

**2004 PERFORMANCE OF  
REGIONAL HIGH-OCCUPANCY VEHICLE  
FACILITIES ON FREEWAYS IN THE  
WASHINGTON REGION**

**July 22, 2005**

**D R A F T**

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**METROPOLITAN WASHINGTON COUNCIL OF GOVERNMENTS  
NATIONAL CAPITAL REGION TRANSPORTATION PLANNING BOARD**

## ABSTRACT FORM

<p><b>TITLE:</b> 2004 PERFORMANCE OF REGIONAL HIGH-OCCUPANCY VEHICLE FACILITIES ON FREEWAYS IN THE WASHINGTON REGION</p>	<p><b>DATE:</b> July 22, 2005 <b>NUMBER OF PAGES:</b> XX <b>PUBLICATION NUMBER:</b> XX</p>
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<p><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.</p>	
<p><b>REPORT ABSTRACT:</b> This report contains a summary of data collected from high-occupancy vehicle (HOV) facilities located along Interstate highways and one toll road in the Washington, D.C. metropolitan region.</p>	
<p><b>SUBJECT:</b> 2004 Performance of Regional High-occupancy Vehicle Facilities on Freeways in the Washington Region</p>	
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## EXECUTIVE SUMMARY

Presented in this report is information developed from data collected in Spring 2004 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 2004:

- I-95/I-395 (Shirley Highway) in Northern Virginia (fully-barrier-separated HOV lanes);
- I-66 inside 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), which has a new concurrent-flow HOV lane; and
- 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, and 1999. Trends and changes are emphasized for the HOV-restricted periods inbound and outbound. The following major trends were observed:

- All of the HOV lanes in Spring 2004 were observed to carry more persons per lane during the HOV-restricted periods than adjacent non-HOV lanes, with the exceptions of the new concurrent-flow HOV lane on U.S. 50 John Hanson Highway, where per-lane person movements were found to be approximately the same in the HOV and non-HOV lanes, and the concurrent-flow HOV lane on I-270 at Md. 187 during the P.M. peak period.
- All of the HOV lanes provide savings in travel times when compared to non-HOV alternatives, especially the barrier-separated HOV lanes in the I-95/I-395 corridor in Northern Virginia.
- There generally has been a decline in average auto occupancy on the HOV facilities in Northern Virginia, particularly in the barrier-separated lanes, due in part to the hybrid vehicle exemption.

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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; and 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 (Shirley Highway) 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;
- Virginia Route 267 (Dulles Toll Road), where operation of concurrent-flow HOV lanes began in December 1998, connecting to I-66 via the Dulles Connector; and
- U.S. 50 (John Hanson Highway) in Prince George's County, Maryland.

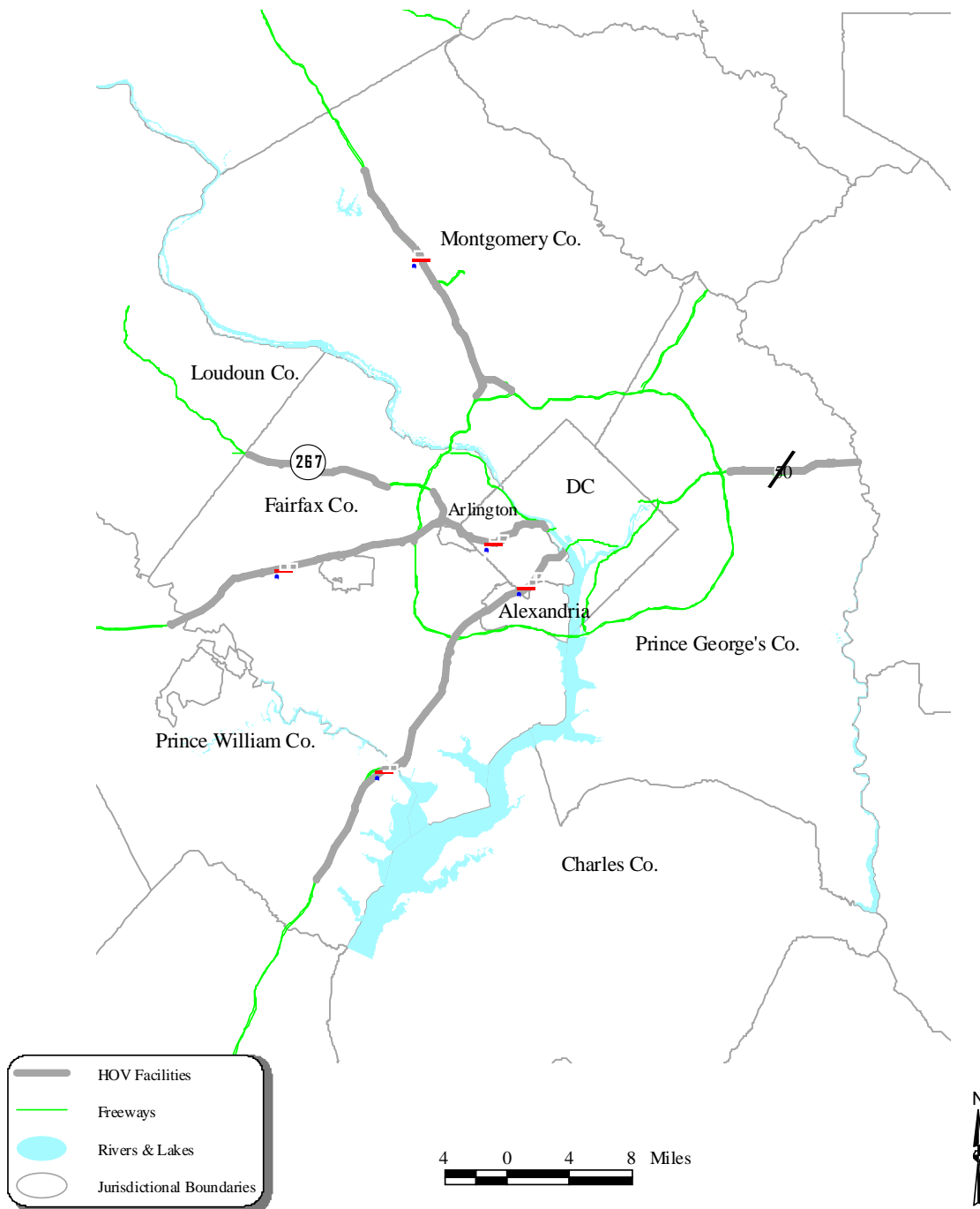
The Shirley Highway and I-66 HOV facilities provide direct access to the core employment centers of the region. I-270 and the I-270 Spur end at the Capital Beltway (I-495) and the new U.S. 50 HOV lanes end just prior to the Beltway. Va. 267's HOV system connects directly to I-66, providing access to 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 2004. 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, and 1999. Comparisons are given in this report between HOV performance in 2004 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; 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.

**Figure 1**  
**Regional HOV Facilities**





## 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 1970's, COG/TPB has provided an automated matching service for car-pools and van-pools through its Commuter Connections program, formerly the Ride Finders Network and Commuter Club. Signs with Commuter Connections' telephone number have been placed along all four 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 car- and van-pools in 1975, with a restriction of HOV-4, which was reduced to HOV-3 in 1989. During the early and mid-1990's, 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 Virginia Route 234 (Business) in Prince William County just north of Manassas.

