Prince George's County, Maryland (concurrent flow HOV lane)

Most comparisons are made with results obtained from the previous Regional HOV Facilities Monitoring reports for 1997, 1998, 1999, 2004, and 2007.

Trends and changes are emphasized for the HOV restricted periods both inbound and outbound. The following major trends were observed:

- During Spring 2010, all of the HOV lanes required fewer cars to carry more persons per lane during the HOV restricted periods than adjacent non-HOV lanes making the HOV lanes more efficient at moving people to their destinations;
- Most of the HOV lanes provide travel time savings when compared to non-HOV alternatives, especially the barrier separated HOV lanes in the I-95/I-395 corridor in Northern Virginia; and
- Average auto occupancy in 2010 was little-changed from 2004 and 2007, even though the HOV lanes in Northern Virginia continue to exempt vehicles with "Clean Special Fuel Vehicle" registration plates from the HOV requirement.

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## I. INTRODUCTION

High occupancy vehicle (HOV) facilities are designed to offer several advantages over conventional lanes and roads. HOV facilities can:

- Increase the average number of persons per motor vehicle using a highway over conventional (non-HOV) lanes or roadways
- preserve the person moving capacity of a lane or roadway as demands for transportation capacity increase
- enhance bus transit operations
- support air quality goals; serve a variety of employment centers in urban and suburban areas
- provide predictable travel times even during periods of high demand for highway capacity

In the Washington area, there are five high occupancy vehicle (HOV) facilities on highways functionally classified as freeways. These are:

- I-95/I-395 in the Northern Virginia counties of Prince William, Fairfax and Arlington, and the City of Alexandria
- I-66, also in the Virginia counties of Prince William, Fairfax and Arlington (this HOV system includes a section of the Dulles Connector in McLean, connecting to VA 267's HOV lanes (see below))
- I-270 and the I-270 Spur in Montgomery County, Maryland
- VA 267, connecting to I-66 via the Dulles Connector
- U.S. 50 in Prince George's County, Maryland

The I-95/I-395 and I-66 HOV facilities provide direct access to core employment centers of the region in Arlington County and the District of Columbia. I-270 and the I-270 Spur end at the Capital Beltway (I-495) and the U.S. 50 HOV lanes end just prior to the Beltway. VA 267's HOV system connects directly to I-66, providing access to the regional core from the Dulles Toll Road Corridor. A map of all five facilities is shown in Figure 1. There are arterial HOV lanes and bus only shoulder treatments in the region, but these facilities are beyond the scope of this report. This report contains data collected during the Spring of 2010. Vehicle occupancy and classification counts, as well as the results of

travel time runs are documented in this report. Previous reports have documented conditions on the HOV system in fall 1997, 1998, 1999, 2004, and 2007. Comparisons are given in this report between HOV performance in 2010 and performance in these previous years.

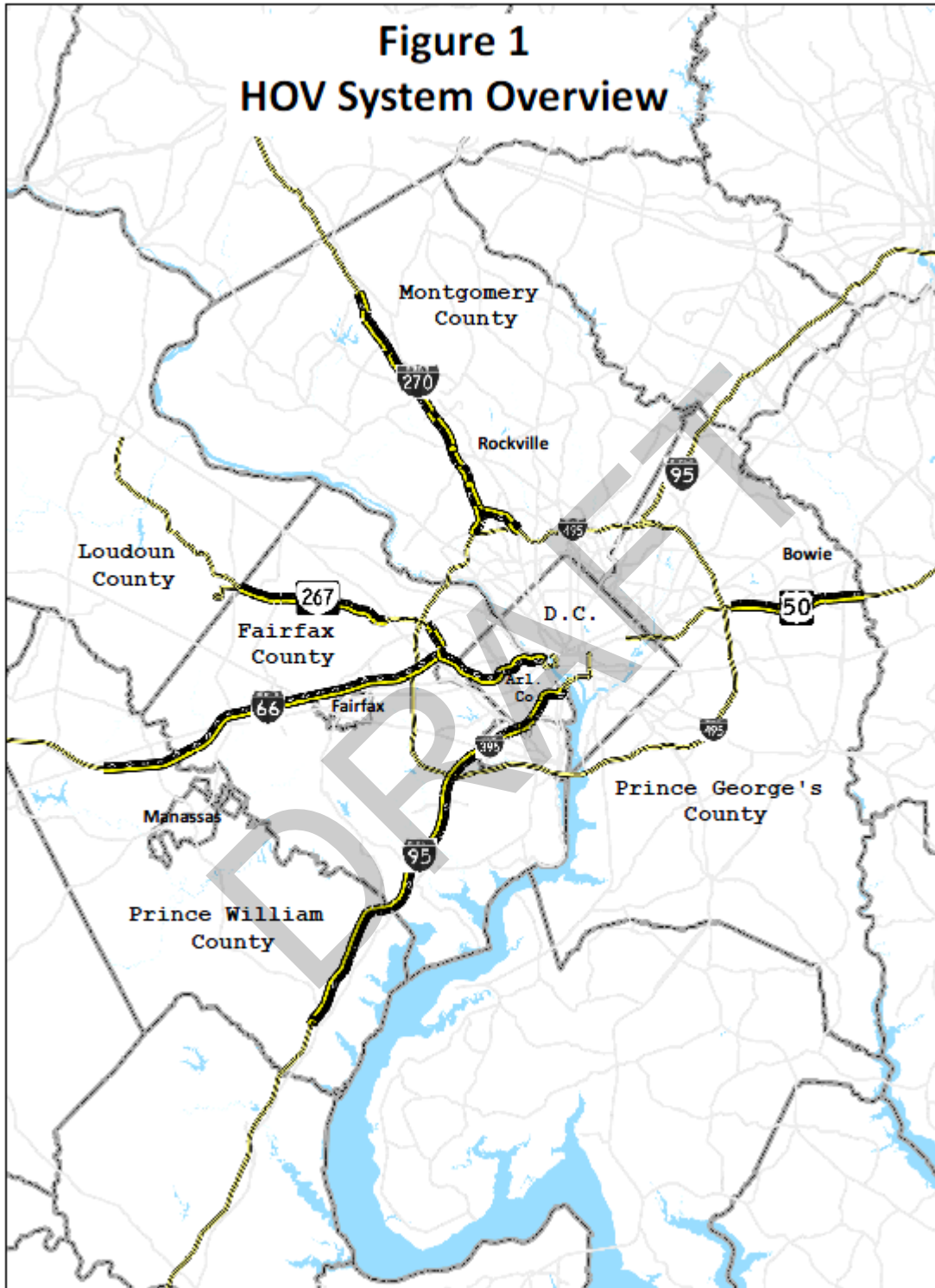
This report is organized as follows:

A history of HOV in the Washington metropolitan area is presented in Chapter II; a description of the HOV corridors is given in Chapter III; a description of the methodology used to collect data for this report is found in Chapter IV; the performance of each of the HOV facilities is presented in Chapter V; conclusions are presented in Chapter VI; detailed summaries of person movements in the A.M. peak direction at stations along the five corridors are contained in Appendix A; similar data for the P.M. peak direction are in Appendix B; A.M. travel time run data are contained in Appendix C; P.M. travel time run data are contained in Appendix D; count locations are described in Appendix E; the counting methodology is described in Appendix F; a summary of van-pool monitoring methodology (and van load factor) is contained in Appendix G; the travel time data collection methodology is described in Appendix H; and a glossary of terms and abbreviations used in this report can be found in Appendix I.

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Figure 1



## II. BRIEF HISTORY OF HOV IN THE WASHINGTON REGION

Car-pooling has a long history in the Washington region, going at least as far back as World War II, when pooling by office workers in Washington was encouraged as a way of preserving scarce petroleum, rubber, and other resources for the war effort.

Since the gasoline shortages of the early 1970s, COG/TPB has provided an automated matching service for carpools and vanpools through its Commuter Connections program. Signs with Commuter Connections' telephone number have been placed along all five HOV corridors.

In 1969, a bus-on-freeway demonstration project began on the Shirley Highway (now known as I-395 north of the Capital Beltway and I-95 south of the Beltway), linking the Springfield area of Fairfax County and intermediate points in the corridor such as western Alexandria and Shirlington to core employment areas in Arlington and downtown Washington. Initially limited to buses only, the barrier separated lanes opened to carpools and vanpools in 1975, with a restriction of HOV-4<sup>1</sup>, which was reduced to HOV-3 in 1989. During the early and mid-1990s, the barrier separated HOV lanes were extended from Springfield south along I-95 to their present terminus just south of VA 234 near Dumfries in Prince William County.

In 1982, I-66 was opened to traffic between the Capital Beltway (I-495) and Rosslyn, in Arlington County, as a multi-modal facility limited to high occupancy vehicles in the peak commute direction during periods of peak demand. The facility was initially restricted to HOV-4 traffic, which was lowered to HOV-3 in late 1983 and to HOV-2 in March 1995. During the 1990s, I-66 outside the Beltway was expanded to include a concurrent flow HOV lane to VA 234 Business in Prince William County just north of Manassas.

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<sup>1</sup> HOV restrictions are denoted by the number of occupants required in the vehicle for permitted travel on the facility: HOV-4 means four or more occupants (including the driver) must be present in the vehicle to travel on the facility during restricted times.

The first HOV lane on an Interstate highway in Maryland opened along the northbound lanes in the P.M. peak direction of I-270 between the Capital Beltway/Rockville Pike (I-495/MD 355) interchange and the I-270 Spur in 1993. A southbound HOV lane in the A.M. peak direction was opened along this segment in 1994. In December 1996, a conventional lane was converted to HOV use in the southbound direction from I-370/Sam Eig Highway to the I-270 "split" in North Bethesda. Northbound, a conventional lane was converted to HOV from the "split" to Germantown Road (MD 118) at Germantown, and a new lane for HOV use was opened from MD 118 to Clarksburg Road (MD 121) at Clarksburg. New HOV lanes were also opened in both directions on the I-270 Spur, along with direct access HOV ramps that eliminate the need for HOV traffic to weave across the non-HOV lanes. Except for the direct HOV ramps at the I-270 "split," HOV lanes along the I-270 corridor are concurrent flow. In 2004, a new ramp connecting the southbound HOV lane of the I-270 Spur (in A.M.) and the northbound HOV lane of the Spur (in P.M.) was completed and opened to traffic.

HOV lanes were opened on VA 267 in December 1998, and a large park-and-ride garage was opened adjacent to VA 267 in Herndon.

