4.3 POTENTIAL TO IMPROVE TRANSIT SERVICE WITH MNPASS LANES

There is a natural synergy between the MnPASS concept and bus rapid transit (BRT) or enhanced express bus service. BRT needs dedicated right-of-way to operate without congestion, and MnPASS lanes can provide a very high level of service. Since buses carry many multiples of the number of person-trips that autos do (whether SOV or HOV), there is a strong incentive for transportation policy makers to incorporate BRT or express bus into the MnPASS system.

Improving transit service on Twin Cities freeways has been an important issue in recent years. Through an innovative program, Mn/DOT and the Metropolitan Council have already implemented 224 miles of bus-only shoulders in the Twin Cities metropolitan area, and project that an additional 221 miles will be needed in the next 20 years. These shoulders allow transit buses to use designated bus-only shoulders during times of congestion (when main-line traffic speeds are less than 35 miles per hour). Drivers of buses being operated on the shoulder may not exceed the speed of main-line traffic by more than 15 miles per hour and may never exceed 35 miles per hour. Due to the inherent speed advantages that toll-free use of MnPASS lanes would provide to BRT or express bus, MnPASS implementation may replace the need for some existing and/or planned bus-only shoulders on various corridors.

However, there are also numerous issues associated with making BRT or express bus work with MnPASS lanes. This collaboration is the topic of ongoing study in many locations. Some of the key issues that relate to the MnPASS situation are:

- **Access to and from the lanes.** Buses would benefit from direct access to and from the MnPASS lanes, without having to weave across general purpose lanes. However, such direct connections are expensive, and require careful placement.
- **Need for adequate transit stops.** Highways are not pleasant waiting environments for passengers. Ideally, buses would be able to stop without significant deviation from their mainline path. However bus stops in the middle of the highway are difficult to get to, and potentially unpleasant for passengers. Dedicated transit stations adjacent to the highways, in conjunction with park and ride lots makes for a better access environment, but requires buses to deviate more from their mainline path.
- **Operating speeds.** MnPASS lanes will be most successful if near free-flow freeway speed operating speeds can be maintained. Buses are less maneuverable and may not be able to maintain these speeds, leading to potential degradation of conditions on the MnPASS lanes since auto drivers are unable to pass in a single-lane operation.

To evaluate the potential increase to transit ridership that might result from allowing express buses to take advantage of MnPASS lanes, we conducted a test model run under the following conditions:

- 2010 travel demand;
- MnPASS toll rate of 30 cents per mile for autos; and
- Enhanced service for two lines in the TH 36 corridor, both of which run from downtown Minneapolis to TH 36 at U.S. 61 (and then beyond). The two routes were coded as routes 52 and 270 in the Metropolitan Council's travel demand model.

Both of these lines already run express bus service on TH 36 (not BRT), with one of them making one stop at the Rosedale Mall near the I-35W junction. The main difference between current operation and the proposed operation would be the ability to use the uncongested MnPASS lanes instead of the congested mainline. The net result of these improvements is summarized in Table 13.

Table 13. Potential Effect of MnPASS on Transit Ridership, TH 36

Transit ridership on TH 36 lines without realignment to MnPASS Lanes	1,947
Transit ridership on TH 36 lines with realignment to MnPASS Lanes	2,068
Additional riders	121
Percent increase	6.2%

These are modest, but measurable increases in transit ridership. Changing the headways or service characteristics of the service (which may be possible with an enhanced transit mode) could improve these results.

4.4 POTENTIAL IMPACT OF HOVS AND HYBRIDS ON MNPASS LANES

In identifying a potential MnPASS tolling lane system, our basic assumption is that all traffic will pay tolls to access the MnPASS lanes, except for transit vehicles. The two exceptions are for I-394 and I-35W south, where HOV lanes already exist. These HOV lanes will be converted to HOT lanes, with HOVs and transit vehicles continuing to enjoy free access. Mn/DOT expressed interest in a limited off-model analysis to address the potential impacts of allowing HOVs and/or hybrid vehicles free access into **all** MnPASS lanes. This strategy provides additional incentives to HOV formation and hybrid use.