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/Maryland 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 Maryland 118 at Germantown, and a new lane for HOV use was opened from Maryland 118 to Maryland 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.

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 9-mile stretch of U.S.50 John Hanson Highway in October 2002.

### III. DESCRIPTION OF THE HOV CORRIDORS

Summaries of physical characteristics and operational policies effective in the Spring of 2004 are presented in this chapter. All corridors have an extensive system of park-and-ride lots to support car-pool formation.<sup>1</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. A description of the operating characteristics for all of the HOV facilities monitored is presented in Table 1.

#### **I-395/I-95 (Shirley Highway)**

The HOV lanes in this corridor are entirely barrier-separated, and reversible, so 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 Virginia Route 234 (Dumfries Road) near Dumfries, Prince William County to South Eads Street near the Pentagon in Arlington County. Several HOV-only ramps provide direct access to the HOV lanes from park-and-ride facilities in Prince William County. 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. In southbound operation, non-HOV users may use the HOV lanes between the Turkeycock Run area (south of Virginia Route 236, Duke Street) and Springfield.

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. A map of the corridor is presented in Figure 2.

The corridor is also served by the Virginia Railway Express (VRE) Fredericksburg Line. The Metrorail Blue Line terminates in the corridor at Franconia-Springfield. Numerous bus lines serve the corridor, including Metrobus, the City of Alexandria's DASH, 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>1</sup> Please see the COG/TPB report *Washington Regional Park-and-Ride 1995 Inventory and Analysis* for a detailed description of lot locations and utilization.

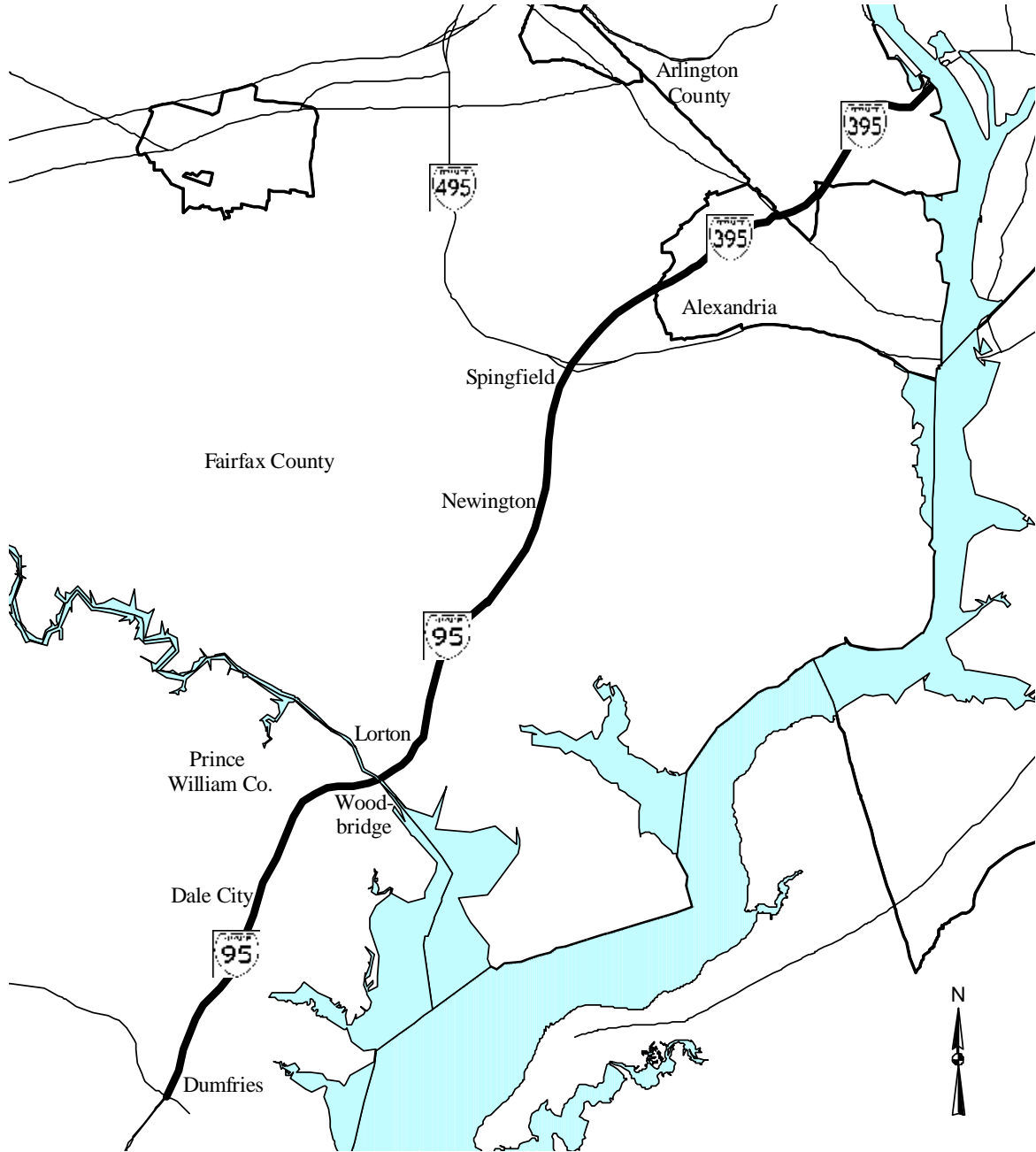
**Table 1**  
**2004 HOV Facility Summary**

Facility Name	Length	Facility Description	Occupancy Requirement	AM HOV Period/ Direction	PM HOV Period/ Direction	Truck Restrictions	Motorcycles Restrictions <sup>1</sup>
I-95/I-395 Shirley Highway	28 miles	2 Lanes Barrier Separated, Reversible	3	6:00 - 9:00 AM (Northbound)	3:30 - 6:00 PM (Southbound)	Permitted with Occupancy Compliance North of Dale City, Prohibited South of Dale City	Permitted
I-66	28 miles	1 Lane Concurrent Flow Outside of the Beltway, 2 Lane exclusive facility inside the Beltway	2	5:30-9:30 AM Outside Beltway; 6:30- 9:00 AM Inside Beltway (Eastbound)	3:00-7:00 PM Outside Beltway; 4:00- 6:30 AM Inside Beltway (Westbound)	Prohibited	Permitted
I-270	9 miles Southbound; 18 miles Northbound	1 Lane Concurrent Flow	2	6:00- 9:00 AM (Southbound)	3:30- 6:30 PM (Northbound)	Prohibited	Permitted
VA 267 (Dulles Toll Road)	23 miles <sup>2</sup>	1 Lane Concurrent Flow	2	6:30- 9:00 AM (Eastbound)	4:00- 6:30 PM (Westbound)	Permitted with Occupancy Compliance outside Beltway	Permitted
US 50	9 miles	1 Lane Concurrent Flow	2	(HOV Restrictions Effective 24-Hours)		Prohibited	Permitted

**Notes:** <sup>1</sup> Motorcycles are permitted on all facilities

<sup>2</sup> Length includes the Washington Dulles Airport Access road and I-66 segment to the T.R. Bridge.

