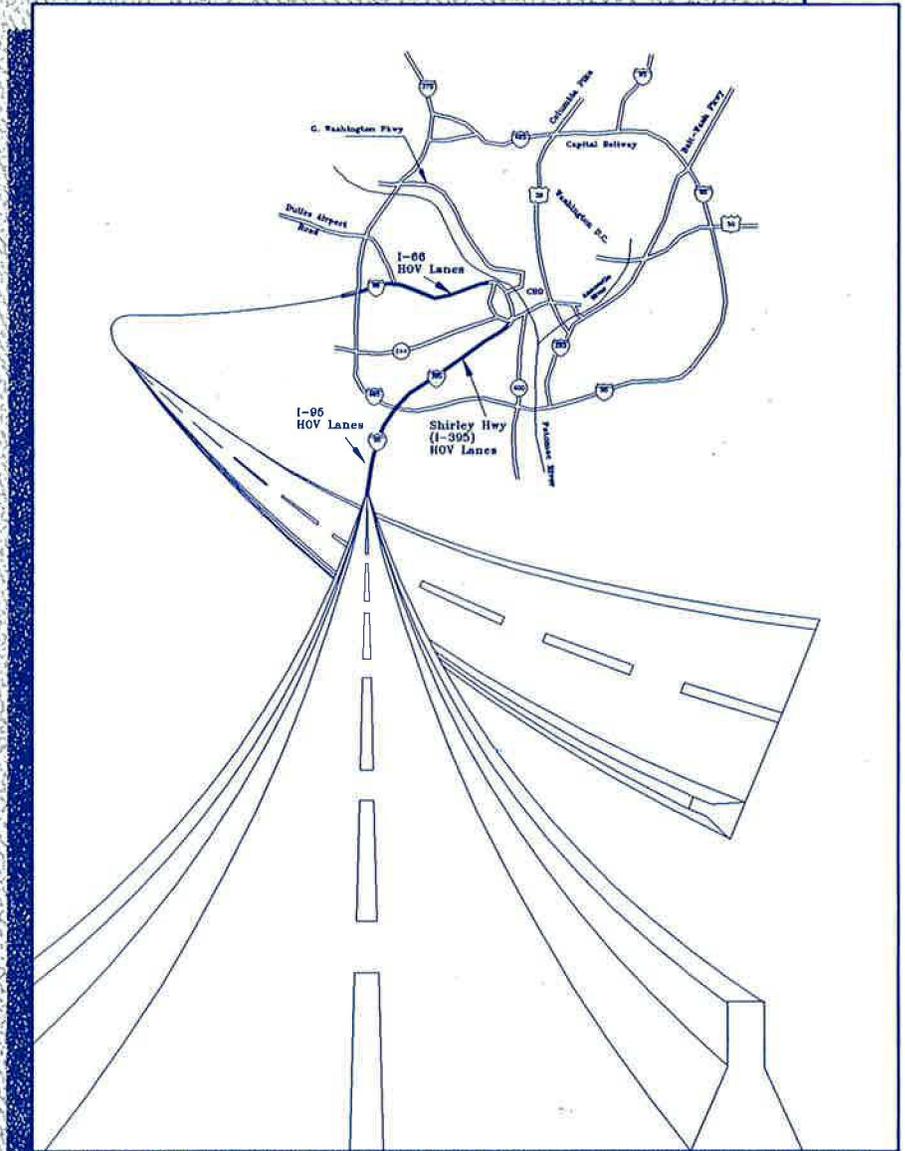


1990 HOV Facilities Conference



Conference Proceedings

April 10-12, 1990 Washington, D.C.

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The **Transportation Research Board** is a unit of the National Research Council, which serves as an independent advisor to the federal government on scientific and technical questions of national importance. The Research Council, jointly administered by the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine, brings the resources of the entire scientific and technical community to bear on national problems through its volunteer advisory committees.

CONFERENCE PROCEEDINGS

Fourth National High-Occupancy Vehicle (HOV) Facilities Conference

April 10-12, 1990
Washington, D.C.

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Building on the success of the previous HOV Conferences held in Southern California, Houston, and Minneapolis, the 1990 HOV Conference held in Washington, D.C. this past April provided the opportunity to share information and ideas with our peers in the transportation community. With over 200 transportation professionals in attendance, the conference provided a good indication of the continuing and growing interest in HOV facilities.

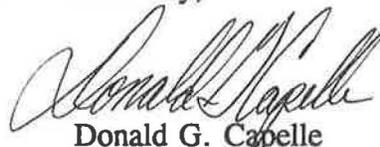
The success of the 1990 conference was the result of the dedication and hard work of many individuals and groups. The local planning group and the Transportation Research Board (TRB) staff did an excellent job in developing and organizing the conference. Credit is also due the TRB and the Metropolitan Washington Council of Governments for their sponsorship of the conference in cooperation with the Federal Highway Administration and the Urban Mass Transportation Administration.

The conferences represent just one of the many activities being pursued by the HOV Systems Committee of the Transportation Research Board. Other activities of the Committee include the publication of a HOV newsletter, development of an HOV video, a technical glossary, and a marketing outreach program. In addition, the Committee sponsors technical sessions at the TRB Annual Meetings and is active in identifying and promoting research associated with HOV facilities.

The next National HOV Conference will be held in Seattle, Washington April 29-May 1, 1991. The planning for this program is well under way. The 1992 Conference is scheduled for Ottawa, Ontario. We encourage you to plan now to attend and actively participate in these conferences.

We trust that you will find the Proceedings of the 1990 Conference informative and useful. We also hope this material will challenge you to consider new and innovative approaches to many of the urban mobility problems we face. We strongly urge you to become actively involved in the many different activities of the HOV Systems Committee. Your participation can make a difference!

Sincerely,



Donald G. Capelle

Chairman

HOV Systems Committee

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OPENING PLENARY SESSION

Introduction

Ronald F. Kirby



Metropolitan Washington Council of Governments

I would like to welcome you to the Fourth National Conference on high-occupancy vehicle facilities. I was delighted to be asked to serve as the chair of the local planning group for the conference. I would like to take this opportunity to acknowledge the help I received from other members of the conference planning committee. The members of this group are listed on the inside cover of the conference program. I would especially like to recognize the efforts of Jon Williams, one of my staff members. Jon was responsible for developing much of the program, contacting the speakers, and making sure that everything was organized.

We are glad that the national conference has finally come to Washington, D.C., the home of HOV facilities. As you probably know, the Shirley Highway HOV

lanes were the first major application of HOV lanes in this country. Many of you saw the Shirley Highway HOV lanes and the traffic management center on the bus tour yesterday. We also have the I-66 facility, which operates as an HOV facility during the peak periods. In addition, there are plans for a number of future HOV facilities in the region. You will be hearing more about the existing HOV facilities in the Washington, DC. and northern Virginia area and the future plans in the second session this morning.

I think you will find the conference program very informative. We hope that you will learn from the speakers and workshops sessions, and share your ideas and experiences with others to make this a worthwhile conference. There is a good deal that we can learn from each other. We look forward to a very productive conference.

Opening Address

Eugene R. McCormick



*Deputy Administrator
Federal Highway Administration*

It is a pleasure to be here, especially with such a cross-section of the transportation community represented. I think conferences of this type provide an excellent opportunity to share our thoughts and ideas. I would like to thank the Transportation Research Board on behalf of the Federal Highway Administration (FHWA) for hosting the conference and thank the Metropolitan Washington Council of Governments for their co-sponsorship, along with the Urban Mass Transportation Administration. FHWA is proud to be a partner in this effort.

I would like to focus my comments on a number somewhat independent, but closely integrated topics. These include the National Transportation Policy and HOV facilities. While these may appear independent topics, I think they are closely

integrated. I would like to start by providing a brief overview of some of the main elements of the National Transportation Policy.

It is important to realize that the National Transportation Policy was developed during the first year of the new administration. The last such policy was developed twelve years ago. As many of you know, Secretary of Transportation Skinner made the development of this policy his number one priority. He made it clear during his confirmation hearings that the nation needed an overall integrated transportation policy to guide future investments in the transportation system.

I am sure that many of you have seen copies of the document by now. Also, as many of you may know, the development of the plan was the result of a very intensive effort within the Department. The National Transportation Policy was officially presented about a month ago, with President Bush participating in the announcement.

There has been some criticism of the policy. The most common criticism I have heard is that it lacks detail. I think the policy does contain a number of specific elements. I have also heard concerns that the policy sets the course for a diminished role for the federal government in funding transportation, at the expense of local and state governments. I do not think the policy sets this direction. In fact, the document states that there is a need for a strong federal role in transportation. In most cases, user fees are identified as the base for this support.

It is important to remember that the document was not intended to be a legislative action document for Congress. Rather, it was intended to provide the

framework and the goals for the future transportation program. The timing of the policy is important, not just because it was developed in the first year of the new administration, but also because it was developed before Congressional consideration of major transportation reauthorizing legislation. The air system reauthorization bill will be debated this year, and the highway and transit reauthorization bill will be considered next year. Thus, the timing of the policy is important.

Last summer and fall the Department organized a very extensive outreach program to assist with the development of the policy. A total of 117 events were held throughout the country. The Department learned a great deal at these meetings from users of the system, operators, state and local governments, and other elements of the transportation community. Part of the challenge for the future is how we bring all these diverse interests together to improve all aspects of the transportation system.

Six basic policy themes emerge in the document. The first of these is maintaining and expanding the existing transportation system. Obviously, the productivity of the country and our competitive position in the world depends to a large extent on our transportation system. We must protect our past investments in the system. Maintaining the transportation system does not come without cost. We must also address some of the emerging problems, such as congestion and grid-lock, in our major metropolitan areas. One approach in many of these areas is the subject of this conference; HOV facilities.

We must foster a strong financial base for our transportation system. It is clear in our minds that the financial responsibilities can not be met solely at any

one level; local, state, or federal. It will take the combined best efforts of all three levels to adequately address the problems. The private sector must also be involved, and I think we will see the growing involvement of the private sector. It will take all these groups working together to provide the sound financial base to address our future transportation needs. We at the federal level do realize that we are a partner in this effort and that there is a need for a strong federal role.

We must keep the transportation system competitive and strong, and we must insure safety and security on the system. At the same time, we need to be concerned about protecting our environment and enhancing our quality of life. We must also continue to explore advanced technologies as they relate to all modes of transportation.

I would like to talk briefly about each of these elements in more detail. As I mentioned, the policy promotes the strengthening of the partnership between the federal, state, and local levels, and the private sector. We believe the federal role should focus primarily on systems of national significance. We also think the states should be given more flexibility to address specific problems unique to each area.

I think we all realize that we can not build our way out of our current traffic problems. We must learn to operate and manage the existing system more efficiently and effectively. This does not mean that we should overlook new projects or critically needed expansion projects. These must also be addressed as appropriate. Again, HOV facilities fall into both of these categories. HOV lanes provide for more efficient and effective utilization of our highway systems

and can expand the person-carrying capacity of these facilities.

An increased reliance on user fees is a premise of the policy, along with a decreased reliance on general fund support. Fostering innovative financial approaches will be important in the future. This may include additional private sector participation in the funding of many transportation improvements. HOV facilities, especially providing links to major activity centers, provide one opportunity for private sector participation.

I would also like to outline for you how the policy document is moving forward into the next step of policy implementation. The air system reauthorization bill was recently sent to Congress by the Administration. Obviously, this legislation was developed within the context of the National Transportation Policy. A number of elements related to the air system reauthorization may establish trends that we will see contained in the highway and transit reauthorization next year.

The administration's aviation proposal would increase the reliance on user fees in the air system program. Today, federal funding is split, with 55% from user fees and 45% from general revenue funds. The proposal would increase the reliance on user fees to about 85%, with a corresponding reduction in general funds. The 85% represents the estimated cost of the public utility of the air system, with the remaining 15% attributed to military defense. The proposal also includes a recommendation to draw down the balance in the airport trust fund. Again, the proposal recommends a greater dependence on user fees, increases in user fees, increases in funding, and drawing down the airport trust fund balance.

To keep the transportation industry strong and competitive we must continue to encourage cost-effective mass transportation, merchant marine, and shipping services. We need to look at state requirements on motor carriers, many of which are inconsistent. We need to look at some of the railroad requirements that may be outdated and overly costly. We must also continue to reassess the federal user charges and subsidies to ensure that the user fee concept is being equitable implemented.

Ensuring public safety and security is another important element of the policy. Reducing highway fatalities is an area we need to improve on. Some 46,000 people are killed every year on our highway system. We need to reduce this level. HOV facilities can help improve the overall safety of roadways. Safety considerations must be an integral part of any new transportation program. For example, the highway reauthorization bill may contain a number of safety related elements. We hope these will provide a renewed focus on developing safer highways, vehicles, and drivers. All three of these elements must be addressed to effectively improve safety.

HOV facilities can also play an important role in protecting the environment and enhancing the quality of life in our metropolitan areas. We must be sensitive to the environment. A new clean air bill is currently being considered by Congress. I suspect it will include new requirements on non-attainment metropolitan areas.

HOV lanes are one approach being considered in many areas to assist in meeting current requirements. We must also enhance energy efficiency. The development of the National Transportation Policy was coordinated with the Department of Energy and the development of a

National Strategic Energy Policy. One of the benefits of HOV facilities is increased energy efficiency, along with enhancing mobility and minimizing congestion. It has been estimated that on an annual nationwide basis congestion costs some \$16 billion in lost time, productivity, effort, and earnings. This is an almost unbelievable situation.

Later in the conference you will be hearing about many of the successful HOV projects. As you know, successful projects require the close coordination and cooperation among many different agencies, governmental levels, and the public and private sectors. This is one of the real challenges of all transportation projects, but especially HOV facilities, which by their very nature require the involvement of many groups. In closing, I think it is this ongoing cooperation and coordination in all areas of transportation that is the key to solving many of our transportation problems. HOV facilities can play a very integral part as one element of the overall solution. This coordination and cooperation does not come easily, however. We must continue to work to ensure that it happens.

I would like to leave you with two challenges. First, is the challenge to work together to ensure the coordination and cooperation on transportation projects, especially HOV facilities. Second, is the challenge to meet the public's demands for transportation through a better appreciation of the system and better management of the system.

Update on National HOV Developments

Katherine F. Turnbull



Texas Transportation Institute

It is a pleasure to have the opportunity to provide an update on HOV-related activities in North America. Having been involved in planning the 1988 conference, I have a good idea of the effort that goes into planning and carrying out a national conference. Ron Kirby, Jon Williams, the TRB staff, and the local planning group are to be commended for the great job they have done with the conference this year.

It is appropriate that the conference is being held in Washington, D.C., since the Shirley Highway represents the first major HOV facility in the country. A great deal has happened since the opening of the initial bus-only lane on the Shirley Highway in 1969. As transportation professionals, we have learned a great deal over the past twenty years concerning the role HOV facilities can play in helping to relieve traffic congestion. Obviously, however, we

do not have all the answers to dealing with congestion and mobility problems in major metropolitan areas. If we did, there would be no need for conferences like this.

It is important to note that HOV facilities represent just one approach to dealing with urban congestion problems. HOV facilities should not be viewed as the only solution, nor should they be viewed as the most appropriate solution in all cases. However, HOV facilities can be an efficient and effective approach in many situations. Also, implementing HOV facilities does not preclude the need for other improvements.

The number of HOV facilities in operation has increased significantly since the opening of the Shirley Highway exclusive bus lane demonstration project in 1969. In fact, a number of new HOV projects have been implemented since the last HOV conference in 1988. In addition, there are many more in the planning, design, and construction stages.

Currently, there are 40 HOV projects in operation on either separate rights-of-way or within freeway rights-of-way in 20 metropolitan areas in North America. In addition, there are many more applications of HOV projects on arterial streets, bus-only lanes in downtown areas, and HOV bypasses at freeway ramp meters. The Texas Transportation Institute (TTI) has recently completed a survey of HOV projects on either freeways or in separate rights-of-way. The survey represents one element of a multi-year study funded by the Urban Mass Transportation Administration through the Texas State Department of Highways and Public Transportation. I would like to thank all of the individuals with the different agencies around the country who completed the surveys.

I would like to provide a quick overview of the variety of HOV projects currently in operation today and then focus more specifically on recent projects and issues. Appendix 1 provides a summary of the basic characteristics of the 40 HOV facilities.

High-occupancy vehicle lanes are usually classified into four general categories; exclusive HOV facilities on separate rights-of-way, exclusive HOV lanes within freeway rights-of-way, concurrent flow lanes, and contraflow lanes. The Ottawa Transitway system and the East and South Busways in Pittsburgh are the three HOV facilities in operation on separate rights-of-way. There are 11 barrier separated facilities in operation including the Houston Transitways, the San Bernardino Freeway Busway in Los Angeles, the Shirley Highway and I-66 HOV facilities here in Washington, D.C. and northern Virginia areas, I-394 in Minneapolis, and new facilities in San Diego, Pittsburgh, and Hartford.

Concurrent flow HOV facilities represent the largest group of projects, with some 22 facilities currently in operation. They also represent the most diverse group of projects. Concurrent flow HOV lanes are located on the outside lanes or shoulders of freeways or expressways in Seattle, Santa Clara County, Denver, and Vancouver. Concurrent flow HOV facilities also utilize in the inside lane on freeways in Phoenix, Miami, Orlando, Los Angeles, Orange County, Marin County, San Francisco, Seattle, and northern Virginia.

There are 3 contraflow facilities currently in operation, all in the New York City area. These are the Route 495 approach to the Lincoln Tunnel, the

Gowanus Expressway and the Long Island Expressway.

A variety of operating characteristics are associated with the different HOV facilities. The exclusive bus-only facilities in Ottawa and Pittsburgh operate over extended periods of the day. Some HOV lanes, such as those in Seattle, Los Angeles, Orange County, and Hartford operate on a 24-hour basis. Many of the exclusive facilities within freeway rights-of-way are reversible. These facilities, such as the Houston transitways operate inbound in the morning, are closed for a period to reverse the direction of operation, and then are open in the afternoon, in the outbound direction. Some HOV facilities are open only during the peak-periods, while others are open only in the peak-direction or the morning peak-period.

The use of these facilities during the non-HOV restricted periods also varies greatly. Some facilities are closed to all traffic. Others revert to general-purpose lanes, while still others revert to emergency shoulders.

Vehicle occupancy requirements on the different HOV facilities are about evenly split between those requiring 3 or more people and those requiring 2 or more people. Only one HOV facility, the Katy Transitway in Houston, uses different occupancy requirements during different times of the day. During the morning from 6:45 a.m. to 8:00 a.m. a 3+ occupancy requirement is in effect. During other times of the day, a 2+ occupancy requirement is used.

The types of vehicles allowed and the occupancy requirements have changed on many HOV facilities over the years. The Katy Transitway again provides a good

example of these changes. The transitway was open initially only to buses. This was expanded to include authorized carpools and vanpools with 3 or more person due to the public perception that the facility was underutilized. When this perception continued to exist, the authorization requirement was removed and the occupancy requirement was lowered to 2+.

Focusing more specifically on activities that have occurred since the last HOV conference, I would like to talk briefly about the new projects, project extensions, support services, enforcement activities, system plans, and related activities that are being pursued around the country. The following five new HOV facilities have opened in the last 1 1/2 years.

New HOV Projects
San Diego, I-15
Orange County, I-405
Pittsburgh, I-279
Hartford, I-94
Seattle, I-90



I-15, San Diego

- I-405 in Orange County. Approximately 14 miles of this concurrent flow HOV facility are currently in operation, with another 10 miles scheduled to open in the next month or so. The I-405 facility is open on a 24-hour basis and utilizes a 2+ occupancy requirement. Current volumes average approximately 1,200 to 1,400 vehicles during the morning peak-hour in the northbound direction and some 950 vehicles in the southbound direction.
- I-279 in Pittsburgh. This is a 4-mile, 2-lane, reversible HOV facility located in the median of the I-279 freeway. It separates into two short, one-lane segments, with one going into the downtown area and the other going to Three Rivers Stadium. A 3+ vehicle occupancy requirement is used. The facility is open for HOVs in the inbound direction in the morning and in the outbound direction in the afternoon. From 8:00 p.m. to 3:00 a.m. it is open to general traffic. This period was identified for general use primarily to accommodate traffic leaving sporting and special events at Three
- I-15 in San Diego. This is an eight-mile 2-lane, reversible, exclusive HOV facility, located in the median of the I-15 freeway. It is open only during the morning and afternoon peak-periods. A 2+ occupancy requirement is used. Initial volumes have been averaging 1,500 vehicles in the peak-hour for the facility. The cost to construct the I-15 HOV facility averaged approximately \$4 million a mile.

Rivers Stadium. The I-279 HOV project was open in the fall of 1989. Initial peak-hour volumes have averaged between 160-220 vehicles.

- I-84 in Hartford. This is a two directional, 10-mile exclusive facility. It is considered an exclusive HOV facility as the HOV lanes are separated from the general traffic lanes by 12-foot painted buffers. A 3+ vehicle occupancy requirement is utilized on the facility. Initial peak-hour volumes on the I-84 facility, which opened in the fall of 1989, have averaged between 150-200 vehicles.



I-84, Hartford

- I-90 in Seattle. In 1989 a 6-mile interim westbound HOV lane was opened on the I-90 facility. The final I-90 HOV facility, scheduled to open in 1992, will include 10 miles of 2-lane reversible HOV lanes.

A number of extensions to existing projects have also been completed recently, including the following facilities.

