FINAL REPORT

for

LONG TERM NEEDS ASSESSMENT AND ALTERNATIVE ANALYSIS
I-287 / TAPPAN ZEE BRIDGE CORRIDOR

Prepared for:

Governor's I-287 Task Force

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Prepared by:

VOLLMER ASSOCIATES LLP
ENGINEERS • LANDSCAPE ARCHITECTS • PLANNERS

with

Linda M. Spock
Edwards & Kelcey
Allee King Rosen & Fleming
Zetlin Strategic Communications

Table of Contents

Background

In late 1997, Governor Pataki formed the I-287 Task Force to recommend alternatives to a high occupancy vehicle lane on the Cross Westchester Expressway and to address the transportation issues in the lower Hudson Valley. The Task Force was chaired by E. Virgil Conway of the Metropolitan Transportation Authority and also included Ambassador Charles Gargano, Chairman of the Empire State Development Corporation, Joseph Boardman, the Commissioner of the Department of Transportation, John Cahill, the Commissioner of the Department of Environmental Conservation and John Platt, Executive Director of the Thruway Authority. The Task Force retained an outside consultant team to perform a preliminary study of such alternatives. This report provides the technical foundation for the Task Force to consider in making recommendations regarding those alternatives and the long term needs.

Study Approach

The study included the following tasks:

- Document the nature, magnitude, and underlying causes of current traffic problems
- Project "baseline" future conditions in the absence of major transportation improvements
- Identify and perform a preliminary screening analysis of potential solutions
- Evaluate specific alternative transportation improvement strategies based on established study goals and objectives

The study sought public input by conducting personal interviews with two groups:

- A twelve-member Advisory Committee that included representatives from a broad spectrum of groups, including local government, members of the environmental community, business leaders and the building trades
- A sampling of 18 employers chosen as representative of the businesses in Westchester and Rockland counties

Study Goals and Objectives

Using input from the Advisory Committee, the Task Force established six major goals:

- Improve mobility in the I-287 corridor
- Minimize environmental impacts
- Develop an acceptable corridor wide transportation strategy
- Develop timely solutions

- Develop cost effective alternatives
- Foster growth in regional employment

For each goal, more specific objectives and performance measures were developed. These formed the basis for a comparative assessment of the effectiveness of seven discrete alternatives that were narrowed down from the 60 suggestions made by a variety of sources, including Advisory Committee members and area employers, as possible solutions to reducing congestion in the corridor.

Key Aspects of Corridor Transportation Conditions

The study uncovered the following facts that are important considerations in understanding the corridor's problems and evaluating possible solutions:

- **Congestion is Growing.** Eastbound available capacity in the current AM peak is limited, causing congestion and long travel times. Westbound PM peak conditions are generally less severe but reverse commuting is growing rapidly. Growth in traffic has been greater during the shoulder hours (before and after the peak hour) than during the peak hours, resulting in a "spreading" of the peak period and shrinking of available capacity in the shoulder hours of travel.

- **There is No Single Remedy to Address the Complexity of Corridor Travel Patterns .** The corridor has a wide variety of origins and destinations. Travel may be intra-county within Rockland or Westchester, between the two counties, bound for New York City, or through trips to points outside the I-287 corridor. These diverse travel patterns make it difficult to identify a "silver bullet" that can address the corridor's varied needs.

- **Future Traffic Forecasts Show Worsened Conditions.** Under either a low growth (20 percent more growth overall) or high growth (30 percent more growth overall) forecast, future traffic levels will result in I-287 carrying volume in excess of capacity in the peak periods, resulting in lower speeds than at present and substantially greater travel times. New bottlenecks causing downstream congestion will exacerbate travel conditions. Even in the reverse commuting direction (westbound in the AM; eastbound in the PM), volumes are projected to equal or exceed capacity along the entire corridor. These forecast traffic conditions suggest that dedicating existing lanes for priority treatment of high occupancy vehicles will not solve future congestion. Lanes from the non-peak direction cannot be utilized for peak direction travel because reverse commuting is already too high and growing too rapidly. Similarly, there will be no available capacity in the peak direction that could be dedicated to buses or carpools without exacerbating congestion. Peak period congestion will spread over more hours in 2020 and the corridor will experience four rush hours rather than the current two. This renders long-term solutions that rely on shifting commuters to the shoulder periods (the hours directly before and after the rush hours) ineffectual.