**Figure 2**  
**I-95 / I-395 HOV Corridor**



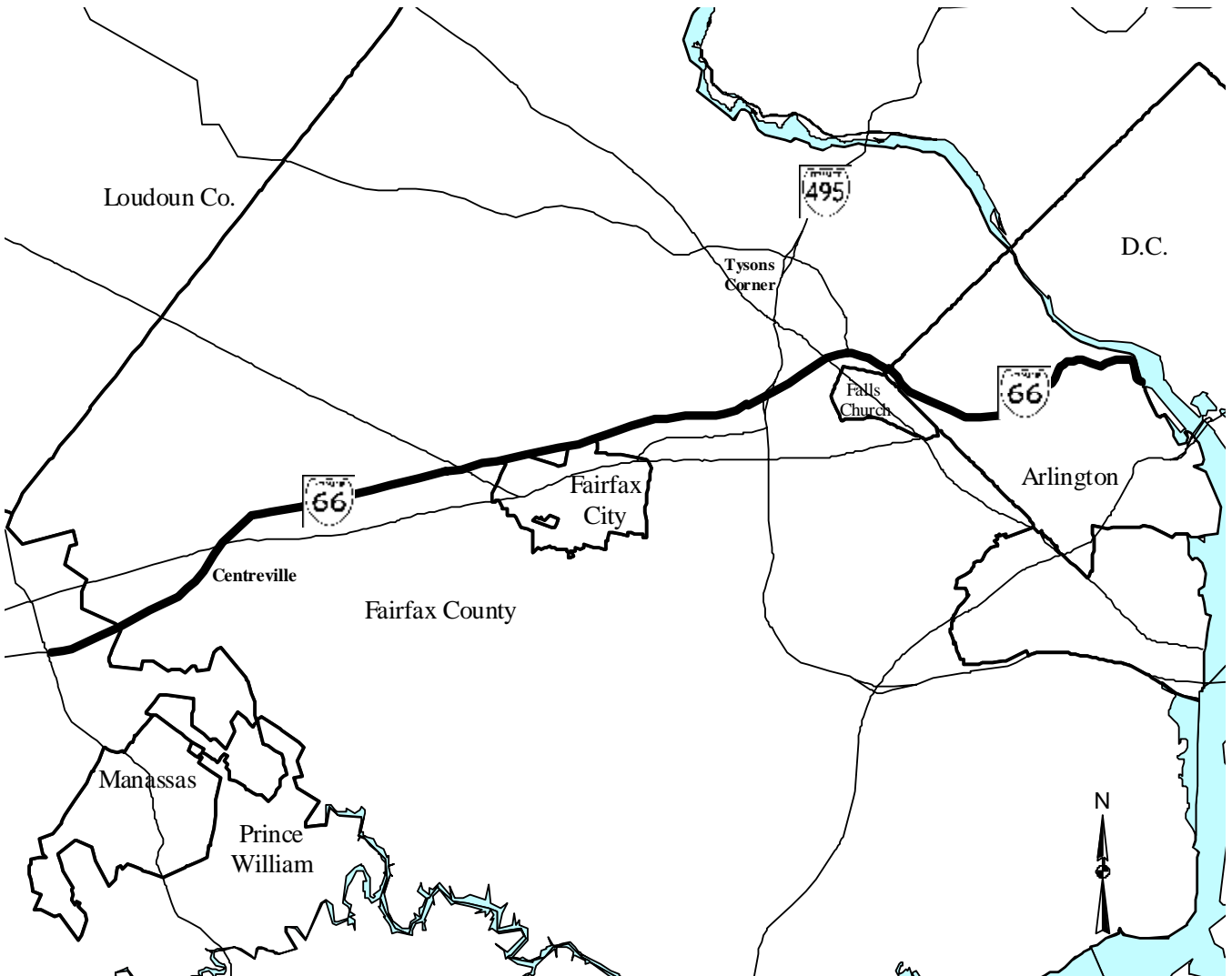
**I-66**

This HOV corridor consists of two distinct sections. Between the Capital Beltway (I-495) and Rosslyn, I-66 is restricted to HOV use only during the peak commute period in the peak direction. The Dulles Connector Road is subject to the same HOV restrictions as I-66 between Virginia Route 123 (Dolley Madison Boulevard) at McLean and I-66. Single-occupant vehicles (SOV) 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 Virginia Route 234 Business near Manassas and the Beltway, the HOV facility is a concurrent-flow lane. The entire HOV corridor is about 27 miles in length, about 9 miles inside the Beltway and 18 miles outside the Beltway.

Direct access to employment centers in Washington, D.C. 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 Virginia Route 243 (Nutley Street) south of Vienna and Fairfax Drive in Arlington. Four rail transit stations serve this section of the Orange Line. 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**  
**I-66 HOV Corridor**