Concurrent flow HOV lanes were opened on a 7.8-mile stretch of U.S. 50 in October 2002. These are the only HOV lanes in the region which are HOV-restricted 24 hours a day, 7 days a week.

### III. DESCRIPTION OF THE HOV CORRIDORS

This chapter presents summaries of physical characteristics and operational policies effective in the spring of 2010. All corridors have an extensive system of park-and-ride lots to support carpool formation.<sup>2</sup> In some cases, these lots are located a considerable distance beyond the "outer" termini of the HOV lanes. Other park-and-ride lots are located in the right-of-way of the freeway, and some lots in the I-95/I-395 corridor feature direct HOV-only access ramps to the barrier-separated HOV lanes. There are two HOV-only ramps along I-66 west of the Beltway, at Monument Drive and at Stringfellow Road. The I-270 Spur has HOV-only lanes at Westlake Drive in North Bethesda.

A description of the operating characteristics for all of the HOV facilities monitored is presented in Table 1.

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<sup>2</sup>Please see the Commuter Connections website for a detailed description of lot locations, capacities, and transportation options for each of them.  
<http://www.mwcog.org/commuter2/commuter/ridesharing/prlocations.html>

**Table 1**

2010 HOV Facility Summary							
Facility Route Number(s) and Name	Length	Facility Description	Occupancy Requirement	Hybrid Exemption	A.M. HOV Restricted Period and Direction	P.M. HOV Restricted Period and Direction	Truck Restrictions
I-95/I-395 Shirley Highway	28 miles	2 lanes, barrier-separated, reversible	3	Yes	6:00 to 9:00 (North)	3:30 to 6:00 (South)	Permitted with Occupancy Compliance North of Dale City (Exit 156), Prohibited South of Dale City
I-66	28 miles (HOV lane extension to Va. 234 Bypass)	1 Lane Concurrent Flow Outside of the Beltway, 2 Lane exclusive HOV facility inside the Beltway	2	Yes	5:30 to 9:30 AM Outside Beltway; 6:30 to 9:00 AM Inside Beltway (East)	3:00 to 7:00 PM Outside Beltway; 4:00 to 6:30 PM Inside Beltway (West)	Prohibited
I-270	9 miles Southbound; 18 miles Northbound	1 Lane Concurrent Flow	2	No	6:00 to 9:00 AM (South)	3:30 to 6:30 PM (North)	Prohibited
Va. 267 Dulles Toll Road	23 miles (includes Dulles Connector Road and I-66 from Rosslyn to Dulles Connector)	1 Lane Concurrent Flow	2	Yes	6:30 to 9:00 AM (East)	4:00 to 6:30 PM (West)	Permitted with Occupancy Compliance outside Beltway
U.S. 50	9 miles	1 Lane Concurrent Flow	2	No	HOV-2 restriction in effect 24 hours/day, 7 days/week (West and East)		Prohibited

Note: Motorcycles are permitted on all HOV restricted facilities

## I-395/I-95

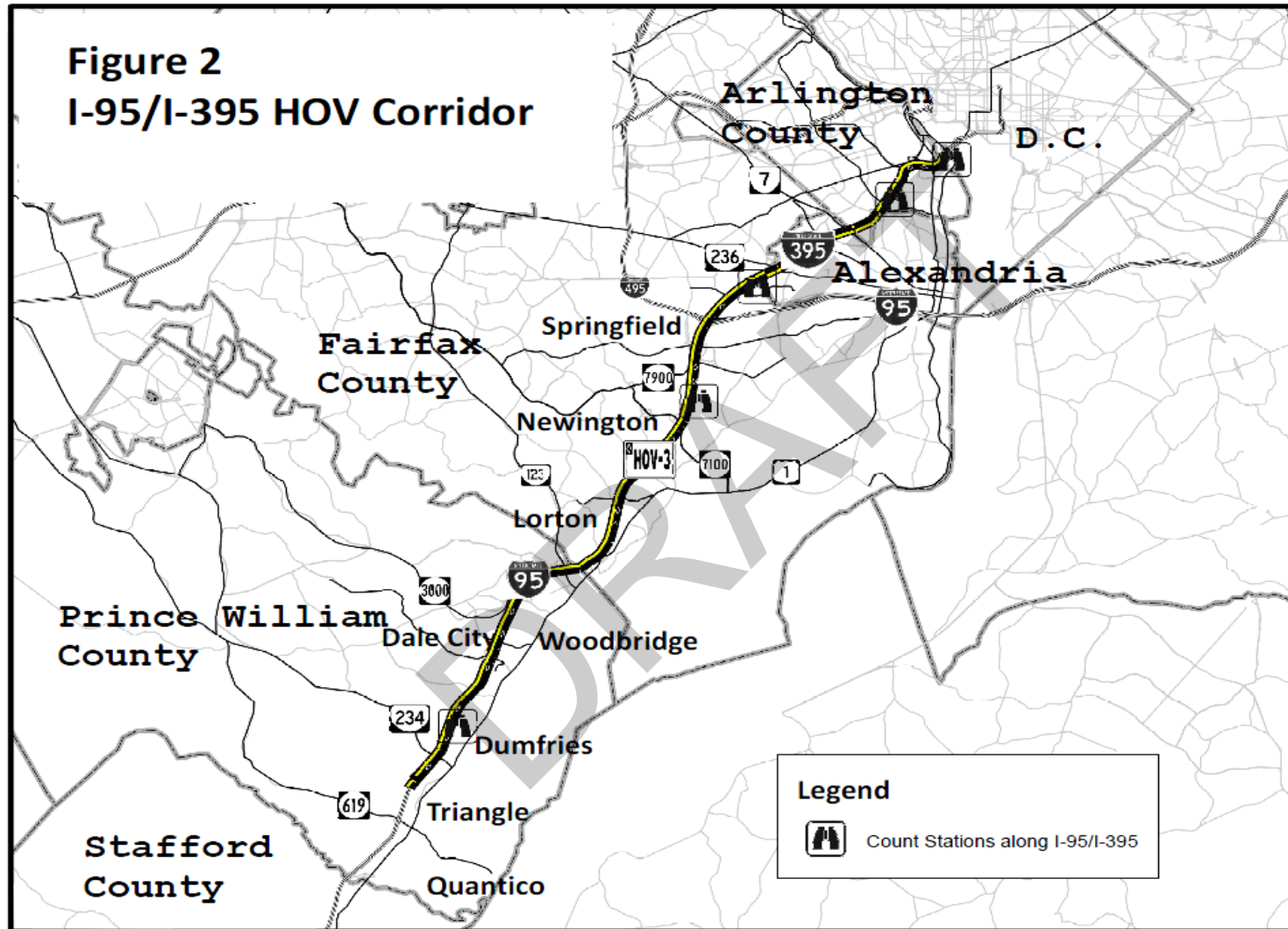
The I-395/95 corridor HOV lanes require at least 3 people in a vehicle to satisfy the occupancy requirement between 6 and 9 A.M. and 3:30 and 6 P.M. The HOV lanes in this corridor are entirely barrier separated and reversible; they serve A.M. peak period northbound movements and operate southbound in the P.M. peak period. The HOV roadway is about 27 miles long, extending from Dumfries Road (VA 234) near Dumfries, Prince William County to South Eads Street near the Pentagon in Arlington County. The Horner Road park-and-ride lot in Prince William County provides direct access onto the HOV lanes as does a special ramp from the Prince William County Parkway. At the northern end of the facility, HOV-only ramps are provided to traffic arriving at the Pentagon and the Pentagon City area of Arlington.

There is approximately one mile of barrier separated roadway north of the Pentagon, crossing the 14th Street Bridge into the District of Columbia, but no HOV restrictions currently apply to this portion of the facility.<sup>3</sup> A map of the corridor is presented in Figure 2. The corridor is also served by the Virginia Railway Express (VRE) Fredericksburg Line. The Washington Metropolitan Area Transit Authority (WMATA) Metrorail Blue Line terminates in the corridor at Franconia Springfield. Numerous bus lines serve the corridor, including Metrobus, the City of Alexandria's DASH, the Fairfax Connector, PRTC OmniRide, and private motor coach companies serving communities in Stafford and Spotsylvania Counties and the City of Fredericksburg.

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<sup>3</sup> HOV restrictions on the I-395 express lanes in the District of Columbia were removed in the late 1980's.