HOV Project Extensions

Ottawa Transitway System
 Houston Transitways
 San Bernardino Busway Downtown Extension
 Santa Clara County Commuter Lanes
 Phoenix, I-10
 Minneapolis, Third Avenue Distributor
 Downtown Parking Garages

- Ottawa Transitway. An addition segment of the Ottawa Transitway system was opened in 1989, bringing the total length of the operating system to 23 kilometers of a planned 31 kilometer system. Currently, an additional 9 kilometers are under construction and more are in the planning stage.
- Houston Transitways. The Houston transitway system has continued to expand. Currently 47 miles of a 97-mile system are in operation. Six miles of the Gulf Transitway were open in 1988. The initial 9.5-mile segment of the Northwest Transitway was open in 1988 and the final 4 miles were just opened in February, 1990. The completion of the Northwest Transitway has resulted in significant increases in use. In December 1989, the morning peak-hour volumes were averaging approximately 950 vehicles. After the opening of the final 4 miles in February, 1990, the peak-hour volumes increased to approximately 1,200 vehicles, and counts as high as 1,400 have been recorded. In addition, the one-mile eastern extension on the Katy Transitway was completed in January, 1990. This provides an additional 1-to-2 minutes of travel time savings for

vehicles continuing through the I-610 loop. An increase in utilization levels has also been noted from this improvement. The Northwest Transit Station located at the end of the Northwest and Katy Transitways was just opened last week. This facility provides transfer connections between different services.



Katy Transitway Eastern Extension

- San Bernardino Busway Downtown Extension. In 1989, the one-mile extension of the San Bernardino Busway into downtown Los Angeles was completed. This extension provides 1-to-2 minutes in travel time savings for HOVs traveling into the downtown area.
- Santa Clara County. Extensions to the San Thomas and I-101 HOV facilities have been opened over the past two years.
- I-10 in Phoenix. An additional 10-mile segment of the I-10 HOV facility in Phoenix opened in early 1990.
- Third Avenue Distributor (TAD) Garages in Minneapolis. The 4th Street Garage, the first of the TAD

Garages being constructed as part of the I-394 project, was opened in August, 1989. It contains a total of 1,600 parking spaces. Reduced rates of \$10 a month are available for registered carpools and vanpools, compared to \$80 for single-occupant vehicles. Currently, carpools account for approximately 30% to 35% of the daily parkers. Thus, the facility, which also includes a bus loading area and a connection into the downtown skyway system, appears to be well received.

A good deal of recent HOV-related activities throughout the country have focused on many of the supporting facilities associated with HOV lanes. The Seattle area often refers to the actual HOV lanes as the "hardware" and the supporting facilities as the "software". The "software" elements include such things as the supporting transit and rideshare services, different travel demand management (TDM) strategies, enforcement, and other activities intended to increase utilization levels and improve operation of the HOV facility. While a number of the workshop sessions will be focusing on many of these topics, I would like to highlight a few of the major activities that have occurred over the past year.



HERO Program Seattle

Enforcement continues to be a concern in most areas. A number of new programs, such as the HERO program and the ticket by mail program, have been implemented to try to address enforcement problems. The HERO program, initially implemented in the Seattle area and now being used in the northern Virginia/Washington D.C. area, provides a telephone number for individuals to report apparent HOV lane violators. The ticket by mail program, which allows the Virginia State Police to issue citations for violations of the HOV requirements by mail, was implemented in 1989 based on a change in state law. This program has been successful in increasing the number of citations an officer can write. In addition, a number of areas reported that they are considering the use of electronic surveillance techniques to improve enforcement levels. Insuring that enforcement issues and needs are adequately considered in the planning and design stages continues to be an important element in the development of HOV facilities.

Traffic management systems or central control systems, which monitor both the HOV and freeway facilities, are being considered and developed in many areas. In addition, many areas are examining the role HOV facilities can play in assisting with special events and incident management. For example, some of the highest volumes on the I-394 interim HOV lane in Minneapolis have been recorded when the facility was opened for Minnesota Twins and Vikings games. In addition, two of the Houston transitways, the Gulf and Katy, are now open for weekend use.

Experience continues to be gained with the use of different support services and travel demand management (TDM) strategies. Most of the current bus service and park-and-ride lots associated with HOV

lanes are oriented toward serving downtown areas. These serve the traditional transit market that tends to be well known and well established. However, much is still being learned about how to serve other markets, especially the suburban-to-suburban market. There are a number of examples, primarily in California and Houston, where carpools using the HOV lanes are oriented to suburban travel markets. Some areas are also exploring the use of timed-transfer bus service to better serve suburban origins and destinations. It appears that the flexibility offered by HOV facilities may play a significant role in providing a variety of services to these markets.



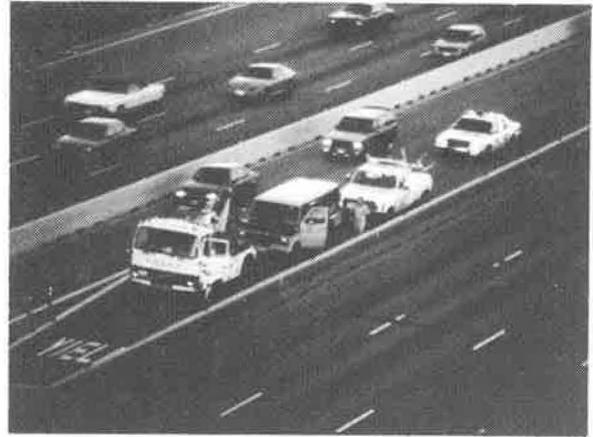
Addicks Park-and-Ride Lot Houston

Many areas are also exploring the use of a variety of TDM strategies to encourage the use of HOV facilities. Consideration is being given to the appropriate combination of incentives and disincentives, or "carrots" and "sticks", to use with many of these programs. Experience seems to indicate that we need to go beyond selling bus use and carpooling as a common sense approach. Providing some type of cost savings, through reduced parking fees or subsidized bus fares, travel time savings, and other incentives appear to be important for influencing mode changes.

The role the private sector can and should play is one of key areas many of the TDM strategies are trying to address. Should private sector participation be voluntary or mandatory? How these strategies fit in with many of the local TDM, trip reduction, air quality, and land use ordinances are also being considered.

The marketing and public information programs associated with HOV facilities is other area that is continuing to evolve as more experience is gained. Many of the more traditional approaches, such as opening ceremonies, billboards, and newspaper advertisements, continue to be used. However, new techniques, such as focus groups and more sophisticated survey procedures, are also being tried in many areas. Both Caltrans and the Washington State Department of Transportation are currently developing HOV marketing and public information programs. The I-394 project made use of an extensive marketing program, as have other areas.

Many metropolitan areas are beginning to examine the application of HOV facilities on a systemwide or network basis. Instead of simply focusing on individual projects, these areas are examining the linkage between different types of HOV and support facilities. The intent of these efforts is to provide a unified, coordinated system of HOV facilities on freeways, ramps, and arterial streets. A freeway HOV lane may not be attractive to commuters if they encounter major congestion getting to and from the facility. Many of these approaches tie back into the idea of providing better overall management of the total transportation system.



Houston Metro Tow Truck

Last, there is a good deal of interest in many parts of the country with examining different applications of intelligent vehicle highway systems (IVHS) technology to HOV facilities. By offering a real world, but protected, environment, barrier separated HOV lanes have been identified as potential locations for the testing of many of the "smart vehicle" IVHS technologies. For example, the I-15 HOV lanes in San Diego are scheduled to be used to test these types of vehicles being developed as part of the California IVHS program. Other areas are exploring different approaches to using IVHS technologies to encourage transit use. This appears to be an area with a good deal of potential and one which should see variety of activities in the future.

Having examined the past and current status of HOV facilities, it is appropriate to discuss what the future may hold. A good deal of what the future holds will depend on the people in this room and other transportation professionals around the country. The topics that are discussed over the next two days, the issues that you identify as important, as well as the solutions and approaches that are identified, will help set the agenda for the next year. Many of the topics touched on this morning including enforcement, support services, TDM strategies, increasing utilization on some facilities and managing the demand on

others, and IVHS-related research and demonstration projects will all continue to be important.

It appears that the number of HOV facilities will continue to increase. If the facilities currently in the design and construction stage are completed, an addition of approximately by 550 miles of HOV lanes will be in operation by the year 2000. This represents a significant increase from the 332 miles currently in operation.

In conclusion, while we have learned a great deal about the role HOV facilities can play, the challenge still exists to look for new and innovative ways to deal with mobility and congestion problems in our metropolitan areas. HOV facilities will continue to be one approach considered in many areas for addressing these issues.

Public-Private Initiatives on HOV Lanes

Fred G. Currey



*President
Greyhound Lines, Inc.*

Good morning, it is a pleasure to be here. The HOV world is obviously in a very positive state of change. The attendance at this conference indicates not only the continued interest, but also the broad spectrum of interest, in HOV facilities. The other speakers this morning have given you an excellent overview of the federal policies related to HOV facilities, the new national transportation plan, and the status of HOV facilities in North America.

I would like to focus my remarks more on the political aspects of HOV facilities, specifically the HOV coalition that Greyhound has been an integral part of forming. However, before I address these topics, I would like to mention that Greyhound is on schedule in building back its business since the strike began. We continue to operate in an orderly fashion and

will continue to add routes back into the system as new drivers are hired and trained.

I want to send a strong message to you concerning Greyhound's involvement in issues associated with HOV facilities. With limited financial resources at the federal, state, and local levels, the more efficient utilization of existing facilities becomes more important. We have come to realize that we can not always build new highways to address congestion problems. HOV facilities often represent the most cost-effective approach to increasing the capacity of roadways in many of our metropolitan areas. HOV facilities represent the policy option whose time has come. It is up to us to make sure the correct choices are made. For these reasons, we at Greyhound have been pleased to take the lead in the development of an HOV coalition. We strongly support the formation and ongoing role of the coalition. The emphasis on the coalition is important because nothing really happens in Washington, D.C. without strong backers or without a strong effort. Now is the time for a strong coalition effort to promote the development of HOV facilities in metropolitan areas throughout the country.

I think the timing of the creation of the coalition and its initial activities is good. One of the major efforts of the coalition will be to push for preferential funding for HOV facilities. Obviously funding is needed to make HOV facilities happen. The coalition will be promoting preferential financial treatment for HOV projects with Congress. The coalition will also be working to promote the inclusion of an urban block grant program in the forthcoming transportation reauthorization. Such a program will address urban congestion problems and will remove any barriers between transit and highway funding. We

must have a coordinated funding policy. In addition, we need to work with local planners to make sure that all transportation options are explored from a cost-effective standpoint.

I think it is an appropriate time for the coalition to promote these interests. We have a clear direction from the Secretary of Transportation, we have a President with a heavy interest in the environment, we have growing congestion problems that demand action, we have budget constraints that demand cost-effective approaches, and we have proven success stories with HOV facilities in major cities throughout the country. It is for these reasons that we at Greyhound support the formation of an HOV political coalition to obtain the preferential action we feel is necessary to promote the development of HOV facilities.

**PLENARY SESSION: HOV IN THE
WASHINGTON, D.C. REGION**

Introduction

Larry Darnes



Federal Highway Administration

It is a pleasure to welcome you to the session addressing HOV facilities in the Washington, D.C. area. The Federal Highway Administration is proud to be a part of this conference. FHWA has been actively involved in many aspects related to planning, designing, and implementing HOV facilities. In addition, FHWA has supported and participated in past conferences and the different activities of the TRB HOV Committee.

Many of you had the opportunity to tour some of the HOV facilities in the Washington, D.C. area yesterday. At this session, the speakers will be providing you with additional information on a variety of HOV related activities currently underway in Washington, D.C., northern Virginia, and Maryland. A number of planning efforts are being conducted that include HOV facilities.

In addition, supporting services and programs, such as vanpooling and enforcement, will be discussed.



I-95, Northern Virginia

Northern Virginia Sub-Regional Plan

Richard Lockwood



*State Transportation Planning Engineer
Virginia Department of Transportation*

I would like to focus my comments on the development of the sub-regional planning process in Virginia, with some specific references to the role HOV facilities play in the plan. The portion of the sub-regional plan that I think is of most interest to this group encompasses the area south of the Potomac River. The area includes 4 counties, 5 cities, and 3 towns.

Traffic congestion in northern Virginia today has reached crisis proportions. More than 50 percent of all the vehicle miles of travel during the peak-period occurs at an unacceptable level of service. Overall, average speeds during the peak-period are less than 30 miles an hour. This means that individuals are experiencing speeds lower than this for at least a portion of their commute. Seventy percent of all

vehicles during the peak-period are carrying only one individual - the driver.

Recognizing these problems, in 1987 all northern Virginia jurisdictions were charged by the Governor with working with the Virginia Department of Transportation to develop a transportation plan for the region. It was envisioned that this plan would then be used to prioritize, program, and implement transportation projects over the next 20 years. This joint effort became known as the sub-regional planning process. To accomplish this task, three committees were established to direct the planning effort and evaluate the technical results. The Policy Committee was comprised of mayors or chairs of the Boards of Supervisors of each major jurisdiction, members of the northern Virginia delegation, and heads of regional agencies. The Technical Committee was comprised of the senior transportation planning staff from each of the jurisdictions and agencies. The Citizens Advisory Committee was comprised of some 80 citizens representing all jurisdictions. Many of these citizens also participated in the technical sub-committees.

Early in the process a set of goals and policies were adopted by the Policy Committee to guide the planning effort. These clearly identified the commitment at the policy level to providing a balanced regional transportation system and to identifying the financial resources and potential legislative actions that would be needed to carry out the plan.

A major part of the process reviewed the anticipated growth factors for the region. Between 1985 and 2010, the population for the area is expected to increase by 50 percent. The number of households is projected to increase by 67 percent. Employment opportunities will almost

double. Automobile ownership, a major indicator of the propensity for trip making is expected to double. The sharpest rate of growth in all areas is expected between now and 1995.

Between now and 2010, radial travel across the beltway is forecast to increase by 50 percent and travel from the outlying counties is expected to more than double. Circumferential travel is expected to grow at an even faster rate. The growth and distribution of work trips represents another good indicator of transportation needs. The overall number of work trips is expected to grow and the direction of many of these trips is expected to change, further compounding the problem. In 1985, 63 percent of all work trips were made entirely within the area. By 2010, this is expected to increase to 75 percent. While the District of Columbia continues to be a major attractor of work trips from northern Virginia, major activity centers within the area are expected to attract increased numbers of work trips. Thus, the demand to serve these areas with an adequate transportation system will continue.

A variety of alternatives and options were examined and noted as part of the sub-regional plan development process. Two future year time horizons were examined; 1995 and 2010. The 1995 system included all the projects currently committed. Several different 2010 alternative systems were examined. The recommended 2010 plan includes the following elements:

- HOV - An HOV and transit system grid is an integral part of the plan. These focus on the major travel corridors and will provide a system for HOVs linking the major activity centers. HOV facilities are recommended for I-66 to Gainesville,

the Capital Beltway, the Dulles Toll Road, and sections of Route 234, Route 1, and Braddock Road, in addition to those currently planned for I-95.

- Rail - Substantial increases in rail service is also identified in the plan. This includes completion of long planned service, such as the Springfield Metro rail expansion and the commuter rail line from Fredericksburg and Manassas to the District. It also proposes new rail extensions in the I-66 corridor to Centreville, and new rail service in the Dulles corridor to Leesburg. Extending the Yellow Line to Lorton will also be examined at the request of the Policy Committee.

- Bus - The plan includes significant increases in bus service. New express service would be added to utilize the HOV lanes and other services would be improved. A timed-transfer system is recommended to provide better service to all the major activity centers.

- Highway - The highway component includes a variety of new projects, widenings, upgradings, and the interstate facilities. New highway facilities are relatively limited, with the emphasis on other improvements and the HOV/transit elements.

- TSM - There is also a good deal of emphasis on TSM measures to improve the efficiency of the existing system and to maximize the efficiency of the future system.

Implementation of the recommended 2010 plan will dramatically increase the total miles of transit service provided in northern Virginia. The number of miles of HOV lanes in the recommended plan is a 500 percent increase over existing services, while 54 miles would be added to the Metro rail system, and 97 miles of commuter rail service would be added. The results of all these improvements will increase commuter trips made on transit by almost 85 percent. A number of additional studies are also currently underway. Once completed, recommendations from these studies must be incorporated into the 2010 sub-regional plan.

The plan identifies the estimated capital costs for the recommended system. In 1988 dollars these improvements total some \$7 billion. Approximately \$4 billion of this is for HOV facilities and transit improvements. An additional \$3 billion in transit operating costs will also be required. Obviously, funding has not been identified to cover all these costs. Now that the overall plan has been developed, the next steps include further examination of the recommendations on a corridor basis and further refinement of the financial aspects of the plan.

**Maryland Commuter
Assistance Study**

Steve Reich



*Deputy Director
Office of Transportation Planning
Maryland Department of Transportation*

The Maryland Department of Transportation is nearing the completion of an 18 month intensive effort to develop a multi-modal systems level plan. The plan focuses on the 24 most congested corridors. The structure of the department allows for this type of coordinated effort, in that we have a fully integrated trust fund. All transportation expenditures for the state come from this transportation trust fund.

By way of background, with the passage of the 1987 Surface Transportation Act at the federal level and a significant revenue increase at the state level, a number of projects that had been in the planning stage were able to move forward. This seemed like an appropriate time to start a long range planning effort. A multi-modal

approach is being taken to look at a full range of options within each corridor.

The study was initiated in 1989. Eleven of the 24 corridors under study are close to the Washington, D.C. area. A number of alternatives are being considered in each corridor and are being examined in a sequential manner. These include, carpools, vanpools, park-and-ride facilities, express bus service, highway improvements, a variety of types of HOV facilities, light rail transit, commuter rail, and heavy rail transit.

In terms of the process, one of the first steps was a detailed examination of the existing conditions in each corridor and the future plans for each area. The plan focuses on the year 2010. Capital and operating cost models have been developed for each of the alternatives for use in the evaluation process. For the purposes of the evaluation, HOVs are being defined as vehicles with 3 or more occupants and buses.

The evaluation will focus on four general areas. First, the existing and future problems will be identified in each corridor. Next, the alternatives will be evaluated based on how well they provide solutions to these problems and how practical they are. Last, the costs associated with each alternative will be examined.

The study should be completed in the near future. While no specific recommendations have been made yet, I think HOV facilities will be an important part of the plan. As you might expect, I think we will also see a mix of approaches in different corridors. One of our challenges as transportation professionals is to educate the decision makers on which solutions work best in each area and to explain why one approach does not work in every instance.

Vanpools and HOV Lanes

Lew W. Pratsch



*President
Virginia Vanpool Association*

I think vanpools and HOV lanes represent two of the most important options available to reduce commuter traffic congestion, air pollution, and energy consumption in the 1990's. HOV lanes, carpools, and vanpools serve an infinite number of origins and destinations and provide a cost effective and energy efficient commute option. Combining HOV systems with a "leveling of the playing field" related to commuter parking fees represents an affordable and quick-to-implement approach to reducing traffic congestion within the next five years.

I would like you give you a little background on the Virginia Vanpool Association (VVPA), which is the largest association of independent vanpool owners and operators in the nation. It was started before there were many ridesharing offices

and without the assistance of any employer or government agency. The catalyst for the VVPA was the opening of the I-395 HOV lanes. Since the late 1970's the VVPA has worked behind the scenes supporting the creation of vanpools, ridesharing offices, insurance programs, park-and-ride lots, and HOV lanes. The VVPA offers maintenance, safety, operational, and matching services for its members through newsletters and periodic meetings.

The nearly 500 vanpools on the I-395 HOV lanes -- about 10% of the commuters in the corridor -- represents the best market penetration of vanpools in the nation. In addition, approximately 18% of all central business district (CBD) bound work trips from Prince William County, which is served by both the I-95 and I-66 HOV lanes, utilize vanpools.

I would like to make a few points concerning driver owned and operated vanpools. First, operators receive no subsidy or significant financial assistance from their employers or local government, yet fares are some of the lowest among the various commute modes. Second, even when drivers change jobs or leave the area, another driver usually emerges from the vanpool network. Thus, vanpools often continue to operate over relatively long periods of time. Third, the emergence of the part-time vanpool entrepreneur is a key component in the success of the Northern Virginia vanpool market. Some of the individuals own up to 40 vans. Last, to maximize carpool and vanpool expansion, states should consider fully deregulating all commuter driven vehicles carrying up to 15 people as Congress did in 1978.

I feel that permitting carpools and vanpools to make a profit, rather than simply share expenses, is a major key to

reducing traffic congestion. Surveys, such as those conducted by the Department of Energy in 1979 and 1980, have indicated that individuals would be much more interested in carpooling and vanpooling if they could make money from organizing and operating the pool.

There are a number of actions that could be taken to encourage vanpooling. These include low cost aids for vanpool formation such as, 100% financing from banks and credit unions, reasonably priced and readily available insurance, and start-up assistance. When a driver buys a van, there exists a level of commitment to vanpooling not found with third party vanpooling or employer-sponsored vanpools. Other vanpool aids that should be considered include additional park-and-ride lots, drop-off and pick-up areas at employment centers, readily available access to parking garages, which requires minimum height clearance, and access to parking when a vanpool forms.

A 1986 survey of vanpool riders and drivers, conducted by VVPA, showed a high level of satisfaction among riders. It also identified the importance of HOV lanes to the success of vanpools. Highlights from the survey included the following:

- 94% considered vanpools more convenient than their previous mode
- 99% of vanpoolers intend to continue vanpooling
- 59% said HOV lanes were a major factor in deciding to vanpool
- 49% found the door-to-door travel time faster than their prior mode, while 24% found vanpooling slower
- 58% said vanpool fares were less than their previous mode, while 15% noted that vanpool fares were more expensive

- 40% were former single occupant auto users, 42% were former carpoolers, and the balance used transit

In 1989, the Metropolitan Washington Council of Governments conducted a survey of vanpool drivers in the Washington metro area. This survey indicated that nearly 60% of the metro area vanpool drivers identified the need for more HOV lanes as their primary concern. Other issues raised included parking, insurance, costs, and maintaining riders.

