

Principal Arterial Study FOR THE TWIN CITIES METROPOLITAN AREA Summary and Conclusions



**A Metropolitan Council/MnDOT Staff Report
Publication No. 35-08-043**

June 2008

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Principal Arterial Study Summary and Conclusions

INTRODUCTION

The Principal Arterial Study was undertaken to answer a number of questions that had surfaced as the Metropolitan Council prepared the 2004 update of the *2030 Transportation Policy Plan* (TPP). The plan requires that:

“The Council, working with the Minnesota Department of Transportation (Mn/DOT), the counties and cities, will conduct an analysis to determine highway needs on Principal Arterials and “A” Minor Arterials to accommodate the region’s growth to 2030. This analysis will include the need for new and/or expanded Principal Arterials, and new or expanded “A” Minor Arterials. The 2030 Transit Plan defined in this document [the 2030 TPP] will be assumed in place for the purpose of the analysis. Mn/DOT’s Transportation System Plan (TSP) will be utilized to the extent possible.”

The Council, Mn/DOT Metro and Mn/DOT Central Office agreed to conduct the study jointly. The analysis was largely conducted by staff. The Council’s Transportation Advisory Board (TAB) and the TAB’s Technical Advisory Committee (TAC) appointed both policy and technical task forces to advise staff during the study. The Policy Task Force was made up of TAB members. The Technical Task Force was made up of TAC members, a representative of an adjacent Mn/DOT district and a representative of the Wisconsin DOT.

The analysis included three major steps:

1. Twelve themes were defined. Each one represented a different way to improve the system of Principal Arterial roadways in the seven-county metropolitan area. Each theme used the 2030 socioeconomic forecasts for the region.
2. Each theme was analyzed for its potential impacts on the system and compared to the existing system. At least two themes included new Principal Arterials that had been requested during the 2004 TPP update and the subsequent Mn/DOT Statewide Functional Classification Study.
3. Ultimately, the analysis of themes led to the development of four general approaches to improving the Principal Arterial System. Each approach was analyzed; this report compares the costs and benefits of each approach.

The analysis resulted in a number of conclusions:

- The region will never have sufficient resources to build a system of Principal Arterials to accommodate future growth, given the design assumptions used today to plan major highway expansion projects.
- The cost to provide a congestion-free Principal Arterial System is 20 times the amount available for expansion projects in the 2030 TPP. Achieving system-wide reductions in congestion will require a level of funding much higher than forecasted.
- The region should focus its investments on low-cost/high-benefit projects that help mitigate existing congestion and safety problems.
- Alternatives to congestion can be provided with bus-only shoulders, priced dynamic shoulders and the addition of MnPASS lanes.

Designating New Principal Arterials

In the Developing Area, as defined by the Council's *2030 Regional Development Framework*, the Council's arterial spacing policies make designating additional Principal Arterials problematic. The TAC Planning Committee was asked to review and suggest policy changes to address this. In addition, the committee reviewed how access to the Principal Arterial System should be managed when a Minor Arterial roadway is upgraded to a Principal Arterial.

Mn/DOT requested the Council to reclassify five highways to Principal Arterials as part of the Statewide Functional Classification Study. One was determined to be a technical correction and was incorporated into the new Regional Functional Classification Map prior to review by the Principal Arterial Technical Task Force. The other four were reviewed by the Principal Arterial Technical Task Force.

The technical task force recommended TH 55 west of I-494 and TH 101 north of I-94 be reclassified as Principal Arterials. These changes will be incorporated into the draft 2008 update of the TPP now being prepared. The task force concluded that TH 3 in Dakota County and TH 10 in Washington County should not be reclassified at this time.

Analysis of Themes

The main thrust of the work was to define and evaluate Principal Arterial improvement "themes," based on a number of criteria and characteristics. The analysis began by defining a base-case highway system. The base case was the existing highway system and the additions and improvements provided for in the 2007-2010 Transportation Improvement Program (TIP).

The base case also included region-wide transit system improvements that would be possible with the increased transfer of the Motor Vehicle Sales Tax (MVST) from the state's General Fund to Transportation, passed by Minnesota voters in November 2006. The service additions, in aggregate, would increase the region-wide share of trips taken on transit from 1.6% to 2.2%, a growth rate of approximately 38%.

In Phase 1 of the analysis, seven themes were defined. Each theme consisted of certain types of improvements and/or additions to the Principal Arterial System. The improvements were either assumed region-wide or made to a specific subregion. The evaluation measured the system-wide effectiveness of the theme. Key factors analyzed were congestion, safety, cost and regional equity. The themes exhibited a range of system-wide or subregional impacts, but these were limited due to the size of the system, its use and the limited investments of each theme.

Phase 1 themes were then eliminated or modified and new themes were added for Phase 2 of the analysis. In Phase 2, seven themes were again analyzed and evaluated for their impacts on congestion, safety, cost and regional equity.

The analysis showed various themes had certain strengths, while others consistently performed poorly in comparison. Two themes exhibited the most significant level of system-wide benefits: these were called the Region-wide Priced System and Fix Congestion.

ANALYSIS AND COMPARISON OF FOUR PLAN APPROACHES

At this point in the study, staff suggested that the focus of the work shift from the original objective of “developing highway project priorities and an implementation program” to defining alternatives to be used in developing options for the draft TPP. This work would define and describe alternative approaches to the highway system.

The four approaches studied further were:

- Existing TPP
- Low-Cost/High-Benefit Projects
- Region-wide Priced System
- Fix Congestion

The second alternative was based on the low-cost/high-benefit projects that were initially developed in late 2006 and early 2007 as part of the work on the region’s Congestion Management Process/Plan. The basic characteristics of the four approaches are recorded in Table 1.

The four alternative approaches are based on different philosophies of how to address the future highway system needs; they result in a range of impacts, both positive and negative. They also represent a wide range of investments. This contrast is valuable for comparison purposes as the TPP is developed.

Table 1
Comparison of Approaches
Characteristics

<u>TPP/TSP</u>	<u>Low Cost/High Benefit</u>	<u>Priced System</u>	<u>Fix Congestion</u>
Commitment to specific large projects	Widely disbursed, low-cost projects	Provides congestion-free alternative	Region-wide distribution of major investments
Geographically focused due to limited resources	Assumed/required design exceptions	Concentrated investments create a system that responds to congestion	Significant benefit to Minor Arterial System due to shift of traffic to PAs. Will probably shift trips off collectors to minors but this hasn't been modeled
LOS design assumes a congestion fix		Assumes lanes are always added and not "take aways"	
Due to increased cost of preservation and expansion, fiscal constraints not met	Planned level of investment fiscally constrained over 22-year period at \$1.5 billion	Approach not intended to be fiscally constrained	Approach not intended to be fiscally constrained

The four alternative approaches are summarized and compared in the section below.

1. 2030 Transportation Policy Plan (2004 Update) – Fig 2

This is the region’s present plan and is in close agreement with Mn/DOT’s Transportation System Plan (2005). The forecast year is 2030, the same as the other three approaches.

The origins of the plan date back to the 1970s. The intent at that time was to accommodate added traffic on Interstate-type highway facilities, which were extremely successful in meeting the needs of U.S. cities after World War II. Post-war congestion was reduced as the Interstate System was built.

In subsequent years, the number of vehicles on public roadways increased considerably. The population was booming, more people obtained a driver’s license, and households purchased more vehicles. Together with the spread of development, these factors led to decreases in transit use. Highway funding did not allow construction to keep up with the demand. Congestion grew as the capacity of the Interstate Highways was absorbed by increasing demand.