Figure 2



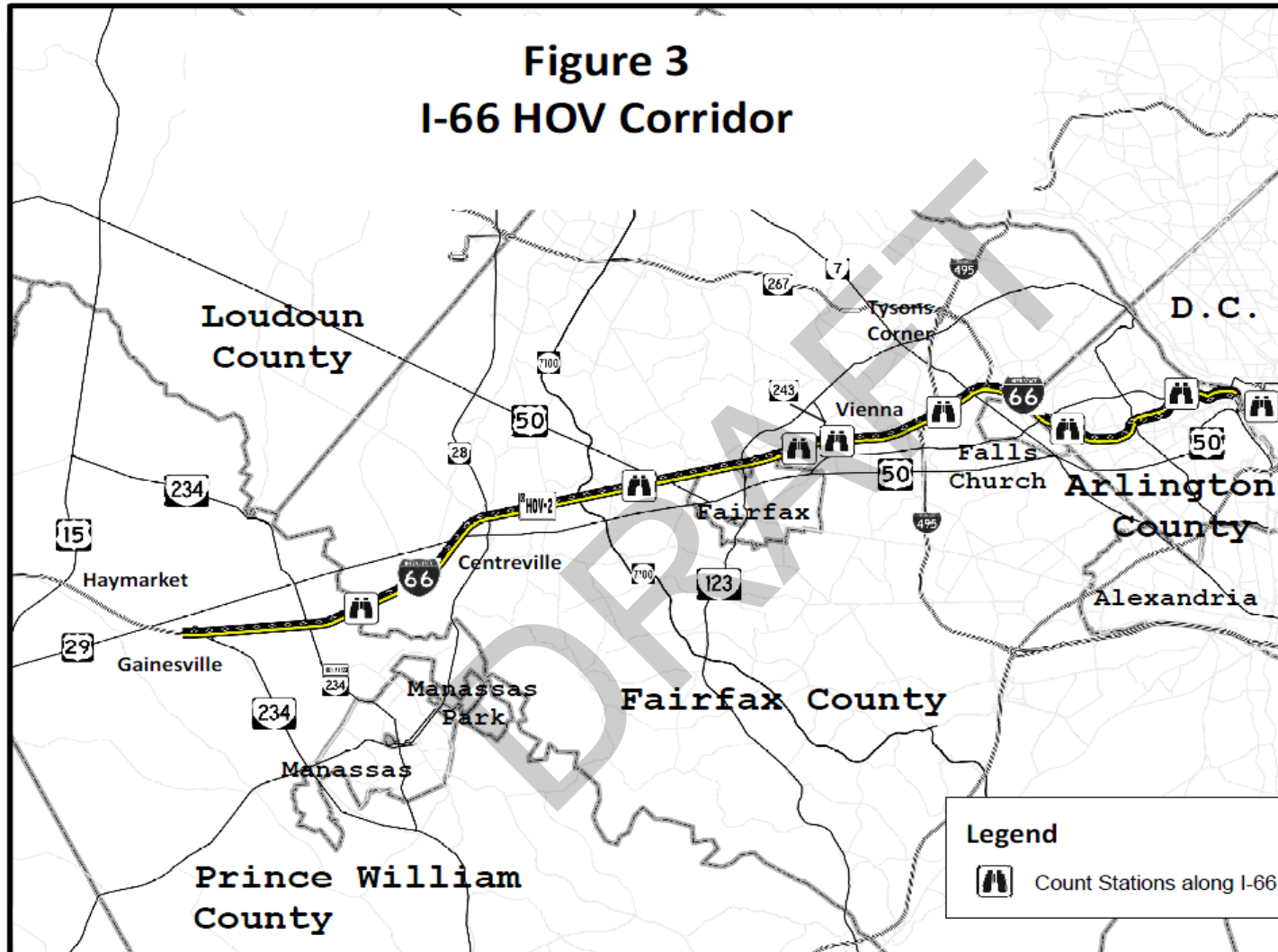
## I-66

This HOV corridor consists of two distinct sections. Between I-495 and Rosslyn, I-66 is restricted to HOV use only during the peak commute period in the peak direction with a requirement of at least two persons per vehicle. The Dulles Connector Road is subject to the same HOV restrictions as I-66 between Dolley Madison Boulevard (VA 123) at McLean and I-66. Single occupant vehicles (SOVs) traveling to or from Dulles Airport via the Dulles Connector and Dulles Access Road may use I-66, even during its HOV restricted times. Between VA 234 Business near Manassas and the Beltway, the HOV facility is a concurrent flow lane also requiring at least two persons per vehicle. The entire HOV corridor is about 27 miles in length, about 9 miles inside the Beltway and 18 miles outside the Beltway. The A.M. restricted period extends from 5:30 to 9:30 outside the Beltway and 6:30 to 9 inside the Beltway. During the P.M. restricted period, HOV requirements extend from 3 to 7:00 outside the Beltway and 4 to 6:30 inside the Beltway.

Direct access to employment centers in the District of Columbia is provided via the Theodore Roosevelt Bridge over the Potomac River. No HOV restrictions apply along I-66 east of Rosslyn, nor in the District of Columbia. A map of the corridor is presented in Figure 3. The Metrorail Orange Line uses the median of I-66 between Nutley Street (VA 243) south of Vienna and Fairfax Drive in Arlington. Four rail transit stations serve this section of the Orange Line: Vienna/Fairfax-GMU (the current terminal station), Dunn Loring/Merrifield, West Falls Church-VT/UVA, and East Falls Church. Metrobus service feeding the Vienna Metro stop operates along I-66 west of Vienna. The Virginia Railway Express Manassas Line also serves the I-66 corridor. PRTC OmniRide buses, coach service operated on behalf of Loudoun County, and private bus service use the I-66 corridor.



Figure 3



## VA 267 (Dulles Toll Road)

Concurrent flow HOV lanes operate along this corridor from a point between Sully Road (VA 28) and Centreville Road (VA 657) to just west of Leesburg Pike (VA 7). There are no HOV lanes through the interchanges at VA 7, the main toll plaza, Spring Hill Road (VA 684), I-495 and VA 123. HOV restrictions apply to all lanes of the Dulles Connector road from east of VA 123 to I-66. Fairfax Connector provides most transit bus service in the corridor, with the Loudoun County Commuter Express providing commuter bus service from Loudoun County to the Metro Core area (including stops in Rosslyn, Arlington County and downtown Washington, D.C.).<sup>4</sup> WMATA operates the route 5A Metrobus service between Washington Dulles International Airport and the L'Enfant Plaza Metrorail station, with intermediate stops at the Herndon/Monroe Park and Ride, the Tysons-Westpark Transit Station, and the Rosslyn Metrorail station.

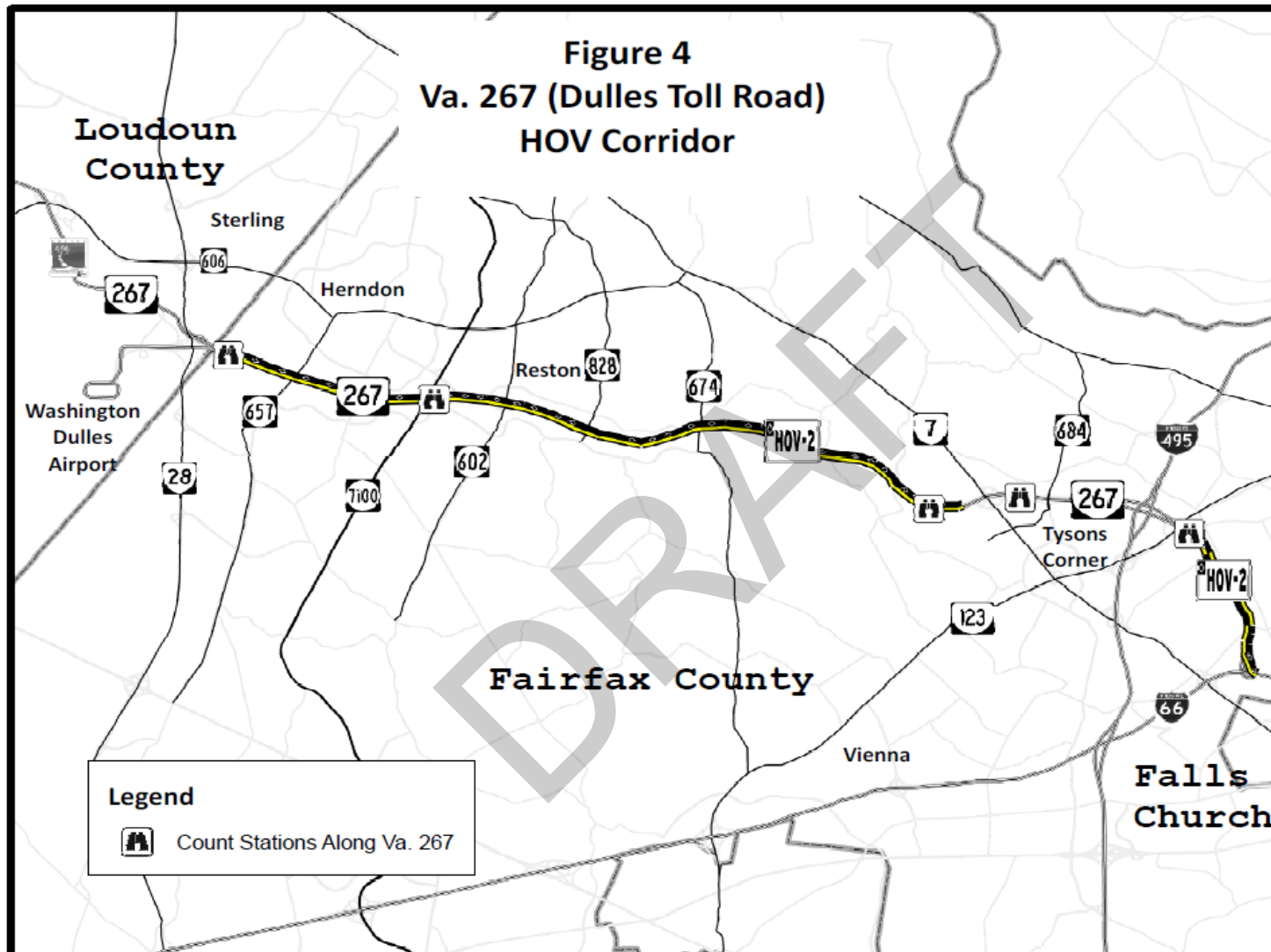
The HOV lanes require at least two persons per vehicle and the requirement is from 6:30 A.M. to 9:00 A.M. and from 4:00 P.M. to 6:30 P. M. Figure 4 contains a map of the Dulles Toll Road corridor.

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<sup>4</sup>

By special arrangement with the Metropolitan Washington Airports Authority (MWAA), some buses serving the corridor are permitted to use the Dulles Access Road (normally restricted to airport traffic only).