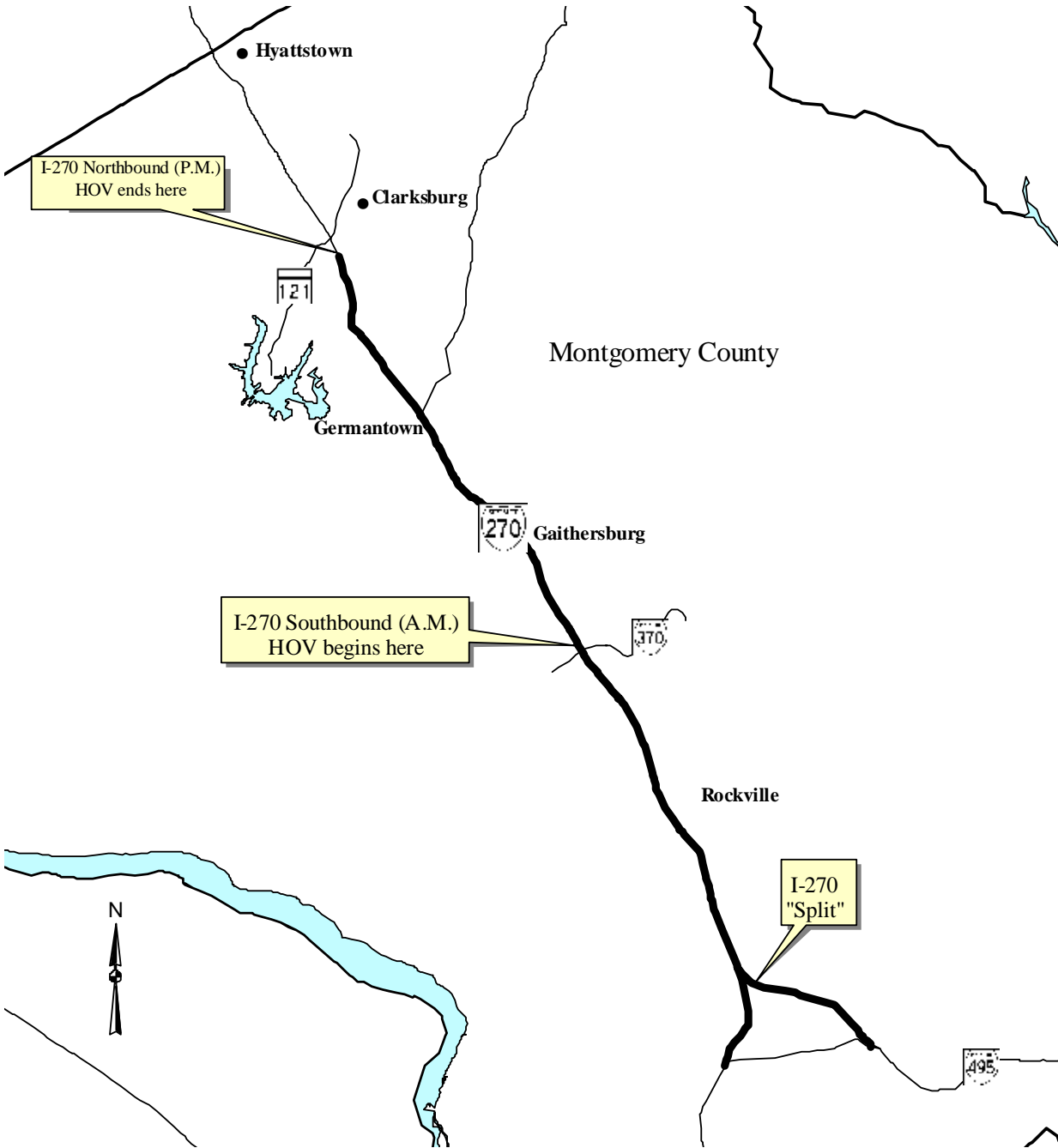
**I-270**

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 Spur is just under 2 miles long.

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 Maryland 121 near Clarksburg. A map of the I-270 corridor is shown in Figure 4.

The Metro Red Line serves the I-270 corridor from Shady Grove (I-370), and continues south to Bethesda and on to the downtown area of the District of Columbia. The Mass 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 Ride-On 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 4**  
**I-270 HOV Corridor**

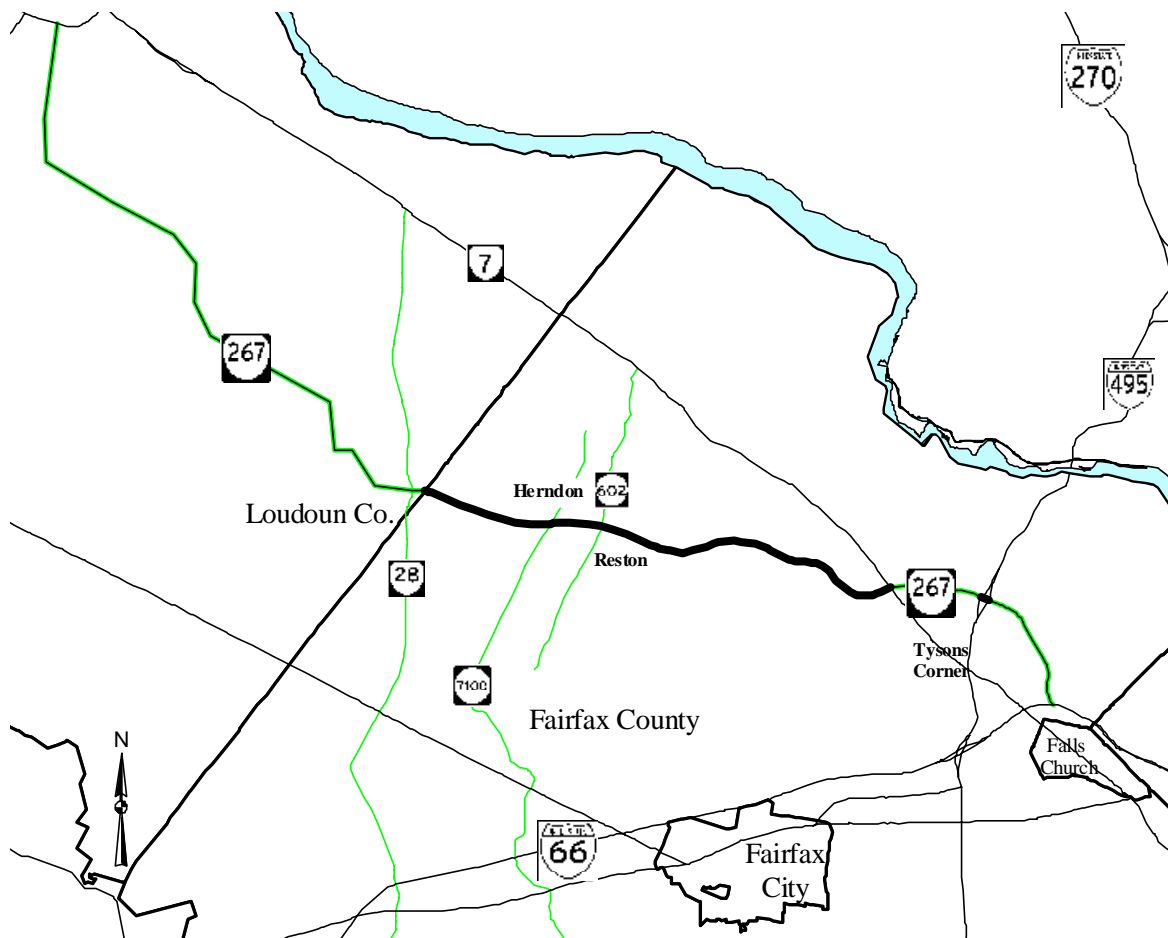




### **Va. 267 (Dulles Toll Road)**

Concurrent-flow HOV lanes operate along this corridor from a point between Va. 28 (Sully Road) and Va. 657 (Centreville Road) to just west of Va. 7 (Leesburg Pike). There are no HOV lanes through the interchanges at Va. 7, the main toll barrier, Va. 684 (Spring Hill Road), I-495 and Va. 123. HOV restrictions apply to all lanes of the Dulles Connector road from east of Va. 123 to I-66. The Fairfax County Department of Transportation 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>2</sup> WMATA operates bus service between Washington Dulles International Airport and the L'Enfant Plaza Metrorail station, with intermediate stops at Herndon/Monroe, Tysons Transit center and the Rosslyn Metrorail station.