Thus, it appears that the HOV lanes have had a significant impact on the use of vanpools. Without the HOV lanes, vanpooling on I-395 would never have grown from 70 vanpools in 1978 to nearly 500 by 1981, where they have stabilized.

I would like to suggest a number of ideas for expanding the use of HOV facilities. First, interim HOV lanes could be added quickly and at a relatively low cost to many facilities by using shoulders. Second, it may be appropriate to require the use of HOV lanes after a facility reaches 6 to 8 lanes or to require that the last lanes added be HOV lanes. Further, ensuring that the HOV lanes will maintain a relatively free flow condition, through changing the occupancy requirement when necessary, and providing adequate enforcement, is important. Last, using HOV facilities to assist with incident management should be provided.

I think one of the main obstacles to reducing commuter traffic congestion, air pollution, and energy consumption is the free or low cost parking that is provided in many areas. I think that to "level the playing field" on free parking, Congress should either tax employers providing free

parking where the market value exceeds \$50 per month or allow the employer to provide a tax free transportation allowance for all employees equal to or less than the market value of parking. The objective in either case would be to charge market rates for parking. This provision would allow commuters to decide if it is in their best interest to pay market rates for parking and drive alone or to carpool, vanpool, or ride transit.

Several studies have indicated that drive-alone commuting would be reduced by 20% or more if drivers had to pay their own parking. A recent report summarizing existing studies on the relationship between free parking and commuting identified that free parking greatly increases solo driving and many solo drivers shift to carpools, vanpools, and transit when they must pay for parking. The case studies reviewed indicated that eliminating parking subsidies has a dramatic effect on the commute mode split. Four examples from the Los Angeles area and one from Ottawa identified higher vehicle occupancy rates and a decrease in driving alone when employees were responsible for paying for parking.

I think the expanded use of HOV lanes is a critical component to solving many of the existing traffic problems. However, to achieve the maximum reduction in traffic congestion, air pollution, and energy consumption, HOV lanes must be complemented by changes in policies relating to paid parking, deregulation of carpools and vanpools, and zoning changes. I think genuine transportation systems management, including HOV lane systems, is a key to reducing commuter traffic congestion within the next few years and providing for our Nation's future growth.

Enforcement Activities in Northern Virginia

David Tollett



*Captain
Virginia State Police*

I would like to briefly review the types of HOV facilities we have in northern Virginia and talk a little about enforcement activities on each. The first facility is the I-95 HOV lane. The inside lane operates as an HOV lane in the peak-direction during the peak-period. A 3+ occupancy requirement is used on the lane. At the time the HOV lane was implemented, the outside shoulder was also reinforced and it is used as an active conventional lane during peak-period. This provides a total of 3 general purpose lanes and one HOV lane during the peak-period in the peak-direction. The shoulder lanes are closed to general traffic during the non-restrictive periods and function as emergency shoulders. However, it has been difficult to communicate this to drivers and there is some abuse of the restrictions.

I-395, or the Shirley Highway, includes two barrier separated reversible HOV lanes located in the median of the freeway. A 3+ occupancy requirement is also used on this facility. The I-395 HOV lanes have shoulders on both sides, making enforcement easier.

I-66 is the last HOV facility in the area. A 10-mile segment of I-66 is reserved for HOVs during the peak-hour in the peak-direction. This provides a two-lane exclusive HOV facility. A 3+ occupancy requirement is used. There is an exemption from this restriction for traffic going to and from Dulles Airport. This exception does cause some problems from an enforcement perspective.

I-95 was opened in the northbound direction in 1985 and in the southbound direction in 1986. At first, a 4+ vehicle occupancy requirement was used, but in 1989 this was lowered to 3+. The diamond lanes will continue to operate until 1994 or 1995 when the extension of reversible lanes to Woodbridge is complete. The HOV restricted periods are from 6:00 a.m. to 9:00 a.m. in the morning, northbound, direction, and 3:30 p.m. to 6:00 p.m. in the afternoon, southbound, direction. During the morning peak-hour, from 6:30 a.m. to 7:30 a.m., the violation rate in the diamond lane is about 24%. During the peak-period the violation rate is 46%. Both of these levels are unacceptable. The problem along most of the diamond lane length is that there is no room for enforcement activities. There are only a few spots with adequate room to pull violators over.

I-395 was initially opened to buses in 1969. Carpools and vanpools, with 4+ occupants, were allowed in 1973. The traffic management system was added in 1985. In 1989, the vehicle occupancy level

was lowered from 4+ to 3+. The HOV restricted period is from 6:00 a.m. to 9:00 a.m. northbound, and 3:30 p.m. to 6:00 p.m., southbound. The violation rate during the peak-hour, from 6:45 a.m. to 7:45 a.m., is approximately 6 percent. During the peak-period the violation rate is around 17 percent. The difference in violation rates between the diamond lanes and the barrier separated lanes is very noticeable. This is due to both the barrier separation and the shoulders which provide space for enforcement activities. The shoulders also provide space for disabled vehicles and incident management activities.

I-66 was initially open to HOV traffic in 1982. The Dulles connector road was open in 1983. The traffic management system was implemented in 1985. The vehicle occupancy requirements were lowered from 4+ to 3+ in 1986. The HOV operating hours are 6:30 a.m. to 9:00 a.m. eastbound, and 4:00 p.m. to 6:00 p.m. westbound. During the peak-hour, from 7:00 a.m. to 8:00 a.m., the violation rates average about 38 percent. In the peak-period this increases to 52 percent. However, some of these vehicle may be exceptions going to Dulles Airport. The problem is that there is no easy way to measure what percent of the violators these may be. Dulles must be the busiest airport in the world, because it seems that all the single occupant vehicles are going to or from there. There are good enforcement areas on I-66, so this is not a problem.

Northern Virginia implemented a HERO program in 1989, modeled after the program in Seattle. Signs are located along the facilities encouraging motorists to call a toll free number to report violators of the HOV requirements. We were overwhelmed at the beginning with the response we received. During the first seven months, the

response was very high. When a call is received, an initial informational letter and brochure is sent to the owner of the vehicle reported to be in violation of the HOV occupancy requirements. The attempt here is to inform the individual about the purpose and requirements of the lanes, and the types of transit and rideshare services available in the area. Since we do have a large number of visitors and new arrivals in the area, we feel this first educational step is very important. If the violator is reported a second time, a second letter is sent from the department. The wording of this letter, while still informational in nature, is a little stronger. The letter indicates that if the violations continue, the individuals name will be turned over to the state police for enforcement. The third letter comes from the state police indicating the vehicle has been placed on the enforcement list.

The results of the program indicate that it has been successful at lowering violation rates. During the first seven months of operation some 54,000 calls were received. Of this, 70 percent were on the I-95 diamond lanes, 3 percent were on the I-394 lanes, and 27 percent were on I-66. Seventy-six percent of the calls were on first time violators, with 21 percent second time violators, and only 3 percent were reported a third time. Thus, it seems that the program has reduced the number of repeat offenders. Of course, the HERO program is not the total answer to reducing violation on the HOV facilities. However, used in combination with other enforcement approaches it can have a positive influence on reducing HOV violation rates. We will continue to use the HERO program, with some modifications. Due to the Dulles airport exemption on I-66, the HERO signs have been removed from that facility. We found we were receiving a large number of calls on vehicles who owners claimed they

were going to or from the airport. The signs were relocated to the ramps where we have enforcement and beyond the Dulles connector road.

The other recent enforcement program implemented in northern Virginia is the ticket by mail program. This program has enabled the state police to ticket in areas that we were unable to before. Last year, legislation was passed allowing a change in the ticketing process. This change allows a police officer to ticket by mail for an HOV violation. It made the violation a traffic infraction, and thus no points toward revocation of the drivers license are assessed. There is a \$70 fine; a \$50 fine and \$20 court cost, associated with the violation that the registered owner of the vehicle is responsible for. However, the ticket is rebuttable if the registered owner wishes to appear in court and testify under oath that they were not operating the vehicle.

The ticket by mail program has increased by 4 or 5 times the number of tickets one officer can issue. The program has not been without problems, however. We feel most of these can be addressed and we feel the program has resulted in a number of benefits. The violation rates have been reduced, traffic flow is not interrupted as much as it is with normal enforcement methods, and the safety of the police officer and the motorist are enhanced. These are all important points. In addition, few violators are actually going to court to fight the tickets. Initially, all violators were required to appear in court. This was changed so that now only individuals wishing to fight the ticket have to appear in court. Approximately 80 percent of all observed violators are mailed tickets. Some vehicles, such as rental cars, some out-of-state vehicles, and company owned vehicles

are not sent tickets. Officers are also now momentarily stopping the vehicles to obtain the drivers license or social security number to ensure that the proper individual receives the ticket. The ticket is then sent by mail to this individual. Even stopping the vehicle to obtain this information is much shorter than the 15 minutes or so it normally takes to issue a citation. However, there are limited areas to pull vehicles over on some of the facilities, restricting this method.

We continue to look at additional ways to improve all of these programs. A recent evaluation within the agency recommended continuing the ticket by mail program and expanding its capabilities through automation. I do not think we were prepared for the large volume of summons the program has generated. To make it more effective, a consistent ongoing program is needed. Automation of the whole system would greatly improve its efficiency, especially in terms of writing the tickets and mailing the letters.

In conclusion, I would like to stress the importance of enforcement activities to making HOV facilities work successfully. Enforcement needs to be considered in the planning and design of HOV lanes, and in the operation of the completed facilities. The recent experience in northern Virginia with the HERO and ticket by mail programs seems to indicate that these types of approaches can reduce violation rates and generate public awareness and support for the HOV facilities.

**PLENARY SESSION: IMPLICATIONS
OF LEGISLATIVE AND
POLICY DEVELOPMENTS FOR THE
HOV SYSTEM**

Opening Comments

Lester Lamm



*President
Highway Users Federation*

Good morning. It is a pleasure for me to act as moderator for this plenary session, as I have been involved with different aspects of HOV facilities from the early days. I believe in the HOV concept and I hope the panel session this morning will provide a good deal of information on the different perspectives related to HOV facilities. I would like to make a few opening remarks concerning my thoughts on the subject and provide you with some information on the Highway Users Federation.

As I mentioned, I believe in the concept of HOV facilities and I think it is a concept whose time has come. HOV

facilities are in use in many areas. I think HOV facilities often represent the best public policy. Obviously, one of the key elements is financing the development of HOV facilities. I think this is a very appropriate and timely question given the uncertainty of the direction future federal highway and transit programs may take. As you are aware, the federal highway and transit programs are due to expire next year. The comments from many of our panelists this morning may give us some insights into what we might expect during the reauthorization process. In turn, I think it is important for people who are working on the legislation to know what the professionals in the industry are thinking. The real issue for all of us is ensuring the best use of public funds. As we all are so well aware, transportation demands far outweigh available funding. Establishing priorities and determining the most effective financing mechanisms will be a major challenge.

The Highway Users Federation has identified what we feel represents a logical 9 point highway and transit program for the future. Without going into the program in detail, the Federation believes that one of the greatest unmet needs relates to the growth in urban and suburban traffic congestion. We believe that any continued federal activity in transportation should include more assistance to state and local governments in relieving urban and suburban traffic congestion. In fact, our program recommends a significant increase in funding for both highway and transit programs. Under our concept, 4 billion dollars would be available from the trust fund for use in a flexible manner. Funding would flow through the states to the urban areas and would be available for congestion relief programs determined appropriate by the state and local governments. This would

allow for greater flexibility in the use of funds for a variety of projects.

As I mentioned, the important thing is that we are at a turning point in terms of federal funding levels and programs. I hope everyone of you will give some consideration to the level of funding and approach you would like to see included in the reauthorization. I would further encourage you to work with your Congressional delegation and with the different groups and committees to promote the approach you favor.

I would also like to suggest two points for consideration at future conferences on this topic. First, in relation to the financing issue, I think there is an appropriate role for the private sector to play. I think traffic congestion is a national problem that effects private industry very significantly. The people that suffer from traffic congestion include employees, employers, businesses and the economic activities of communities. When people are stalled in traffic it means that some kind of desired economic activity is not taking place. I think we would be well advised to involve the private sector as early as possible in the development of HOV facilities. Including them in conferences of this type might be one way to start this process.

The second point I would like to make relates to the application of advanced technologies to HOV facilities. We are now experiencing the rapid development of advanced technologies in a number of different areas, including both vehicle and communication technologies. Terms like "smart vehicles", "smart highways", and Intelligent Vehicle Highway Systems (IVHS) are being used to describe these systems. I think that technology is going to be an even

greater help to us in the future than it has been in the past. HOV facilities represent a real potential for the application of much of this technology. I would encourage you to become actively involved in these activities.

The panel members you will be hearing from cover the national, both administrative and legislative, and state perspectives. This will provide valuable insight into what is currently going on in each of these areas and what we can expect in the future.

Federal Highway
Administration Perspective

Steve Lockwood



*Associate Administrator of Policy
Federal Highway Administration*

Thank you. It is a pleasure to be asked to speak at this conference and to appear with my counterpart from the Urban Mass Transportation Administration. The level and nature of the conference attendance underlines the approach that the department is taking these days to issues such as urban mobility and congestion. Looking back at the first three HOV conferences it appears that the high level of interest and enthusiasm has continued through to this conference. If the attendance at this conference is any indication, it appears that the interest in HOV facilities continues to be strong.

I also look forward to addressing this particular group because I think the attendance reflects a fairly unique cross-section of interests and fields. It is

especially nice to see the mix of transit and highway interests, in addition to the mix of federal, state, and local interests and private sector representatives. It is fairly unusual that a transportation conference brings together this unique array of interests. I hope this interest continues in the future. As Gene McCormick indicated in his comments yesterday, it is this kind of new scenergisim among a range of perspectives and programs that is one of the main elements of the new National Transportation Policy.

This morning I would like to provide a little more detail on the highway elements of the National Transportation Policy. The National Transportation Policy sets the framework within which new legislation will be developed for the aviation, highway, and transit programs. Legislation for these components will consider new programs, as well as the funding sources to support them. It is our intention at the Department that the reauthorization program will provide a new structure and set of programs that are appropriate to the post-Interstate years. It is important to note that the essential elements of the program under development represent a broad consensus among the transportation community, and not just the thinking of transportation bureaucrats in Washington.

I would like to outline the key elements of our thinking at the department and note those aspects of the emerging program that relate most closely to HOV facilities. Underlying the highway program are several key features that the department feels are essential elements to restructuring the future highway program. The first, and probably most important one, is to focus federal investments on those aspects of the highway program that are of key national interest. These include the preservation of the enormous investment in the physical

facilities that have been made over the past several years, the management of congestion, the provision of new capacity, and a more focused program to simplify and consolidate the complex array of existing programs.

In addition, we want to provide flexibility in funding programs at the state and local level, along with the appropriate accountability. The department is also examining the possibility of expanding the funding eligibility among and between the different highway and transit programs. There is also a clear recognition on the part of most groups that we need to encourage greater private sector participation in both the development and financing of transportation projects. In addition, the expanded use of user fees will play an important role, as will the improvement of the transportation planning and decision making process at the federal, state, regional, and local levels.

A strong commitment to safety will be included in the reauthorization. The National Transportation Policy also contains a strong concern for the environment. In many areas there is limited right-of-way available for new or expanded facilities. It is no secret that our concern with air quality may be one of the driving forces shaping our transportation programs over the next few years. This includes a recognition of the importance of flexible transportation programs. HOV facilities offer many advantages from an energy and air quality standpoint.

The department is also concerned with regaining the country's leadership position in research and development. The increasing focus on new technologies can be linked to HOV facilities.

With these general principles in mind, the idea of restructuring the federal highway program into three major programs is being examined. These are; a national highway system program, an urban/rural program, and a bridge program. These major programs could combined with smaller supplementary programs focusing on such areas as air quality, rural development, and research and technology.

The program for highways of national significance recognizes the strong federal interest in an overall highway system of national significance. Such a system could consist of not only the existing Interstate system, but a substantial component of the current primary system. It is envisioned that the system would focus on the high performance, high capacity component of the highway system. Such a system would be designated by the states, working closely with the local governments and regional organizations, and would ultimately be approved by the Secretary of Transportation. There would be a high level of federal financing for system, as it is considered essential to the federal interest. Along with this relatively high federal share goes a high degree of accountability from the states for making sure that the physical and operating integrity of the system is preserved.

Consideration is also being given to introducing a management program for pavement, bridges, and for safety aspects of the system. In addition, a congestion management plan may be a requirement. Such a plan would identify the priorities and strategies to be used to preserve an adequate level of service on the national highway system.

To cope with constrained metropolitan corridors, consideration is

being given to the provision of funding for capital improvements on parallel facilities, where it can be clearly demonstrated that these facilities will have an impact on improving the level of service on the national highway system itself. A high federal match for operational improvements on freeways is also part of our approach. HOV facilities would certainly be eligible for this type of funding. This could provide a very important level of funding for HOV projects.

The urban/rural program would essentially collapse the categorical programs that are now a part of the primary, federal-aid urban, and the rural secondary systems into a more flexible and streamlined grant program. Some of you may be familiar with the Combined Road Program, which is essentially an experiment on the part of several states and the Department, to reduce federal requirements, oversight, review, and inspection, and to provide increased flexibility at the state level. This is the type of approach we are considering, oriented toward providing the flexibility that is needed in some states to allow local governments to custom tailor highway and roadway improvements to match specific problems, without being hampered by the requirements that go along with the traditional programs. The urban/rural program could also be expanded to include transit capital costs. Again, HOV facilities may be eligible for funding under this program.

Expansion of the existing revolving fund to include advanced acquisition of right-of-way may also be an eligible expense under the urban/rural program. This concept recognizes the scarcity of rights-of-way in many metropolitan areas and the potential opportunities to take advantage of rail abandonments or other available

property. It may be appropriate to purchase this right-of-way now, for later use or for alternatives such as HOV facilities. Substantial funding levels may be provided for this program.

The third element of the overall program is the bridge program, which represents an essential element of the transportation system. A targeted program is needed to address the very substantial bridge deterioration problem.

Air quality issues need to be addressed in many metropolitan areas, especially those designated as non-attainment areas. We want to encourage innovation approaches to addressing these concerns. Obviously, HOV facilities can play a major role in addressing some of these concerns.

On the planning level, we are talking about strengthening the metropolitan planning and programming process in a variety of ways. Reducing the requirements for smaller urban areas may be one way. Relaxing requirements in those areas under 200,000 in population, where a less formal process may make more sense, is one approach. In larger metropolitan areas, there are a number of ways to strengthen the planning process to encourage cost-effective transportation improvements, including HOV facilities. One element may be some type of congestion management requirement, as part of the Section 134 process. This would provide a parallel requirement to the one discussed earlier in conjunction with the national highway system. Under this program, MPO's would be required to develop congestion management plans for the metropolitan area, including all highway and transit components.

Overall we are working towards a greater degree of parallelism between the

highway and transit requirements and programs. A consistent process between UMTA and FHWA for cost-effectiveness analysis of high cost capital improvements would be an important improvement. Increasing the level of funding for such analysis may be possible. Making improvements to the planning process is important, as the information that results from the process is a key factor in the decision making process. HOV facilities need to be given more careful consideration in many areas and applications.

We also need to carefully consider the role of the private sector, especially in relation to transportation demand management programs and HOV facilities. The planning process can be improved to provide greater opportunities for private sector involvement.

Regaining our national leadership in the research and technology area is essential to a strong transportation program. I think we will see substantially increased levels of activity in this area. This may include the establishment of a separate stand-alone, multi-year program based on a very strong public/private sector partnership. Such a research program could have a series of elements relating the more traditional areas of highway construction, materials, and motor carriers. However, the centerpiece will focus on the application of intelligent-vehicle highway systems (IVHS) technologies. Many of these applications are directly related to HOV facilities. Potential application may include in-vehicle guidance systems, traffic and management systems, and pre-trip travel information. These types of approaches present some very exciting opportunities and I hope at the next HOV conference these types of applications will be discussed in more detail.

In closing, I would like to touch briefly on the funding picture. We are committed to continued reliance to user fees as the core of funding for the federal program and look forward to an extension of the highway trust fund as a major vehicle for funding the federal aid program in the future. We are also committed to a higher level of investment from all levels of government; federal, state, local, and the private sector. Examining possible increases in user fees will be explored, along with other potential funding sources. The further use of toll facilities may be one example of this.

All of these elements will be discussed further as the program moves forward this year. It will be an exciting time to be involved in the development of the new policy.

Urban Mass Transportation
Administration Perspective

John Cline



*Associate Administrator for Policy
Urban Mass Transportation Administration*

It is a pleasure to be here this morning, especially with my counterpart from FHWA and the other panel members. It is important to note that this is a very critical time for transportation in America. The new National Transportation Policy, which had been under development in the Department of Transportation over the past year, was unveiled by the President just a little over a month ago. In the months ahead this dynamic new policy will become a corner stone of the Administrations over all quest for a better and stronger America, was unveiled by the President just a little over a month ago.

The National Transportation Policy allows us to reflect and take a step back from the immediate concerns of this years budget and next years program. The

National Transportation Policy addresses such questions as "what should the federal role be in transportation," "where should decision making powers reside," and "which hidden subsidies are making it difficult to reach sensible transportation decisions at the local level". While previous effects to develop national transportation policies have not been remembered for their lasting effects, I think this policy may be different. The policy will have a major influence on the highway and transit reauthorization programs submitted by the Administration. The spirit of the National Transportation Policy will be reflected in these legislative proposals. It is logical to ask how this policy will be reflected in the legislative proposals.

I think of the key elements you will see reflected from the policy document is intermodalism. During the outreach phase of the National Transportation Policy last summer, this was a key concept that people kept stressing at the hearings. Both the Transit 2000 report from the American Public Transit Association, as well as Project 2020 from the American Association of State Highway and Transportation Officials, recognized early and clearly that the notion of federal transportation assistance delivered through totally separate and modally distinct program categories has outlived its usefulness.