Figure 4



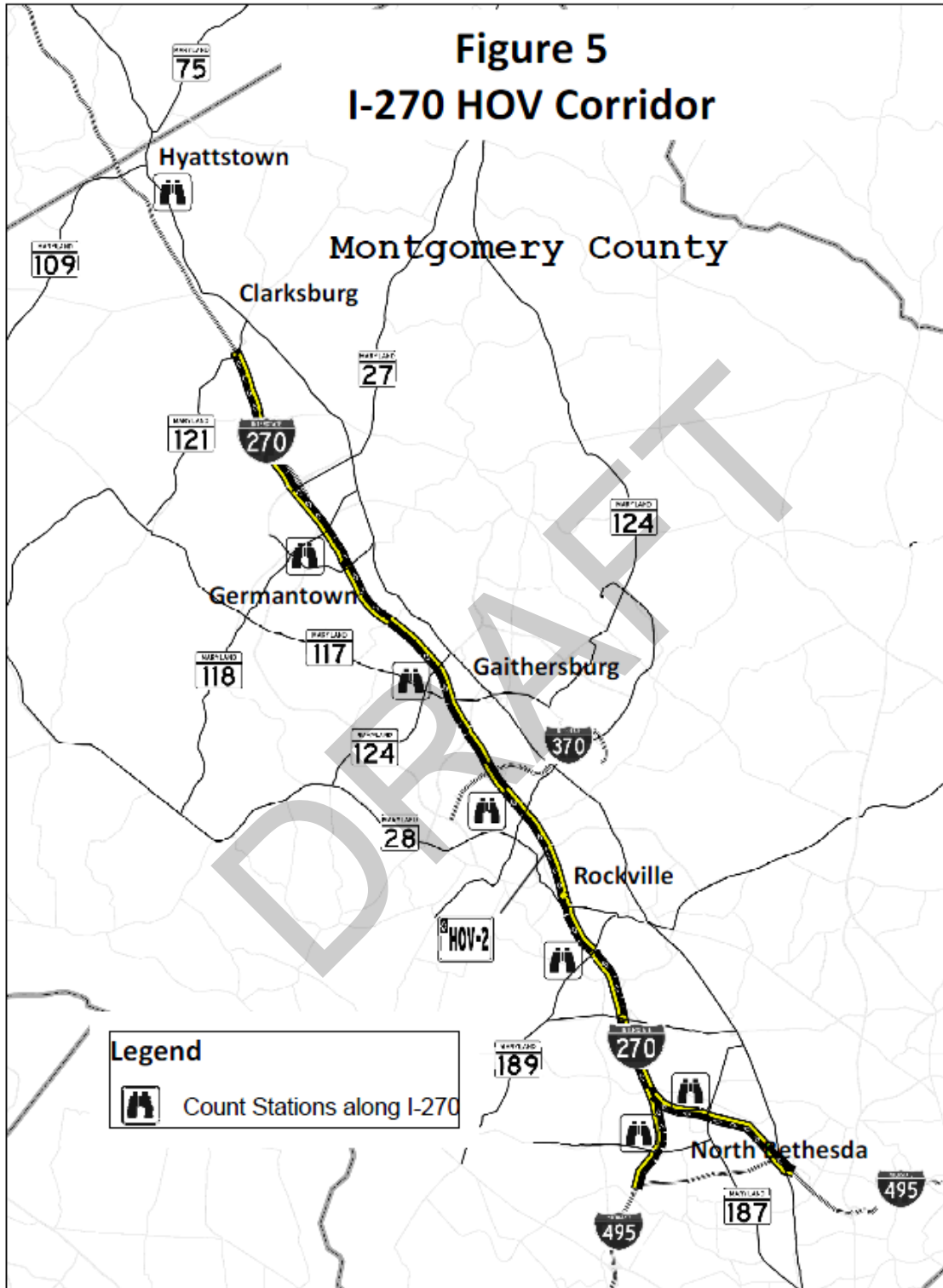
## I-270

In the southbound (A.M. peak) direction, the HOV concurrent flow lane runs from I-370 near Gaithersburg south to the Rockville Pike/Capital Beltway interchange. There is also a concurrent flow HOV lane along the southbound lanes of the I-270 Spur. Together, the A.M. peak flow direction lanes total about 11 miles in length. The I-270 Spur is less than 2 miles long. The HOV restriction is from 6 to 9 A.M. and requires at least two persons per vehicle.

In the northbound (P.M. peak) direction, concurrent flow HOV lanes exist along the entire northbound I-270 Spur, and along I-270 from its southern terminus at I-495/Md. 355 to I-370 (the same sections of the corridor having HOV lanes southbound). Additionally, there are about 7.5 miles of HOV lane between I-370 and MD 121 near Clarksburg. The HOV-2 restriction extends from 3:30 to 6:30 P.M. A map of the I-270 corridor is shown in Figure 5.

The Metrorail Red Line serves the I-270 corridor from Shady Grove (terminal station accessible from I-370), and continues south to Bethesda and on to the downtown area of the District of Columbia. The Maryland Transit Administration's (MTA) MARC Brunswick Line also serves several stops in this corridor, and continues south to Silver Spring and on to Union Station in the District of Columbia. Montgomery County's Ride-On bus serves areas in the corridor north of I-370, and MTA coach service (between Hagerstown, Frederick, and Shady Grove), use the HOV lanes. Express Metrobus service operates on the HOV lanes in the corridor between Bethesda and Gaithersburg.

Figure 5



## U.S. 50

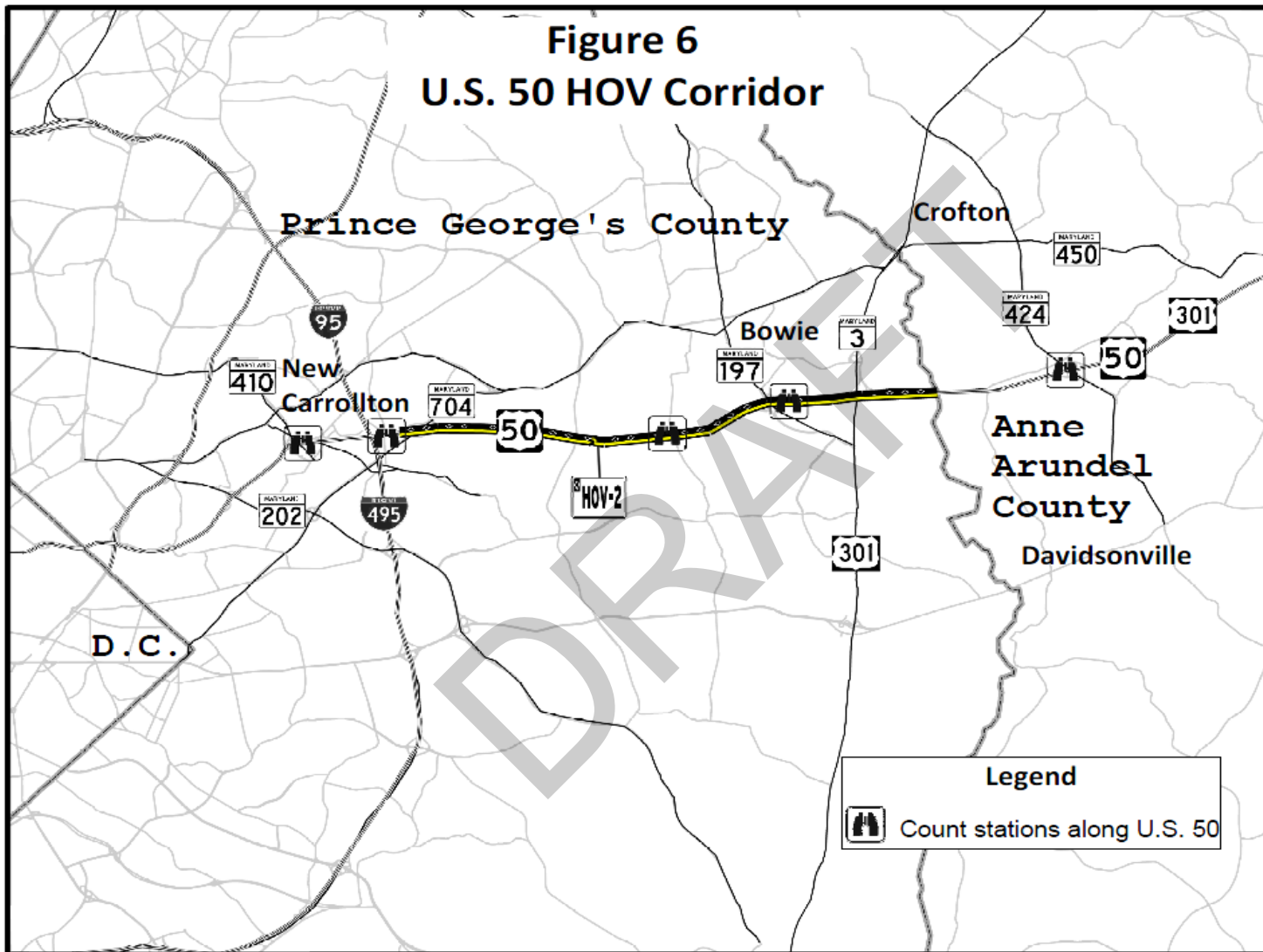
Concurrent flow HOV lanes operate on U.S. 50 (John Hanson Highway) from just west of the Martin Luther King Highway (MD 704) interchange to east of the U.S. 301/MD 3 interchange in Bowie. Unlike all other HOV lanes in the region, these lanes are HOV-2 restricted at all times (24 hours, 7 days) in both directions.

Both WMATA and MTA operate buses on the U.S. 50 HOV lanes. To the east, the buses serve the City of Bowie in Prince George's County, the Annapolis and Crofton areas of Anne Arundel County and Kent Island, Queen Anne's County (east of the Bay Bridge). All WMATA buses operating westbound in the corridor terminate at the New Carrollton rail station. Some MTA buses serve the downtown area of the District of Columbia, others terminate at New Carrollton.

Figure 6 depicts the HOV lanes in the US 50 corridor.

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Figure 6



## IV. METHODOLOGY

The information in this report is multi-modal so that comparisons between the HOV, SOV and transit modes may be made. Data were collected for HOV lanes and adjacent non-HOV lanes, bus transit operating on the HOV lanes, and rail transit operating on the facility (e.g., Metrorail Orange Line along I-66).

Data collection was limited Tuesdays, Wednesdays, and Thursdays only. No data collection took place in weeks prior to, during, and after the Passover and Easter holidays, nor during the public school spring breaks. Data collection was deferred if the weather forecast predicted steady rainfall, or if a serious freeway incident affected traffic operations. The reader is cautioned that count data presented in this document are based on one day counts, which may vary significantly from day to day.

### Occupancy/Classification Counts

These data were collected at a series of locations along each HOV corridor. Temporary personnel were hired and trained to count and classify vehicles. The personnel counted inbound and outbound traffic once at each site on a Tuesday, Wednesday, or Thursday in the spring from 5 A.M. to 10 A.M. inbound and 3 P.M. to 8 P.M. outbound. All vehicles were classified by vehicle type, and in the case of automobiles, were further grouped by number of occupants (from 1 to 7 persons). Pickup trucks, vans, and panel trucks (excepting 15 passenger van-pool vans) were counted as automobiles if they had exactly two axles and exactly four wheels. The traffic count data are distributed by time of day, in fifteen-minute periods from 5 A.M. to 10 A.M. and 3 P.M. through 8 P.M. The reader is urged to exercise caution in using individual site data due to the normal fluctuations in traffic volumes on individual roadways. Because of heavy traffic on interstate highways in the Washington region, generally one person was assigned to count each travel lane. Handheld electronic counting units were used to tally each vehicle and the number of passengers observed as it passed the counting station. At the end of each shift, data were then downloaded to personal computers for further processing and analysis with Microsoft Excel.