Key Issues

In framing the analysis, we considered these questions:

- How much of current traffic flow is represented by HOVs and hybrids?
  - The Metropolitan Council 2000 Travel Behavior Inventory found that 42 percent of all trips in the seven-county area are carpools. However, when considering just home-based work and work-related trips (which are more likely to use MnPASS lanes), only eight percent of all trips are carpools.
  - According to 2003 data, Minnesota ranked nationally in the bottom 30 states for hybrid vehicle registration (fewer than 600 registered hybrids).
- How much will that relationship change over time?
  - Carpooling in the seven-county metro area has been declining. The Metropolitan Council 1990 Travel Behavior Inventory found that 44 percent of all trips were carpools (declining to 42 percent in 2000) and that 11 percent of home-based work trips were carpools (declining to eight percent in 2000). For the entire state of Minnesota, work-related carpools have also declined – from 13.4 percent in 1990 to 11.8 percent in 2000. However, the regional travel demand model forecasts increasing HOV usage over time. In the No Build condition, the percent of total VMT attributable to HOVs is predicted to grow from 2.3 percent in 2010 to five percent in 2030.
  - In 2003, total U.S. hybrid vehicle registrations saw a 25.8 percent increase compared with 2002. Since the introduction of hybrid vehicles in model year 2000, hybrid vehicle sales have increased over 570 percent with a compound annual growth rate of 88.6 percent. J.D. Power and Associates expects U.S. consumers to purchase approximately 350,000 hybrid vehicles annually by 2008.
- What impact might a policy that allows HOVs and hybrids in a MnPASS system for free have on HOV and hybrid makeup in traffic?
  - In Virginia, the number of vehicles registered with special clean fuel plates has risen dramatically since hybrids were allowed to drive in the HOV lanes on I-95, I-395, I-66, and the Dulles Toll Road in Northern Virginia. Without including travel time savings, the literature suggests that it would take hybrids roughly 333,000 miles until the cost savings (gas) recoups the higher purchase cost. Anecdotal evidence suggests that hybrid access to the HOV lanes has contributed to spurring hybrid sales. Virginia is planning to abandon its experiment to allow hybrid vehicles into Northern Virginia's HOV lanes because the policy has been so successful at attracting hybrids that it is congesting the HOV lanes.
  - There is conflicting literature on whether HOV lanes actually increase carpooling mode share. However, a policy of allowing HOVs to drive for free in special lanes does reward carpoolers and may encourage the formation or enhancement of regional ride-sharing programs particularly in areas of extreme congestion.

- How will hybrids and HOVs impact traffic and revenue on the toll lane system?
  - Hybrids and HOVs would switch into MnPASS lanes as part of their normal driving. There would be less room for paying customers, so SOVs would be shifted out (by means of a higher toll rate) to ensure that the lanes can still flow smoothly. We could also expect hybrids and HOVs to change their routes and make more/longer trips to take advantage of the MnPASS lanes.
  - The effect on net revenue is unclear, since there will be fewer paying customers but they will be paying higher toll rates. The effect on net revenue ultimately depends on the mix of paying and nonpaying customers.
  - The 2030 analysis showed that HOVs are expected to virtually fill up the proposed I-35W HOT lanes. Although there would still be some room for paying customers in 2010, the analysis of the I-35W HOT lanes indicates the extent to which carpools limit the revenue potential without cutting back significantly on the costs of operations.
- What are the operational issues?
  - Toll collection and enforcement become extremely difficult when the system has to distinguish SOVs from HOVs and hybrids. HOVs and hybrids could be given a transponder device that prevents tolls from being charged, but there is no simple way to prevent such a device from being used by drivers when traveling alone or in a nonhybrid vehicle. Enforcement also becomes complicated because law enforcement agencies would have to verify hybrid or HOV status for nonpaying customers. It is possible that emerging technologies in HOV screening could help simplify enforcement issues in the future.
- What are the institutional or legal issues?
  - Allowing hybrids into HOV lanes built with Federal funds (e.g., I-394 and I-35W) violates current Federal law. Because of the reduced emissions and improved fuel economy of hybrid vehicles, Arizona, California, and Virginia have all sought Federal approval to allow hybrids in HOV lanes.[13] All three versions of the Federal highway reauthorization bill that failed to pass Congress last year would have changed the law to allow highly fuel efficient vehicles, such as hybrids, into the HOV lanes. We do not know whether any provision will be included in the reauthorization legislation which ultimately passes.

[13] Although Virginia law now allows hybrids in HOV lanes, the Commonwealth has never received approval from the Federal Highway Administration for this practice.