By the 1990s, federal policies changed and required the preparation of fiscally constrained transportation plans. The cost of planned investments had to match the level of “reasonably projected future transportation revenues.” In the metro area, the TPP had to be cut by about \$2 billion to meet this requirement. It was clear future traffic could not be accommodated without significant increases in revenues or changes in travel behavior. The goal of accommodating added travel was changed to attempting to reduce the rate of increasing congestion. Due to the size of these major investments and the limited resources, few areas in the region would see relief from congestion.

The plan today allocates a little over \$2 billion through 2030 for major expansion projects. While these projects reduce congestion significantly in their immediate area, they have little system-wide impact on congestion or speeds.

2. Low-Cost/High-Benefit Investments – Fig. 3

This alternative allocates funds to low-cost/high-benefit projects. The intent is to make spot improvements that will lessen congestion and/or reduce accidents at specific locations. The recently completed projects that characterize these investments are the short length of lane additions at TH 100 and Cedar Lake Rd., I-94 in the vicinity of 3M in Maplewood, and I-394 westbound from TH 100 to TH 169 (see Table 2, below).

Table 2

Low Cost/High Benefit Examples

	Project Cost (dollars in millions)	Reduction in Annual Hours of Delay	Daily Peak Period Vehicle Flow Increase	Increase in Peak Period Speeds
I-394	\$2.6	87,000	4,650	30 mph in PM
I-94	\$10.5	139,500	3,200	40 mph in AM 25 mph in PM
TH 100	\$7.1	1,063,500	14,450	45 mph in AM 30 mph in PM

The philosophy is to identify specific problems on the system and to design solutions that are relatively cheap and can be implemented in a short length of time. The projects smooth traffic flow and increase the effective use of the design capacity of a given highway segment. The objective is not to provide significant capacity increases.

The comprehensive list of potential projects used to develop the low-cost/high-benefit approach was developed in steps. The first list had a cost cap of \$15 million and did not require an environmental document. The second search increased the cap to \$30 million and included the 12 major expansion project areas of the TPP. Finally, the potential dynamic shoulders identified in the federal Urban Partnership Agreement (UPA) proposal were included. These were not capped at \$30 million.

In some cases a design exception may be needed to implement these projects. This means the Federal Highway Administration would have to give Mn/DOT permission to spend federal money to do a project on an Interstate if the project is not consistent with the existing design standards.

Due to the low cost of each project, many problem areas throughout the region could be addressed over the next 20 years to 2030. The approximately 185 projects have an estimated cost of \$1.7 billion.

While the illustrative list of projects identified and evaluated are all on Trunk Highways, if this alternative were to be adopted by the region, a new prioritization process would be developed that would evaluate County State Aid Highways and

Municipal State Aid Highways to find the most cost-effective projects. The funding sources for such a mix of projects would have to be defined.

3. Region-wide Priced System – Fig. 4

This approach is based on a network of MnPASS-type system investments. Mn/DOT, working with a TAB Policy Task Force, analyzed various priced facility investments. The MnPASS system recommendations are strongly supported by Mn/DOT and the Council. The operational characteristics of these facilities are the same as the I-394 MnPASS Lane. This approach, as evaluated in this study, includes some additions to provide an interconnected system of priced lanes.

This alternative does not eliminate congestion. It provides a priced alternative in the most congested corridors in the region. The traveling public accommodates congestion in their daily lives by modifying the time they start their trips, by changing routes, by changing modes, combining trips or eliminating trips. Priced highway lanes add one more option. Surveys find the public selectively uses these facilities when a trip must be taken at a certain time and the normal accommodations noted above are not adequate. In these cases, the single-occupant-vehicle (SOV) driver pays to avoid congestion.

4. Fix Congestion – Fig. 5

This approach defines a set of improvements and additions to the region's Principal Arterial System so that less than 10% of the system's lane mileage will be congested for one or more hours per day in 2030. There will be a significant improvement to traffic flow on both the Principal Arterials and other highways since many trips are attracted to improved Principal Arterials from these Minor Arterials. Generally, anyone could travel at any time in any direction in the region, and will experience little or no congestion. This requires virtually every Principal Arterial to be reconstructed and/or widened.

Figure 1 is a map of the major projects that are either under construction or are in the 2007-2010 TIP. When added to the existing highway system they make up the "Base Case." Figure 2 illustrates the major projects now in the 2030 TPP. The low-cost/high-benefit projects are found on Figure 3, the Priced System on Figure 4, and Fix Congestion on Figure 5.