I would suggest that the Interstate transfer program may be a precursor of the types of programs we will see in the future. It was a categorical and distinct effort that built the national Interstate system. However, in 1974 a compromise was introduced that allowed a limited number of local areas, under certain conditions, to not only stop freeway construction, but to keep the funding for these facilities for use on other transportation projects. Central

federal planning went eyeball-to-eyeball with local decisions, and central federal planning blinked. Someday, someone will put together the full history of the federal Interstate highway system. This would have to include to role President Eisenhower, played, the magnificent engineering achievements, the close federal-state cooperation, and most noticeable, the way it has changed the face of our country. However, there will also have to be a very important chapter on how urban consciousness arose midway through the construction phase of the interstate system and quite literally stopped several segments. For example, there is no inner beltway in Boston today, you can't take the Embarcadero freeway to Fisherman Wharf in San Francisco, and I-95 does not cut through residential neighborhoods in northeast Washington, D.C. These represent examples of intermodalism. It suggests that while there is a federal interest at a broad level of policy and strategy, local decision makers know the territory better than anyone in Washington, D.C. possibly can. It suggests that what the federal government does best is provide resources and what the local areas do best is make the final decision on how best to use those resources.

The reauthorization proposal that the department will soon submit to Congress, will call for a good deal of this type of intermodalism. I think it will suggest that in several of the basic programs, the resources should be made available to the local areas for their determination of what it should be spent on. This is one way to get away from the separation of highway and transit funding programs and the feeling in many areas that the most important thing is to get as much of both as possible. HOV facilities may be one of the best examples to cite for demonstrating that solving the transportation

problem is truly the real issue, not securing the maximum amount of federal dollars. HOV facilities are one of those good ideas that tended to get lost between the strict modal distinctions of competing interests, in this case obviously highways and transit. Why build a simple HOV lane if you can qualify for a light rail line under the UMTA program? Why include HOV lanes in a highway widening project if you can get UMTA to fund them at a later date? I can not think of any category of major investments whos cause will be strengthened more in the forthcoming reauthorization project than HOV lanes. There will be no more modal gamesmanship.

Intermodalism, as critical as it is, will only be one of the major National Transportation Policy themes however, that will be included in the reauthorization proposal. You will be hearing more about the other aspects of the reauthorization program in the months ahead.

Congressional Perspective

Ken House



*Staff
U.S. House of Representatives
Surface Transportation Subcommittee*

I want to thank you for the opportunity to meet with you. When the invitation was first extended I gave a good deal of thought to what I might say about HOV lanes. When I thought about what Congress has done about HOV lanes, the trepidation really began to grow. Just in the Washington, D.C. area alone, the federal government has mandated operation hours and vehicle occupancy requirements. I thought this might not bode to well, as these are decisions we always say should be made at the local level.

This may indicate we need to change our approach as we move forward with reauthorization of the highway and transit bills. I think that this is a positive reaction. When members of Congress react to these types of things it is often a local response.

When Congressmen have to get to and from work they don't look at these issues as national issues, rather they look at them as local concerns that affect them on a daily basis. Maybe this indicates a common theme that there is strong interest in making these decisions at the local level. Unfortunately, being here in the beltway area, you have Congress, along with the local government representatives, to help you make these decisions. So, we will continue to be a partner.

I would like to give you a brief overview of some of the recent activities in the House Public Works Committee. As we establish the agenda for the upcoming legislation, the Public Works Committee will primarily focus on hearings. The new Sub-committee Chairman's approach is to have an open agenda. I think it is important that the Committee is willing to listen to different points of view. This is the first time in many years that the chairman has not started with some preconceived ideas on the final program. In following this approach, we have already had several days of hearings here in Washington, D.C.

Five hearings have been held so far. The Secretary of Transportation presented the new National Transportation Policy at the first hearing. Hearings have continued throughout the month of March. Once we conclude the hearings in Washington, D.C., probably in April, a series of field hearings will be held throughout the country. The sites of these hearings have not yet been decided, other than we will both probably start in California, the home state of both the Sub-committee and Committee Chairmen.

I think this whole session will focus primarily on the hearings. Then during the winter, the staff will begin to identify the

common themes that emerge from the hearings. The initial draft proposals will be developed at this time. The proposals from FHWA and UMTA will be submitted. A draft bill will be circulated for comment and the official hearing process will begin.

As this outline indicates we certainly have a lot of work ahead of us. For the next 19 months the focus will be on the development of the highway and transit program in the post-interstate period. We would welcome any assistance from you. When the Interstate program was first established there was a lot of input from everyone. Over the last 35 years this has been the major focus of the program. Now we are in a new era.

A number of groups have been very active in the identification of issues to be considered in the new program. These include AASHTO, APTA, and other groups. In the highway program there seems to be a common theme emerging that there should be two broad categories; highways of national significance and a flexible program. While there may be general agreement on some of these broad topics, working out the specific details of each program will take a good deal of work. The process will provide the opportunity to discuss and resolve these issues and develop a program that most of us can feel comfortable with.

I think providing flexibility to local areas in the use of funding for highway or transit programs that best meet their needs is important. In the past, mass transportation and highways have been viewed as two separate issues. I think the 1978 Surface Transportation Act represented the first attempt to try to coordinate the timing of the highway and transit reauthorization programs. We now have the opportunity to mesh the two programs even further, and

make them work together. We also have the opportunity to increase the decision making authority of local governments.

One of the tough questions to be faced during the reauthorization is who will pay for the different programs. Determining the mix and match of general funds and highway trust fund dollars will be a challenge. Determining what, if any, formula base should be used to allocate the funds will also be important. Consideration will need to be given to who will make the final decision if there is disagreement at the local level. The two major themes we are hearing are increased funding and flexibility. There is a good deal of support for raising funding levels, but to-date there has been no success at trying to draw down the highway trust fund. We have not heard strong support for increasing the gasoline tax, unless there is a serious and dedicated effort to spend down the trust fund level. So one message appears to be that we need to spend the money we have, and if we can show a continued effort, then maybe increasing taxes can be considered. I don't think you will see any support for gasoline tax increases unless there is a serious effort to spend down the trust fund balance.

The other common theme we have heard is flexibility. Many members of Congress get a little nervous when this term is used. The reason for this nervousness is related to the issue of accountability. I think we will need to show congress that flexibility does work and there are numerous benefits from a more flexible approach.

HOV facilities have been considered a local issue, that, for the most part, Congress has not been involved with. The federal perspective has been that the types of facilities needed to meet the demands should be determined at the local level. The

UMTA Alternatives Analysis includes considerations of these types of facilities. It may be that the FHWA process should also include an examination of such options. The clean air legislation is driving a reexamination of how we address our growing congestion problems. HOV facilities clearly have a role to play in this area. Clearly, just building more highways is not the answer. We need to look at how to move more people more efficiently.

Planning and coordination are clearly part of the answer to many of our problems. We must first show what the problems and needs are and then identify the most cost-effective solutions. It must be a continued and cooperative effort at the local level to show that the local governments have the resources, are accountable, and can make work the programs work.

State Perspective

Ruth Fisher



*Representative
Washington State Legislature*

Seattle, and the surrounding Puget Sound area, continues to experience rapid economic growth and population increases. This translates into increasing congestion on our roadway system. HOV lanes were first implemented in the Seattle area in the late 1970's and early 1980's. The lanes are now a central part of the area's transportation system. Currently only about a quarter of the planned system has been completed.

Much of the early development of HOV lanes grew out of concerns related to expanding freeway facilities in many parts of our community. While many freeways were stopped, the population and economic development boom continued. The good news out of this is that we have economic growth, but the bad news is that we have grid-lock. HOV facilities are an innovative, energy efficient, cost-effective, and

environmentally sound way of maximizing the capacity of freeways.

HOV facilities in the Seattle area include those on SR 520, I-5, I-405, and I-90. Today there are some 41 lane miles of HOV lanes in operation, and plans for an additional 114 lane miles. This would result in a total of 156 lane miles of HOV facilities. In addition, many local jurisdictions have plans for HOV lanes. However, just adding HOV lanes to the highway system is not enough. The HOV facilities in Seattle are part of an overall transportation management plan called the FLOW system. The major elements of this system are:

- HOV lanes
- Park-and-ride facilities
- Express bus service
- Surveillance, control and driver information system
- Carpool and vanpool programs
- Arterial sign control system
- Reversible roadway system
- Tow truck operations

These elements are either currently in operation or soon will be. However, all of these physical facilities, or hardware, as they are sometimes referred to in the Seattle area, work only if people use them. Additional efforts are needed to encourage usage. The HOV system "software" includes activities such as public and private ride-matching and vanpool programs, target marketing, rideshare programs, city ordinances that control parking provisions or mandate other HOV incentives, the guaranteed ride home program, a monitoring and information gathering processes that allows us to evaluate the system, employer funded HOV incentives, and the HERO program, which is designed to allow motorists to report HOV lane violators.

A few examples indicate the success of many of these program elements. On SR 520, the HOV lane carries 42% of the people and in only 7% of the vehicles during the morning peak-hour. On the I-5 HOV lane, carpoolers can travel twice as fast as the single driver travelling in the adjacent freeway lane. The HOV lanes also provide more reliable travel times. For example, in 1984, 25% of the office employees in the central business district rode the bus or carpooled or vanpooled to work. The city of Bellevue has enacted an ordinance requiring new development outside the central business district to establish transportation management programs, including such elements as a guaranteed ride home program. Recent results indicate that the Bellevue rideshare program has increased the number of employees using transit and carpooling from 17 percent to 42 percent over a 15 month period. The easy-ride program implemented in the I-90 and Bellevue areas has resulted in 183 new vanpoolers, 251 new carpoolers, and 197 individuals registering for the guaranteed ride home program. In addition, 43 percent of the daily home-based work trips to the Seattle central business district are by transit or carpool.

There are numerous plans for additional facilities and services in the Seattle area. The Council of Governments, Seattle Metro, and the Washington State Department of Transportation all have plans for additional HOV lanes and support services. To help fund these activities the Washington state legislature passed four critical pieces of legislation in 1990. First, the gas tax was increased from 18 cents per gallon to 23 cents per gallon. Second, truck weight fees were increased by 40 percent. Third, the state motor vehicle excise tax was increased. Last, legislation was passed

allowing for local option transportation taxes.



I-5, Seattle

In addition, a major high capacity transportation bill was passed that is referred to by its number-1825. Representative Dick Nelson, who is also attending this conference, and I were responsible for this bill. It addresses rail freight, high capacity system development, and AMTRAK facilities, as well as HOV lane development. The bill allows counties to impose local taxes to assist in the development and construction of HOV facilities. The bill provides for the use of an employer tax up to \$2.00 per employee per month and other funding mechanisms that require voter approval. In addition, cities that operate transit systems, county transportation authorities, metropolitan municipal cooperations, and public transit benefit areas may submit up to a 1% sales tax to the voters.

Thus, funding options are now available to accelerate the development of HOV lanes, park-and-ride lots, and other support facilities. However, to be successful, we believe a partnership among federal, state, and local authorities is needed. Now is not time for the federal

government to withdraw financial support. A continued joint effort from state and federal transportation agencies, local jurisdiction, and the private sector is needed to provide an environment conducive to HOV development. It was not an easy task to get these measures approved, as this is an election year in the state of Washington. All of the House is up for re-election, along with half of the senate. It is never easy to pass tax bills and run for re-election at the same time. The two houses are also split politically, with the democrats controlling the House and the republicans controlling the senate. The Chairman of the Senate Transportation Committee is a republican from eastern Washington. He was concerned with the roads in the eastern part of the state, while I was interested in the high capacity bill. We both got what we wanted. I voted for his taxes and he voted to get the high capacity bill through.

The legislature also passed a growth management bill this year. The bill ties land use to capital improvements and transportation. It is an approach that has not been really tried before. Overall, I think transportation did very well this session in the state of Washington and I was proud to be a part of the effort.

LUNCHEON SPEECH

What the 1990 Census Will Tell Us About Commuting in America

Alan E. Pisarski



Consultant

This is an aptly timed conference, given that most of us have just returned our 1990 Census forms to Suitland, Maryland. Although a few of us may still have forms residing on our coffee tables at home, making us feel guilty.

Those of you who received the long form know that it includes questions that will be the major source of information on the commuting characteristics of the American work trip. The data will include workplace address, mode of transportation to work, time of departure for work, and travel time to work, in addition to the usual extensive census data on the demographic characteristics of the population.

I received the long form to fill out. It seems like I always receive the long form. The Bureau of the Census insists that it sends the long form to a statistically controlled random sample of roughly one person in 7, but I suspect that the Bureau has a "hit list" and that I am on it .

In a year and a half we will have a report on the status of commuting in America this week. It was a good week for reporting, with no major storms, hurricanes, earthquakes, or other natural catastrophes. I thought it would be useful to spend a little time today pondering what the data will tell us about the state of commuting in America. The following then are my thoughts on what the census will tell us about ourselves. Some of these predictions are more certain than others, some are very much open to conjecture.

First, we know that the population of the United State has increased by approximately 10% since 1980. This translates into a population base of some 250 million people, compared with 226 million in 1980. Second, it appears that employment levels are close to 120 million, reflecting a 25% increase from 1980 levels. This means that about 48% of the population is employed, up from 42% in 1980.

This increase in employment translates into approximately 24 million new workers and commuters in the decade of the 1980's. Some 9 million of these new workers resulted from the increases in population, while 15 million are the result of changing characteristics of the population. Approximately 60% of the new workers are women.

Lets look more closely at the commuting characteristics of these workers. Probably 3 million, or 2.5%, work at home,

while some 4 million, or 3.3%, walk to work. This means that there are probably between 6 and 8 million workers who do not use some type of vehicle to get to and from work. This leaves 114 million commuters, or a 27% to 29% increase from 1980, that do use some type of vehicle for their daily commute.

Of this group, I would guess that no more than about 5%, or some 6 million, use transit on a regular basis. This is probably about the same number as in 1980. Subtracting these transit users leaves between 106 and 108 million people who use their automobile as their primary commute mode. This represents a 30% or 35% increase over 1980 levels. If the trends identified in the 1985 American Housing Survey are correct, there also appears to have been a shift away from carpooling and vanpooling to driving alone. All of these trends translate into an almost 50% increase in the use of single occupant vehicles since 1980, with the absolute number of transit and rideshare users holding about the same.

Looking at the geographical distribution of these new commuting trips, it appears the largest gains will be in suburban areas, especially in cities in the south and west. However, it appears that even northeastern cities experiencing little or no overall growth will experience increased levels of automobile commuting in suburban areas.

While the census data do not directly measure trip length, it is my guess that we may see shorter trip lengths, as suburb-to-suburb commute trips are substituted for suburb-to-central city trips. However, this could be overwhelmed by the general centrifugal effects acting on metropolitan travel patterns. This could lead to one of

the strangest changes; that of slightly lower travel times than those in 1980. This may result from the change to faster modes, such as from transit to driving alone, and from a larger percent of suburban based trips, with corresponding greater speeds. These trends could counteract the overall slowing of travel times in each sector. However, it is important to note that the overall variation from 1980 to 1990 will probably be in the range of no more than 5%.

It appears that in this regard the country is slipping toward what could be referred to as the "black hole" of commuting; the use of the single occupant automobile for suburb-to-suburb trips. Commuter behavior appears to be shifting toward the shortest travel times and most convenient commute patterns.

The impact of some of these trends on the use of HOV facilities may not be good. The results from the 1985 American Housing Survey indicate that while the total automobile-oriented travel share grew only slightly, about 2.5 percentage points, from 1980 to 1985, the composition changed significantly. The percent of shared rides dropped from approximately 20% to 14%. This represents a drop in vehicle occupancy rates from roughly 1.15 in 1980, to 1.10 in 1985. It is difficult to believe that this pattern could have changed so quickly.

I have often noted to rideshare program enthusiasts how difficult it is to obtain even a small increase in vehicle occupancy rates, from 1.15 to 1.16. To see such a major drop in the other direction is astonishing. If these trends are not wrong it suggests that the total number of automobiles used for commuter trips grew from roughly 70 million to 100 million.

In summary, I think we will see the following trends emerge from the 1990 census data:

- A 10% increase in population
- A 25% increase in employment levels
- A corresponding 27% to 29% increase in the number of commuters
- A 42% increase in the use of automobiles as the primary commute mode
- A 50% increase in single occupant vehicle use for commuting

These trends reflect many of those previously identified in the report *Commuting in America*. Trends cited in that report included; the dramatic increase in commuters due to the baby boom generation reaching working age and the arrival of women workers in the labor force, the increase in automobile travel due to the increase in auto availability, the decline in transit and other shared-ride alternatives, and the shift to suburban job destinations.

Where will these trends take us in the future? Given the current situations it appears that some of these will be changing, while others will continue. A brief review of trends we may expect to see in the future include the following.

First, it appears that the boom in work force participation should be softening. The growth in the labor force has slowed and there may be more concern in the future about too few workers rather than too many. In addition, the rate of women entering the labor force will slow from the rates experienced during the 1970's and 1980's.

It appears that the shift to automobile commuting has about reached its maximum level; there is little left to change. The number of people working at home, walking to work or taking transit are close to their base levels. We are seeing some signs that the number of individuals working at home may finally begin to increase, as so often has been predicted.

A number of demographic factors have almost reached a saturation point. These include the possession of a drivers license among adults and the possession of automobiles. We have more automobiles than drivers today, indicating that most workers have access to an auto for work trips. The geographic shift of jobs and workers to suburban areas and southern and western cities will continue, but at a somewhat slower rate.

It appears that we have lived through a period of significant change; one that we failed to see coming. However, we should not assume that these rates of change are permanent and are the base for the future. In addition, there are some bright spots in these trends.

The shift in commuting patterns to the suburbs has improved the overall use of the roadway system. Instead of the diurnal flow pattern of the past, roads are being used in both directions. Trip lengths have declined as a result of the shift to more suburb-to-suburb based travel. In addition, we may have been worse off if all of the recent job growth had continued to occur in downtown areas, overburdening already overcrowded roadways. Finally, changes in job patterns and work hours have had an impact on spreading the traditional peak periods.

I think there are four major areas that will continue to face us in the future. First, many people view the current problems as unsolvable. To me our traffic problems are too important and too expensive not to solve. The problems we face are treatable and we must address them.

Second, I think many of the institutions we have relied on to address these problems have failed us, both in terms of failing to sense the trends and problems, and in stimulating adequate responses to address the changing needs. Third, we have still not learned how to operate efficient transit services in the low density, dispersed trip patterns of the suburbs. We need to continue to explore cost-effective suburban transit options. Fourth, we have to "tame" the automobile to make it useful and benign to both the overall society and each of us as individuals.

These problems are not insurmountable. Realistic, doable solutions do exist. Money is not really the issue. Rather, it is the public decision making process and public support that appear to be the lacking ingredients.

CLOSING SESSION

The Future of HOV Facilities

Donald Capelle



*Parsons Brinckerhoff Quade &
Douglas, Inc.
Chairman, TRB Committee on
HOV Systems*

I would like to take this opportunity to share with you some of my thoughts on the future of HOV facilities. I consider it an honor to be asked to make a few concluding comments to the HOV conference on a subject that I find of intense interest.

To start my comments I think it is appropriate to step back in time and take a look at where we have been, why we are where we are, and how we got here in the development of HOV facilities. As many of you are aware, the development of HOV facilities in this country dates back many years. However, most of this development has occurred in the last 20 years. I think by examining what has happened in the last 20

years we can get a better perspective on what is likely to happen over the next 5, 10, and even 20 years.

In the late 1960's and early 1970's, many people questioned whether HOV facilities would really work. Given these concerns, there was a great deal of uncertainty and anxiety over the development of HOV projects. However, it was clear at the time that we could not continue to operate our highway facilities in the same way that we had in the past, as most metropolitan areas were having a difficult time responding to the continuing dramatic increase in traffic and vehicle miles of travel. At the same time, the financial capabilities of many areas and the federal highway programs that had been used in the past to fund major capital improvements, were changing.

As a result, most metropolitan areas began to realize that building more highways to solve mobility and traffic congestion problems was not feasible. This resulted in the re-examination of alternative approaches to addressing traffic growth. HOV facilities emerged as one realistic approach to accommodating this growth. The emphasis turned to moving people rather than vehicles. Many of the early HOV projects were implemented as part of Transportation Systems Management (TSM) programs, and TSM became a major focus of transportation programs in many areas during the 1970's. High-occupancy vehicle facilities were an important component of many of these TSM programs. This was a major step in taking a different approach to addressing the traffic problems we were facing.

The projects initiated during the early 1970's have been referred to at other sessions throughout the conference this week. These included the Shirley Highway

HOV lanes in northern Virginia, the contraflow lane on the approach to the Lincoln Tunnel in New York City, and many other highly successful projects. The Lincoln Tunnel contraflow lane currently carries approximately 35,000 people or person trips during the morning peak hour. It has been estimated that maintaining the same level of service as this single contraflow lane provides would require some 20 new tunnels under the Hudson River. Thus, it is obvious that the contraflow lane does have a very significant impact on traffic flows in that corridor.

While the Lincoln Tunnel contraflow lane probably represents that high end of the person-carrying capacity of HOV facilities, there are many other examples of successful projects. The Shirley Highway HOV lanes, which many of us had the opportunity to tour this week, have added greatly to the person-carrying capacity of a very important freeway corridor. The Shirley Highway HOV facility carries as many people as some rail systems in our major metropolitan areas.