**Figure 5**  
**Va. 267 HOV Corridor**



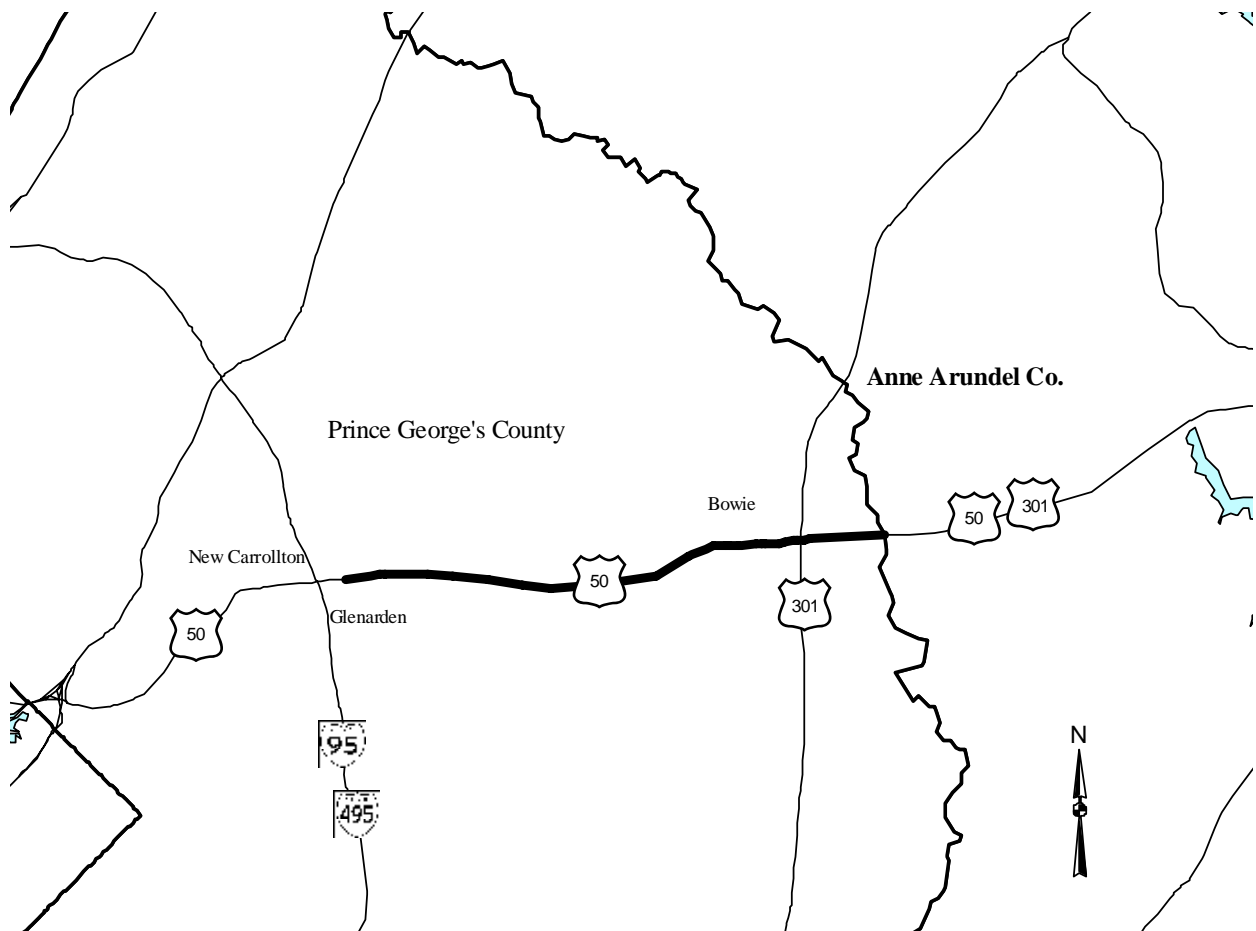
<sup>2</sup> By special arrangement with the Metropolitan Washington Airports Authority (MWAA), some buses serving the corridor are permitted to use the Dulles Access Road (normally restricted to airport traffic only).

**U.S.50 (John Hanson Highway)**

Concurrent-flow HOV lanes operate in the U.S. 50 (John Hanson Highway) Corridor from just west of the Md. 704 Martin Luther King Highway 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.

Buses operated the Washington Metropolitan Area Transit Authority (WMATA) and the Maryland Transit Administration (MTA) operate on the U.S. 50 HOV lanes. To the east, the buses serve the City of Bowie in Prince George’s County, and the Annapolis and Crofton areas of Anne Arundel County. All WMATA buses 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  
U.S. 50 HOV Corridor**



#### **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) or nearby and reasonably parallel to the HOV lanes.

Data collection was limited to 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 classify vehicles according to the standard COG/TPB counting methodology. Because of heavy traffic on interstate highways in the Washington region, generally one person was assigned per travel lane. A laptop personal computer running a simple BASIC denominator program was used to tally each vehicle and the number of passengers observed as it passed the counting station. The data were recorded onto disks for further processing.

##### **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, Fairfax County Department of Transportation, 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 collected by WMATA, Montgomery County, and the MTA. 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 of 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.

## Travel Time Runs

Travel time data were collected in Spring, 2004 using the “floating car” methodology. Data were collected with the use of stopwatches and pre-printed run sheets for each corridor, showing landmarks and associated milepoints, 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, between 6:45 a.m. and 7:50 a.m. in the inbound direction. Afternoon runs started from the inner limits of each corridor, between 4:45 p.m. and 5:20 p.m. The number of floating car travel time runs conducted on each facility is presented in Table 2.

**Table 2**  
**2004 Regional HOV Monitoring**  
**Number of 'Floating Car' Travel Time Runs by Facility & Time Period**  
**(All Runs Made in the Peak-Flow Direction)**

Facility	Origin/Destination	AM Period		PM Period	
		HOV	Non-HOV	HOV	Non-HOV
I-95/I-395	From Va.619 to the Pentagon	9	9	6	6
I-66	From Va.234 to TR Bridge	7	7	7	7
I-270	From I-370 to MD 187 (E.Spur)	7	7	6	6
	From I-370 to Democracy (W.Spur)	4	5	6	6
Va. 267	From Va 28 to TR Bridge	8	8	7	8
US 50	From US 301 to MD 410	16	16	16	15

## 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 and auto-like vehicle; 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 funds State Police overtime to supplement routine enforcement, which is conducted on randomly-selected days at randomly-selected 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 corridor are aware of the HOV restriction, and enforce HOV restrictions in addition to other duties. The State Highway Administration of the Maryland Department of Transportation 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. 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 van-pools counted times 12 (See Appendix G, Van-pool Monitoring Method). The denominator is the number of autos, auto-like vehicles and van-pools counted.

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. However, this is not always the case. 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, clean fuel vehicles (those powered by compressed natural gas (CNG) may use the HOV lanes regardless of occupancy). 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, and 2004 are shown in Tables 5 and 6 for A.M. and P.M. HOV-restricted periods, respectively.

Average auto occupancies in 2004 during the A.M. peak period were highest on HOV lanes in the corridors with HOV-3 restrictions, I-95 and I-395. The average auto occupancy on the I-95 HOV lanes south of I-495 was 2.6, and the average on the I-395 HOV lanes was 2.5. On facilities designated HOV-2, observed average auto occupancies during the A.M. peak period ranged from 1.5 to 2.0. During the P.M. peak period in 2004, average auto occupancy on I-395 was observed at 2.8 and at 2.7 on I-95. In the corridors with HOV-2 restrictions, the average ranged from 1.5 to 2.1.

Auto occupancy averages observed in 2004 declined noticeably from those experienced in 1999 for I-95, I-395, and I-66 inside the Capital Beltway. Average auto occupancy remained the same or increased slightly on Va. 267 and I-66 outside the Capital Beltway. The increased use of hybrid (non-HOV) autos in the barrier-separated HOV lanes where time savings are greatest may offer some explanation.