Figure 1

Transportation Improvement Program Base

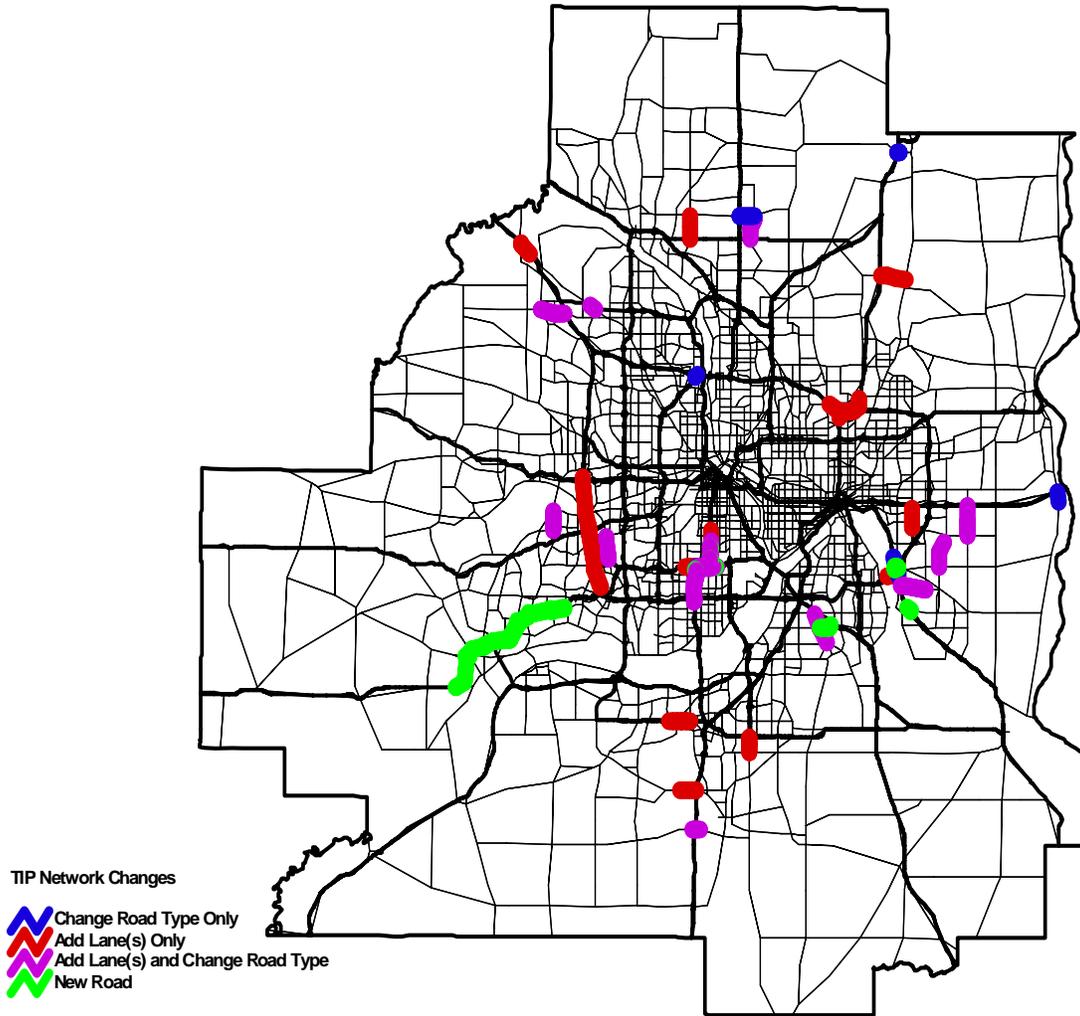


Figure 2

2030 Transportation Policy Plan Approach (adopted in 2004)

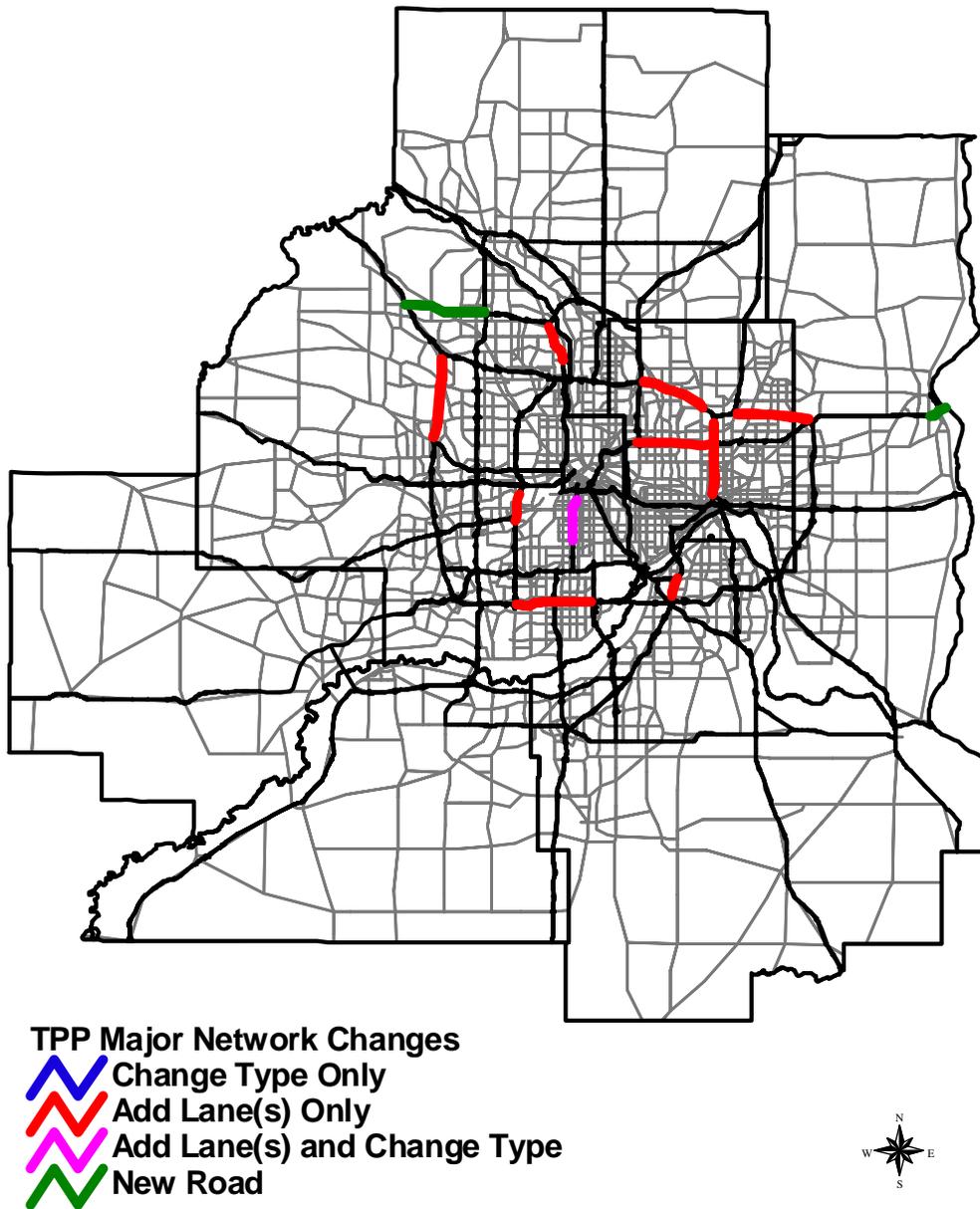


Figure 3

Low Cost/High Benefit Approach

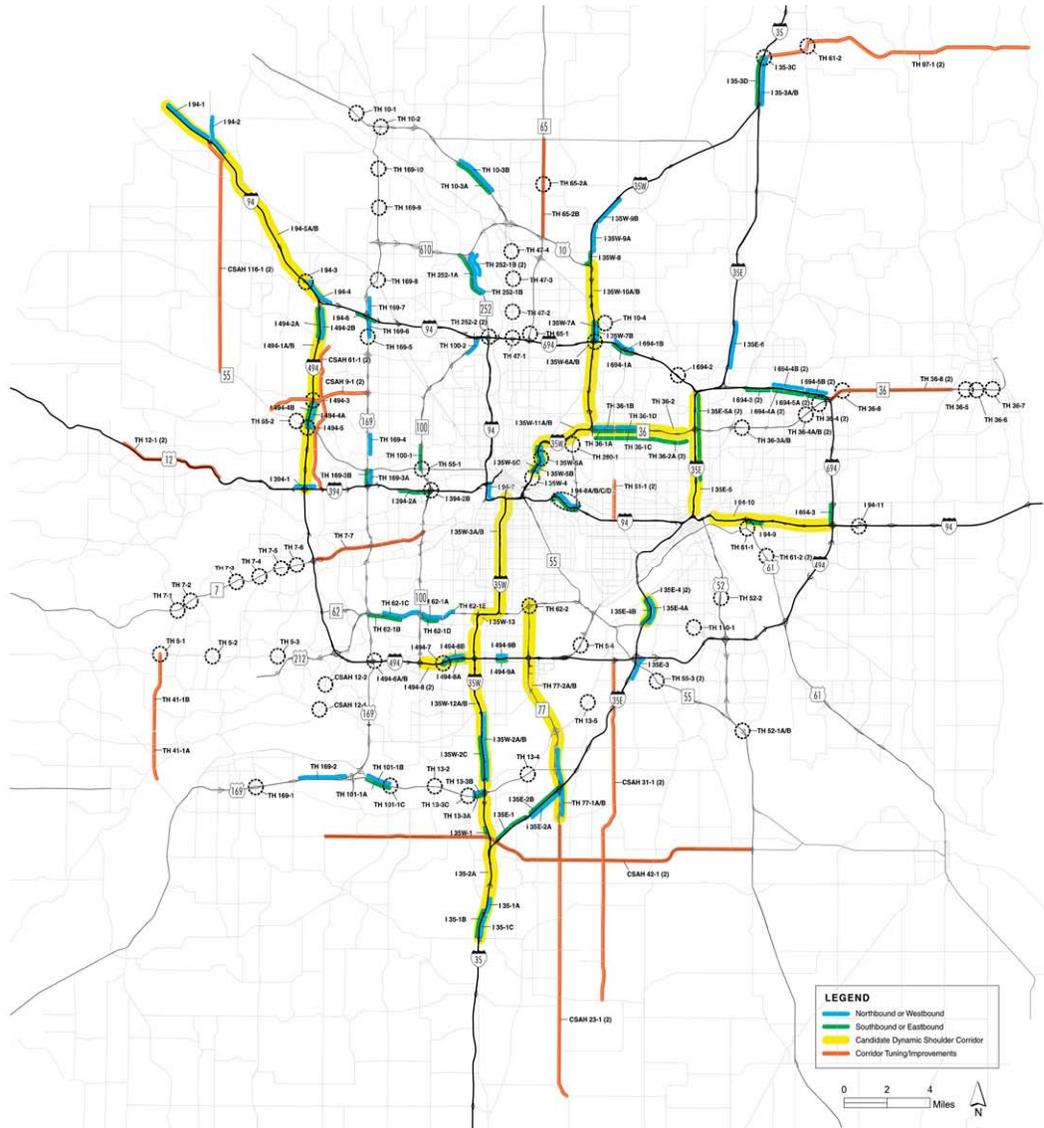


Figure 4

**Region-wide Priced System
Approach**

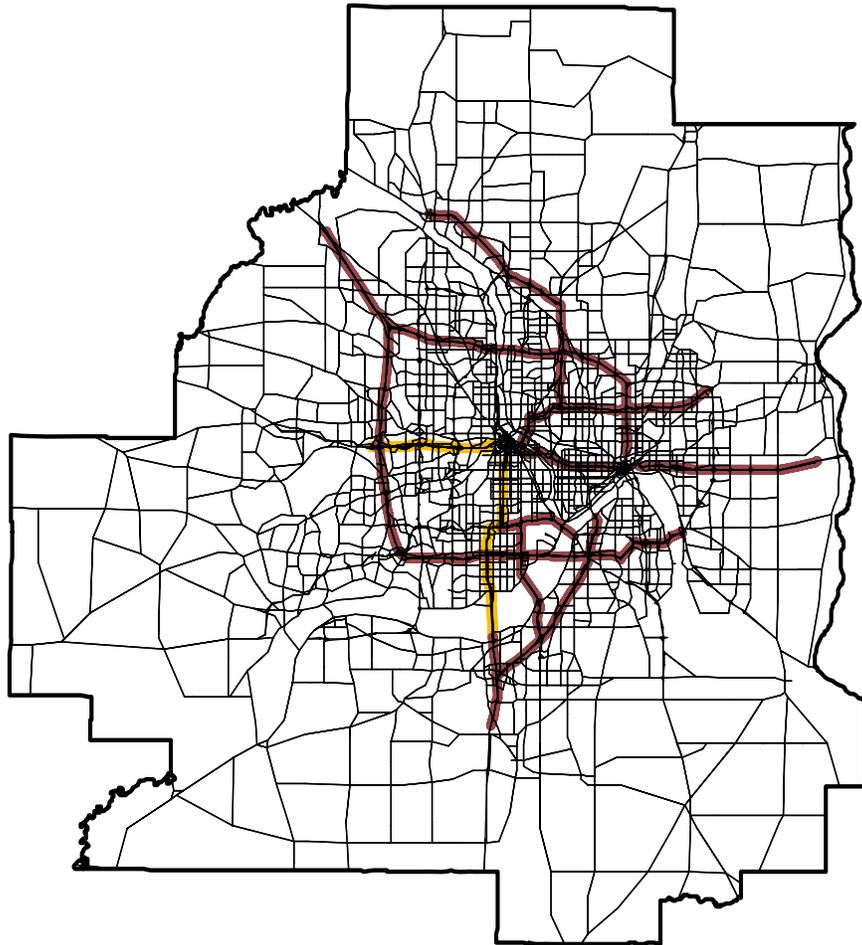
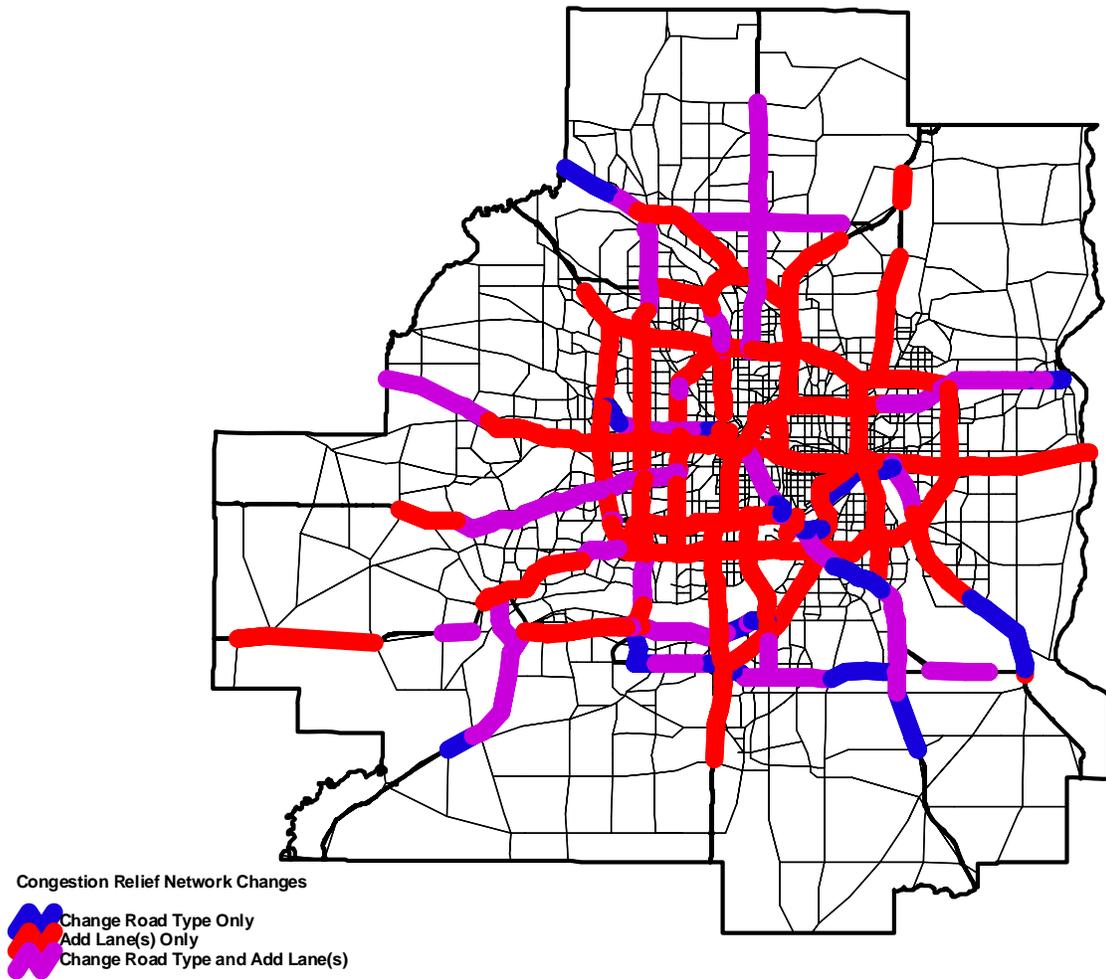


Figure 5

Congestion Relief Approach



The costs of the approaches vary widely (see Table 3). The costs are consistent with the magnitude of changes that define each approach.

Table 3

**Comparison of Approaches
Capital Cost and Existing Funding**

	TPP/TSP	Low Cost/High Benefit	Priced System	Fix Congestion
Capital Cost	\$3.0 B	\$1.7 B	\$8.0 B	\$43 B
Expansion Funds & Tolls	\$1.5 B	\$1.5 B	\$2.3 B	\$1.5 B
Deficit	\$1.5 B	\$0.213 B	\$5.7 B	\$41.5 B

The TPP approach contains the projects currently in the plan. These costs are either consistent with the TPP or were modified through more detailed project development and cost estimation. In Low-Cost/High-Benefit, projects were defined based on various criteria with a cap of \$15 M in the initial analysis and \$30 M in major expansion corridors. Some of the dynamic shoulder projects had a higher cost. The 185 projects have a resulting cost of about \$1.7 B.