- Allowing hybrids free passage on HOV lanes also raises equity issues, perhaps even more so than the issues raised by toll lanes. Hybrids cost several thousand dollars more than comparable non-hybrid vehicles. In effect, allowing hybrids into HOV lanes is just another means for allowing people to choose to pay for improved travel conditions, just like MnPASS lanes. However, unlike MnPASS lanes which operate on a pay-as-you-go basis, purchasing a hybrid requires a significant upfront capital outlay which is more likely to limit the universe of users to higher-income drivers.

Summary

From a policy perspective, allowing HOVs and hybrid vehicles free access to travel time savings supports the environmentally beneficial policies of encouraging carpools and hybrid utilization. However, unlike HOV lanes (which cannot be accessed by SOVs), the MnPASS lanes can also be accessed by paying a toll. The tradeoff for MnPASS users becomes the toll cost versus the purchase cost of a hybrid or the lifestyle/flexibility cost of a carpool. Because the toll cost is relatively small, it is unclear whether granting free MnPASS access will actually encourage new HOV formation and hybrid utilization.

From a traffic perspective, the number of HOVs and hybrid vehicles using MnPASS lanes cannot be managed through dynamic toll rates. Allowing free passage to these vehicles therefore limits Mn/DOT's ability to use MnPASS lanes as a traffic management tool, since the MnPASS lanes could become congested with HOVs and hybrids. High numbers of HOVs and hybrids would also limit the effectiveness of integrating MnPASS lanes with Bus Rapid Transit, since BRT needs to operate without congestion.

In deciding whether to implement this policy, Mn/DOT should weigh the impact on MnPASS traffic, revenue, and operations against the anticipated benefits in encouraging or rewarding hybrid and HOV use. Mn/DOT should also consider that other incentives besides travel time savings are available to encourage new hybrids and HOVs – for example, additional tax credits.

4.5 OPERATIONS AND DESIGN ISSUES

Express toll lanes are a new type of transportation "product." There are only three operating toll express lane projects in the United States. None of these operating systems have the kind of complexity envisioned in a system of MnPASS lanes, with multiple access points and lack of barrier or baton separation between toll lanes and toll-free lanes. Although similar toll lane concepts are under study in several regions of the U.S., no industry standards are yet in place. Furthermore, each region has unique considerations in terms of roadway configurations, traffic patterns, and weather conditions.

There are numerous operation and design issues associated with implementation of MnPASS lanes. What follows below is an overview of some of the main issues, and some potential direction for how these issues might be resolved – at least to the point of providing a basis for use in preparing this study.

Toll Collection Concepts

Express toll lanes require electronic toll collection. Each vehicle must carry a unique device to identify itself as a valid toll payer, and equipment in the lane is needed to record the passage of vehicles. Equipment and systems to enforce the payment of tolls is also needed. This section provides an initial discussion of toll collection and related issues such as enforcement and incident management.

Pricing Strategy

Since traffic levels vary by time of day and the MnPASS lanes must be kept free flowing under all traffic demand conditions, the system must be able to accommodate different prices at different times of day. One way to accomplish this is to publish a fixed toll schedule according to historical traffic patterns. However, it is not possible to predict with absolute certainty that day-to-day traffic will conform to historical norms and that a particular toll rate will keep the lanes free flowing.

The other approach is to use dynamic pricing, in which sensors in the MnPASS lane monitor volume and speed, and adjust prices according to a pricing algorithm. Although more complex than using a published toll schedule, dynamic pricing is better able to manage day-to-day and hour-to-hour traffic variations, and keep traffic flowing. Dynamic pricing will be used for the I-394 MnPASS express toll lane facility currently under implementation.

Toll Collection Points

There are two common approaches for assessing user charges in the United States. The first is to charge a flat rate per toll collection point, irrespective of where the user enters or exits the system. The second is to record the specific points that a customer enters and exits the system, and calculate the toll based on a predefined interchange-to-interchange toll schedule (usually oriented to a per-mile system). Under either system, it is important not to allow toll-free movements.

The MnPASS express toll lane system poses unique challenges that differ both from standard toll roads and from the HOT lane projects that are already in service. In a traditional toll road, well-defined highways and on- and off-ramps provide relatively easy opportunities to construct toll plazas or tolling gantries. HOT lanes already in operation around the nation provide single entry and exit points and single toll collection points.

The proposed MnPASS system is very different. It will have numerous access points, and will therefore need numerous locations to record the passage of cars.

Although there may be locations where barriers may be erected, the toll lanes may only be separated from the regular lanes by a double-white stripe, and the points of entry and exit to the toll lane will be simply a virtual on or off "ramp" designated by paint and signing. Practical considerations would preclude the placement of toll collection gantries on these virtual on- and off- ramps.