### Transit Patronage Data

Transit ridership data were obtained from providers of bus and rail service in each corridor. I-95/I-395 corridor transit data were provided by WMATA, the Fairfax County Department of Transportation, the City of Alexandria, VRE, PRTC, and by the private coach operators National Coach, Quick's, and Lee. I-66 corridor transit data were provided by WMATA, PRTC, and VRE. In the I-270 corridor, transit data were provided by WMATA, Montgomery County, and the MTA. The Fairfax County Department of Transportation, Loudoun County Department of Planning, and WMATA provided patronage data for the VA 267 corridor. Ridership data in the U.S. 50 corridor were provided by WMATA and MTA.



Bus ridership data were collected from services operating on HOV facilities only. Rail ridership data were obtained from parallel rail lines at locations similar to the occupancy/classification count stations. Actual patronage data for parallel rail lines is reported in the appendices of this report, as is patronage of "traditional" transit bus services operated by WMATA, Montgomery County Ride-On, Alexandria DASH and Fairfax Connector.

Because other buses such as commuter, charter, inter-city and school buses also operate on the HOV facilities, a load factor was developed for each corridor based on commuter bus patronage. The load factors were then applied to each bus observed but not reported above as part of traditional transit services and range from 35 to 45 passengers

### Travel Time Runs

Travel time data were collected in the spring of 2010, using the floating car method. Data were collected with the use of stopwatches and pre-printed run sheets for each corridor, showing landmarks and associated mile points, which were later translated to elapsed times. To compute travel times for HOV and non-HOV routes, all travel time runs were done in pairs, with one vehicle following the HOV route, and a second vehicle following the parallel non-HOV route.

Morning runs were scheduled to start at the outer limits of each HOV corridor. Afternoon runs started from the inner limits of each corridor. Both A.M. and P.M. runs are conducted on the entire length of the corridor. The number of floating car travel time runs conducted on each facility is presented in Table 2.

**Table 2**

2010 Regional HOV Monitoring Number of 'Floating Car' Travel Time Runs by Facility & Time Period				
Facility	A.M. Period		P.M. Period	
	HOV	Non-HOV	HOV	Non-HOV
I-95/I-395 [Shirley Hwy.] between Va. 619 (Triangle) and 14th St. & Independence Ave., S.W. Washington, D.C.	9	9	9	9
I-66 between U.S. 15 (Haymarket) and 23rd St. and Constitution Ave., N.W. (Washington, D.C.)	8	8	8	8
I-270 between Md. 109 (Hyattstown) and I-495 (at Md. 185 (Connecticut Ave.))	7	7	7	7
I-270Y [I-270 Spur] (between Md. 109 (Hyattstown) and I- 495 (at Md. 190 (River Rd.))	6	6	7	7
Va. 267 [Dulles Toll Rd.] between Va. 28 (Sully Rd.) and 23rd St. and Constitution Ave., N.W. (Washington, D.C.) [via Dulles Connector Rd. and I-66 inside Capital	7	7	7	7
U.S. 50 [John Hanson Hwy.] between Md. 424 (Davidsonville Rd.) and Md. 202 (Landover Rd.)	5	5	6	6
I-95/I-495 - Wilson Bridge between Virginia and Maryland	5	5	5	5

## V. HOV FACILITY PERFORMANCE

HOV facilities can be evaluated using several measures of effectiveness. Examples include average auto occupancy, which is the average number of persons in each auto; total person movements by auto and transit bus; and travel times for users of HOV facilities in comparison with non-HOV or conventional lanes.

Motorist compliance with HOV restrictions is essential in maintaining HOV facility performance. The enforcement of those restrictions is required to maintain travel time savings on HOV facilities. The Virginia and Maryland State Police have primary responsibility for enforcement of HOV restrictions described in this document and located in their respective states. In Virginia, troopers routinely conduct HOV enforcement along with other assigned duties. Additionally, the Virginia Department of Transportation (VDOT) funds State Police overtime to supplement routine enforcement, which is conducted on randomly selected days and locations along all HOV corridors in Northern Virginia, and consists of roving patrols, as well as stationary enforcement on HOV entrance and exit ramps. Fines for HOV violators in Virginia range from \$50 to \$500. In Maryland, troopers assigned to the I-270 and U.S. 50 corridors are aware of the HOV restriction, and enforce HOV restrictions in addition to other duties. The State Highway Administration (SHA) of the Maryland Department of Transportation (MDOT) also funds overtime for troopers assigned exclusively to HOV enforcement on randomly selected days. HOV violations in Maryland carry a penalty of one point and fines ranging from \$70 to \$500.

### Average Auto Occupancy

Average auto occupancy is a measure of the number of auto drivers and passengers served by a highway facility, and of motorist compliance with HOV restrictions. It is expressed as the average number of persons per vehicle. The numerator of the calculation is the number of auto passengers and drivers observed passing a count station in autos (for the purposes of computing average vehicle occupancy, pickup trucks, panel trucks and vans with exactly four wheels are considered autos). Trucks and transit passengers are not included in the calculation. The numerator also includes the number of vanpools counted times 12 (See Appendix G, Vanpool Monitoring Method). The denominator is the number of autos, auto like vehicles and vanpools counted. The example below is simplified (normally there would be 3 through 6 person vehicles), but shows the calculation for the average auto occupancy.

EXAMPLE:

	1-Person Vehicle	2-Person Vehicle	7-Person Vehicle	Vanpool	Motorcycle	TOTAL
Count	5	20	2	3	2	32
People	5	40	14	24	2	85
Ave. Occupancy	total people/total vehicles:					2.65

Average auto occupancy gives a rough measure of motorist compliance with HOV restrictions because most vehicles entered into the calculation as single occupancy vehicles are HOV violators, although there are some exceptions. Some vehicles counted are law enforcement vehicles, freeway service patrol trucks and other official highway vehicles permitted to use the HOV lanes, and, in Virginia vehicles with clean fuel registration plates are exempt from the HOV requirement.<sup>5</sup> In addition, the use of tinted glass in some vehicles makes measurement of occupancy difficult. Field count personnel are instructed to note only the occupants that can be viewed, and this may tend to underestimate average car occupancy. Observed average auto occupancies and the number of autos needed to move 1,000 persons at this occupancy rate (HOV and non-HOV lanes) for each of the maximum load locations during the HOV restricted periods in the morning peak direction are presented in Table 3. The same data observed during the afternoon peak direction are described in Table 4. Comparisons of average occupancy data from 1997, 1998, 1999, 2004, 2007, and 2010 are shown in Tables 5 and 6 for A.M. and P.M. HOV-restricted periods, respectively.

Average auto occupancies in 2010 during the A.M. peak period were highest on the HOV lanes in the corridor with the HOV-3 restriction: I-95/I-395. The average auto occupancy on the I-95 HOV lanes south of I-495 was 2.5 persons per vehicle in the AM Peak Period, and 2.9 in the PM Peak Period. Meanwhile, the average on the I-395 HOV lanes north of S. Glebe Road (VA 120) was about 2.8 in both the A.M. and P.M. Peak Periods. On facilities designated HOV-2, observed average auto occupancies during the A.M. peak period ranged from 1.5 to 2.0. In the corridors with HOV-2 restrictions for the P.M. Peak Period, the average ranged from 1.4 to 2.0.

With each time point, average auto occupancies tend to go up or down slightly, but overall have remained fairly stable on each facility over time, reflecting no direct trend towards higher or lower auto occupancies. The Dulles Toll Road and I-66 inside the Beltway have the lowest rates of compliance with average auto occupancies ranging from 1.4 to 1.7 across both facilities and the AM and PM peak periods. I-66 outside the Beltway has better compliance with 1.8 in the morning and 1.9 in the afternoon. By contrast, the I-270

<sup>5</sup> The most-common vehicles with these registration plates are hybrid vehicles (including, but not limited to, the Toyota Prius, Honda Civic Hybrid, and the Honda Insight) and vehicles powered by compressed natural gas (CNG). Detailed information on this program and eligible vehicles by model year can be found on the Virginia DMV website at the following URL: <http://www.dmv.state.va.us/webdoc/citizen/vehicles/cleanspecialfuel.asp>

corridor shows average auto occupancies of 1.9 to 2.0 for HOV-2 and that number extends onto both legs of the spur on the southern end of I-270. On U.S. 50 between MD 197 and MD 704, there was a decrease of 0.1 in occupancy observed in both time periods.

Table 5 shows a mixed trend over time for auto occupancies. In the morning, increases were seen only on I-395 and I-270. All other facilities showed a slight decline. In contrast, Table 6 only showed an increase on I-95, with I-270 at the max load point and the east side of the spur holding steady. All other facilities showed a decline. In both time periods, I-66 inside the Beltway shows the lowest auto-occupancy which could be the result of the construction for both the HOT lanes on the Beltway or Metro to Dulles making non-HOV drivers less more open to violations. The next data point will show whether this is a trend or an anomaly.

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**Table 3**

Observed average auto occupancies in the A.M. peak direction during HOV-restricted periods (Spring, 2010)				
Facility	HOV lane average auto occupancies	Number of autos needed to move 1000 persons	Non-HOV lane average auto occupancies	Number of autos needed to move 1000 persons
I-395 Shirley Highway between Va. 120 (S. Glebe Road) and Arlington Ridge Road	2.8	360	1.1	910
I-95 Shirley Highway between Va. 7100 (Fairfax County Parkway) and Va. 7900 (Franconia Springfield Parkway)	2.5	400	1.1	910
I-66 between Sycamore Street and Fairfax Drive	1.5	670	N/A	N/A
I-66 between Va. 243 (Nutley Street) and I-495	1.8	560	1.1	910
Va. 267 (Dulles Toll Road) west of Va. 7 (Leesburg Pike)	1.7	590	1.1	910
I-270 between Montrose Road and the "split" (Max Load Point)	1.9	530	1.0	1000
I-270 between the "split" and Rockledge Drive	2.0	500	1.0	1000
I-270Y (I-270 Spur) between the "split" and Democracy Boulevard	1.9	530	1.0	1000
U.S 50 between Md. 197 (Collington Road) and Md. 704 (MLK, Jr. Hwy)	1.8	560	1.0	1000

Note: Average auto occupancy rounded to nearest 1/10.