The Priced System approach provides improvements where demand is sufficient to justify a priced lane. The Fix Congestion approach adds lanes and reconstructs highway segments until less than 10% of the system is congested.

In Table 4, the equivalent revenue sources needed to generate the cost of the four approaches is calculated. Mn/DOT is in the process of estimating the revenue that will be available to the state and metro area in the future and is recalculating the cost of the major projects. This will likely change the cost and available funds shown in Table 3.

Table 4

**Comparison of Approaches
Potential Source of Additional Revenue Analysis**

	TPP/TSP	Low Cost/High Benefit	Priced System	Fix Congestion
<u>Gas Tax</u>				
Metro 43.1%	8 cents/gal	---	32 cents/gal.	\$2.30/gal.
Metro 50%	7.5 cents/gal.	---	27 cents/gal.	\$2.07/gal.
<u>Regional Sales Tax</u>				
	3/10 cents	---	1.1 cents	8.3 cents
<u>Vehicle Registration</u>				
Metro 43.1%	125% of 2006 legislative proposal	---	4.75 times legislative proposal	35 times legislative proposal
Metro 50%	100% of legislative proposal	---	4.0 times legislative proposal	30 times legislative proposal
<u>Wheelage Tax</u>				
	\$52/vehicle/yr. For 22 years	---	\$144/vehicle/yr. For 22 years	\$1450/vehicle/yr. For 22 years

In Tables 5 through 9, the four approaches are compared for non-mathematical factors. Table 5 notes that only the Fix Congestion approach is inconsistent with adopted regional policy. Table 6 notes geographic distribution of the projects in each approach. The Low-Cost/High-Benefit and Fix Congestion approaches have many projects throughout the region.

Transit benefits will result from three of the four approaches (Table 7). If there were a congestion-free highway system, the use of transit by the choice rider would likely fall, which would require the public subsidy for the transit system to be increased.

The impact of the four approaches on goods movement is characterized in Table 8. The approaches have significant differences. As expected, Fixing Congestion would provide the greatest benefits to trucking since it creates a congestion-free system.

In Table 9, environmental and cultural impacts are noted. Obviously this table does not attempt to define or calculate impacts, as this would be done in an environmental analysis; it is designed to note the differences in approaches. Due to the extensive improvements needed under Fixing Congestion, it is conceivable that a number of projects could not be implemented due to the need for extensive right-of-way in the most built-up parts of the region. While the Priced System improvements would also occur in the built-up area, only one lane would be added in each direction; therefore, the right-of-way needs would be significantly less in many cases.

Table 5

**Comparison of Approaches for
Consistency with Policy**

<u>TPP/TSP</u>	<u>Low Cost/High Benefit</u>	<u>Priced System</u>	<u>Fix Congestion</u>
Adopted regional policy	Existing policy supports “management” investments consistent with approach Existing congestion management plan supports incremental investments New congestion management plan/process guidance (to date) supports concept	Pricing strongly supported by regional and state policy	Inconsistent with regional or state policy – “slow the growth of congestion”

Table 6

**Comparison of Approaches
Geographic Distribution**

<u>TPP/TSP</u>	<u>Low Cost/High Benefit</u>	<u>Priced System</u>	<u>Fix Congestion</u>
Geographically focused due to limited resources	Widely disbursed, low-cost projects	Concentrated investments create a system that responds to congestion	Region-wide distribution of major investments

Table 7

**Comparison of Approaches
Transit Impacts**

<u>TPP/TSP</u>	<u>Low Cost/High Benefit</u>	<u>Priced System</u>	<u>Fix Congestion</u>
Transit service benefits in select corridors	Potentially localized transit benefits	Congestion-free alternative for those who use transit and share rides in most congested corridors Provides congestion-free busways, BRT-type service	Negative impact on transit usage likely

Table 8

**Comparison of Approaches
Goods Movement**

<u>TPP/TSP</u>	<u>Low Cost/ High Benefit</u>	<u>Priced System</u>	<u>Fix Congestion</u>
Goods movement benefits are limited to major project travel sheds	Modest goods movement benefit, but widely distributed	Priced lanes restrict commercial vehicle use to 2 axles, 26,000 lbs.	Very supportive of goods movement, just-in-time delivery

Table 9

**Comparison of Approaches
Environmental/Cultural Impacts**

<u>TPP/TSP</u>	<u>Low Cost/ High Benefit</u>	<u>Priced System</u>	<u>Fix Congestion</u>
Major project environmental/cultural impacts concentrated in select corridors	Least impact on natural or built environment	Major project environmental/cultural impacts concentrated in select corridors	Most significant impacts on natural and built environment Most likely approach to encourage sprawl

The Regional Traffic Forecast Model was used extensively to analyze the four approaches and the 12 themes in the prior stages of this work. The model assessed the congestion impacts on the Principal Arterials and other roads. The analysis does not compare “oranges to oranges” due to the significant difference in the investment levels prescribed in each approach. The data presented below is nevertheless informative.

Figures 6 through 10, below, address the travel congestion and delay of the four approaches. The Base Case/TIP, TPP and Low-Cost/High-Benefit approaches all produce relatively modest impacts on traffic. Pricing System and Fix Congestion produce significant reductions in congestion.

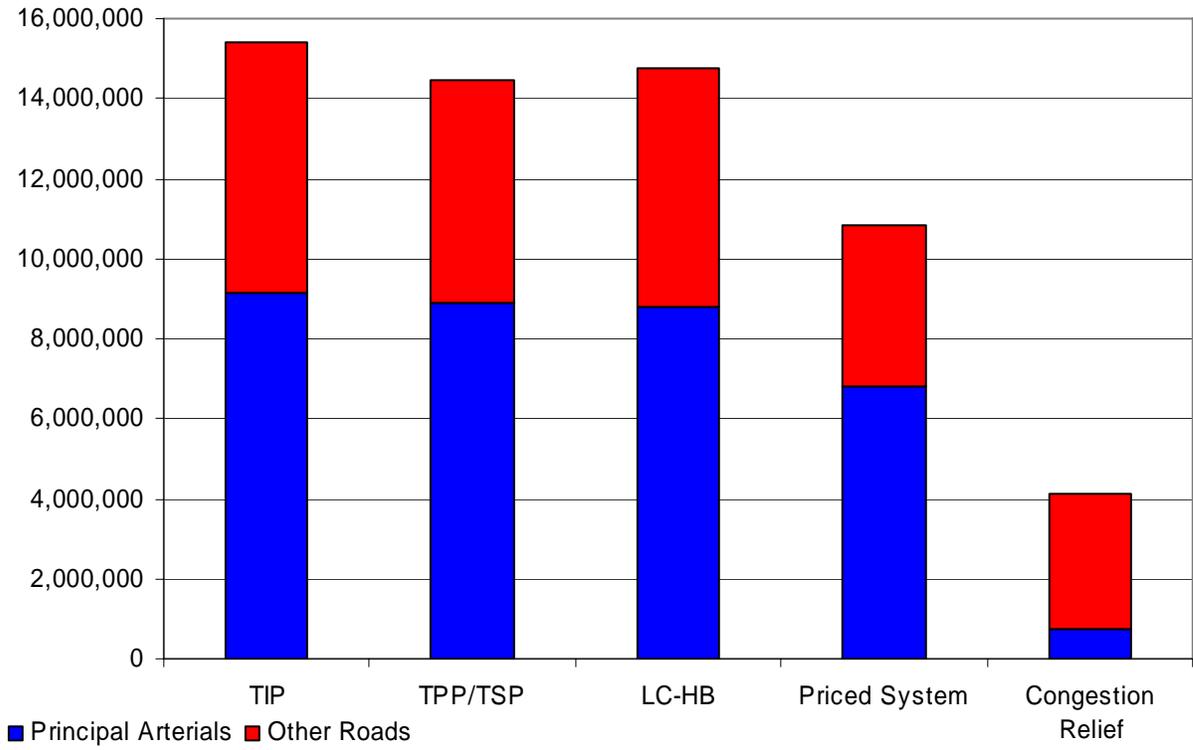
Figure 6 illustrates the reduced miles traveled in congested conditions in 2030 with the various approaches in place. Virtually all congestion on Principal Arterials is eliminated in the Fix Congestion approach and a significant amount of congestion is removed from other roads that are included in the modeled highway network.