Another of the successful early projects was the El Monte or San Bernardino Freeway Busway in Los Angeles. Like the Shirley Highway HOV lanes, the El Monte Busway started as a bus-only facility. In 1976, two years after it first opened to buses, carpools were allowed on the facility, partly as a result of a strike by bus drivers. Initially, carpools with 3 or more occupants were required to obtain a permit to use the facility. The permit - only requirement was later dropped, and today the facility is open to buses, vanpools, and carpools with three or more occupants. The San Bernardino Freeway Busway is a good example of a very cost-effective method of moving people in a congested corridor.

There are many other examples of HOV facilities implemented during the 1970's, and the decade ended with a good deal of interest in HOV lanes in many parts of the country. However, there were still relatively few projects in operation at that time. The interest was there, but the number of operational projects was limited. One of the interesting aspects of the development of many of these early HOV projects was that transit agencies and highway agencies started to work together in partnership, sharing common goals. Transit and highway agencies began to realize that they shared the common objective of moving people not just vehicles. I consider this one of the greatest results of the HOV efforts during the 1970's.

The 1980's saw a slightly different focus. The attention of transportation professionals had changed from one of questioning the feasibility of HOV facilities to examining the types of facilities that should be built and how they could best be planned, designed, and implemented. Most metropolitan areas continued to experience significant increases in traffic congestion during the 1980's. Better management of existing facilities and moving people, rather than vehicles, became the focus in most areas.

During the 1980's, a variety of different HOV projects were implemented across North America. In Ottawa and Pittsburgh, exclusive bus-only facilities were developed on exclusive rights-of-way. These represented slightly different approaches than the HOV projects that had been implemented earlier. In Seattle and Houston, major HOV projects were developed on a number of freeways, HOV facilities were opened in Orange County, California and many other projects around the country were also implemented during

this period. There was a growing commitment to HOV facilities.

There are now some 40 major HOV facilities in 20 metropolitan areas. This is quite a growth from the first projects back in the early 1970's. With this background, I would now like to address the future of HOV facilities; where are we going? There are six general areas I would like to cover.

First, I think the time has come for HOV facilities in this country. HOV projects are becoming a very important element in our total transportation system. In many corridors HOV lanes represent a very cost-effective method of moving people in fewer vehicles. This has been demonstrated in many of the examples presented throughout this conference. The numerous projects in planning, design, and construction around the country provide a good measure that many agencies are now realizing the benefits that HOV facilities can provide.

Second, I think there will be more emphasis on the development of HOV systems. While there is some disagreement over how the term "system" is defined, I would suggest that it means providing HOV users with a way to travel throughout the region at speeds that provide travel time savings over single-occupant vehicles. This system approach provides greater acceptance for HOV facilities on the part of the general public and also greatly increases mobility in our urban areas.

Third, I think HOV facilities will lose the "step-child" image they have in many areas. HOV projects are being recognized as an important factor in alleviating congestion problems in our major urban corridors.

Fourth, with the increased emphasis on regaining the United State's lead in transportation technology, there will be a significant investment of funds for the development of what is called Intelligent Vehicle Highway Systems or IVHS. HOV facilities appear to be appropriate for the testing and development of many of these projects and for the initial application of many of the advanced technologies. This is an area that must be pursued actively.

Fifth, I think we will see an increased involvement of the private sector in the development of HOV facilities. In many areas, air quality regulations are placing specific requirements on developers and employers to reduce trip generation levels. Thus, the private sector has become more active in working with public agencies on different approaches to reducing traffic congestion levels and air quality concerns. HOV facilities are being considered in many areas to achieve these objectives.

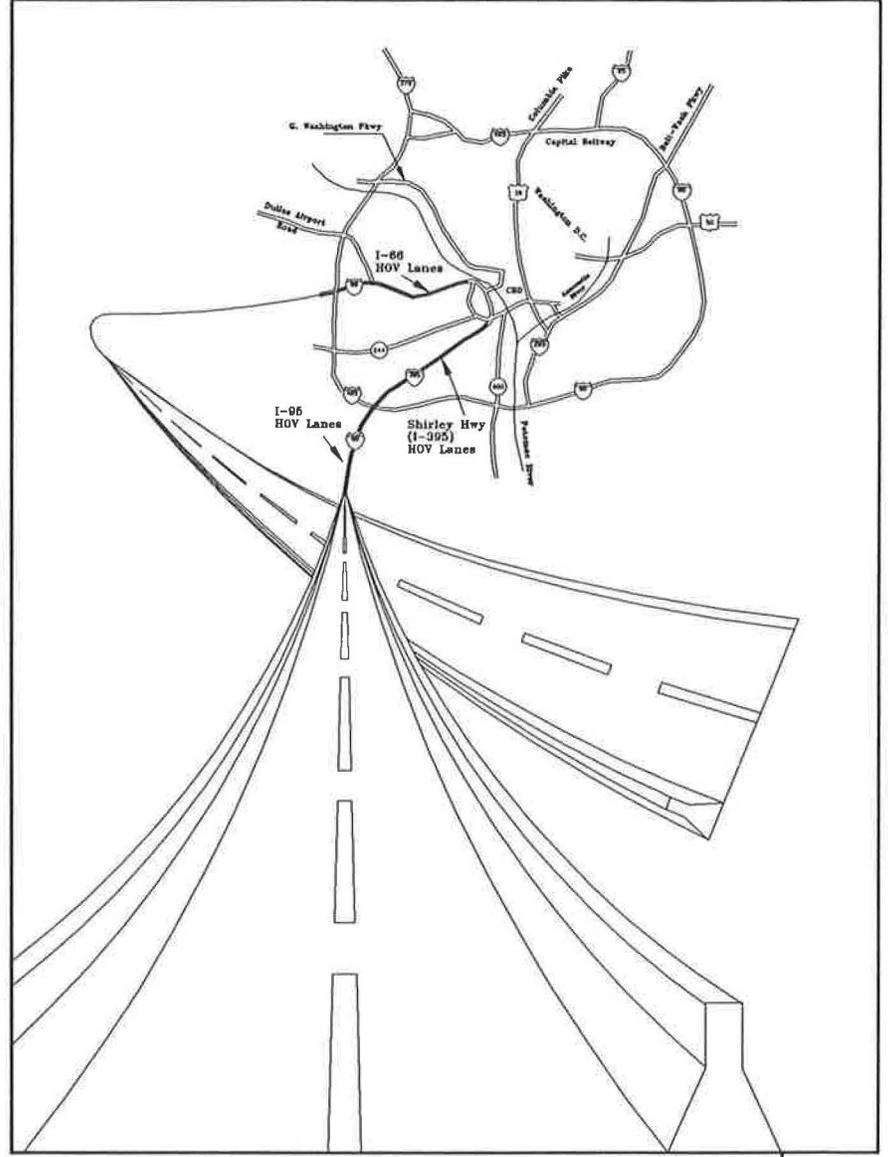
Sixth, due to the acceptance and success of HOV facilities, I think we will continue to see greater cooperation between highway and transit agencies on a variety of projects. Many transit agencies are broadening their view, and their definition of transit now includes carpools and vanpools. Instead of looking at carpools and vanpools as competition to regular transit service, most agencies now view these as part of the family of transit services. The American Public Transit Associations' "Transit 2000 Plan" is evidence of this support for the development of HOV facilities.

In summary, I feel that the future of HOV facilities is very bright. The only limitation we have is the creativity and imagination that each of us uses to address specific problems in our metropolitan areas.

We have a great product. We have a product that continues to be improved as we gain new experiences from existing projects. Sharing our experiences through conferences like this, is needed to ensure that we continue to improve and move forward with the development of facilities that will enhance urban mobility. HOV facilities are one approach that will help achieve these objectives. Our biggest challenge now is to deliver the HOV projects that are being planned and designed.

Planning

Demand Estimation
Projects and Related Issues
Including HOV Facilities in Regional Plans



PLANNING

Moderator - George Wickstrom



Metropolitan Washington Council of Governments

The three planning workshops focused on the topics of HOV demand estimation, current HOV project planning, and including HOV facilities in regional plans. Highlights from the presentations and group discussions are summarized below, followed by more detailed information on each session.

- Recent experience with the use of different demand modeling processes for estimating the demand on HOV facilities was discussed. Examples were provided that use the traditional 4-step demand estimation process and newer computer programs. Discussion focused on the trade-offs between the different high-occupancy modes, how these can be accounted for within the modeling process, and the influence of other incentives and

disincentives on the demand estimation process.

- Presentations were given on specific HOV projects. These included a discussion of the UMTA major investment rating system, the Central Artery/Third Harbor Tunnel Crossing project in Boston, the I-25 HOV lane in Denver, and the U.S. 29 corridor in Maryland.
- The inclusion of HOV facilities in the regional planning process was discussed. Examples of the approaches taken in New York City, Maryland, and Virginia were presented. Discussion focused on the importance of examining HOV facilities from a regional perspective and providing a more comprehensive approach to the development of HOV facilities.

Demand Estimation

Jim Ryan, COMSIS Corporation

Mr. Ryan presented a summary of recent experience and research activities focusing on the application of different modeling techniques used to estimate the demand on HOV facilities. Topics covered included recent experience with demand forecasts for project planning, research activities associated with the Shirley Highway HOV lanes, and the evaluation of information from Seattle on the influence of work-place based incentives. Mr. Ryan discussed the following six points.

- At the project planning level it appears that reasonable forecasts of HOV demand can be made that provide a reasonable level of confidence. A number of different software packages are available that can be used for HOV demand estimation. The traditional 4-step travel forecasting methodology can be used to provide reasonable estimates for planning HOV facilities.
- Within the 4-step process there is not total agreement on what elasticities are appropriate to use. The research that has been done on the Shirley Highway HOV lanes indicates that where within the demand estimation process the HOV estimation is made is important. It does not appear that the standard multi-nominal logit model is the best for portraying the trade-offs people make in the mode choice decision making process. The model assumes that the modes compete equally among themselves. The Shirley Highway data seems to indicate that there is a much higher

trade-off between HOV modes than between HOV modes and driving alone.

- The nested logit model starts with the initial mode selection between transit and the automobile. Within the automobile mode there are additional options. The main occupancy trade-off is between driving alone or not driving alone. Only after the decision to rideshare is made is the occupancy level examined. This approach has a major impact on where the HOV users are drawn from. With the nested model fewer carpoolers are attracted from buses.
- This structure can be imposed, but not the coefficients, in different areas to reflect local conditions.
- Other incentives and disincentives clearly have an impact on the decision to rideshare. These include reserved parking, reduced parking charges, transit fares, subsidies, and flexible work hours.
- However, the omission of these additional influences from the mode choice model does not appear to bias the model.

David Roden, JHK and Associates

Mr. Roden discussed an approach to forecasting the demand for HOV facilities using a quicker and less data intensive modeling process. Such an approach may be appropriate to use for modeling demand at the facility level; to identify the number

of people that could be expected to use a certain HOV facility. Mr. Roden highlighted the following points concerning this approach.

- The approach is more appropriate for use with exclusive and concurrent flow HOV lanes, and ramp meter by-passes. The key element is that a change in travel time needs to be identified.
- The model uses a diversion curve that was based on Shirley Highway HOV lane data from 1982 and 1983. This has been updated using other more recent data.
- The process has been used to develop HOV forecasts in a number of different areas, including many for facilities in northern Virginia. At least one example has been on a circumferential, non-CBD oriented HOV facility.
- The basic inputs to the model are the home-based work (HBW) person-trip table, in-vehicle travel time by mode (LOV, HOV, and bus), out of vehicle travel time by mode, out of pocket costs by mode, and the current average occupancy rate for the corridor. The average occupancy rate is an important element.
- The model, which is based on the diversion curve and ratio of LOV to HOV travel times, generally provides a good estimate of HOV demand. However, as trip lengths increase, the model tends to underestimate HOV usage, and as trip lengths shorten it may tend to overestimate HOV use.

- The diversion curve can be adjusted based on additional information specific to the corridor under consideration.

- Advantages to the use of this model include the relatively small amount of data needed, the relatively simple and quick process, its compatibility with many demand estimation computer programs, and its transferability.

June Kahng, Parsons, Brinkerhoff, Quade and Douglas, Inc.

Mr. Kahng discussed the method used to forecast potential HOV lane usage on the Long Island Expressway in New York City. While the TRANPLAN model was used in this case, a number of other computer models could have been used. An extensive postcard survey of some 140,000 vehicles in the corridor was used as the basis for developing the trip table needed for the model. A 25% response rate was realized with the survey. Major points covered by Mr. Kahng relating to the use of the model included the following.

- Two types of HOV facilities were modeled; a barrier separated lane and a buffer separated lane.
- Both spacial shifts and mode shifts were examined. Spacial shifts refer to cases where existing carpoolers and transit users shift to the HOV lane, while mode shifts refer to HOVs changing of HOVs.
- The methodology appears to provide reasonable forecasts and can be used to evaluate the impacts of both different types of HOV facilities and different operating characteristics.

- The methodology appears to provide reasonable forecasts and can be used to evaluate the impacts of different types of HOV facilities and different operating characteristics.
- A number of recommendations could be considered to improve the modeling process for HOV lanes. These include providing more time for evaluating the impacts of the forecasts, examining the impact of non-travel time variables, conducting before-and-after studies to verify the forecasts, and the need to account for temporal shifts.

Jeffery Bruggeman, KPMG Peat Marwick

Mr. Bruggeman provided a number of observations related to HOV modeling in the multi-modal planning setting. In many areas, HOV facilities have formed a bridge between the rather conventional highway modeling that many areas have been doing as part of the 3-C process, and newer modeling approaches used in transit planning. Mr. Bruggeman suggested the following points for consideration in the HOV modeling process.

- The HOV modeling effort should tie into the regular modal split modeling process if possible.
- The model structure needs to be sensitive to the HOV operating policies.
- The models need to be integrated so that the process accounts for both the automobile and bus elements.
- The impact of the HOVs on the LOV network, especially on the

approaches to the HOV facility, need to be accounted for.

- It is important to examine the results of the HOV forecast to identify how much of the HOV demand is the result of diversion of existing HOVs and how much is really a change in mode.
- A closer examination of the following issues would benefit the level of understanding relating to the HOV modeling process.
 - Who are the people using HOV facilities?
 - How are carpools formed and have the types of people carpooling changed?
 - What is the perceived value of time?
 - Are the models and approaches currently in use appropriate to smaller urban areas and suburban activity centers?
 - How do other strategies impact the modeling process?
 - Why do people use and not use HOV facilities?

Projects and Related Issues

Kenneth U. Mowll, Urban Mass Transportation Administration

Mr. Mowll reviewed the role of the Urban Mass Transportation Administration (UMTA) in evaluating major transit investments, both HOV and rail facilities. In response to a growing demand for federal funding for new start fixed-guideway transit projects, UMTA developed a major investment rating system. This system focuses on the selection of cost-effective projects by examining the total marginal cost of attracting new trips to the HOV or rail facility. Currently, a value of \$6.00 per new rider is the threshold projects must meet to be considered. Mr. Mowll discussed the results of the investment rating system on three HOV projects and provided general comments about its use.

- The Seattle downtown bus tunnel rated the highest of any recent new project on the investment rating system. The tunnel, which will provide travel time savings to riders, has an effectiveness index of \$1.44 per new rider.
- The Houston transitway system also scores highly on the investment rating system. While some of the older transitways were implemented before the UMTA cost-effectiveness indices were developed, they would easily meet the standards. The newer transitways, while higher in cost, are still well below the threshold limits.
- The recently completed Alternatives Analysis process for the I-5/State Street corridor in Salt Lake City considered both HOV and LRT

options. Neither of these alternatives met the \$6.00 per new trip threshold.

- The HOV projects which score high on the investment rating system are those that provide additional capacity in highly congested corridors.
- UMTA will continue to use the investment rating system to evaluate funding requests for major transit projects. The use of this approach results in a "rating" for each project. Individual projects are not ranked due to variations in local conditions and other special considerations.

Matt Coogan, Massachusetts Department of Public Works

Mr. Coogan described the complex planning and design issues associated with development of the Central Artery/Third Harbor Tunnel Crossing project in Boston. This project represents a very unique approach taken to respond to the specific travel demands, legislative directions, and capacity of adjacent facilities. Some of the elements of the project discussed by Mr. Coogan included the following.

- The daily demand for HOVs at the month of the Third Harbor Tunnel is estimated at approximately 35,000 passengers per lane in each direction. In addition, some 55,000 passengers a day will be on buses. Thus, the demand for some type of HOV facility appears warranted.
- Legislative requirements restrict the number of lanes that can be constructed in the tunnel to four. Thus, even though the demand projections may show the need for more lanes, the size of the facility is

limited. In addition, the cost of constructing of any type of facility in the area is very expensive.

- A number of different alternatives were examined in the planning process. Due to the unique characteristics of the area and public policy concerns, the use of an HOV lane for the full length of the tunnel was eliminated early in the process. Instead, strategies focusing on different ways to provide preferential access for HOVs were examined.
- Different design strategies were considered for the eastbound and westbound approaches to the tunnel. The recommended approach meters both SOVs and HOVs, but provides priority to HOVs.

William Jorgenson, Denver Regional Transportation District

Mr. Jorgenson described the new HOV project in Denver and discussed some of the problems encountered in trying to "fast track" the process. The Mile High Transitway will be a 5.8-mile, 2-lane reversible facility located in the median of I-25. Some of the problems encountered in the processes included the following.

- The mixing of FHWA and UMTA funding created some problems due to different funding requirements and processes.
- Coordinating the activities and involvement of the five agencies involved in the process took more time than originally anticipated. For example, agreement between the different agencies on the cross-section took approximately a year.

- Neighborhood opposition to taking additional right-of-way became a problem late in the process after the RTD had worked with these groups for two years.
- Concerns over hazardous waste in some parts of the corridor also became an issue.
- The preferred alternative included replacing a viaduct into the downtown area that was based on the relocation of passenger rail service to the Denver Union Terminal. While there was previous agreement on this, changes were made which resulted in the need to change the design of the facility.
- Other issues included dealing with the different enforcement districts covered by the project and obtaining agreement among the different agencies on the responsibilities for operation and maintenance of the completed facility.
- While none of these issues was insurmountable, they do provide a good indication of the types of problems that can arise during the planning and design stage. Other areas may be able to benefit from some of the lessons learned on the Denver project.

Neil Pederson, Maryland Department of Transportation

Mr. Pedersen discussed the process and alternatives examined on the U.S. 29 corridor in Maryland, which runs between Washington, D.C. and Baltimore. One of the anchors in the corridor is Silver Spring, which is currently undergoing major

redevelopment. U.S. 29 is a major suburban arterial. Mr. Pedersen covered the following points in his presentation.

- Currently, a portion of the facility operates as a reversible lane system, with 4 lanes in the peak-direction and 2 lanes in the off-peak direction. Bus volumes are fairly heavy in this one-mile segment. The remainder of the corridor differs in both the cross-section and the surrounding neighborhoods. Traffic congestion is a serious problem in many areas.
- The availability of right-of-way to expand the facility varies along the corridor. In the areas where it is most needed, right-of-way is not available.
- Based on the realization that the anticipated travel demand will not be able to be met in a conventional fashion, the master plan for the area calls for the extensive use of transit services in the corridor.
- A number of different alternatives were looked at for different segments of the facility. As a short term solution in one area that was being expanded from 4 to 6 lanes, the shoulders were also built up and buses are allowed to use the shoulders. This has allowed buses to bypass queues in the traffic lanes, resulting in significant time savings. Other alternatives are being examined, including a reversible HOV lane in the center of the facility.
- A number of issues were raised during the process. These included public perception of the low use of

the shoulder bus lanes, dealing with left turn and pedestrian movements, safety issues associated with contraflow HOV lanes, difficulties in locating park-and-ride facilities, and the general perception on the part of the public that light rail was a preferable alternative, even at double the cost.

Including HOV Facilities
in Regional Plans

*Larry Malsam, New York Metropolitan
Transportation Council*

Mr. Malsam discussed both the projected travel increases in the New York City area and the approaches being examined to meet this growing demand. While the region's transportation infrastructure is basically in place, automobile VMT continues to increase by 2% to 3% a year on a state-wide basis and by as much as 10% to 20% in some parts of the New York City area. Population and employment rates are also projected to increase. Currently, the use of HOV facilities is somewhat limited. Exclusive bus lanes are in operation on approaches to some of the bridges and tunnels leading to the Manhattan CBD and on some city streets. While many of these are very effective facilities, the HOV concept has not been used extensively in other areas.

HOV facilities are now being considered in a number of areas including the Westchester area and the Long Island Expressway. To date, there has been a good deal of support from both the public and private sectors for an HOV facility in the Westchester area. In addition, a number of alternatives are being examined for the Long Island Expressway. However, at the present time, it does not appear that there is much public support for an HOV lane on the expressway. The state DOT is also examining potential applications for HOV facilities as part of a long range planning effort.

*Robert Winick and Patrick Hare, Maryland
National Capital Park and Planning
Commission*

Mr. Winick discussed the role of the Maryland National Capital Park and Planning Commission in the sub-regional planning process. The agency is concerned with the long-term interdependence between land use and transportation. HOV facilities are one element of the transportation system that are being examined. The Commission is concerned with looking at the land use aspects of these facilities.

The Comprehensive Growth Policy study the Commission conducted looked at different scenarios of land use and transportation alternatives. Different land use patterns, locations, and densities were examined with three different transportation scenarios; an automobile focused option, an HOV option, and a rail alternative. These were examined in different combinations and the congestion impacts were identified. The analysis indicated that HOV facilities can have a significant overall impact on providing the opportunity for increased development capacity.

Mr. Hare explained the modeling and analysis process used in the Comprehensive Growth Policy study. The initial analysis did not include buses as HOVs, since making buses detour off the freeway to pick-up and drop-off passengers was felt to be an unattractive option. The analysis did consider HOV facilities on arterial streets as well as freeways. To address the bus concerns, a bus/HOV transfer station concept was developed to make the bus alternatives more attractive. A number of different design treatments were examined for these stations. In addition, the potential of increasing the land use densities around these stations was examined.