**Table 3**  
**Observed average auto occupancies in the A.M. peak direction**  
**during HOV-restricted periods (Spring, 2004)**

Facility	HOV lane average auto occupancies	Number of autos needed to move 1000 persons at HOV occupancy rate	Non-HOV lane average auto occupancies	Number of autos needed to move 1000 persons at non-HOV occupancy rate
I-395 (Shirley Highway) north of Va. 120 (Glebe Road)	2.5	400	1.1	910
I-95 (Shirley Highway) north of Va. 7100 (Fairfax County Parkway)	2.6	380	1.1	910
I-66 (exclusive HOV facility, east of I-495)	1.7	590	N/A	N/A
I-66 (concurrent-flow HOV facility west of I-495)	2.0	500	1.1	910
I-270 at Md. 187 (Old Georgetown Road)	1.9	530	1.1	910
I-270 (West Spur) at Democracy Boulevard	1.5	670	1.1	910
I-270 North of "split"	1.7	590	1.1	910
Va. 267 (Dulles Toll Road) west of Va. 7 (Leesburg Pike)	1.8	560	1.1	910
U.S 50 (At MD 197 & MLK, Jr. HWY)	1.6	630	1.0	1000

**Table 4**  
**Observed average auto occupancies in the P.M. peak direction**  
**during HOV-restricted periods (Spring, 2004)**

Facility	HOV lane average auto occupancies	Number of autos needed to move 1000 persons at HOV occupancy rate	Non-HOV lane average auto occupancies	Number of autos needed to move 1000 persons at non-HOV occupancy rate
I-395 (Shirley Highway) north of Va. 120 (Glebe Road)	2.8	360	1.2	830
I-95 (Shirley Highway) north of Va. 7100 (Fairfax County Parkway)	2.7	370	1.2	830
I-66 (exclusive HOV facility, east of I-495)	1.7	590	N/A	N/A
I-66 (concurrent-flow HOV facility west of I-495)	2.0	500	1.1	910
I-270 at Md. 187 (Old Georgetown Road)	2.1	480	1.1	910
I-270 (West Spur) at Democracy Boulevard	1.5	670	1.1	910
I-270 North of "split"	1.8	560	1.1	910
Va. 267 (Dulles Toll Road) west of Va. 7 (Leesburg Pike)	1.8	560	1.1	910
U.S 50 (At MD 197 & MLK, Jr. HWY)	2.1	480	1.1	910



**Table 5**  
**Observed average HOV auto occupancies**  
**in the A.M. Peak Direction Over Time**

Facility	Year			
	1997	1998	1999	2004
I-395 (Shirley Highway) north of Va. 120 (Glebe Road)	2.7	2.6	2.9	2.5
I-95 (Shirley Highway) north of Va. 7100 (Fairfax County Parkway)	2.6	2.8	2.8	2.6
I-66 (exclusive HOV facility, east of I-495)	1.8	1.8	1.8	1.7
I-66 (concurrent-flow HOV facility west of I-495)	2.0	1.7	1.9	2.0
I-270 at Md. 187 (Old Georgetown Road)	1.9	1.7	1.7	1.9
I-270 (West Spur) at Democracy Boulevard	1.9	1.8	1.8	1.5
I-270 North of Split	N/A	N/A	N/A	1.7
Va. 267 (Dulles Toll Road) west of Va. 7 (Leesburg Pike)	N/A	N/A	1.8	1.8
U.S 50 (At MD 197 & MLK, Jr. HWY)	N/A	N/A	N/A	1.6

**Table 6**  
**Observed Average Auto Occupancies**  
**in the P.M. Peak Direction Over Time**

Facility	Year			
	1997	1998	1999	2004
I-395 (Shirley Highway) north of Va. 120 (Glebe Road)	3.1	3.1	3.2	2.8
I-95 (Shirley Highway) north of Va. 7100 (Fairfax County Parkway)	2.9	2.7	3.0	2.7
I-66 (exclusive HOV facility, east of I-495)	1.8	1.8	1.9	1.7
I-66 (concurrent-flow HOV facility west of I-495)	2.0	2.0	1.9	2.0
I-270 at Md. 187 (Old Georgetown Road)	2.1	1.8	1.6	2.1
I-270 (West Spur) at Democracy Boulevard	2.1	1.8	2.1	1.5
I-270 North of Split	N/A	N/A	N/A	1.8
Va. 267 (Dulles Toll Road) west of Va. 7 (Leesburg Pike)	N/A	N/A	1.8	1.8
U.S 50 (At MD 197 & MLK, Jr. HWY)	N/A	N/A	N/A	2.1

## **Person Movements**

HOV facilities can move much higher numbers of people than can conventional highways, especially when motorists comply with HOV restrictions. In addition, HOV facilities serve more travelers in fewer vehicles. Shown in Tables 7 and 8 are 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.

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. In some cases, person-moving differences between HOV and non-HOV facilities during the peak hour are significant. For example, during the A.M. peak hour on I-395, the barrier-separated HOV lanes were able to serve 11,300 persons in two lanes, while four conventional lanes moved 8,800 persons. In the afternoon peak hour, I-95 at Newington moved 9,100 persons in two HOV lanes, and 3,700 in four non-HOV lanes. The exclusive HOV section of I-66 served 6,500 persons in one hour in the A.M. and 6,600 in the P.M. peak hour. 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 4,700. Along I-270 north of the "split", the southbound HOV lane served 3,300 persons in the A.M. peak hour, while five conventional lanes served 8,900 persons. At this location in the northbound (P.M.) direction, one HOV lane served 3,300 travelers, while 5 non-HOV lanes carried 11,000.

## **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 2004, 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 2004. 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 and 1999. A comparison of 1997 and 1999 observed times is made with times observed in 2004 in Table 11 for the A.M. peak period and in Table 12 for the P.M. peak period.

The time savings during the A.M. peak period in 2004 are greater in 2004 than in 1999, with the exception of I-66. During the P.M. peak period, however, the pattern is decreased time savings in nearly all corridors.

Shown in Tables 13 and 14 are detailed travel time run comparisons in 2004 for HOV and non-HOV lanes during the A.M. peak period and the P.M. peak period, respectively. Savings expressed as minutes per mile are also shown, illustrating that the A.M. peak period time savings decline on I-66 is likely due to congestion on the concurrent-flow lane outside the Capital Beltway.