Therefore, toll collection points will have to be somewhere on the "mainline" portion of the toll lane. This means that tolling gantries will need to be placed across the road at every point where a vehicle may enter or exit the toll lane. The toll for each gantry could be set to represent the toll that would maximize revenue or vehicle throughput on the lane.

Equipment Needs

The tolling system will require transponder equipment in the vehicle and an overhead gantry in the lane. Communications equipment will be necessary to move data from the lanes to a central location, and a back-office system will be necessary to collect and process the transaction data. A system of dynamic message signs will provide information in advance on toll rates, so that motorists have enough time to decide whether they want to enter an MnPASS lane.

Since Mn/DOT is already implementing a toll lane system on I-394, we have assumed that the same basic system will be used. This will enable the average MnPASS user to access and utilize all MnPASS lanes without having to maintain separate accounts.

Overhead Equipment

Current technologies involve locating the antenna array serving the lane directly above the lane with vehicles driving underneath. The ideal location for mounting transponders is on vehicle windshields behind rear view mirrors. The antenna array would be mounted in close proximity to the radio frequency (RF) module which serves it, usually within 50 feet or less. In most cases, the RF modules would be mounted on the same structure on which the antenna array is mounted.

Also mounted above the flow of traffic would be a series of cameras and illuminators. These devices would be dedicated to violation enforcement and would constitute the violation enforcement system (VES). In some configurations, a VES takes a picture of each vehicle passing through the read zone and then subsequently eliminates images of any vehicles not in violation. In other systems, the VES operates only when it has been determined a violation has been incurred. In either system, the images to be saved are fed to a storage system adjacent to the gantry for later download to the back office for review and processing. In most states, special legislation is required to allow the VES photos as prima facie evidence that a violation has occurred. In addition, that legislation places the onus for the violation on the owner of the vehicle not on its operator at the time. Presently, Minnesota law does not allow VES. This could be a signifi-

cant issue in maintaining the integrity of the toll collection system, which relies entirely on electronic toll collection.

The number of antennas, RF modules, cameras, and illuminators will be a function of the coverage desired and the functions to be served.

Lane Equipment

In-lane equipment would consist of a series of detector loops and piezo-electric or similar type sensors. The detector loops would be designed to provide information about the vehicle passing above them, where the vehicle begins, where it ends, and its length as a means to classifying the vehicle. The loops would be similar in appearance to those used for traffic signals, but more sensitive. Because of this sensitivity, the loops should be installed in non-reinforced concrete pavement with a positive separation between the loops and any ferromagnetic material adjacent to the loops of three to four feet minimum to avoid false readings. Two sets of loops are generally used. One set would be located before the read zone and would provide initial data about the vehicle being tolled. These loops would be called the pre-classification loops. A second set of loops could be and often are installed for use as the vehicle exits the read zone of the lane. These loops would generate the same type of information as the pre-classification loops produce. The two sets of data would then be compared to assure consistency and accuracy of data.

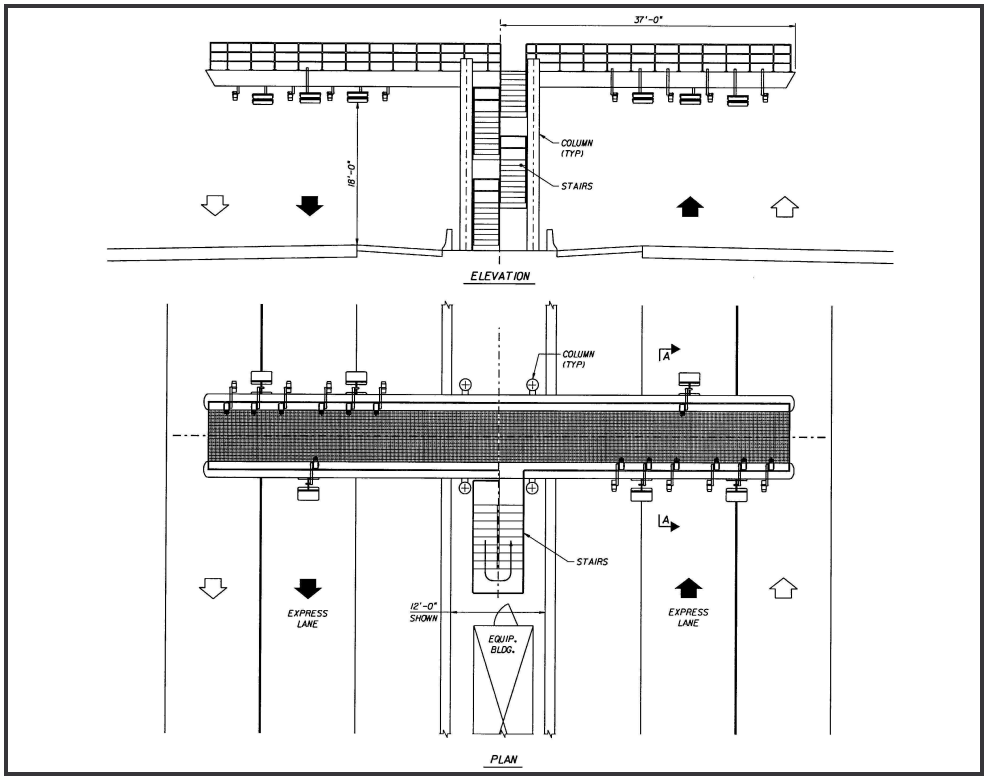
Loop detectors would also be required in the toll lanes to determine volumes and speeds to provide data to the dynamic pricing system.