**Table 4**

Observed average auto occupancies in the P.M. peak direction during HOV-restricted periods (Spring, 2010)				
Facility	HOV lane average auto occupancies	Number of autos needed to move 1000 persons	Non-HOV lane average auto occupancies	Number of autos needed to move 1000 persons
I-395 Shirley Highway between Arlington Ridge Road and Va. 120 (S. Glebe Road)	2 . 8	360	1 . 1	910
I-95 Shirley Highway between Va. 7900 (Franconia Springfield Parkway) and Va. 7100 (Fairfax County Parkway)	2 . 9	340	1 . 1	910
I-66 between Fairfax Drive and Sycamore Street	1 . 4	710	N/A	N/A
I-66 between I-495 and Va. 243 (Nutley Street)	1 . 9	530	1 . 1	910
Va. 267 (Dulles Toll Road) west of Va. 7 (Leesburg Pike)	1 . 5	670	1 . 1	910
I-270 between Rockledge Drive and the "split"	1 . 9	530	1 . 1	910
I-270Y (I-270 Spur) between Democracy Boulevard and the "split"	2 . 0	500	1 . 1	910
I-270 between the "split" and Montrose Road (Max Load Point)	2 . 0	500	1 . 1	910
U.S 50 between Md. 704 (MLK, Jr. Hwy) and Md. 197 (Collington Road)	1 . 7	590	1 . 0	1000

Note: Average auto occupancy rounded to nearest 1/10.

**Table 5**

2010 Observed average HOV auto occupancies in the A.M. Peak Direction Over Time						
Facility	Year					
	1997	1998	1999	2004	2007	2010
I-395 Shirley Highway between Va. 120 (S. Glebe Road) and Arlington Ridge Road	2.7	2.6	2.9	2.5	2.5	2.8
I-95 Shirley Highway between Va. 7100 (Fairfax County Parkway) and Va. 7900 (Franconia Springfield Parkway)	2.6	2.8	2.8	2.6	2.6	2.5
I-66 between Sycamore Street and Fairfax Drive	1.8	1.8	1.8	1.7	1.8	1.5
I-66 between Va. 243 (Nutley Street) and I-495	2.0	1.7	1.9	2.0	1.9	1.8
Va. 267 (Dulles Toll Road) west of Va. 7 (Leesburg Pike)	N/A	N/A	1.8	1.8	1.8	1.7
I-270 between Montrose Road and the "split" (Max Load Point)	N/A	N/A	N/A	1.7	1.6	1.9
I-270 between the "split" and Rockledge Drive	1.9	1.7	1.7	1.9	1.5	2.0
I-270Y (I-270 Spur) between the "split" and Democracy Boulevard	1.9	1.8	1.8	1.5	1.8	1.9
U.S 50 between Md. 197 (Collington Road) and Md. 704 (MLK, Jr. Hwy)	N/A	N/A	N/A	1.6	1.9	1.8

Notes: Data in table are rounded.



**Table 6**

2010 Observed average HOV auto occupancies in the P.M. Peak Direction Over Time						
Facility	Year					
	1997	1998	1999	2004	2007	2010
I-395 Shirley Highway between Arlington Ridge Road and Va. 120 (S. Glebe Road)	3.1	3.1	3.2	2.8	2.9	2.8
I-95 Shirley Highway between Va. 7900 (Franconia Springfield Parkway) and Va. 7100 (Fairfax County Parkway)	2.9	2.7	3.0	2.7	2.8	2.9
I-66 between Fairfax Drive and Sycamore Street	1.8	1.8	1.9	1.7	1.8	1.4
I-66 between I-495 and Va. 243 (Nutley Street)	2.0	2.0	1.9	2.0	2.0	1.9
Va. 267 (Dulles Toll Road) west of Va. 7 (Leesburg Pike)	N/A	N/A	1.8	1.8	1.6	1.5
I-270 between Rockledge Drive and the "split"	2.1	1.8	1.6	2.1	1.9	1.9
I-270Y (I-270 Spur) between Democracy Boulevard and the "split"	2.1	1.8	2.1	1.5	2.1	2.0
I-270 between the "split" and Montrose Road (Max Load Point)	N/A	N/A	N/A	1.8	2.0	2.0
U.S 50 between Md. 704 (MLK, Jr. Hwy) and Md. 197 (Collington Road)	N/A	N/A	N/A	2.1	1.8	1.7

Notes: Data in table are rounded.

## Person Movements

HOV facilities can move more people than conventional highway lanes, especially when motorists comply with HOV restrictions. In addition, HOV facilities serve more travelers in fewer vehicles. Tables 7 and 8 show the number of HOV and non-HOV lanes at maximum load locations in the region and the person movements in the lanes during A.M. peak and P.M. peak HOV-restricted periods, respectively.

Not surprisingly, the I-95/I-395 corridor with its requirement of 3 people per vehicle yields the highest lane person movements in the region with a maximum observed value of 5,100 persons per lane per hour along I-395 between S. Glebe Road (VA 120) and Arlington Ridge Road during both the A.M. and P.M. Peak Periods. The next highest people per hour movements are observed on I-95 between the Fairfax County Parkway (VA 7100) and the Franconia Springfield Parkway (VA 7900) in the A.M. Peak Period.

Interstate 270 also moves more people in the HOV lane than in the non-HOV lanes. In the morning the HOV lanes moves 3,000 persons per hour while each of the non-HOV lanes move 1,900 persons per hour. In the afternoon, the non-HOV lanes move 1,700 persons while the HOV lane moves 4,100 persons per hour, considerably more than in the morning.

The ability of HOV facilities to carry more people in fewer vehicles becomes especially apparent during hours of peak demand. Illustrated in Tables 9 and 10 are person movements in the peak hour of the morning and evening HOV restricted periods, respectively. The peak hour is identified by looking at the number of people moved in both the HOV and non-HOV lanes together and determining which hour had the greatest number of people moving past the relevant count station. In some cases, person moving differences between HOV and non-HOV facilities during the peak hour are dramatic.

For example, during the A.M. peak hour of 7:30 to 8:30 A.M. on I-395, the barrier separated HOV lanes were able to serve 11,000 persons in two lanes, while four conventional lanes moved 9,300 persons. In the afternoon peak hour of 6 to 7 P.M., I-95 at Newington moved 6,000 persons in two HOV lanes, and 4,200 in four non-HOV lanes.<sup>6</sup> The peak hour at Newington is surprisingly late given that the peak hour in the morning is from 5:30 to 6:30 A.M.

Similarly, I-66 inside the Beltway experiences an early peak hour in the morning (5:30 to 6:30 A.M.) and a relatively late peak hour in the afternoon (6:45 – 7:45 P.M.); the exclusive HOV section of I-66 served 4,900 persons in one hour in two lanes in the A.M. and the P.M. peak hour. Readers are alerted to the fact that both peak hours on I-66 inside the Beltway shoulder the times that HOV restrictions are in effect (6:30 A.M to 9:00 A.M. and 4:00 to 6:30 P.M.).

The concurrent flow HOV lane along I-66 outside the Beltway served 3,000 persons in the A.M. peak hour, while the three conventional lanes served 5,100 (1,700 persons per lane per hour). The peak hour on I-66 at Nutley Street (VA 243) is also early (5:45 to 6:45 A.M.), but starts just after the peak hour inside the Beltway suggesting that many people are commuting on just sections of the highway or connecting to or from the Beltway to a wide variety of destinations.

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<sup>6</sup> There is a lane drop in the southbound I-95 non-HOV lanes (from 4 to 3) just south of the monitoring location at the Fairfax County Parkway (VA 7100) interchange.

On the Maryland HOV facilities, the peak hour on I-270 and U.S. 50 is well into what is considered the more traditional rush hour period of 7-8 A.M. at the max load point on I-270 and not until 7:30-8:30 on U.S. 50. Along I-270 south of Montrose Road and north of the "split", the southbound HOV lane served 3,700 persons in the A.M. peak hour, while five conventional lanes served 10,500 persons (2,100 persons per lane per hour). In the afternoon, the peak hour is surprisingly early (3:45 and 4:45 P.M.) at the max load point on I-270. At this location in the northbound (P.M.) direction, one HOV lane served 4,300 travelers, while 5 non-HOV lanes carried 8,500 (1,700 persons per lane per hour). In contrast, U.S. 50 has a P.M. peak hour of 5:30-6:30, suggesting most commuters leave their workplace around 5 P.M., and the HOV lane on U.S. 50 moves an additional 500 people over the conventional lanes during that hour.

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**Table 7**

Observed person movements in the A.M. peak direction during HOV-restricted periods (Spring, 2010)						
Facility  And Hours of HOV-restricted operation	Number of HOV lanes	HOV lane person movements during HOV-restricted period	HOV lane persons per lane per hour	Number of non-HOV lanes	Non-HOV lane person movements during HOV-restricted period	Non-HOV lane persons per lane per hour
I-395 between Va. 120 and Arlington Ridge Rd 6:00 A.M. to 9:00 A.M.	2	30,800	5,100	4	24,200	2,000
I-95 between Va. 7100 and Va. 7900  6:00 A.M. to 9:00 A.M.	2  <i>Includes Newington Flyover Ramp</i>	24,200	4,000	4	17,000	1,400
I-66 between Sycamore St and Fairfax Dr  6:30 A.M. to 9:00 A.M.	2	15,800	3,200	0  <i>No non-HOV lanes</i>	N/A	N/A
I-66 between Va. 243 & I-495 5:30 A.M. to 9:30 A.M.	1	10,400	2,600	3	20,100	1,700
Va. 267 west of Va. 7 6:30 A.M. to 9:00 A.M.	1	10,200	4,100	3	12,800	1,700
I-270 between Montrose Road and the "split" 6:00 A.M. to 9:00 A.M.	1	8,900	3,000	5	27,800	1,900
I-270 between the "split" and Rockledge Drive 6:00 A.M. to 9:00 A.M.	1	5,500	1,800	3	15,000	1,700
I-270 Spur between the "split" and Democracy Blvd  6:00 A.M. to 9:00 A.M.	1  <i>Includes Westlake Drive Ramp</i>	3,400	1,100	2	12,800	2,100
U.S 50 between Md. 197 & Md. 704  24 Hours, 7 Days/Week (5:00 A.M. to 10:00 A.M. assumed in calculations)	1	4,600	900	3	21,800	1,500