The Priced System approach produces a significant reduction in travel in congested conditions. The priced lanes, in the most congested corridors in the region, allow a large number of people to choose to use these congestion-free lanes for a price. In turn, the adjacent lanes will be used by less traffic and will also see an improvement in congestion levels.

The TPP and Low-Cost/High-Benefit approaches produce about the same level of improvement.

Figure 7, Vehicle-Hours Traveled in Congested Conditions, shows a pattern very similar to that shown in Figure 6, Vehicle-Miles Traveled in Congested Conditions*, as would be expected since these measures are closely related. This is also true of Vehicle-Hours of Delay, illustrated in Figure 8.

Figure 6
**Vehicle Miles Traveled in
 Congested Conditions ***



* Congested defined as Volume/Capacity = 1 or greater

Figure 7
**Vehicle Hours Traveled Daily
in Congested Conditions**

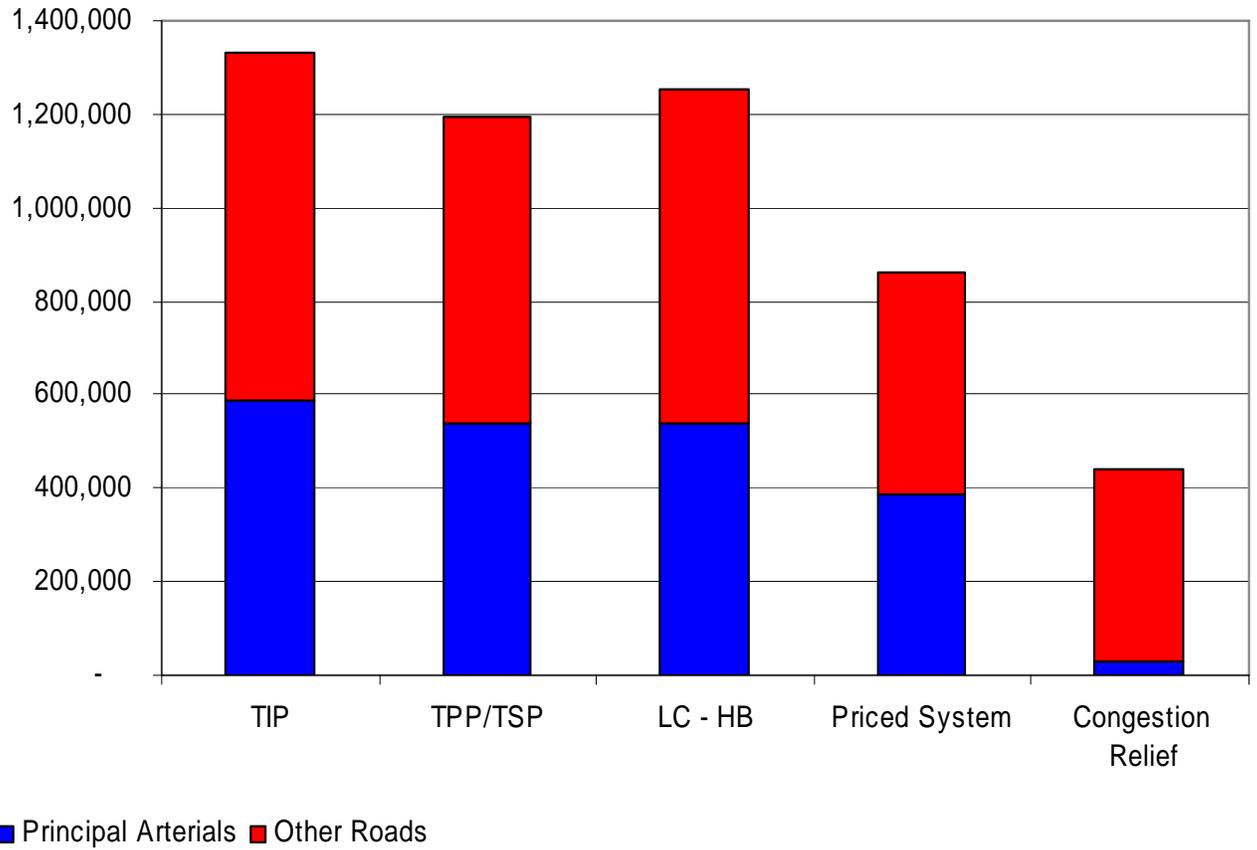
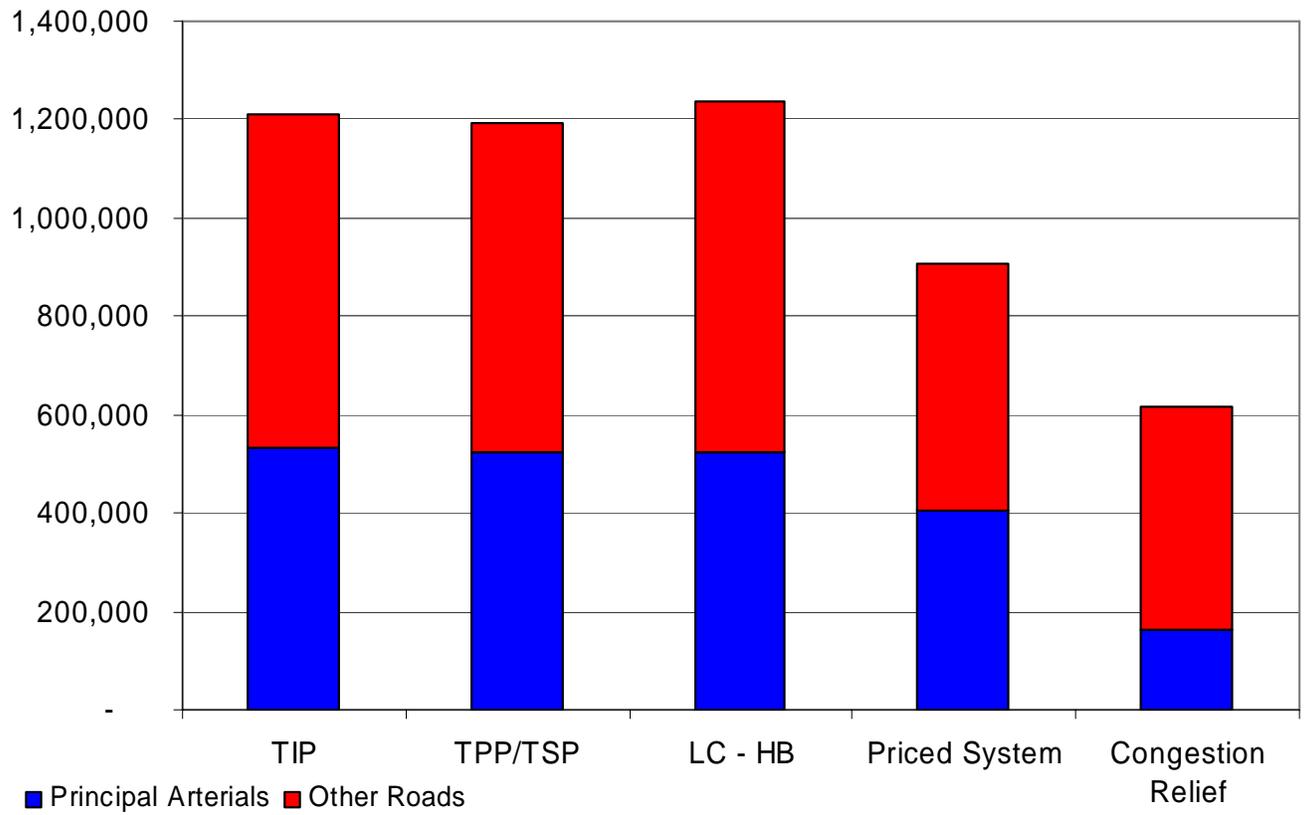