Tolling Gantry Configuration

A primary consideration in placing tolling equipment in lanes to be tolled is how to maintain that equipment without interfering with the flow of traffic or creating an unsafe condition for maintenance personnel. The required antennas, RF modules, cameras, and illuminators can be mounted on conventional overhead sign structures. Accessing that equipment for maintenance and upkeep will require the use of bucket trucks thereby resulting in the closure of the affected lane to traffic. Closure will force traffic normally using that lane into the more congested adjacent lanes. In addition, setting up the lane closure when needed requires extensive planning and use of traffic control devices.

A number of agencies operating electronic toll collection lanes of the type envisioned for the Minneapolis-St. Paul area have determined that it is advisable to set up their gantries to allow for service of the gantry-mounted equipment without having to close the affected lane to traffic. These gantries provide a working platform for maintenance personnel and mechanisms to allow access to the equipment to be maintained without closing the lane below. A possible gantry design that can be implemented for the MnPASS lanes is shown in Figure 10. This gantry design draws on concepts developed by URS for the Florida Turnpike Enterprise's Signature SunPass Electronic Toll Collection Gantry.

Figure 10. Conceptual Gantry Design



Housings or enclosures for lane controllers, data processing and storage units, communications equipment, uninterruptible power supplies or standby generators, and other equipment supporting the operation of the equipment on the gantry are also needed. Depending on the systems to be provided at each gantry location, the enclosures could range from a series of traffic signal type control boxes to a small building. The exact type of housing should be a function of the equipment needed for a particular location and the environmental constraints within which that equipment is designed to operate. The housings should also facilitate maintenance and upkeep of the equipment. Since maintenance may take place in inclement weather, the gantry concept includes a small building to house that equipment. The building would be environmentally controlled and would provide a safe, protected area for maintenance personnel.

As an alternative to constructing an expensive gantry, it is possible to mount antennas, RF modules, cameras, and illuminators on existing overhead structures, provided there is adequate clearance between the roadway and equipment. These structures could include existing overpasses and existing sign structures. However, this approach may have several drawbacks. First, it does not permit maintenance of the mounted equipment without closing the affected lane to traffic. Second, antennas and cameras are sensitive to vibration and existing overhead structures may not be rigid enough to permit the equipment to operate as intended. A gantry intended for electronic toll collection purposes is

designed to provide rigidity and stiffness. Third, mounting equipment on existing overpasses and other overhead structures does not eliminate the need to house equipment supporting the antennas and other equipment mounted on the existing structures.

Enforcement Issues

Since the MnPASS lane may be separated from the other lanes only by a pair of white stripes, meticulous and consistent enforcement is needed to prevent the MnPASS lane being taken over by non-MnPASS traffic. While most drivers will honor the intent of the double white stripes, the temptation to use the MnPASS lane will be high. A persistent law enforcement presence and observation of the usage of the lane is a necessity.

The lack of physical separation between the MnPASS lane and adjacent lane could pose another enforcement challenge as well. Drivers using the MnPASS lane could avoid paying the toll by moving across the double white stripes into the adjacent non-tolled lane to avoid the tolling gantry. This would threaten the financial stability of the MnPASS system. If photographic images could not be used as prima facie evidence of a violation, a physical law enforcement presence would become crucial for enforcement. Weaving from lane to lane to avoid the gantries would also increase the risk of crashes.