Note: All person movements rounded to nearest 100

**Table 8**

Observed person movements in the P.M. peak direction during HOV-restricted periods (Spring, 2010)						
Facility And Hours of HOV operation	Number of HOV lanes	HOV lane person movements during HOV-restricted period	HOV lane persons per lane per hour	Number of non-HOV lanes	Non-HOV lane person movements during HOV-restricted period	Non-HOV lane persons per lane per hour
I-395 between Arlington Ridge Rd. and Va. 120 3:30 P.M. to 6:00 P.M.	2	25,600	5,100	4	22,200	2,200
I-95 between Va. 7900 and Va. 7100 3:30 P.M. to 6:00 P.M.	2	24,000	4,800	4	9,300	900
I-66 between Fairfax Dr and Sycamore St 4:00 P.M. to 6:30 P.M.	2	14,000	2,800	0 <i>No non-HOV lanes</i>	N/A	N/A
I-66 between I-495 and Va. 243 3:00 P.M. to 7:00 P.M.	1	9,200	2,300	3	17,500	1,500
Va. 267 west of Va. 7 4:00 P.M. to 6:30 P.M.	1	11,100	4,400	3	15,300	2,000
I-270 between Rockledge Drive and the "split" 3:30 P.M. to 6:30 P.M.	1	5,700	1,900	2	12,400	2,100
I-270Y Spur between Democracy Blvd & the "split" 3:30 P.M. to 6:30 P.M.	1 <i>Includes Westlake Drive Ramp</i>	6,700	2,200	2	13,300	2,200
I-270 between the "split" and Montrose Road 3:30 P.M. to 6:30 P.M.	1	12,400	4,100	5	25,700	1,700
U.S 50 between Md. 704 and Md. 197 24 Hours, 7 Days/Week (3:00 P.M. to 8:00 P.M. assumed in calculations)	1	8,100	1,600	3	22,200	1,500

Note: All person movements rounded to nearest 100

**Table 9**

A.M. peak hour person movements during HOV-restricted periods (Spring 2010)						
Facility  And peak hour within HOV-restricted period	Number of HOV lanes	HOV lane person movements during peak hour in HOV-restricted period	HOV lane persons per lane per hour	Number of non-HOV lanes	Non-HOV lane person movements during HOV-restricted period	Non-HOV lane persons per lane per hour
I-395 between Va. 120 and Arlington Ridge Rd. 7:30 A.M. to 8:30 A.M.	2	11,000	5,500	4	9,300	2,300
I-95 between Va. 7100 and Va. 7900  5:30 A.M. to 6:30 A.M.	2  <i>Includes Newington Flyover Ramp</i>	8,400	4,200	4	6,200	1,600
I-66 between Sycamore St and Fairfax Dr  5:30 A.M. to 6:30 A.M.	2	4,900	2,500	0  <i>No non-HOV lanes</i>	N/A	N/A
I-66 between Va. 243 & I-495  5:45 A.M. to 6:45 A.M.	1	3,000	3,000	3	5,100	1,700
Va. 267 west of Va. 7 6:45 A.M. to 7:45 A.M.	1	4,400	4,400	3	5,900	2,000
I-270 between the "split" and Rockledge Dr  7:00 A.M. to 8:00 A.M.	1	2,200	2,200	3	6,100	2,000
I-270 Spur between the "split" & Democracy Blvd  7:00 A.M. to 8:00 A.M.	1  <i>Includes Westlake Drive Ramp</i>	1,400	1,400	2	4,400	2,200
I-270 between Montrose Road and the "split"  6:45 A.M. to 7:45 A.M.	1	3,700	3,700	5	10,500	2,100
U.S 50 between Md. 197 and Md. 704  7:30 A.M. to 8:30 A.M.	1	700	700	3	6,400	2,100

Note: All person movements rounded to nearest 100

**Table 10**

P.M. peak hour person movements during HOV-restricted periods (Spring 2010)						
Facility And peak hour within HOV-restricted period	Number of HOV lanes	HOV lane person movements during peak hour in HOV-restricted period	HOV lane persons per lane per hour	Number of non-HOV lanes	Non-HOV lane person movements during HOV-restricted period	Non-HOV lane persons per lane per hour
I-395 between Arlington Ridge Rd. and Va. 120 4:30 P.M. to 5:30 P.M.	2	12,800	6,400	4	9,600	2,400
I-95 between Va. 7100 and Va. 7900 6:00 P.M. to 7:00 P.M.	2	6,000	3,000	4	4,200	1,100
I-66 between Fairfax Dr and Sycamore St 6:45 P.M. to 7:45 P.M.	2	4,900	2,500	0 <i>No non-HOV lanes</i>	N/A	N/A
I-66 between I-495 & Va. 243 6:15 P.M. to 7:15 P.M.	1	2,400	2,400	3	5,500	1,800
Va. 267 west of Va. 7 5:15 P.M. to 6:15 P.M.	1	4,900	4,900	3	6,500	2,200
I-270 between Rockledge Drive and the "split" 3:45 P.M. to 4:45 P.M.	1	2,000	2,000	2	3,900	2,000
I-270 Spur between Democracy Blvd & the "split" 3:30 P.M. to 4:30 P.M.	1 <i>Includes Westlake Drive Ramp</i>	2,600	2,600	2	4,900	2,500
I-270 between the "split" and Montrose Road 3:45 P.M. to 4:45 P.M.	1	4,300	4,300	5	8,500	1,700
U.S 50 between Md. 704 and Md. 197 5:30 P.M. to 6:30 P.M.	1	2,300	2,300	3	5,500	1,800

Note: All person movements rounded to nearest 100

## Travel Times

HOV facilities are designed to provide faster travel times and more predictable speeds than parallel non-HOV facilities (please see Appendices C and D for detailed A.M. and P.M. travel time data for 2010, respectively, and Appendix H for a description of the methodology used to collect these data).

To compare the travel times of HOV and non-HOV routes, a set of travel time runs was conducted in each corridor during peak commute periods in 2010. Generally, the results showed that in all corridors HOV routes saved time and operated at higher average speeds than parallel non-HOV routes. Travel time runs were previously conducted in 1997, 1999, 2004, and 2007. A comparison of the previous travel time is made with times observed in 2010 in Table 11 for A.M. HOV-restricted periods and in Table 12 for the P.M. restricted period. The time savings during the A.M. restricted periods in 2010 are greater than those observed in 2007 for the I-66 and the Dulles Toll Road corridors and have declined slightly in the I-95/I-395 and the I-270 corridors. The travel time advantage of HOV over non-HOV in the U.S. 50 corridor is negligible.

I-66 has seen growth in its time savings, but it has also seen an increase in the unreliability of the travel time as is marked by the margin of error more than doubling from 13 minutes in 2007 to 29 minutes in 2010 in the non-HOV lanes and nearly doubling from 9 to 17 minutes in the HOV lane. When the I-66 corridor is split into two segments, divided at the Beltway, the differences are more striking. Outside the Beltway, where the HOV lane is concurrent with the non-HOV lanes, the average speeds are 30 miles per hour (mph) and 24 mph, while inside the Beltway, the exclusive HOV facility sees average speeds increase to 35 mph while the non-HOV traffic must use Arlington Boulevard (U.S. 50) through Arlington, and sees a decline to 18 mph.

As shown in Table 13, the areas with the greatest time savings are I-395 and I-66 inside the Beltway. All other segments save less than a minute per mile, but on I-395 inside the Beltway time savings are 2.9 minutes per mile and I-66 sees 2.4 minutes per mile time savings. This is particularly evident outside the Beltway where the HOV facility is concurrent with the non-HOV facility and the time savings are more analogous to those found on I-270.

During the P.M. HOV-restricted periods, the results were similar: improved travel time advantages for HOV in the I-95/I-395 and I-66 corridors, some rebound in time savings in the Dulles Toll Road and U.S. 50 corridors over 2007, and I-270 held steady on west side of the spur while experiencing a 3 minute increase in travel time savings from the east spur. The I-95/I-395 corridor shows the most time savings with the HOV travel time at less than half of the of the non-HOV lanes. It also has much more reliability in the times with a margin of error that is less than a third of the non-HOV lanes. Interestingly, the greater time savings occur outside the Beltway in contrast to the morning savings which are inside the Beltway. The average speeds are nearly twice the non-HOV speeds (64 mph vs. 33 mph) on I-95/I-395; this difference is partially attributed to the barrier separated HOV facilities, as such speed differences would be very unsafe on concurrent flow HOV facilities.

I-66 is the only other facility with significant time savings, and as in the morning, the exclusive HOV section inside the Beltway shows greater savings with 1.5 minutes per mile savings over 0.4 minutes per mile savings outside the Beltway. The overall time savings on I-270 have been much smaller than on the Virginia HOV facilities, but the 2010 travel time runs are showing a slight decline in time savings after a decade of growth. Another data point will be necessary to see if a new trend is developing or if



the 2010 data are an anomaly. As has been previously observed, U.S. 50 has little congestion during the peak period, outside the Beltway, so both HOV and non-HOV travel times are close with a small margin of error

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**Table 11**  
**Mean A.M. Peak Period / Peak Direction Travel Times Over Time by Facility**  
(95% Margin of Error in Parenthesis)

Facility	HOV route travel time (minutes)					Non-HOV route travel time (minutes)					Time Savings (HOV Time - Non-HOV Time)				
	1997	1999	2004	2007	2010	1997	1999	2004	2007	2010	1997	1999	2004	2007	2010
I-95/I-395 (northbound) From Va.234 (Dumfries) to Va. end of 14th St. Bridge  HOV route is 28.1 miles	26 (+/-1)	27 (+/-1)	29 (+/-4)	31 (+/-6)	35 (+/-8)	65 (+/-6)	58 (+/-3)	66 (+/-15)	82 (+/-22)	76 (+/-26)	39	31	37*	51*	41*
I-66 (eastbound) From Va.234 Business (Manassas) to Va. end of T. Roosevelt Bridge  HOV route is 27.8 miles	43 (+/-3)	41 (+/-8)	53 (+/-8)	48 (+/-9)	66 (+/-17)	71 (+/-11)	69 (+/-5)	70 (+/-14)	76 (+/-13)	102 (+/-29)	28	28	17*	28*	36*
Va.267/I-66 (eastbound) From Va.28 to Va. end of T. Roosevelt Bridge HOV route is 23.4 miles  HOV route is 23.4 miles	N/A	31 (+/-1)	28 (+/-1)	26 (+/-2)	47 (+/-9)	N/A	51 (+/-5)	48 (+/-2)	33 (+/-5)	77 (+/-17)	N/A	20	20*	7	30
I-270 & East Spur (southbound) From I-370 to Old G'town Road  HOV route is 8.8 miles	11 (+/-1)	18 (+/-1)	13 (+/-2)	12 (+/-4)	12 (+/-3)	16 (+/-3)	22 (+/-4)	19 (+/-3)	20 (+/-8)	18 (+/-3)	5	4	6	8	6
I-270 and West Spur (southbound) From I-370 to S end of I-270 Spur  HOV route is 8.6 miles	11 (+/-2)	16 (+/-3)	14 (+/-7)	13 (+/-3)	12 (+/-3)	17 (+/-4)	23 (+/-3)	22 (+/-3)	18 (+/-5)	16 (+/-5)	6	7	8	5	4
U.S.50 (westbound) From U.S.301/Md.3 to I-95/I-495  HOV route is 9.0 miles	N/A	N/A	9 (+/-0)	7 (+/-1)	7 (+/-1)	N/A	13 (+/-2)	12 (+/-2)	8 (+/-2)	8 (+/-1)	N/A	N/A	3	1	1

- Notes:
- Data in table are rounded to whole minutes.
  - I-66 (eastbound) non-HOV route uses I-66 to I-495 (southbound) to U.S.50 (eastbound) to I-66 on T. Roosevelt Bridge
  - Va.267 (eastbound) HOV route uses Va. 267 to Dulles Connector Road to I-66 (eastbound)
  - Va.267 (eastbound) non-HOV route uses Va.267 to I-495 (northbound) to G.Washington Mem. Parkway (southbound) to I-66 on T. Roosevelt Bridge
  - All travel time runs on Va.267 (HOV and non-HOV) performed with an EZ-Pass transponder.
  - Travel time savings shown with an asterisk (\*) are statistically significant at the 95% confidence level using a Tukey Test for 2004-2010. Time savings without an asterisk are not statistically significant.
  - Margins of Error computed at 95% confidence level using two-tailed test.