Mr. Winick concluded by describing some other activities occurring in the area. These included the network studies, which focus on available right-of-way for potential transportation systems, the development of a local Transportation Management Association (TMA) that has formed a local HOV Task Force, and some specific project studies.

Robert Huddy, Southern California Association of Governments

Mr. Huddy described a number of the major issues that are being examined in the Los Angeles area. These included the following.

- Forecasts indicate the number of daily trips in the region will increase from some 40 million today to 66 million by the year 2010.
- In the Irvine area alone, one-half million jobs are expected to be created and over 60 activity centers will contain 30,000 or more jobs each.
- Congestion on the region's freeways and roadways will continue to increase. Currently, some 450 lane miles of freeway operate at a level-of-service F. The number of miles operating at level-of-service F is projected to increase 10-fold.
- To address the congestion and air quality problems, the current 12% rideshare and 6% transit mode shares will have to increase significantly. To just maintain the current levels of service, these will have to increase to approximately 23% and 19% respectively.

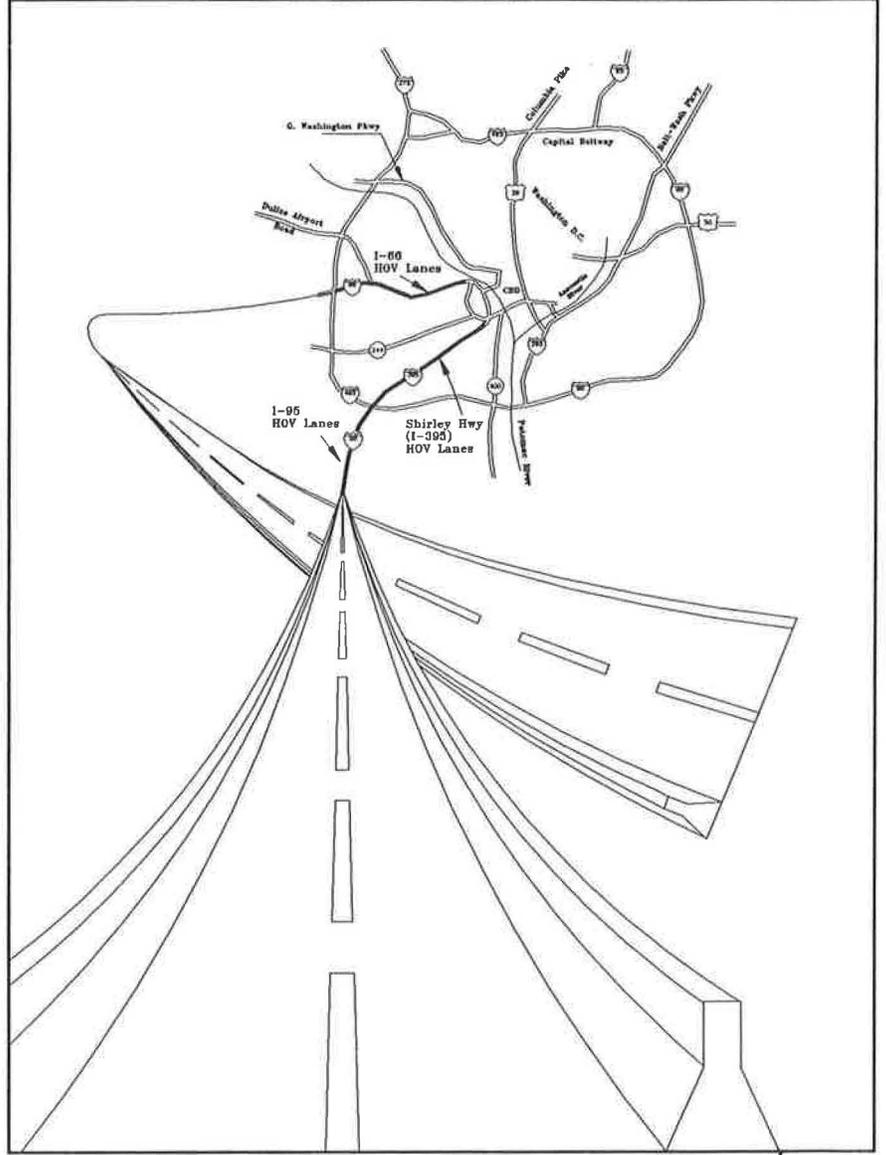
- In order to address these issues, a multi-modal approach is being pursued. This includes some 400 miles of rail transit, 300 miles of transitways, 1,300 miles of HOV lanes, travel demand management programs, parking policies, and other supporting policies and programs.

Richard Lockwood, Virginia Department of Transportation

Mr. Lockwood provided some additional thoughts on HOV facilities from a regional perspective. He stressed the need to build a consensus and constituency for the HOV project during the development process. He also suggested that it is important to promote the flexibility provided by HOV facilities. Even with the most successful projects, there is often a public perception that the HOV facilities are underutilized.

Design

Guidelines
Projects
Access/Egress and Safety



DESIGN

Moderator - Morris Rothenberg



The three design workshops focused on the topics of design guidelines, specific HOV projects, and access/egress and safety. Highlights from the presentations and group discussions are summarized below, followed by more detailed information on each session.

- Design guidelines for HOV facilities are being prepared by a number of groups including the American Association of State Highway Transportation Officials (AASHTO), a technical committee of the Institute of Transportation Engineers (ITE), and the California Department of Transportation (Caltrans). All of these manuals, which should be available in early 1991, provide general guidelines for planning and designing HOV facilities. There appeared to be general agreement among the workshop participants that these manuals will be of help in

providing more standardized approaches to designing HOV facilities, while allowing continued flexibility needed to respond to local characteristics.

- A number of interesting HOV projects are being planned and implemented around the country. Two of the more unique projects, the Seattle bus tunnel and the use of moveable barriers on the I-30 contraflow lane in Dallas, were discussed. In addition, discussion focused on the need to continue to pursue low cost HOV facilities that can be implemented relatively quickly in response to immediate congestion problems in major travel corridors.
- The different types of access and egress utilized with HOV facilities were discussed, along with the accident and safety experiences of HOV projects. It was suggested that more research needs to be done on safety issues, as good data do not appear to be readily available.

Guidelines

Ann Hansen, California Department of Transportation

Ms. Hansen discussed the status of the update of the American Association of State Highway Transportation Officials (AASHTO) HOV facility design manual. The original manual covered both the design of park-and-ride facilities and HOV lanes. These have now been separated into two volumes. The HOV lane design manual presents guidelines, rather than strict requirements.

The contents of the HOV manual includes three major sections; planning and operations, design, and design of HOV facilities on surface and arterial streets. The planning and operations section is complete new and the design section has been updated and expanded. Additional assistance on identifying good examples of HOV lanes on arterial streets is still needed. The new manual will provide more information and examples than the old manual.

The draft manual is currently being reviewed by the AASHTO Task Force and others. It is anticipated that the manual will be published in March, 1991.

Tim Lomax, Texas Transportation Institute

Mr. Lomax discussed the draft Institute of Transportation Engineers (ITE) report on the Design Features of HOV Lanes. Following the ITE format, this is an informational report containing a summary of practices that may be useful in designing HOV facilities. In developing the report, existing HOV facilities and design guidelines were examined to identify current practices and issues. A total of 14 exclusive, 20 concurrent flow, and 4 contraflow lanes

were examined. It is anticipated that the report will be available by the end of the year or early 1991.

Mr. Lomax reviewed the following major elements of the report.

- The design characteristics of the different types of HOV lanes are detailed. Cross-sections for the different types of facilities are provided, along with additional information for exclusive barrier separated lanes, concurrent flow lanes, and contraflow lanes. Both desirable and reduced design dimensions are provided.
- The different approaches to signing and marking HOV facilities are outlined and discussed. While the MUTCD guidelines are still used, many areas have developed their own signs, pavement markings, and changeable message signs.
- Only a summary of the issues associated with priority entry ramps is provided. It is recommended that a separate ITE committee look at this area in more detail.

Ron Klusza, California Department of Transportation

Mr. Klusza discussed the development of the design manual for the California Department of Transportation (Caltrans). It was felt there was a need to develop a common approach for designing HOV facilities within the state. Like the other documents discussed, the California manual is intended to provide guidelines for designing HOV facilities, not specific requirements. However, the reasons for the recommended approaches are discussed to

provide a greater understanding of the trade-offs associated with many design issues.

Mr. Kluza summarized the following elements of the 8 chapters contained in the manual.

- Planning. This chapter includes a discussion of the planning process, the interface with different agencies, and the coordination with regional and local plans associated with the development of HOV facilities.
- Geometric Design. This section includes a discussion of the desirable and minimal design standards for a wide variety of HOV facilities.
- Direct Connections and Drop Ramps. Examples are provided of the design and physical requirements for different types of connections to the HOV lane.
- Signing and Delineation. Specific recommendations are provided for each type of HOV lane. Typical standard signing plans are outlined for each type of facility.
- Enforcement Areas. This section outlines the desired design of enforcement areas and other key elements that should be considered to ensure that adequate and safe enforcement areas are provided.
- Ingress and Egress. A discussion of the issues associated with and design of different at-grade ingress and egress is presented.
- Park-and-Ride Facilities. This chapter outlines planning and design guidelines for park-and-ride lots. It

includes examples of specifications for different types of facilities.

- HOV Operations. The last chapter provides general guidelines on the current operational issues associated with the different types of HOV facilities and the different operating scenarios.

Projects

Dan Rathbone, DBR & Associates

Mr. Rathbone discussed the planning and design of the I-30 contraflow HOV lane in Dallas. This will be the first HOV facility in the country to use the movable barrier technology. The feasibility study for the project was done by the Texas Transportation Institute for the Texas State Department of Highways and Public Transportation (SDHPT) and Dallas Area Rapid Transit (DART). The I-30 contraflow HOV lane is a joint project, funded by both agencies.

Mr. Rathbone showed a short film on the movable barrier technology. The I-30 contraflow HOV lane would use this type of barrier, which would be moved four times during the day to create the HOV lane. The project, which is tentatively scheduled to start in early 1991, would operate approximately 5 miles in the a.m. peak-direction and 3 miles in the p.m. peak-direction. The facility would operate only during the morning and afternoon peak-periods. Estimated travel time savings for users of the lane is 9 minutes in the morning and 7 minutes in the afternoon.

Use of the movable barrier has a number of advantages. These include providing an acceptable level of physical separation between opposing traffic flows, relatively quick implementation, ability to maintain the HOV lane throughout a freeway construction period, and providing a physical barrier to reduce violation rates.

Robert Mannell, Virginia Department of Transportation

Mr. Mannell described a number of the HOV projects in Virginia in the planning

and implementation stages. These include extensions to the Shirley Highway HOV lanes and the to I-66 facility, a reversible HOV lane in the Norfolk area, and the possibility of a shoulder HOV lane on the toll road to Virginia Beach.

Mr. Mannell stressed that moving these facilities through planning, design, and implementation is not a fast process. Implementing many of the major HOV facilities in Virginia has taken 15 to 20 years. This will continue to be the case, especially given the costs of many of the major facilities. Mr. Mannell suggested that, in addition to these major HOV facilities, areas like northern Virginia need to also examine lower cost HOV alternatives that can be implemented quickly to help provide immediate congestion relief. He described a few examples of these types of HOV applications. There are risks and issues associated with many of these types of projects, but they can represent viable alternatives to increasing the people-moving capacity of a freeway facility.

Rick Walsh, Seattle Metro

Mr. Walsh provided an overview of the Seattle bus tunnel project. The project is unique in a number of ways. First, the tunnel is built for the operation of dual powered vehicles. Buses will operate using diesel fuel on the surface streets. However, when the buses enter the tunnel, they will switch to electric power. Second, artwork was designed into the architecture of the tunnel and plays an integral role in the design of the facility. Third, the project has been constructed relatively quickly. Ground breaking for the utility relocation occurred in 1986 and construction of the facility started in 1987.

The project will be an integral part of the overall transit and transportation system for the Seattle area and will provide an important link with the HOV system. Specifically, the tunnel will provide excellent connections with the I-5 and I-90 HOV lanes. The decision to build the tunnel was based on the rapid growth in the downtown area, which is projected to continue. It is anticipated that transit will serve 50% to 60% of the downtown work force.

The tunnel is 1.3 miles in length, with 5 stations. Walsh described the construction process and the general design of the tunnel. Buses will move through the tunnel in platoons, switching to the electric power mode as they enter the tunnel. The estimated travel time through the tunnel is approximately 8 minutes.

Currently all of the major structural work has been completed. The software elements are also almost complete. However, only 4 of the 236 dual powered buses have been delivered at this point. At least 50 buses are needed to operate the system. The system is scheduled for opening in September 1990.

Access/Egress and Safety

Jim Robinson, Federal Highway Administration

Mr. Robinson discussed the accident and safety experiences associated with different types of HOV facilities. In general, there is not a lot of information on accident rates, as many areas have not collected this type of data. In addition, even in areas that do monitor safety and accident information, it is not always possible to identify if the accident was caused by traffic in the HOV lane or in the general-purpose lanes. Mr. Robinson made the following general observations related to accident rates and safety issues associated with different types of HOV facilities. He noted that many of these comments reflect general observations from individuals associated with the different projects rather than detailed reports.

- Exclusive HOV facilities. The accident rates on barrier separated HOV facilities tend to be very low. Accident rates on exclusive, buffer separated facilities also tend to be low, although there are a few examples of accidents occurring in the buffer area.
- Contraflow HOV facilities. These types of facilities also appear to have low accident rates. This may be partially due to the fact that many of these facilities are limited to buses, with a few allowing vans.
- Concurrent flow HOV facilities. There are many different types of these facilities. Due to the nature of some of these, which may involve the use of a shoulder or the narrowing of the general-purpose

freeway lanes, the safety issue becomes more complex. With no barrier separation, the potential for accidents is greater. However, most of the available information seems to indicate that the accident rates usually remain relatively constant, or even go down. There are a few examples which seem to indicate that the accident rates have increased. However, it is difficult to tell if the increase is due to the HOV lane or to other changes that have been made in the freeway facility.

Don Stankovsky, Metropolitan Transit Authority of Harris County

Mr. Stankovsky provided an overview of the development and current status of the Houston transitway system, with specific reference to the different types of access and egress used and the experiences with safety and accidents. Major topics covered by Mr. Stankovsky included the following.

- The Houston transitways utilize a number of different types of access and egress facilities. The main types are slip ramps, T-ramps, and fly over ramps. There are advantages and draw backs to each type. In determining the appropriate types of access and egress, consideration should be given to the location and physical characteristics, type of HOV lane, anticipated volumes and operating speeds, spacing requirements, and safety and enforcement concerns.
- Due to safety and enforcement concerns, the use of intermediate slip ramps on the transitways are limited.

- T-ramps are used to provide direct access from many park-and-ride lots. Flyover ramps are used to provide access to the local street system.
- Providing enforcement areas for the Metro Transit Police was an important consideration in the design of the transitways.
- Tow trucks are located on each transitway to quickly respond to any accidents or incidents.

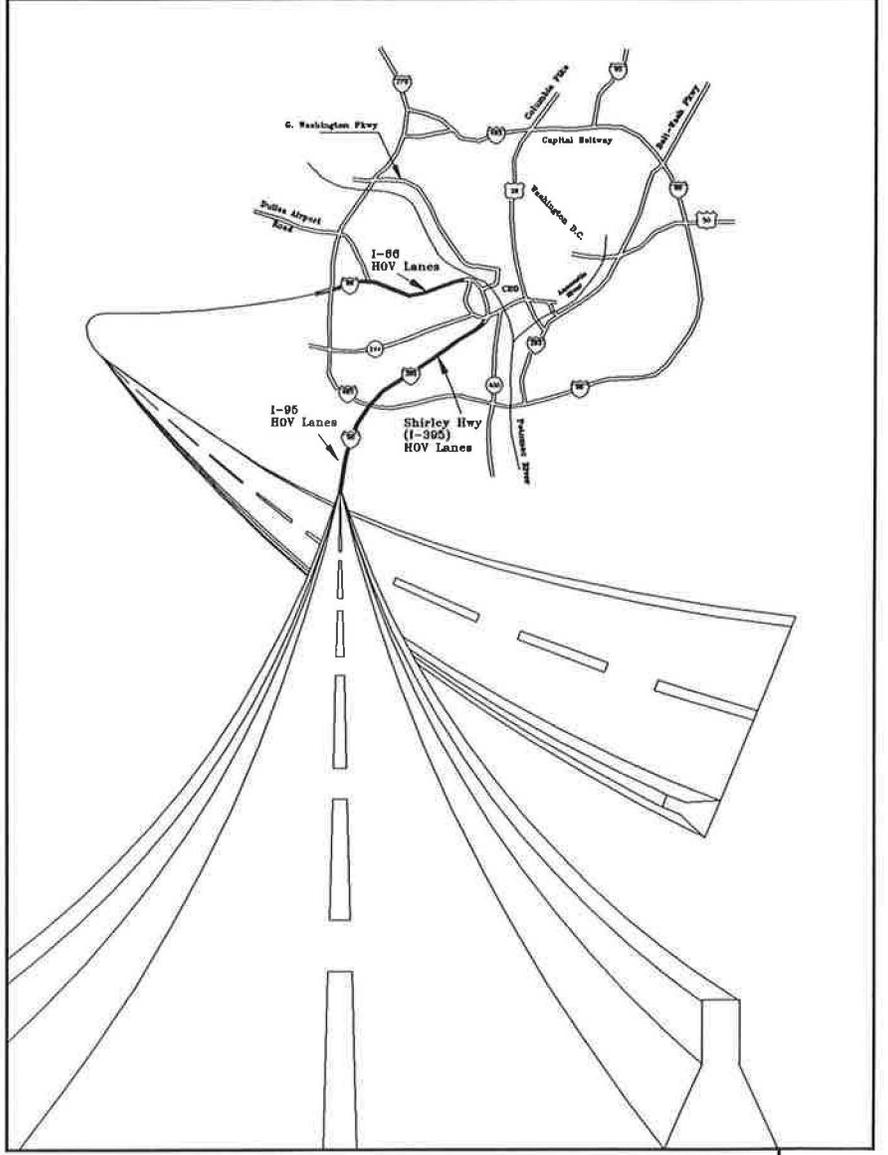
Ron Klusza, California Department of Transportation

Mr. Klusza discussed the approaches to access and egress being utilized in California. He noted that the Caltrans design manual, which is currently being developed, addresses these issues. He also noted that most of the HOV facilities in California are concurrent flow lanes; the approaches to access and egress reflect this. Caltrans is also examining the use of different buffer widths separating the HOV lane from the general-purpose lanes. At this point, there is little information available on the impacts of these different buffer widths on safety concerns.

Mr. Klusza suggested that keeping the design of the HOV system and signing simple will help keep accident rates low and provide for a safer system. Available accident information on Routes 55 and 91 seem to indicate that both facilities operate very safely. Obtaining good accident data is difficult. The exact nature and location of the accident is not always accurately recorded. In order to be able to evaluate the safety impacts, obtaining good before-and-after accident data is important. A more detailed examination of accidents and safety issues associated with HOV is needed.

Operations and Enforcement

Occupancy and Off-Peak Use
Enforcement Cases
Evaluation



Occupancy and Off-Peak Use

Carole Valentine, Virginia Department of Transportation

Ms. Valentine described the operational experiences on the HOV facilities in the northern Virginia/Washington, D.C. area. She noted that the operating experiences differ greatly between the different types of HOV facilities. Ms. Valentine provided the following highlights concerning operations on the I-66, I-95, and I-395 HOV facilities.

- Current utilization rates on the Shirley Highway (I-395) HOV lanes are approximately 19,000 people per-lane for the 3-hour morning peak-period. This compares to about 7,300 people per-lane in the adjacent conventional traffic lanes.
- The barrier separated design of the Shirley Highway HOV lanes and the enforcement provided result in relatively low violation rates.
- The Shirley Highway and I-66 HOV facilities are both monitored by the traffic management control center. This greatly enhances incident detection and management of these facilities.
- The diamond lanes on I-95 were implemented as an interim measure. At the same time the HOV lanes were opened, the outside shoulders were also opened for use as a regular traffic lane during the peak-period in the peak-direction. This was accomplished by strengthening the shoulders and providing emergency pull-out areas.

- Enforcement is a problem with the I-95 HOV lanes due to lack of a physical barrier separating the lane from the mixed-traffic lanes, the lack of adequate shoulders, and the lack of adequate enforcement areas.
- Even with these problems the I-95 HOV lanes serve approximately 14,800 people during the 3-hour morning peak period, compared to 3,580 people per lane for the general purpose lanes.
- In January, 1989, the vehicle occupancy requirement was lowered from 4+ to 3+ on the Shirley Highway HOV lanes. This resulted in a general decline in the vehicle occupancy rates on the facility. Currently the vehicle occupancy rates are 5.8 on the Shirley HOV lanes and 3.8 on the I-95 diamond lanes. The vehicle occupancy rates in the regular traffic lanes are 1.19.
- In general, it is felt that 1,500 vehicles per-lane per-hour is the maximum volume for efficient HOV lane operation.

Les Jacobson, Washington State Department of Transportation

Mr. Jacobson reviewed the operational and enforcement experiences associated with the different HOV facilities in the Seattle area. He made the following points relating to occupancy requirements and enforcement issues.

- Occupancy requirements should be defined based on the anticipated demand and goals for each facility. Different occupancy requirements are used on different facilities in the

OPERATIONS AND ENFORCEMENT

Moderator - Charles Fuhs



Parsons Brinckerhoff Quade & Douglas

The three operations workshops focused on the topics of occupancy and off-peak use, enforcement, and evaluating HOV facilities. Highlights from the presentations are summarized below, followed by more detailed information on each session.