The I-394 HOT lane project will enhance the enforcement capabilities of the law enforcement agencies through the use of enforcement transponders, mobile enforcement readers, and enforcement beacons. These devices will allow roving patrol officers to determine whether drivers in the MnPASS lane have paid a toll. On the HOT lane portions of the system, the officers will visually assess whether a vehicle has one or more occupants, so as not to charge HOVs with a toll violation offense.[14]

Surveillance and Crash Removal Issues

The success of the MnPASS system is highly dependent on the ease with which drivers can use the MnPASS lanes. Any impedance to entrances and exits will discourage motorists from using the lanes. Vehicles blocking a MnPASS lane, whether from mechanical malfunction or from crashes, will be the most serious deterrent. The swift removal of these vehicles will be critical to the success of the MnPASS lanes. Road patrols, circulating tow trucks, and other common means of addressing the problem of disabled vehicles will not provide the quick response that will be required. Real-time or near real-time information is needed so that blocked lanes can quickly be cleared. Prior to implementing the MnPASS

[14] Further details on the I-394 enforcement scheme can be found in the I-394 Community Task Force Final Report, at http://www.dot.state.mn.us/information/mnpass/394/finalreport.html.

system, Mn/DOT should ensure that the camera coverage now provided by the Traffic Management Center (TMC) can identify blockages as they occur and trigger the appropriate response from authorities. These cameras might also assist in monitoring lane violations. The monitoring staff could then notify the appropriate law enforcement agency to observe the suspect activity and to take appropriate action. It may be necessary to provide additional monitoring staff for this purpose.

System Connections

This study assumed that direct system connections should be provided, whenever possible, between the MnPASS lanes on one highway and the MnPASS lanes on another. Ideally, MnPASS users would not have to exit the toll lanes, merge with other vehicles in the interchange, and then re-enter the MnPASS system.

However, system connections are extremely costly. Omitting them would result in substantial cost savings, but would also reduce the effectiveness of the system. Moreover, without direct connections, autos and buses would be required to weave more frequently across the general purpose lanes to access the MnPASS lanes. This increased merging and weaving has safety and congestion implications that are not captured in the Metropolitan Council's travel demand model, and would be better studied in an advanced corridor simulation.

One potential alternative to direct system connections is to allow MnPASS users to bypass the ramp meters that control many of the interchanges in the Twin Cities metropolitan region. At several locations, HOVs are already allowed to bypass the ramp meters via a separate lane. Using these bypasses would significantly reduce the cost of system connections; however, enforcement would be a major issue. It is not possible to model ramp meter bypasses in the Metropolitan Council's travel demand model – more detailed corridor simulations are needed to capture these effects.

Ultimately, the decision as to whether system connections are desirable should be made on a case by case basis.

Assumptions Regarding Buffer Zones

An important consideration in the design of an MnPASS lane is the treatment of the transition between the general purpose lanes and the MnPASS lanes. The general purpose lanes will often be operating under congested, reduced-speed conditions, and the MnPASS lanes will be managed to be always free flowing. The resulting speed differential is a potential safety concern. One way to address this concern is to create a buffer zone between the two types of facilities large enough to allow for acceleration, deceleration, and merging/weaving. The ideal buffer zone would be 10 feet; however it may not be realistic to assume that full 10-foot buffers can be provided in all locations.

For purposes of generating a cost estimate, URS prepared typical cross sections and applied them to each of the highway segments studied in Concept A. In addition to considering other factors, these cross sections assumed different buffer widths based on the prevailing conditions expected to be in place at the time of MnPASS lane construction. The rationale for choice of buffer widths for different segments is described below.