Figure 8

Daily Vehicle Hours of Delay



Figures 9 and 10 illustrate the impact of the approaches in a different manner. These figures report “hours of congestion” that occur on the Principal Arterials and other roadways. It is better to see more segments showing 0 hours of congestion and fewer showing 3+ hours of congestion.

The average system-wide speeds are reported in Table 10 for the four approaches and by highway type; the higher speeds illustrate that less of the system is congested. The Fix Congestion approach shows a significant improvement.

Figure 9
Duration of Congestion
Principal Arterials

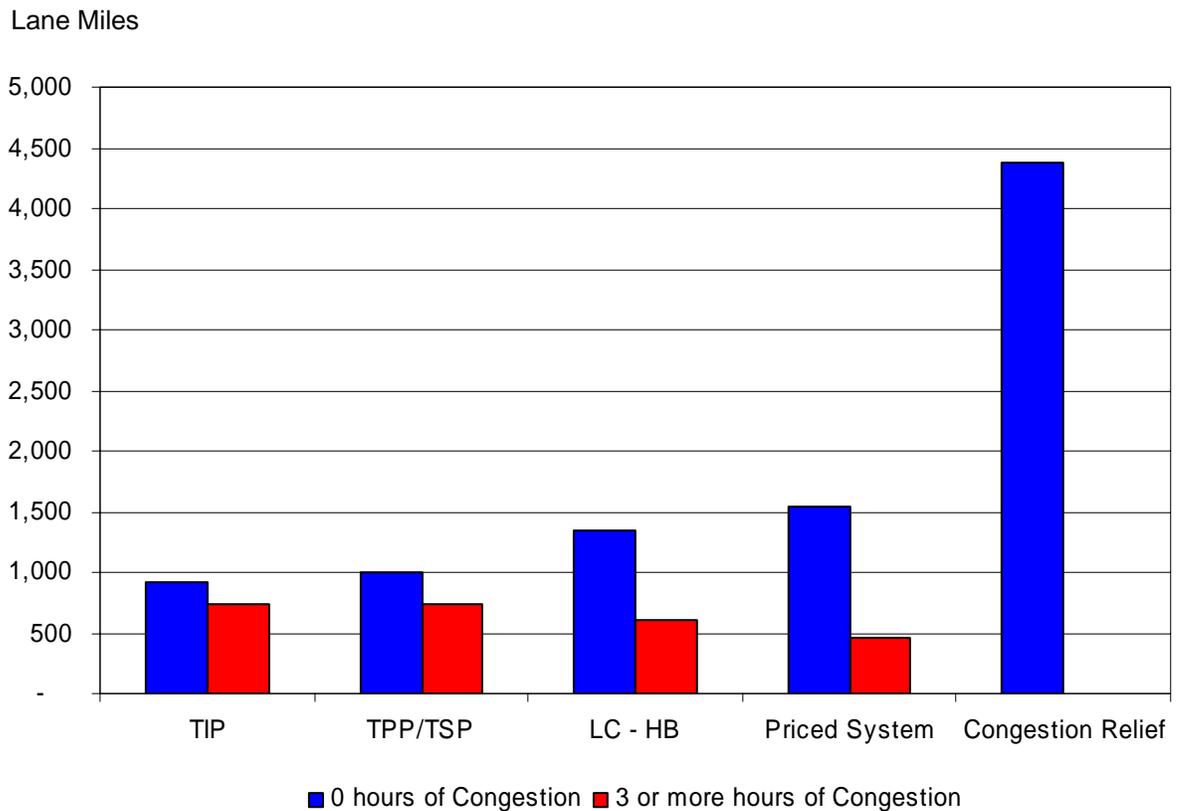
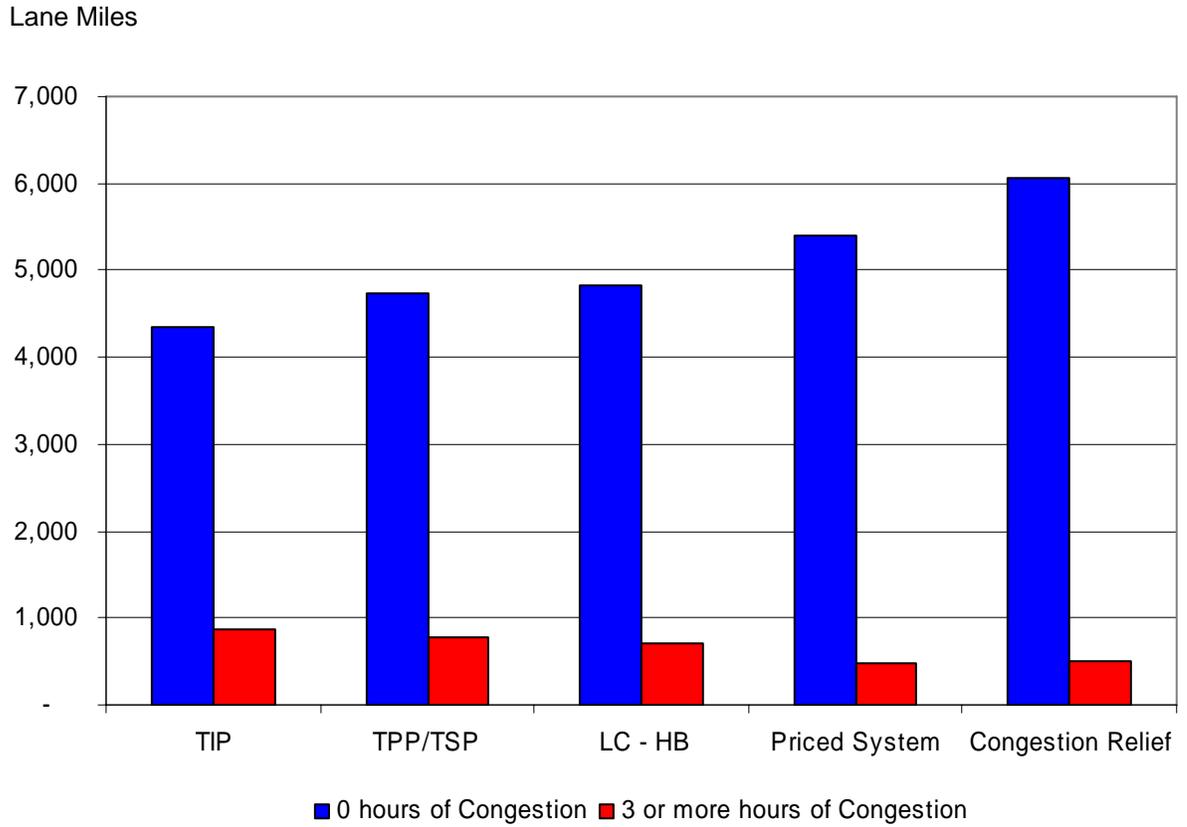