- Operating experiences on the HOV facilities in northern Virginia, Seattle, and Houston were discussed. Topics covered included current utilization rates, desired maximum volumes, current occupancy requirements, and the potential to increase occupancy levels in response to increasing demands.
- Enforcement techniques utilized in Houston and California were presented and discussed. There was general agreement among the workshop participants that enforcement concerns needed to be addressed early in the planning and

design stages. There was also agreement that the continued sharing of information on the use of different enforcement techniques was important.

- Current approaches to evaluating HOV facilities were discussed. Many of the common problems or issues associated with these evaluations were highlighted, along with approaches to improve the evaluation process. There appeared to be general agreement among the workshop participants that evaluating HOV facilities was important and that improvements could be made in most of the approaches currently used.

Seattle area. The Seattle experience indicates 2+ and 3+ occupancy requirements on different facilities can be used successfully within a metropolitan area. Recent surveys have shown that motorists are aware of the different requirements.

- Three criteria are used in the Seattle metropolitan area to determine the occupancy requirement. The first is the maximum volume criteria, which is generally estimated at 1,500 vehicles per-hour for an inside concurrent flow lane and 1,100 for an outside concurrent flow lane. These may vary with different facilities, however. The second criteria is the maximum average gap between vehicles to avoid the "empty lane" syndrome. The final criteria is that the HOV lane should move more people than the adjacent general-purpose lanes.
- It may be necessary to raise the current occupancy requirements at some future point if vehicle volumes continue to increase.
- Innovative enforcement methods need to continue to be examined. The HERO program has been successful in the Seattle area in both reducing the violation rates and as a general education program. In addition, the use of special enforcement efforts, especially during the initial period of operation, has proven to be effective.
- It is also important to continue to monitor HOV facilities to evaluate the success of the lanes, identify potential violation problems, and

provide adequate management and public information for the facilities.

Katherine F. Turnbull, Texas Transportation Institute

Ms. Turnbull provided an overview of many of the current practices with HOV facilities around the country and specific examples from the Houston area. Many areas are concerned with both the minimum utilization levels to ensure that the lanes are perceived to be well used and the maximum capacity of the facilities. These questions were asked in the recent survey of operating HOV facilities. The results indicate some general trends, but also differences between facilities.

In general, most people identified 1,500 vehicles per hour as the maximum capacity of an exclusive HOV facility. However, lower ranges were often cited for concurrent and contraflow lanes. Only a few examples were identified of HOV lanes beginning to reach these levels. However, a number of individuals did indicate that consideration was being given to the potential need to raise occupancy requirements at some point in the future.

The Houston transitways provide a good example of the changes in occupancy requirements that have occurred on some facilities. For example, initially, the Katy Transitway was opened only to buses and authorized vanpools. Due to low utilization levels, authorized carpools with 4+ occupants were allowed. The occupancy requirement for authorized vehicles was later lowered to 3+. As the utilization levels were still perceived to be relatively low, the authorization requirement was dropped and the occupancy requirement was lowered to 2+.

In the fall of 1988, the occupancy requirement on the Katy Transitway was raised to 3+ from 6:45 a.m. to 8:15 a.m. in the morning. This change was made in response to demands exceeding 1,500 vehicles during the morning peak-hour. Even though the change was made with little advanced warning, there was little negative public reaction. While the utilization level dropped after this change, there has been a steady increase in vehicle volumes. This experience, which represents the first time occupancy levels have been increased on an HOV facility, indicates that increasing occupancy levels in response to increasing demands can be a publicly acceptable alternative.

Enforcement

Edward Harris, Jr., Metropolitan Transit Authority of Harris County (Houston Metro)

Mr. Harris reviewed the experiences with enforcement on the Houston transitways. Topics covered included the role of enforcement personnel, enforcement areas, signing as it relates to enforcement, violation rates, enforcing different occupancy levels during different times of the day on the same facility, and potential future enforcement methods. Mr. Harris stressed the following key points related to effective enforcement.

- Adequate enforcement areas need to be incorporated into the design of HOV lanes. Enforcement personnel must have a safe and convenient area to pull violators over and issue citations.
- A highly visible enforcement level is needed to keep violation rates at a minimum. Providing enforcement at locations where potential violators have little chance of accessing the lane without being ticketed is an effective strategy.
- Enforcement personnel should be actively involved in all aspects of planning, designing, and operating HOV facilities. The Houston Metro Transit Police actively participate in these different activities.
- More work needs to be done in identifying effective measures to combat HOV lane violators. While it appears appropriate that enforcement techniques should be tailored to individual HOV facilities around the country, more sharing of

information on techniques that have worked, as well as those that have not worked, would be beneficial.

John Billheimer, SYSTAN, Inc.

Dr. Billheimer provided an overview of the findings from a number of recent enforcement studies conducted on different HOV facilities in California. A recent study, conducted for the California Department of Transportation (Caltrans) and the California Highway Patrol (CHP), focused on the design features, enforcement procedures, and public attitudes associated with mainlane HOV facilities in California. The purpose of the study was to identify factors leading to high violation rates and developing counter measures to address these factors. Dr. Billheimer focused his comments on the following three elements of the study.

- One aspect of the study examined enforcement techniques. The most common methods of enforcement used by the CHP are to drive in the adjacent freeway lane, wait in enforcement areas, and wait in the shoulder areas. All of these have their limitations and draw backs. When asked to name the major enforcement issues, most police officers indicated lack of adequate enforcement areas as the major concern. Not being able to see children in baby seats or passengers in a reclining position were also noted as issues.
- In terms of design features, providing adequate enforcement areas appears to be an important consideration. A number of different configurations and designs were

examined, and general guidelines were identified.

- Focus groups and surveys were used to determine public attitudes toward the HOV facilities. As in past studies, the time savings for using the HOV lanes were generally overstated. In general, most people felt the lanes were effective and fair, but there was a perception in Southern California that the lanes were unsafe due to the speed differences between the HOV and general-purpose lanes. While violation rates tended to be overstated, most people generally felt that enforcement levels were adequate.

Dr. Billheimer also presented a video, developed by Caltrans, that discussed the use of video technology to assist in monitoring HOV lane violators. A number of different camera set-ups were used to try to take pictures of both the number of occupants in the vehicle and the license plate. Different enforcement techniques were used with the video monitoring, such as having enforcement personnel downstream from the cameras to apprehend violators.

Evaluating HOV Facilities

Cy Ulberg, Washington State University

Mr. Ulberg reviewed many of the deficiencies associated with commonly used measures of effectiveness and presented a set of general guidelines for consideration in evaluating HOV facilities. Deficiencies in some of the currently used evaluation measures cited by Mr. Ulberg included the following.

- Focusing only on comparing the number of people in the HOV lane with the number of people in the mixed-traffic lanes. While the people moving capacity of the HOV lane is obviously important, having more people in the lane does not necessarily mean that the HOV lane has improved the overall person-movement of the corridor. For example, it is relatively easy to develop a scenario where there are more people in the HOV lane than the general traffic lanes, but the average travel time for all people in the corridor is longer than before the introduction of the HOV lane.
- Focusing on the shorter travel times experienced in the HOV lane compared to the mixed-traffic lane may actually understate the benefits of the HOV lane. If the HOV lane is successful in attracting people out of the general-purpose lanes, the speeds experienced in those lanes should increase.
- Attributing any increase in the number of high-occupancy vehicles solely to the HOV lane. The use of this statistic can be misleading, unless it considers the number of

HOVs on the facility before the lane was opened, HOVs diverted from parallel facilities, and new HOVs formed directly to take advantage of the lane.

Mr. Ulberg suggested that the following guidelines be considered in evaluating HOV facilities.

- Evaluate the whole corridor, not just the HOV lane. Adjacent freeway lanes, as well as parallel arterials need to be taken into account.
- Evaluate the overall commute time to account for temporal shifts in travel patterns.
- Measure modal shift carefully. Conducting surveys of HOV lane users is necessary to identify the formation of new carpools and vanpools. Simply conducting vehicle occupancy counts is not sufficient.
- Ongoing, long-term measurements and evaluations are needed to identify the full range of benefits that may develop over time.

Darrell Borchardt, Texas Transportation Institute

Mr. Borchardt reviewed the general elements of the evaluation program currently conducted for the Houston transitways. The program is sponsored by the Texas State Department of Highways and Public Transportation and the Metropolitan Transit Authority of Harris County and conducted by the Texas Transportation Institute (TTI). Major topics covered by Mr. Borchardt included the following.

- A variety of information is collected and analyzed on a regular basis for the transitways, the adjacent freeway lanes, "control" freeways, and parallel alternate routes. These include manual vehicle and occupancy counts, travel time runs, and surveys of users and non-users. Quarterly reports are prepared summarizing much of this information, and a more detailed annual report provide a complete evaluation.
- In addition to this ongoing data collection, a number of special studies have been conducted when requested. For example, Friday afternoon operations on the Katy Transitway have been examined in more detail recently due to high vehicle volumes. Also, when two transitways were open to weekend use, monthly monitoring of these facilities was initiated.
- Providing accurate occupancy counts can be a problem, as it is sometimes difficult to see inside a vehicle during the early morning and late afternoon time periods. Positioning the counters at the best location and using vans to give a better vantage point can help.
- Documenting any incidents that occur is important to obtain accurate operational information.
- Surveys of bus riders, carpoolers, vanpoolers, and drivers in the adjacent general traffic lanes are also an important part of the evaluation process in Houston. These surveys can provide valuable information on

public perceptions toward the HOV facility.

- The most important part of the data collection effort is what is done with the data. It does not do much good to collect information if nothing is done with it. Instead, the results should be viewed as important tools that can help identify problems or issues that need to be addressed.

John Billheimer, SYSTAN, Inc.

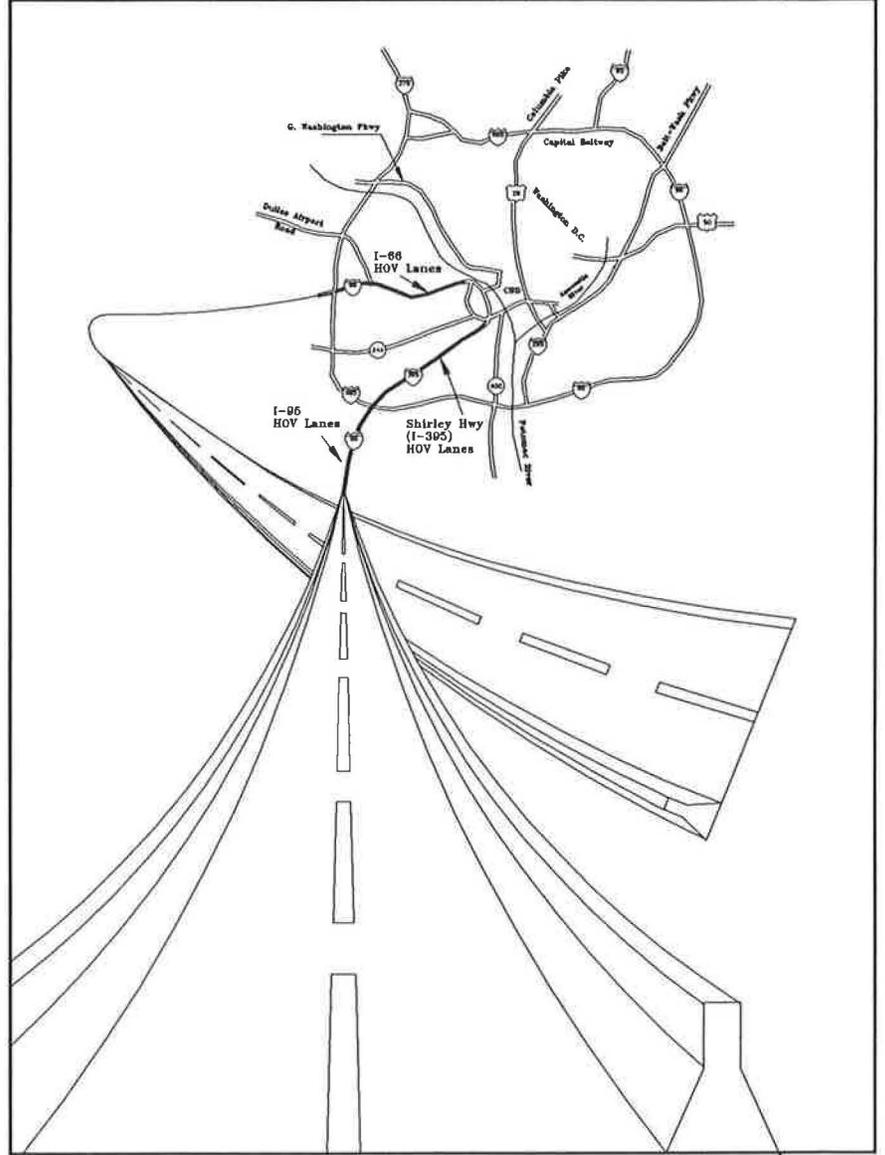
Dr. Billheimer discussed many of the typical problems encountered with conducting evaluations of HOV facilities. He addressed 10 common problems often associated with data collection and evaluation studies and approaches to minimize the impact of these concerns. The 10 problems covered included exogenous events, maturation, measurement error, time interference, instrumentation, variable selection, population projection, statistical regression, mortality, and instability.

Data collection activities associated with HOV facilities often present additional problems. For example, conducting accurate occupancy counts can be difficult, especially during the early morning and late afternoon. Counters can tend to over estimate the number of violators, as they can not always see infants in baby seats or reclining passengers.

Dr. Billheimer reviewed some of the major evaluation studies that have been conducted on HOV facilities in California. He pointed out ways to improve the evaluation process and overcome many of the common problems.

HOV Systems

Demand Management
HOV Networks
Constituency Building



HOV SYSTEMS

Moderator - Dennis L. Christiansen



Texas Transportation Institute

The three HOV system workshops focused on the topics of demand management, HOV networks, and constituency building. Highlights from the presentations and group discussions are summarized below, followed by more detailed information on each session.

- The approaches being taken in different areas to demand management were discussed, including the role HOV facilities can play. Examples from Orange County and Seattle were presented to show how some transit agencies are taking a comprehensive approach to providing a wide range of services. Transit agencies in these areas provide not only bus service, but also a variety of rideshare and travel demand management (TDM) programs to address a variety of markets. The potential application of IVHS technology to HOV

facilities, buses, and ridesharing was also discussed. A general consensus emerged from this workshop that opportunities to use IVHS technology in these areas needed to be examined further.

- The approaches to developing HOV networks in Santa Clara County, Seattle, and Houston were described and discussed. While each area has taken a different approach to the development of HOV projects, each considers the HOV facilities to be part of a network. In addition to the HOV lanes, all the speakers stressed the importance of supporting policies, programs, and services.
- Different approaches to building constituencies for HOV facilities were discussed. Examples from Orange County and Boston were described, as well as activities at the national level. There was general agreement that building a consensus and constituency for HOV projects at all levels was important and warranted more attention.

Demand Management

Paul Bay, BRW, Inc.

Mr. Bay discussed some of the basic concepts related to different approaches to demand management. These are all based on the idea that resources, both financial and right-of-way, can be saved by influencing or managing the demand on the transportation system. During World War II gasoline rationing was one form of demand management. The current use of travel pricing in Singapore is another example.

Approaches have also been taken to try to influence the distribution of demand through flexible work hour programs. Many people do this by leaving earlier for work in the morning and coming home later in the evening. Travel demands are also distributed spacially through the use of alternate routes.

Lastly, demand is influenced modally. HOV lanes can influence modal change and thus are sometimes considered a demand management strategy. HOV facilities can assist in influencing people to take higher-occupancy modes by providing travel time savings and increased trip reliability. Also, the support policies and services that are used with HOV facilities can influence demand.

Mr. Bay raised the following questions for consideration in defining the role of demand management strategies.

- Who should do it? What is the role of the state department of transportation, metropolitan planning organization, and local transit agency? How can these groups be encouraged to work together?

- How do we relate the demand estimation process to demand management? How do you estimate the demand for an HOV facility and then how do you manage the demand that actually occurs on the facility? The policies and programs utilized to influence demand management, such as low cost parking for HOVs, will influence the demand on the facility. These need to be considered and evaluated in the planning process.

Brian Pearson, Orange County Transit District

Mr. Pearson outlined the approach taken to TDM programs in the Orange County area. The Orange County Transit District (OCTD) operates both the bus service and a TDM program, that includes rideshare services, assistance in developing flexible work hour programs, and other support services. These services are thought of as complimentary to the bus system, rather than competitive. Many areas are realizing that transit agencies need to be more than just a bus or rail operator. OCTD tries to provide a full range of services to meet the needs of different market groups.

Some of the specific elements of the approach being taken in Orange County include the following.

- A 120-mile network of commuter lanes and transitways is being developed. Currently, some 21 miles are in operation and 18 miles are under construction. OCTD has a good working relationship with Caltrans to develop these facilities, based on a county wide plan developed by OCTD. When completed, these facilities will be

operated by Caltrans. However, OCTD will continue to be responsible for the bus, rideshare, and other support services.

- Currently, few bus routes operate on the Orange County HOV lanes; with most of the demand coming from carpools and vanpools. The projections indicate that even by the year 2010, approximately two-thirds of the demand will still come from carpools and vanpools. As a result, the emphasis on TDM programs will continue to be important.
- The TDM program has evolved in the Orange County area, starting with just providing rideshare matching services in the early 1980s. As rapid development continued to occur in the County, OCTD expanded the types services offered to include a full range of TDM programs. Currently there are 4 travel demand management organizations in the county.
- The Southwest Air Quality Management District implemented Regulation 15 a few years ago which mandated specific requirements for developers and large employers for rideshare and TDM programs. This has obviously resulted in OCTD providing more technical assistance and services to businesses. OCTD reorganized its commuter network section to provide a full range of services, which now represents a major effort for OCTD.
- This effort has raised some questions that are appropriate for further discussion. These include; what are the appropriate institutional

arrangements for TDM programs, what should the balance be between regulations and incentives, and what is the cost-effectiveness of TDM programs.

Bill Roach, Seattle Metro

Mr. Roach described many of the supporting program elements associated with the HOV system in the Seattle area. These programs and policies are important to ensure that the HOV lanes are utilized to their full potential. Seattle Metro provides a full range of transit and rideshare services to support the HOV facilities. In addition, Metro is concerned with the land use and transportation interrelationship.

Metro is currently completing its long range plan. The area of demand management is receiving a good deal of attention and discussion in this effort. Much of this discussion focuses on three basic questions; what are the different markets transit is trying to serve, how should the impacts of the different services and policies be measured, and how should the issues associated with parking and parking costs be addressed. It appears that parking, policies, and pricing are key aspects to influencing mode shifts. This is an area we do not know as much about as we probably should, and it is a very sensitive issue, as many people feel low-cost or free parking is almost a right.

Due to recent state legislation, the Seattle area will be exploring a parking tax, or more appropriately, a commuter congestion fee. This would focus on the commuter market and long-term parking. In downtown Seattle, where parking is relatively expensive, it appears that a large number of daily commuters receive free parking. This definitely influences an

individuals mode choice. Identifying ways to discourage this wide spread use of free parking appears to be at the core of an effective demand management program.

Ron Fisher, Urban Mass Transportation Administration

Mr. Fisher provided an overview to some of the recent activities associated with the development of advanced technologies, the intelligent vehicle highway system (IVHS) projects, and the tie to HOV facilities. Many of the current IVHS projects focus on making vehicles operate more efficiently. It appears that some of the technologies used with these approaches have potential application in the transit and rideshare areas. Mr. Fisher suggested that technologies that focus on the ability to provide better information may help encourage people to change modes. In addition, the use of advanced technologies to provide more dynamic rideshare matching capabilities appears to offer potential.

The potential for these types of applications were discussed. A number of people suggested that this was an area that should be examined further. More research and the potential for demonstration projects were suggested. In addition, the use of HOV facilities to test the development of other IVHS technologies was discussed. Many people suggested that this is another area that offers potential and should be explained further.

HOV Networks

Scotty Bruce, Santa Clara Transportation Agency

Mr. Bruce described the approach taken to developing the HOV system in Santa Clara County. He noted that the Santa Clara Transportation Agency is a bit of a hybrid organization, in that it is not a transit agency or a public works department. Rather, it is a combination of both. The county currently operates 70 miles of expressways, over 500 buses, a 10-mile LRT system, and some 33 miles of HOV lanes, called commuter lanes.

Continued rapid population and employment growth is forecast for the county. Due to high housing costs, many people live relatively long distances from the major employment centers in the county. To meet the growing transportation needs, the county is looking at a comprehensive approach that includes highways, LRT, HOV lanes, and other supporting services. The existing commuter lane network has evolved over a number of years.

The commuter lane network in Santa Clara County is really part of an integrated transportation system. The commuter lanes are one component of a larger transportation system. Mr. Bruce briefly described each of the different components in the system. The commuter lane system operates on both the county expressway system and the state highway system. The general policy is that if a lane is being added to a facility, it will be an HOV lane. The complete commuter lane system is programmed to be in operation by the year 2010. The program also includes park-and-ride facilities, ramp metering, and an aggressive public/private program to promote bus and rideshare use.

Les Jacobson, Washington State Department of Transportation

Mr. Jacobson presented an overview of the development of the Seattle HOV system and provided a number of ideas on how to approach HOV treatments from a system perspective. Major points covered by Mr. Jacobson included the following.

- The development of HOV facilities in the Seattle area started with one HOV ramp that was part of the Blue Streak Demonstration Project in 1970. The first HOV lane opened on SR 520 in 1973, as a bus-only facility. Currently, some 40 miles of a planned 156 mile system are in operation.
- The HOV system in Seattle includes more than just the HOV lanes. While the lanes are the most visible component of the system, they could not be successful without other supporting infrastructure elements, services, and policies. These supporting elements include exclusive HOV ramps, HOV bypass ramps at meters, freeway bus stations, park-and-ride lots, transit centers, the downtown bus tunnel, TDM programs, parking management policies and pricing levels, extensive bus services, the rideshare program, and the guaranteed ride home program.
- Even the extensive ferry system in the Seattle area is used to encourage ridesharing. Preferential access lanes are provided and the ferrys are often used as transfer points.
- Enforcement is also an important element of the total system. The

HERO program and periodic special enforcement activities have been used successfully to lower violation rates.