- For segments 494-b and 494-c most bridges are long enough to accommodate a fourth lane, therefore an additional 10-foot buffer and a fourth lane is an unrealistic expectation. In these segments the buffer width was assumed to be two to three feet.
- For segment 694-1, the widening was assumed to be to the outside. The existing inside shoulder is 15 feet wide. URS reduced the inside shoulder width to 11 feet and allocated four feet to the buffer.
- For segment 694-2, it was assumed for this study that the 10-year work program will add a third lane to the outside by 2013 (the segment has recently been removed from the Mn/DOT Ten-Year Work Program). MnPASS will add a fourth lane to the inside. The assumption is that Mn/DOT will provide a wide enough median to provide a 10-foot buffer.
- For segments 35W-3 and 35W-8, HOV lanes will be converted to HOT lanes similar to I-394. A minimum of a two-foot buffer would be possible. Mn/DOT's current proposed section for 35W provides a 14-foot HOV and a 13-foot enforcement lane. These widths could be adjusted at little or no cost.
- Segments 494-a, 494-d, 36-1, 35E-1 and 35E-2 are in the TPP and are planned for construction in the distant future (2014-2030). In these segments, URS used the Mn/DOT concept plan and the TPP cost. The additional lane would be "taken away" and converted to a MnPASS lane.
  - The MnPASS incremental cost in these circumstances is equal to a 25 percent risk factor multiplied by the sum of the construction, project delivery, and right of way costs. The construction cost is calculated as the cost of a 10-foot buffer, plus the cost of gantries, plus the cost of connections. The project delivery cost is simply 20 percent of the construction cost.
- In all other segments, buffer width varies between two feet and four feet. Most of the concepts involve widening to the inside, and increasing the width of the buffer significantly increases costs.

These assumptions were developed to provide a reasonable basis for cost estimating, without addressing detailed design issues. Their inclusion in this document does not indicate Mn/DOT's intention to build lanes to these standards. Before any MnPASS projects would be developed, it would be necessary to develop design standards in cooperation with the Federal Highway Administration.

4.6 SUMMARY OF TECHNICAL FINDINGS

MnPASS lanes are a new transportation "product" that provides new capacity that will not fill up with congestion, as long as tolls are charged and effective enforcement and operational policies are in place. Few other transportation strategies can accomplish this.

However, our analysis shows that these lanes require significant public investment. On average, 22 percent of the regional MnPASS system capital costs could be expected to be recovered from tolls if the toll lanes are built "from scratch" in accord with the Concept A-1 method of looking at costs. Under the Concept A-2 view of costs – i.e., that the lanes be built in conjunction with the Transportation Policy Plan, the cost recovery ratios are much better. There are, however, only a few highway widening projects in the TPP.

The projects that we found to be the most financially viable are not in the Transportation Policy Plan. They are projects on the outskirts of the metropolitan area that provide a combination of relatively low cost and relatively high demand. The financial viability of projects decreases considerably as the projects get closer to the urban core – the result of the high cost of building in these denser areas. Advancing these projects that are not in the TPP would require modifying the TPP. Since these projects are not self-supporting, advancing them would likely mean that other projects that are already in the plan would have to be delayed.

The projects that are in the TPP also require an infusion of public investment. Therefore, these projects are also likely to be many years away in terms of potential implementation.

MnPASS projects on two corridors (I-394 and I-35W in the south) envisioned converting existing or planned HOV lanes to HOT lanes. Our analysis assumed that the HOVs would continue to be defined as two or more people in a vehicle. Under those conditions, we found that HOVs would occupy most of the managed lane capacity during the peak travel periods, leaving little room to be sold to SOVs by 2030. We have not conducted an independent assessment of the HOV forecasts that are generated by the Metropolitan Council's travel demand model. However, it is reasonable to assume that as traffic grows, so will use of the HOV lane by HOVs, so the concern is real. If HOV to HOT lane conversion is pursued, Mn/DOT should build in some flexibility in the definition of HOVs, from today's 2+ standard to a future 3+ standard or transit vehicle-only standard.

Finally, several technical issues should be understood when reviewing these findings:

- **Peak Spreading.** The current model assumes the same distribution of traffic over the course of the day as is evident today. It is reasonable to expect that over time, as congestion grows, the duration of peak traffic conditions will lengthen. This means that the demand for the proposed toll lanes will be

higher in time periods that are not now currently congested, which means that the revenue estimates in this memo may be understated. The Metropolitan Council plans to develop a peak spreading model in the near future, which would help address this issue.