**Table 12**  
**Mean P.M. Peak Period / Peak Direction Travel Times Over Time by Facility**  
(95% Margin of Error in Parenthesis)

Facility	HOV route travel time (minutes)					Non-HOV route travel time (minutes)					Time Savings (Non-HOV Time - HOV Time)				
	1997	1999	2004	2007	2010	1997	1999	2004	2007	2010	1997	1999	2004	2007	2010
I-95/I-395 (southbound) From Va. end of 14th St. Bridge to south of Va. 234	26 (+/-2)	28 (+/-1)	25 (+/-0)	33 (+/-11)	30 (+/-6)	60 (+/-6)	64 (+/-12)	53 (+/-10)	61 (+/-23)	73 (+/-19)	39	31	37 *	28 *	43 *
HOV route is 27.9 miles															
I-66 (westbound) From Va. end of T. Roosevelt Bridge to Va.234 Business (Manassas)	27 (+/-1)	32 (+/-2)	34 (+/-3)	37 (+/-8)	44 (+/-7)	44 (+/-7)	55 (+/-11)	56 (+/-6)	55 (+/-11)	68 (+/-12)	28	28	17 *	18 *	24 *
HOV route is 30.7 miles															
Va.267/I-66 (westbound) From Va. end of T. Roosevelt Bridge to Va.28	N/A	31 (+/-1)	28 (+/-1)	24 (+/-1)	27 (+/-3)	N/A	51 (+/-5)	48 (+/-2)	32 (+/-3)	42 (+/-7)	N/A	20	20	8	15
HOV route is 24.2 miles															
I-270 & E. Spur (northbound) just north of I- 495 to Md. 121 (Clarksburg)	11 (+/-1)	18 (+/-1)	13 (+/-2)	22 (+/-7)	21 (+/-3)	16 (+/-3)	22 (+/-4)	19 (+/-3)	29 (+/-1)	31 (+/-5)	5	4	6 *	7	10
HOV route is 18.4 miles															
I-270Y (I-270 Spur) and I- 270 (northbound) From I- 495 to Md. 121 (Clarksburg)	11 (+/-2)	16 (+/-3)	14 (+/-7)	20 (+/-2)	19 (+/-2)	17 (+/-4)	23 (+/-3)	22 (+/-3)	29 (+/-5)	28 (+/-4)	6	7	8 *	9	9
HOV route is 18.5 miles															
U.S.50 (eastbound) From I- 95/I-495 to U.S.301/Md.3	N/A	N/A	9 (+/-0)	7 (+/-0)	8 (+/-2)	N/A	13 (+/-2)	12 (+/-2)	8 (+/-2)	10 (+/-4)	N/A	N/A	3	1	2
HOV route is 8.4 miles															

- Notes:
- Data in table are rounded to whole minutes.
  - I-66 (westbound) non-HOV route uses T. Roosevelt Bridge to U.S. 50 (westbound) to I-495 (northbound) to I-66 (westbound)
  - Va.267 (westbound) HOV route uses I-66 (westbound) to Dulles Connector Road to Va. 267 (westbound)
  - Va.267 (westbound) non-HOV route uses T.Roosevelt Bridge to G.Washington Mem.Parkway (northbound) to I-495 (southbound) to Va.267 (wes
  - All travel time runs on Va.267 (HOV and non-HOV) performed with an EZ-Pass transponder.
  - Travel time savings shown with an asterisk (\*) are statistically significant at the 95% confidence level using a Tukey Test for 2004-2010. Time savings without an asterisk are not statistically significant.
  - Margins of Error computed at 95% confidence level using two-tailed test.

**Table 13**  
**2010 Regional HOV Monitoring**  
**A.M. Peak Direction Travel Time Summary for HOV and non-HOV Lanes**

Facility	Facility Section	Length (miles)	HOV Time (mins.)	Non-HOV Time (mins.)	Time Savings		Average Speed	
					In Minutes	in Min./Mi.	HOV (MPH)	Non-HOV (MPH)
I-95/I-395	From Va. 234 to the Pentagon	27.6	35	76	41	1.5	50	24
	Outside Beltway	18.0	18	31	13	0.7	64	37
	Inside Beltway	9.6	17	45	28	2.9	36	16
I-66	From Va. 234 (Business) to the T. Roosevelt Bridge	28.8	66	102	36	1.3	31	20
	Outside Beltway	17.8	45	57	12	0.7	30	24
	Inside Beltway	10.5	20	45	25	2.4	35	18
Va. 267	From Va.28 to to the T. Roosevelt Bridge	23.4	47	77	30	1.3	29	20
	Va. 267 only	14.9	25	32	7	0.5	29	25
I-270	From I-370 to I-495 (passing Md. 187)	8.8	12	18	6	0.7	44	30
	I-270Y (I-270 Spur) From I-370 to I-495 (passing Democracy Blvd.)	8.6	12	16	4	0.5	46	34
U.S. 50	From U.S. 301/Md. 3 to Capital Beltway	9.0	7	8	1	0.1	67	60

Notes:

- Facility Length rounded to nearest 1/10 of a mile
- HOV Times, Non-HOV Times and Time Savings in Minutes rounded to nearest whole minute
- Time Savings rounded to nearest 1/10 of a minute

**Table 14**  
**2010 Regional HOV Monitoring**  
**P.M. Peak Direction Travel Time Summary for HOV and non-HOV Lanes**

Facility	Facility Section	Length (miles)	HOV Time (mins.)	Non-HOV Time (mins.)	Time Savings		Average Speed	
					In Minutes	in Min./Mi.	HOV (MPH)	Non- HOV (MPH)
I-95/I-395	From The Pentagon to Va. 234	27.9	30	73	43	1.5	58	24
	Outside Beltway	17.7	21	55	34	1.9	56	22
	Inside Beltway	10.2	9	18	9	0.9	64	33
I-66	From T. Roosevelt Bridge to Va. 234 (Business)	30.7	44	68	24	0.8	43	29
	Outside Beltway	20.3	31	39	8	0.4	42	35
	Inside Beltway	10.4	13	29	16	1.5	51	23
Va. 267	From the T. Roosevelt Bridge to Va. 28	24.2	27	42	15	0.6	47	33
	Va. 267 only	15.5	17	30	13	0.8	35	32
I-270	From I-495 (passing Md. 187) to Md. 121 (Clarksburg)	18.4	21	31	10	0.5	53	36
	I-270Y (I-270 Spur) From I-495 (passing Democracy Blvd.) to Md. 121 (Clarksburg)	18.5	19	28	9	0.5	59	41
U.S. 50	From the Capital Beltway to U.S. 301/Md. 3	8.4	8	10	2	0.2	65	58

Notes:

- Facility Length rounded to nearest 1/10 of a mile
- HOV Times, Non-HOV Times and Time Savings in Minutes rounded to nearest whole minute
- Time Savings rounded to nearest 1/10 of a minute

## VI. CONCLUSIONS

The most successful HOV facility is the barrier separated I-95/I-395 from Dumfries to the 14<sup>th</sup> Street Bridge. The 2010 data shows more than a 40 minute time savings in both the A.M. and P.M. peak periods. While the average auto occupancy has declined somewhat, the requirement of 3 persons per vehicle means that persons moved per lane per hour ranges from 4,800 to 6,900 people in contrast to the same measure on the non-HOV lanes which does not exceed 2,200 people. The success of this facility is due to the three person requirement and the barrier separation that allows traffic to move faster without worrying about a driver cutting in from the non-HOV lanes as can happen on concurrent HOV lane facilities.

Of the other Virginia HOV facilities, I-66 inside the Beltway has the lowest average auto occupancy with only 1.5 people in the A.M. and 1.4 people in the P.M. This is a drop since the 2007 count was conducted, so another data collection will be needed to determine if this is an actual change or if it is a result of construction of the HOT lanes on the Beltway. For the complete I-66 HOV route from Manassas to the Roosevelt Bridge and for VA 267 from VA 28 to the Roosevelt Bridge, the time savings are better in the morning than in the afternoon. For both routes, the bulk of the time savings occurs inside the Beltway in the morning.

In Maryland, the HOV facilities are shorter in distance than the Virginia facilities. As a result, the dramatic time savings are not seen. However, I-270 has a high level of average auto occupancy ranging from 1.8 to 2.0 on the HOV-2 facilities. Another interesting note is the peak hour occurs very early in the P.M. peak period on I-270 (3:45 P.M.-4:45 P.M.). U.S. 50 in Maryland maintains a high rate of speed in both its HOV and non-HOV lanes during the peak periods.

In conclusion, the HOV facilities in the Washington Region will continue to play an important role in helping to move people to their destinations. Additional enforcement and any changes that can tangibly separate HOV from non-HOV lanes will help the HOV lanes to perform at their peak capacity.

Issues for the future:

- The opening of HOT lanes on I-95 and the Beltway in Virginia
- Direct access into and out of the HOV lanes
- Park and Ride lots opening/closing and capacities