**Table 7**  
**Observed person movements in the A.M. peak direction**  
**during HOV-restricted periods (Spring, 2004)**

Facility and HOV-restricted period	Number of HOV lanes	HOV lane person movements (autos, van-pools, motorcycles and buses) 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 (Shirley Highway) north of Va. 120 (Glebe Road) 6 - 9 A.M.	2	30,669	5,100	4	23,461	2,000
I-95 (Shirley Highway) north of Va. 7100 (Fairfax County Parkway) 6 - 9 A.M.	2	23,268	3,900	4	19,304	1,600
I-66 (exclusive HOV facility, east of I-495) 6:30 - 9 A.M.	2	15,697	3,100	0	N/A	N/A
I-66 (concurrent-flow HOV facility west of I-495) 5:30 - 9:30 A.M.	1	8,725	2,200	3	15,620	1,300
I-270 at Md. 187 (Old Georgetown Road) 6 - 9 A.M.	1	5,236	1,700	3	14,372	1,600
I-270 (West Spur) at Democracy Boulevard 6 - 9 A.M.	1	4,635	1,500	3	10,822	1,200
I-270 north of "split" 6 - 9 A.M.	1	9,871	3,300	5	25,194	1,700
Va. 267 (Dulles Toll Road) west of Va. 7 (Leesburg Pike) 6:30 - 9 A.M.	1	7,703	3,100	3	12,212	1,600
U.S 50 (At MD 197 & MLK, Jr. HWY) 24/7 (assume 5 hours here)	1	3,398	700	3	17,718	1,200

**Table 8**  
**Observed person movements in the P.M. peak direction**  
**during HOV-restricted periods (Spring, 2004)**

Facility and HOV-restricted period	Number of HOV lanes	HOV lane person movements (autos, van-pools, motorcycles and buses) 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 (Shirley Highway) north of Va. 120 (Glebe Road) 3:30 - 6 P.M.	2	25,302	5,100	4	19,201	1,900
I-95 (Shirley Highway) north of Va. 7100 (Fairfax County Parkway) 3:30 - 6 P.M.	2	20,423	4,100	4	8,822	900
I-66 (exclusive HOV facility, east of I-495) 4 - 6:30 P.M.	2	15,128	3,000	0	N/A	N/A
I-66 (concurrent-flow HOV facility west of I-495) 3 - 7 P.M.	1	11,737	2,900	3	20,129	1,700
I-270 at Md. 187 (Old Georgetown Road) 3:30 - 6:30 P.M.	1	5,549	1,800	3	16,632	1,800
I-270 (West Spur) at Democracy Boulevard 3:30 - 6:30 P.M.	1	5,006	1,700	3	13,885	1,500
I-270 north of "split" 3:30 - 6:30 P.M.	1	10,555	3,500	5	30,517	2,000
Va. 267 (Dulles Toll Road) west of Va. 7 (Leesburg Pike) 4 - 6:30 P.M.	1	5,387	2,200	3	14,186	1,900
U.S 50 (At MD 197 & MLK, Jr. HWY) 24/7 (assume 5 hours here)	1	4,611	900	3	15,731	1,000

**Table 9**  
**A.M. peak hour person movements during**  
**HOV-restricted periods (Spring 2004)**

Facility and peak hour within HOV-restricted period	Number of HOV lanes	HOV lane person movements (autos, van-pools, motorcycles and buses) during HOV-restricted period peak hour	Number of non-HOV lanes	Non-HOV lane person movements during HOV-restricted period peak hour
I-395 (Shirley Highway) north of Va. 120 (Glebe Road) 7 - 8 A.M.	2	11,328	4	8,832
I-95 (Shirley Highway) north of Va. 7100 (Fairfax County Parkway) 6 - 7 A.M.	2	10,662	4	6,846
I-66 (exclusive HOV facility, east of I-495) 7:30 - 8:30 A.M.	2	6,478	0	N/A
I-66 (concurrent-flow HOV facility west of I-495) 6:00 - 7:00 A.M.	1	2,995	3	4,722
I-270 at Md. 187 (Old Georgetown Road) 7:30 - 8:30 A.M.	1	1,886	3	4,932
I-270 (West Spur) at Democracy Boulevard 7:00 - 8:00 A.M.	1	1,571	3	3,698
I-270 north of "split" 7:30 - 8:30 A.M.	1	3,286	5	8,929
Va. 267 (Dulles Toll Road) west of Va. 7 (Leesburg Pike) 8 - 9 A.M.	1	3,338	3	6,234
U.S 50 (At MD 197 & MLK, Jr. HWY) 7 - 8 A.M.	1	1,006	3	4,894

**Table 10**  
**P.M. peak hour person movements during**  
**HOV-restricted periods (Spring 2004)**

Facility and peak hour within HOV-restricted period	Number of HOV lanes	HOV lane person movements (autos, van-pools, motorcycles and buses) during HOV-restricted period peak hour	Number of non-HOV lanes	Non-HOV lane person movements during HOV-restricted period peak hour
I-395 (Shirley Highway) north of Va. 120 (Glebe Road) 4:30 - 5:30 P.M.	2	11,055	4	8,093
I-95 (Shirley Highway) north of Va. 7100 (Fairfax County Parkway) 4:30 - 5:30 P.M.	2	9,073	4	3,672
I-66 (exclusive HOV facility, east of I-495) 5:30 - 6:30 P.M.	2	6,563	0	N/A
I-66 (concurrent-flow HOV facility west of I-495) 5 - 6 P.M.	1	2,734	3	5,761
I-270 at Md. 187 (Old Georgetown Road) 5 - 6 P.M.	1	1,701	3	6,068
I-270 (West Spur) at Democracy Boulevard 4 - 5 P.M.	1	1,605	3	4,890
I-270 north of "split" 4:30 - 5:30 P.M.	1	3,306	5	10,958
Va. 267 (Dulles Toll Road) west of Va. 7 (Leesburg Pike) 5 - 6 P.M.	1	2,193	3	6,453
U.S 50 (At MD 197 & MLK, Jr. HWY) 4 - 7:00 P.M.	1	1,383	3	6,118

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

Facility	HOV route travel time (minutes)			Non-HOV route travel time (minutes)			Time Savings (HOV Time - Non-HOV Time)		
	1997	1999	2004	1997	1999	2004	1997	1999	2004
I-95/I-395 (northbound) From Va.234 (Dumfries) to Va. end of 14th St. Bridge  <i>HOV route is 28.1 miles</i>	26 (+/- 1)	27 (+/- 1)	29 (+/- 4)	65 (+/- 6)	58 (+/- 3)	66 (+/- 15)	-39	-31	-37
I-66 (eastbound) From Va.234 Business (Manassas) to Va. end of T. Roosevelt Bridge  <i>HOV route is 27.8 miles</i>	43 (+/- 3)	41 (+/- 8)	53 (+/- 8)	71 (+/- 11)	69 (+/- 5)	70 (+/- 14)	-28	-28	-17
I-270 & E. Spur (southbound) From I-370 to Old G'town Road  <i>HOV route is 8.8 miles</i>	11 (+/- 1)	18 (+/- 1)	13 (+/- 2)	16 (+/- 3)	22 (+/- 4)	19 (+/- 3)	-5	-4	-6
I-270 & W. Spur (southbound) From I-370 to Democracy Blvd.  <i>HOV route is 8.6 miles</i>	11 (+/- 2)	16 (+/- 3)	14 (+/- 7)	17 (+/- 4)	23 (+/- 3)	22 (+/- 3)	-6	-7	-8
Va.267/I-66 (eastbound) From Va.28 to Va. end of T. Roosevelt Bridge  <i>HOV route is 23.4 miles</i>	N/A	31 (+/- 1)	28 (+/- 1)	N/A	51 (+/- 5)	48 (+/- 2)	N/A	-20	-20
U.S.50 (westbound) From U.S.301/Md.3 to Md.410  <i>HOV route is 9.0 miles</i>	N/A	N/A	9 (+/- 0)	N/A	13 (+/- 2)	12 (+/- 2)	N/A	N/A	-3

## 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 SmartTag transponder.
- All travel time savings shown are statistically significant at the 95% confidence level using a one-tailed difference of mean test.
- Confidence margins 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% Confidence Margins in Parenthesis)**