- **Fixed Trip Tables.** The Metropolitan Council's mode choice model iterates back through the trip distribution component, resulting in dynamic trip tables that vary between the No-Build and Build scenarios. While it is probably more behaviorally accurate to use this module and have the distribution of trips to origins and destinations change, the Round 1 models never achieved equilibrium due to the inclusion of trip distribution, and the results produced using the variable trip table were unstable. The Round 2 models were run using a fixed trip table (i.e., only iterating additional toll rates from mode choice through the assignment component). Using fixed trip tables is consistent with historical practices in the industry, and is reasonable for use in this study. However, this approach may underestimate the increase in travel demand and resulting congestion if MnPASS lanes were implemented.
- **System Connectivity.** Measures of travel demand were modeled based on entire systems that are more extensive than individual segments built separately. Modeling individual segments separately would produce different (probably lower) levels of travel demand.
- **Recreational Traffic.** Some facilities, such as I-94 between the Fish Lake interchange and Rogers have heavy traffic flows related to recreational traffic that occurs outside of the normal weekday pattern. These recreational travel patterns are not accounted for in the travel demand model. This means that corridors with high recreational usage may have higher demands than indicated in this report.
- **Enhanced Bus Services.** MnPASS lanes can provide enhanced bus or bus rapid transit service. We did not modify the bus networks to take full advantage of these potential synergies. Improved bus services could reduce the demand for paying toll traffic in the MnPASS lanes but provide a high level of service to transit users.
- **Traffic Operations Issues.** One of the most common causes of recurring congestion is bottlenecks caused by merges, diverges, and weaves, particularly around interchanges. The regional model does not take these conditions into account, and potentially underestimates the congestion and delay that might actually occur on the system.
- **Regional and Corridor Traffic Growth.** The traffic growth rates used in this study relate directly to those in the Metropolitan Council's travel demand model. We have not conducted an independent assessment of these growth rates, which would be critical for studies that rely on toll revenue to pay back bonds or loans.

- **Transportation Network Improvements.** Our analysis was conducted entirely on the basis of projects expected to be in place by 2013, in accord with the 10-year Comprehensive Work Program (CWP) in place at the time the study was done (fall/winter 2004). Alternative assumptions regarding transportation network improvements in the Twin Cities could change the traffic demand estimates in particular corridors. We also assumed that projects in the CWP could not be converted to MnPASS lanes. Some members of the Steering Committee would like to change that assumption, which would in turn change the results of the study.
- **Ramp Metering.** Access to most freeways in the Twin Cities metropolitan area is controlled by ramp metering, the intent of which is to optimize traffic flow. The MnPASS toll lanes rely on a speed differential with the general purpose lanes to provide the value for the money spent on the toll. The Metropolitan Council's travel demand model used in this MnPASS system study does not account for the effects of ramp meters. Changing the ramp metering algorithm or policy would affect freeway congestion levels and travel demand for MnPASS toll lanes.

4.7 IMPLICATIONS OF TECHNICAL FINDINGS

The findings of the Round 2 analysis were presented to the Technical Group and Steering Committee on January 28, 2005. These groups felt that there should be less emphasis on the immediate financial feasibility of individual segments or systems of segments, and more attention to an ultimate long-range system of MnPASS lanes in the Twin Cities region that would be built over time.

These two groups also felt that using financial payback criteria as a means of project selection was unusual in a metropolitan or statewide transportation planning context, since traditional highway projects do not contribute a revenue stream. Transit projects are different, in that they do generate revenue to help pay operating costs. Despite the finding that the MnPASS toll lane projects do not seem to be able to be self-supporting, the idea that they can pay back some of their capital costs (lane construction costs and MnPASS incremental costs), albeit at the 22 percent level on average, is actually much more than any other type of capacity project can produce.

Another way to look at the financial potential of the MnPASS system is to consider the ability of the system to cover the incremental cost of building MnPASS lanes over and above the cost of building the lanes as traditional (non-tolled) lanes. Of the $3.5 billion in construction cost to build Concept A from scratch, about $0.6 billion is attributable to the incremental cost of making these lanes ready for MnPASS. This is the cost of buffer zones, gantries, and system connections. This amount is just about covered by the estimated $0.7 billion in net toll revenue expected from the MnPASS lanes (over and above operating costs, and discounted). The implication of these numbers is that we would expect the toll revenue from MnPASS to cover the incremental cost of building

MnPASS, but would not provide significant dollars to the region's highway funding needs.

Because this study has shown that the financial benefits from MnPASS lanes are relatively small, the Technical Group and Steering Committee came to view MnPASS as a long-term traffic management solution rather than a way to accelerate projects through toll revenue financing. The revenue generating aspects of these projects were more of a side benefit. They also saw the potential long-range benefits of MnPASS to the Twin Cities' transit system.

With these findings and reactions in mind, the Round 2 results were used as a stepping stone to outline a broader vision of how the MnPASS concept could be integrated into the Twin Cities' long-term transportation system. This potential vision is described in the next section of this report.