- Marketing and public information activities should also be considered as integral parts of the HOV system. These are necessary to ensure that the traveling public is knowledgeable of and understands how to use the different facilities.
- The development of the HOV system in Seattle has been and will continue to be an evolutionary process.

Don Stankovsky, Metropolitan Transit Authority of Harris county

Mr. Stankovsky presented an overview to the development of the Houston transitway system. The transitways were developed in response to major congestion problems on most freeways in the Houston metropolitan area. The system has been jointly developed by the Metropolitan Transit Authority of Harris County (Metro) and the Texas State Department of Highways and Public Transportation (SDHPT).

The transitways have increased the person-movement capacity of the freeway corridors within which they are located. The transitways offer travel-time savings and increased travel-time reliability to those who use them. Many of the transitways were developed to take advantage of freeway widening projects.

Most of the Houston transitways are one lane, reversible, barrier separated facilities located in the freeway median. Currently, transitways are in operation on 4 of 6 radial freeway corridors. Some 46-

miles of a 95-mile system are currently in operation. Recent extensions to both the Katy Transitway and the Northwest Transitway have resulted in significant increases in utilization rates. Currently, in the afternoon peak-hour the Katy Transitway is experiencing volumes as high as 1,600 vehicles per hour at the 2+ occupancy requirement. Use on the Northwest Transitway has also increased since the opening of the final 4-mile segment in early 1990.

Even though the transitways are not connected, they are still viewed as a "system" or "network". There are a number of links between the different facilities including an extensive express bus system, park-and-ride lots, transit centers that provide for transferring between different services, and the future surveillance, communication, and control system. Enforcement is a part of the system as the Metro Transit Police are responsible for enforcing the lane. Metro is also the rideshare agency, providing a variety of ridematching and marketing services.

that HOV facilities are only one of many solutions that need to be examined. In addition, there is a need to focus on providing a flexible adequate funding level.

- Second, it is important to identify the groups and individuals that the constituency building effort should be focused on. Environmental groups appear to be regaining importance and certainly support many of the transit programs. As mentioned earlier, it is important to obtain support from the business community. It even appears that there may be a middle ground in dealing with some of the automobile groups. The general public is also an important group. The results of a series of recent focus groups conducted by APTA indicated that the general public is not against additional taxes to pay for transportation improvements. However, the types of improvements favored tended to be the large scale, flashy projects.
- Third, APTA is currently undertaking a number of activities relating to building a constituency and coalition for all types of transit programs. APTA is in the initial stages of forming a formal national coalition to support increased funding for and availability of transit services. There has been a great deal of interest to date from users, environmental groups, business groups, and transit agencies.

Paul Bay, BRW, Inc.

Mr. Bay discussed a number of elements that are important for consideration in trying to build a local constituency for any kind of project. The six points covered included the following.

- It is important to take the time necessary to explain the project and build support. Consensus and constituency are not built quickly.
- Communication, telling as well as listening, is a critical element of any process. It is also important to communicate the message effectively.
- Good constituency building should also include a willingness to negotiate and make trade-offs. This involves not only the highway and transit agencies working together, but also working with community groups and local officials.
- There has to be leadership in developing a constituency. This has sometimes been a problem with the development of HOV facilities, as there is no clear indication of which agency is in charge. Sometimes it is the transit agency, sometimes it is the state highway department, and sometimes no one takes a leadership role.
- Lastly, a sound technical analysis must have been completed to show that the facility is needed. Often times, the goals of the project are not clearly articulated or justified.
- There are number of groups that need to be included in the

Constituency Building

Brian Pearson, Orange County Transit District

Mr. Pearson described some of the efforts at building constituencies for transit and HOV projects in Orange County. He noted that constituency building can reflect a wide spectrum of activities. He suggested that on most projects, transit agencies are usually dealing with the scale between modest support and trying to neutralize opposition. Constituency building can also be thought of occurring at four different levels; the political or elected official level, the policy or board level, the community level, and the technical level. Each of these levels is important. Different approaches are often used with each level.

There are three general areas related to HOV facilities that OCTD has been working with each of the four levels on. First, the OCTD transportation demand management program is actively promoted with all of these groups. This program has been well received with all the groups, as most view it as a very beneficial program. Obtaining agreement on a long-term HOV strategy is the second area that OCTD has attempted to build a constituency with the different groups. This effort has not been as successful as the TDM program. There is modest agreement on a plan to develop 120 miles of HOV facilities. Most people see this as a long-term strategy that they do not have to make any immediate decisions to build. The third category, which is the most difficult to build a constituency for, is implementing specific HOV projects. These are the hardest to build a constituency for because they will have an immediate impact on people. Most of the controversy tends to focus on these projects.

Mr. Pearson also described a few examples of specific efforts at constituency building with HOV projects in Orange County. Surveys of users and non-users in the area indicate that there is strong support for HOV programs, even though many people note that they hear mostly negative comments in the press about the facilities.

To assist in developing constituencies, Mr. Pearson noted that the support and commitment from Caltrans and FHWA have been very beneficial. However, in general, the business community has not provided a great deal of support. It also appears that there is a lack of understanding about the importance of the total system approach, rather than just individual facilities.

Bob Stanley, American Public Transit Association

Mr. Stanley discussed the constituency and coalition building effort from a national policy context. The need to build constituencies for HOV facilities and other transit and rideshare programs is especially important now with the upcoming highway and transit reauthorization legislation. Mr. Stanley discussed the following three general areas.

- First, the focus on HOV facilities is important. Currently, there is a good deal of interest in HOV lanes, which have tended to be under emphasized in the past. There is a growing realization that increased occupancy levels and increasing capacity without adding more single-occupant vehicles is important. There is also a recognition that the normal highway and transit strategies no longer work in many situations. However, it is also important to note

constituency building process. Public transit agencies, State DOT's, rideshare organizations, business groups, major employers, developers, environmental groups, neighborhood and citizen groups, and local officials all need to be included.

challenge is to integrate these types of improvements into HOV projects.

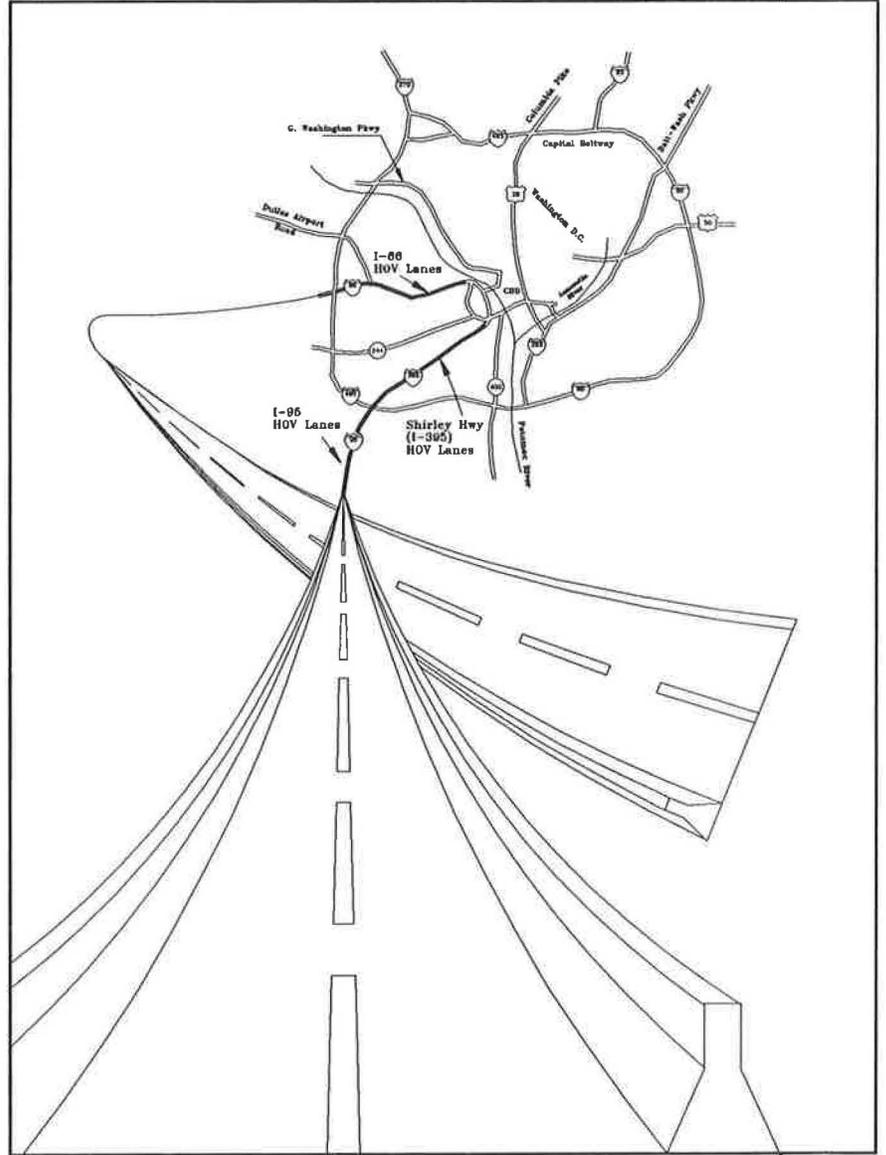
Matt Coogan, Massachusetts Department of Public Works

Mr. Coogan suggested that the challenge facing planners and engineers now is to determine how to reach the full potential of HOV facilities. He suggested that not enough attention has been given to the quality of the vehicles using HOV lanes or the quality of service and supporting facilities. In Boston, a major HOV system is being built from the South Station to Logan Airport.

A number of different systems were examined. In each case, the physical and operating characters were reviewed to identify those most important from a riders point of view. Providing a direct ride, from one enclosed environment to another was identified as important. Also, the system should be fast, clean, and easy to use. While there are some good examples of buses providing this type of service such as those used on the Denver Mall, many systems have not paid enough attention to these features. The bus and system characteristics developed for the Boston project take these concerns into consideration. Using a high platform bus, with specially designed station areas appears to be the best approach.

Mr. Coogan closed his remarks by suggesting that more time and attention needs to be given to the vehicles and vehicle systems used to provide the service. The

Appendices



APPENDIX 1

Table 1. General Characteristics of Operating High-Occupancy Vehicle Projects

City	Number of Lanes ¹	Length (miles)	Year Implemented	Hours of Operation	Total HOV Facility		Carpool Occupancy Requirements
					AM Peak Hour Vehicles	Volumes Passengers	
Exclusive Facilities, Separate Right-of-Way Ottawa, Ontario, Canada Ottawa-Carleton Transitway	1 (Each direction)	14.5 ²	1982-1989	24 hours	180	11,000	Bus Only
Pittsburgh, PA South Busway ³ East Busway	1 (Each direction) 1 (Each direction)	4.0 6.8	1977 1983	24 hours 24 hours	51 103	2,098 5,892	Bus Only Bus Only
Exclusive Facilities, Freeway Right-of-Way Hartford, CT I-84 ⁵	1 (Each direction)	10.0	1989	24 hours	139	1,204	3+
Houston, TX I-45N (North) ⁶	1 (Reversible)	9.1	1979-1984 ⁷	5:45 am - 8:45 am 3:30 pm - 7 pm	139	3,514	Bus/Vanpools Only
I-45S (Gulf) ⁸	1 (Reversible)	6.5	1988	4 am - 1 pm	878	2,923	2+
I-10 (Katy) ⁹	1 (Reversible)	11.5	1984-1987	2 pm - 10 pm 4 am - 1 pm	950	3,316	2+/3+
US 290 (Northwest) ¹⁰	1 ¹¹ (Reversible)	9.5	1988	2 pm - 10 pm 4 am - 1 pm	841	2,439	2+
Los Angeles, CA San Bernardino Fwy. Busway (I-10) ¹²	1 (Each direction)	12	1973 & 1989	24 hours	1,445	7,106	3+
Minneapolis, MN I-394 ¹³	1 (Reversible)	3.4	1985	6 am - 9 am 2 pm - 7 pm	443	1,397	2+
Pittsburgh, PA I-279	2 ¹⁴ (Reversible)	4.1	1989	5 am - noon 2 pm - 8 pm	160	983	3+
San Diego, CA I-15	2 (Reversible)	8.0	1988	6 am - 9 am 3 pm - 6:30 pm	1,375	3,138	2+

Table 1. General Characteristics of Operating High-Occupancy Vehicle Projects (continued)

City	Number of Lanes ¹	Length (miles)	Year Implemented	Hours of Operation	Total HOV Facility		Carpool Occupancy Requirements
					AM Peak Hour Vehicles	Passengers	
Washington, D.C./ Northern Virginia I-395 (Shirley) ¹⁵ I-66 ¹⁶	2 (Reversible) 2 (Peak direction)	11 10.0	1969-1975 1982	6 am - 9 am 3:30 pm - 6 pm 6:30 am - 9 am 4 pm - 6:30 pm	2,590 761	15,308 2,850	3+ 3+
Concurrent Flow Facilities							
Denver, CO US 36-Boulder Turnpike	1 (Eastbound)	4.1	1986-1988	6 am - 9 am	28	1,000	Bus Only
Fort Lee, NJ/New York City I-95	1 (Eastbound)	1.0	1986	7 am - 9 am	290	2,720	3+
Honolulu, Hawaii Moanalua Freeway H-1	1 (Eastbound) 1 (Each direction)	2.5 7	1978 1987	6 am - 8 am 6 am - 8 am 3:30 pm - 6 pm	1,730 ⁴ -	4,750 ⁴ -	2+ 2+
Los Angeles/Orange Co., CA Rt. 55 Commuter Lane I-405 Commuter Lane Rt. 91 Commuter Lane	1 (Each direction) 1 (Each direction) 1 (Eastbound only)	11 10 8	1985 1989 1985	24 hours 24 hours 24 hours	1,298 1,294 -	2,798 3,112 -	2+ 2+ 2+
Miami, FL I-95	1 (Each direction)	14	1976-1978	7 am - 9 am 4 pm - 6 pm	1,310 ⁴	2,810 ⁴	2+
Orlando, FL I-4	1 (Each direction)	30.0	1980	7 am - 9 am 4 pm - 6 pm	815 ⁴	990 ⁴	2+
Phoenix, AZ I-10 ¹⁷	1 (Each direction)	7.0	1987	24 hours	-	-	2+
San Francisco, CA I-280 Oakland Bay Bridge US 101 ¹⁸	1 (Each direction) 3 (Peak direction) 1 (Each direction)	1.6 1.7 7.0	1975 1970 1974 1986-1987	24 hours 5 am - 10 am 3 pm - 6 pm 6:30 am - 8:30 am 4:30 pm - 7:00 pm	- 2,544 624	- 11,859 2,739	3+ 3+ 2+

Table 1. General Characteristics of Operating High-Occupancy Vehicle Projects (continued)

City	Number of Lanes ¹	Length (miles)	Year Implemented	Hours of Operation	Total HOV Facility AM Peak Hour Volumes		Carpool Occupancy Requirements
					Vehicles	Passengers	
San Jose, CA Montague Expressway ¹⁹	1 (Each direction)	5.0	1982, 1984, 1988	6 am - 9 am 3 pm - 7 pm	-	-	2+
Rt. 101	1 (Each direction)	12 SB; 11 NB	1986 & 1988	5 am - 9 am 3 pm - 7 pm	379	908	2+
San Tomas Expressway ²⁰	1 (Each direction)	11	1982 & 1984	6 am - 9 am 3 pm - 7 pm	-	-	2+
Rt. 237 ²¹	1 (Each direction)	4	1984	5 am - 9 am 3 pm - 7 pm	895	2,472	2+
Concurrent Flow Facilities							
Seattle, WA I-90 ²²	1 (Westbound only)	5.8	1988	24 hours	170	1,488	3+
SR 520 ²³	1 (Westbound only)	2.8	1973	24 hours	268	3,656	3+
I-5 ²⁴	1 (Each direction)	6.2 NB; 5.9 SB	1983	24 hours	530	3,710	2+/ ³⁺
I-405	1 (Each direction)	6	1986	24 hours	214	475	
Vancouver, Canada H-99	1 (Each direction)	4S B; 1 NB	1980	24 hours	45	1,650	Bus Only
Washington, D.C./ Northern Virginia I-95 ²⁵	1 (Each direction)	6.8	1985-1986	6 am - 9 am 3:30 pm - 6 pm	1,612	7,012	3+
Contraflow Facilities							
New York City, NY Rt. 495	1 (Inbound only)	2.5	1970	6:30 am - 10 am ²⁶	725 ⁴	34,685 ⁴	Bus Only
Long Island Expressway	1 (Inbound only)	2.2	1971	7 am - 10 am	394	8,254	Bus/Vanpool
Gowanus Expressway	1 (Inbound only)	0.9	1980	7 am - 9:30 am	375	9,585	Bus/Vanpool

Notes: 1. Number of lanes reported by direction; if reversible facility, represents total number of lanes.

2. The total 15 mile Ottawa Transitway system includes 1.4 miles of downtown bus-only lanes and 2.3 miles operated in mixed-traffic. In the downtown area, buses operate in bus-only lanes on parallel one-way streets. To the west of the downtown area, buses operate in mixed-traffic lanes on the Ottawa River Parkway for approximately 2.4 miles. The parkway is a limited access facility, allowing buses to travel at high speeds.

3. A portion of the South Busway includes a shared right-of-way with a light rail transit line.

4. No 1989 information provided. Data shown are from Institute of Transportation Engineers, "The Effectiveness of High-Occupancy Vehicle Facilities," 1988, Table 12, page 22.

Table 1. General Characteristics of Operating High-Occupancy Vehicle Projects (continued)

5. The Hartford I-84 HOV lane is listed as an exclusive HOV facility. It is separated from the mixed traffic lanes by a 15-17 foot buffer.
6. An additional 5 miles of the North Transitway are scheduled to open in mid-1990. The final 5.6 mile segment is scheduled to open in two phases; 2.9 miles in 1994 and 2.7 miles in 1997. Currently, the facility is restricted to buses and authorized vanpools only. When the next section is opened in mid-1990, it is anticipated that 2+ carpools will be allowed to use the facility.
7. Between 1979 and 1984 a contraflow lane was operated on I-45N. The current exclusive facility was opened in 1985.
8. An additional 9 miles of the Gulf Transitway are scheduled to open in three phases by 1993.
9. The 1.5 mile eastern extension of the Katy Transitway was opened in January, 1990. This brings the total length of the facility to 13 miles. The occupancy requirement on the Katy Transitway is 3+ during the morning peak from 6:45 am to 8:15 am, and 2+ at other times.
10. The final 4 miles of the Northwest Transitway was opened in February, 1990. This brings the total length of the facility to 13.5 miles.
11. Approximately 2-mile of 2-lane, 2-direction HOV lanes are in operation on the Northwest transitway at the connection to the Northwest Transit Center.
12. The San Bernardino Freeway Busway includes 4 miles of barrier separated lanes, 7 miles with a 13 foot paint striped, buffer and a 1 mile connection into the downtown area that was opened in 1989.
13. The I-394 HOV lane is currently an interim facility operating on a signalized arterial street. The final facility includes a combination of reversible barrier separated HOV lanes and concurrent flow diamond lanes.
14. The two lane reversible I-279 HOV facility splits into two short, one lane segments at the southern end. One segment connects to Three Rivers Stadium and one provides access into the downtown.
15. The I-95 concurrent flow lanes in Northern Virginia connect to the exclusive HOV lanes on I-395 (Shirley Highway).
16. I-66 is a 4-lane freeway, with 2 lanes in each direction. The 2 lanes operating in the peak direction are restricted to HOVs during the morning and afternoon peak periods.
17. An additional 10 mile segment of the I-10 HOV lanes in Phoenix was open in January, 1990.
18. The HOV lanes on US 101 in Marin County include two segments, 3 miles and 4 miles in length, separated by approximately 1 mile of mixed traffic lanes.
19. The HOV lanes on the Montague Expressway operate only in the peak direction. The outside lane is used as the HOV lane during the restricted period and is open to general traffic at other times. The Montague Expressway is a signalized arterial.
20. The San Tomas Expressway HOV lanes operate only in the peak direction. The outside lane and shoulder are used for the HOV lane during the restricted period and revert to general purpose lanes and shoulders during other times. The San Tomas Expressway is a signalized arterial.
21. The Rt. 237 HOV lanes operate only in the peak direction. The outside shoulder is used for the HOV lane. The section of Rt. 237 where the HOV lanes are located is a signalized arterial.
22. The I-90 HOV lane included in this survey is an interim facility. It is a contiguous concurrent flow facility on the outside lane. Currently only 5.8 miles are open in the westbound direction. The completed I-90 facility will include a 2-lane reversible HOV located in the freeway median from the downtown bus tunnel approximately 10 miles to the east.
23. The SR 520 HOV lane is located on the outside shoulder and operates only in the westbound direction.
24. Different segments of HOV lanes are operated along I-5. The segment included in this survey is the 6-mile segment north of downtown with HOV lanes operating in both directions on the inside lane.
25. The I-95 concurrent flow lanes connect to the exclusive HOV lanes on I-395 (Shirley Highway). The inside general purpose lanes are used as the HOV lane during the restricted period. They revert back to mixed-traffic lanes when not in use as HOV lanes.
26. The exact closing time for the Route 495 contraflow lane depends on the volume of traffic. While 10:00 a.m. is usually the time the lane is closed, it may be kept open later or closed earlier depending upon the daily demand.

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