Facility	HOV route travel time (minutes)			Non-HOV route travel time (minutes)			HOV Time Savings (HOV Time - Non-HOV Time)		
	1997	1999	2004	1997	1999	2004	1997	1999	2004
I-95/I-395 (southbound) From Va. end of 14th St. Bridge to Va. 619 <i>HOV route is 28.4 miles</i>	26 (+/- 2)	28 (+/- 1)	25 (+/- 0)	60 (+/- 6)	64 (+/- 12)	53 (+/- 10)	-34	-36	-28
I-66 (westbound) From Va. end of T. Roosevelt Bridge to Va. 234 (Business) <i>HOV route is 27.9 miles</i>	27 (+/- 1)	32 (+/- 2)	34 (+/- 3)	44 (+/- 7)	57 (+/- 6)	56 (+/- 6)	-17	-25	-22
I-270 (northbound) From Old G'town Road to Md. 121 <i>HOV route is 18.4 miles</i>	17 (+/- 1)	19 (+/- 1)	19 (+/- 2)	26 (+/- 6)	28 (+/- 4)	31 (+/- 8)	-9	-9	-12
I-270&Spur (northbound) From Capital Beltway to Md. 121 <i>HOV route is 18.1 miles</i>	18 (+/- 1)	18 (+/- 1)	20 (+/- 4)	30 (+/- 12)	27 (+/- 1)	28 (+/- 8)	-12	-10	-8
Va.267/I-66 (westbound) From Va. end of T. Roosevelt Bridge to Va. 28 <i>HOV route is 24.2 miles</i>	N/A	27 (+/- 3)	28 (+/- 1)	N/A	36 (+/- 5)	32 (+/- 2)	N/A	-9	-4
U.S.50 (eastbound) From Md.410 to Md.3/U.S.301 <i>HOV route is 9.1 miles</i>	N/A	N/A	8 (+/- 0)	N/A	10 (+/- 5)	10 (+/- 1)	N/A	N/A	-2

## 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 (westbound)
- All travel time runs on Va.267 (HOV and non-HOV) performed with SmartTag transponder.
- All travel time savings shown are statistically significant at the 95% confidence level using a one-tailed difference of mean test.
- Confidence margins computed at 95% confidence level using two-tailed test.



**Table 13**  
**2004 Regional HOV Monitoring**  
**A.M. Peak Direction Travel Time Summary for HOV and non-HOV Lanes**

Facility	Facility Section	Length (miles)	HOV Time(min)	Non-HOV Time(min)	-- Time Savings in Minutes	-- in Min./Mi.
<b>I-95/I-395</b>	<b>From Va.619 to the Pentagon</b>	<b>28.1</b>	<b>29</b>	<b>66</b>	<b>37</b>	<b>1.3</b>
	<i>Outside Beltway</i>	<i>18.4</i>	<i>17</i>	<i>43</i>	<i>26</i>	<i>1.4</i>
	<i>Inside Beltway</i>	<i>9.7</i>	<i>12</i>	<i>23</i>	<i>11</i>	<i>1.1</i>
<b>I-66</b>	<b>From Va.234 to TR Bridge</b>	<b>27.8</b>	<b>53</b>	<b>70</b>	<b>17</b>	<b>0.6</b>
	<i>Outside Beltway</i>	<i>17.3</i>	<i>37</i>	<i>38</i>	<i>1</i>	<i>0.1</i>
	<i>Inside Beltway</i>	<i>10.5</i>	<i>16</i>	<i>31</i>	<i>15</i>	<i>1.4</i>
<b>I-270</b>	<b>From I-370 to MD 187 (E.Spur)</b>	<b>8.8</b>	<b>13</b>	<b>19</b>	<b>6</b>	<b>0.7</b>
	<b>From I-370 to Democracy (W.Spur)</b>	<b>8.6</b>	<b>14</b>	<b>22</b>	<b>8</b>	<b>0.9</b>
<b>Va. 267</b>	<b>From Va.28 to TR Bridge</b>	<b>23.4</b>	<b>28</b>	<b>48</b>	<b>20</b>	<b>0.9</b>
	<i>Va. 267 only</i>	<i>14.9</i>	<i>12</i>	<i>15</i>	<i>3</i>	<i>0.2</i>
<b>US 50</b>	<b>From US 301 to MD 410</b>	<b>9.0</b>	<b>9</b>	<b>12</b>	<b>3</b>	<b>0.3</b>

**Table 14**  
**2004 Regional HOV Monitoring**  
**P.M. Peak Direction Travel Time Summary for HOV and non-HOV Lanes**

Facility	Facility Section	Length (miles)	HOV Time(min)	Non-HOV Time(min)	-- Time Savings in Minutes	-- in Min./Mi.
<b>I-95/I-395</b>	<b>From Pentagon to Va.619</b>	<b>28.4</b>	<b>25</b>	<b>53</b>	<b>28</b>	<b>1.0</b>
	<i>Outside Beltway</i>	<i>17.1</i>	<i>16</i>	<i>36</i>	<i>20</i>	<i>1.2</i>
	<i>Inside Beltway</i>	<i>10.1</i>	<i>9</i>	<i>17</i>	<i>8</i>	<i>0.8</i>
<b>I-66</b>	<b>From TR Bridge to Va. 234</b>	<b>27.9</b>	<b>34</b>	<b>56</b>	<b>22</b>	<b>0.8</b>
	<i>Outside Beltway</i>	<i>17.1</i>	<i>22</i>	<i>34</i>	<i>12</i>	<i>0.7</i>
	<i>Inside Beltway</i>	<i>10.4</i>	<i>12</i>	<i>22</i>	<i>10</i>	<i>1.0</i>
<b>I-270</b>	<b>Md.187 (E.Spur) to Md.121</b>	<b>18.4</b>	<b>19</b>	<b>31</b>	<b>12</b>	<b>0.7</b>
	<b>Democracy (W.Spur) to Md.121</b>	<b>18.1</b>	<b>20</b>	<b>28</b>	<b>8</b>	<b>0.4</b>
<b>Va. 267</b>	<b>From TR Bridge to Va. 28</b>	<b>24.2</b>	<b>28</b>	<b>32</b>	<b>4</b>	<b>0.2</b>
	<i>Va. 267 only</i>	<i>15.5</i>	<i>16</i>	<i>23</i>	<i>7</i>	<i>0.5</i>
<b>US 50</b>	<b>From US 301 to MD 410</b>	<b>9.1</b>	<b>8</b>	<b>10</b>	<b>2</b>	<b>0.2</b>

## VI. CONCLUSIONS

When combined with data obtained in 1997, 1998, and 1999, the 2004 data reveal the following:

- Barrier-separated and exclusive HOV facilities continue to provide substantial savings in travel time.
- HOV lane person throughput on a per lane per hour basis continues to outperform adjacent non-HOV lanes.
- Travel time benefits from some concurrent-flow HOV lanes are increasingly marginalized due to enforcement challenges and increasing congestion in adjacent non-HOV lanes.
- There is a marked decline in average auto occupancies on Virginia HOV lanes due in part to the hybrid vehicle exemption, but also due to growth in other non-HOV vehicles.