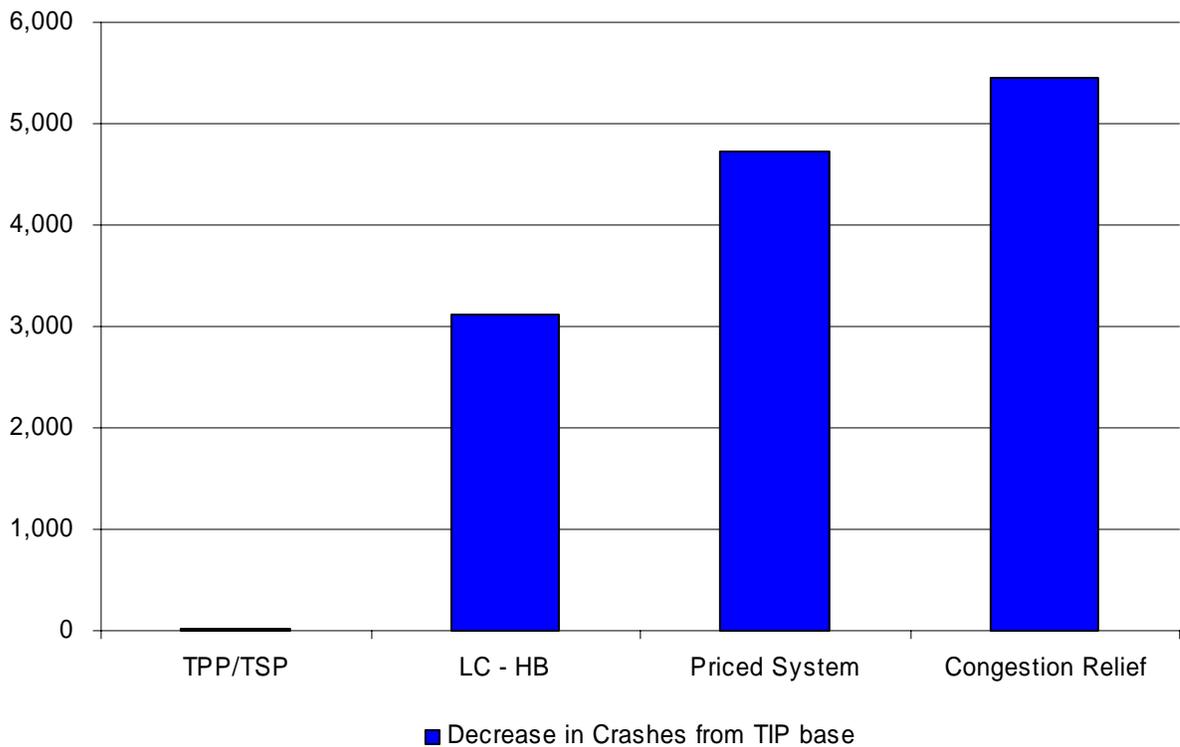
Figure 10
Duration of Congestion
Non-Principal Arterials



Finally, in Figure 11, the safety benefits of the four approaches are shown by the decrease in the number of crashes from the Base Case. The Fix Congestion approach “converted” many miles of expressways to freeways, which are safer. The Priced System creates more lanes, which will carry traffic in a congestion-free, safer environment. The low-cost/high-benefit projects will be selected, in part, by the location of the highest accident rates.

Figure 11

Safety – Change in Crashes



CONCLUSIONS

General Conclusions

Person trips grow significantly from 2000 to 2030 (+36%) because of anticipated growth in population, households and employment.

Forecasted use of transit grows between 2000 and 2030 due to expansion of the transit system, the socioeconomic growth of the region and the increase in congestion during that period. Assuming that Tier 1 transitways are implemented and are using MVST revenues fully, transit use is expected to increase 38% between 2000 and 2030.

The TSP and TPP are no longer in fiscal balance. Bridge and pavement preservation needs have increased, and preservation and expansion project costs have increased. Revenues have not kept pace with inflation. The 2030 TPP, to be adopted in late 2008, must have fewer projects unless more revenue is provided.

For the past 50 years, transportation professionals assumed most travel demand could be met by expanding highway capacity. Existing congestion costs are significant. The reality is that travel demand has greatly outpaced funding.

Major expansion projects do many things: add capacity for 20 years; address long-term maintenance needs; and improve safety. They also concentrate regional investments in a few areas, extending the design life of a major highway segment.

Converting expressways to freeways, adding lanes in congested corridors and building low-cost/high-benefit projects can reduce accidents.

Implementing bus-only shoulders, priced dynamic shoulders and priced MnPASS-type lanes can provide alternatives to congestion. These investments may also help to change travel behavior by making transit and ridesharing more attractive.

Theme Analysis Conclusions

The theme analysis provided a great deal of information about the extent of congestion and the difficulties in resolving these problems.

Generally, all themes add vehicle-miles traveled to the Principal Arterial System and divert this travel from other roads. This is to be expected, since all the improvements are on the Principal Arterials (with the exception of one theme that “improved” the Minor Arterials).

Vehicle-hours traveled are reduced for all themes since the improvements reduce travel time on the Principal Arterials and divert trips from other, slower roads, which also reduces hours of travel.

All themes result in a decline of vehicle-miles traveled under congested conditions on all roads in all congestion-intensity categories.

There is essentially no difference in the use of transit between themes. The same transit service is assumed for all themes.

Approach Analysis Conclusions

TPP Approach

The TPP expansion projects will help improve the effectiveness of the Principal Arterial System. Some projects would be implemented with a priced component.

Major expansion projects in the 2030 TPP (2004) are designed with an underlying assumption that congestion can be fixed. However, because the region can afford to implement so few of these projects, they typically result in simply shifting bottlenecks. Actually eliminating congestion would cost 20 times the money allocated to expansion in the 2030 TPP (2004). This level of public funding will not realistically occur.

The benefits of these projects in aggregate can be observed in system-wide performance measures, but the impacts will be subregional in nature.

Low-Cost/High-Benefit Approach

Low-cost/high-benefit projects are effective because they target a specific problem and have a manageable scope due to imposed cost caps.

The limited scope of the projects would help to control the cost and time to implement the projects. However, the limited scope of each project, focusing on specific problems, would have limited impact on overall congestion levels.

The dynamic lanes assumed in this approach were not priced. These could be implemented as priced lanes and provide an alternative to congestion for the single occupant vehicle (SOV) users as well as transit users and high-occupancy vehicles (HOVs).

A partnership is needed with the Federal Highway Administration if low-cost/high-benefit projects are to be widely implemented. Design exceptions will likely be needed in a number of cases. Pre- and post-construction evaluation is needed to measure the safety and capacity benefits and impacts of these projects.

The large number of improvement projects distributed over a large portion of the region would impact the travel of more people than would spending a similar amount on a few major capacity projects.

Priced System Approach

Priced lanes provide an alternative to congestion.

Priced lanes will generate revenue from tolls, but this revenue will likely not be adequate to pay for the construction of the lanes.

The forecasted travel for this approach assumes direct connections exist from one priced lane to another.

Fix Congestion Approach

Large expansion projects include many improvements to the highway and project areas beyond the capacity increases, such as refurbishing existing road surfaces, improving drainage and adding guard rails. Some of this improvement work will be required whether or not the large capacity projects are done.

Current funding, even with significant increases, will not provide roadway facilities to satisfy peak demand because 1) the public will not support the substantial funding increases needed; and 2) the impacts on the man-made or natural environment would be too extensive.

Fixing congestion would reduce transit use and would encourage more low-density development further from the urbanized core.