- **Weekday Traffic is Dominated by Passenger Cars.** Passenger cars represent between 87 and 95 percent of all vehicle traffic along the corridor, with large truck volumes during the rush hour representing only four percent of traffic on the Tappan Zee Bridge. In the AM peak hour, over 95 percent of trips are to work or work-related. This underscores the need to focus solutions on providing new commuting alternatives for passenger cars making daily trips in the corridor.

- **The Condition of the Tappan Zee Bridge**. The Tappan Zee Bridge will require $1.1 billion for rehabilitation over 13 years. The reconstruction will address the long-term structural needs of the Bridge. However, it will not provide meaningful congestion relief and mobility enhancements and will require continued extensive rehabilitation over its life. In addition, the structure of the existing or reconstructed Tappan Zee Bridge cannot accommodate any fixed transit service; only a replacement bridge could provide such accommodation.

Evaluation of Alternatives

The alternatives that were evaluated represent the full gamut of solutions, ranging from non-capital intensive approaches to major construction projects. They include:

- Expansion of transportation demand management (TDM) measures (for example, expanded vanpool, shuttle and bus service; additional park and ride lots, increased use of federal tax breaks for TransitChek and alternative work schedules)
- Value pricing on the Tappan Zee Bridge
- Restoration of the West Shore Rail Line in Rockland County
- Construction of a new commuter rail service on the Tappan Zee Bridge that would extend from Stewart Airport to Port Chester
- Construction of a light rail system linking Rockland and Westchester counties
- Construction of a bus guideway system linking Rockland and Westchester counties
- Capacity expansion of the highway system

The last four alternatives would require replacement of the Tappan Zee Bridge.

The evaluation process showed that expanding TDM programs beyond the significant base of existing measures in the corridor would provide improvements in mobility and air quality at minimal cost. Similarly, value pricing- in combination with TDM- may also generate some congestion relief, but this strategy would address only the AM peak period on the Tappan Zee Bridge, a segment representing one-third of the corridor's vehicle trips. Both of these alternatives could be implemented in five years or less. However, growing capacity constraints throughout the corridor in the shoulder hours of travel are likely to limit the effectiveness of TDM and value pricing strategies. Thus, longer-term capital improvements in the corridor are still likely to be needed.

The evaluation process indicated that restoration of West Shore rail would have limited benefits within the I-287 corridor because it offers no effective east-west service between Rockland and Westchester counties. The highway capacity expansion alternative would provide travel time improvements along the corridor but such improvements may be expected to diminish over time with the "filling up" of available capacity. While providing a one-time increase in roadway capacity, the increase is finite and the "filling up" of available capacity over time would leave no additional flexibility within the transportation infrastructure to handle traffic growth in the corridor beyond 2020.

The other three transit alternatives, implemented in combination with TDM, would provide more significant mobility improvements within the corridor. The number of vehicle trips removed in the peak hour eastbound ranges from 1430 to 1770, with the high end of this range virtually equivalent to the capacity of one additional lane on the Tappan Zee Bridge. Including the investment that would be required to replace the Tappan Zee Bridge to support fixed transit and build the necessary guideway or rail infrastructure to serve the corridor, the three east-west transit options range in cost from $1.9 billion (bus guideway) to $4.1 billion (commuter rail). All three of these transit options would provide expansion capability to meet demand beyond 2020 by increasing equipment and/or service frequency.

Of the three new east-west transit options that could serve the corridor, commuter rail is projected to yield slightly greater benefits than light rail or bus guideway. Although its costs are greater than the other transit options, commuter rail would provide the greatest improvements in mobility corridor-wide with the most flexibility to expand capacity to meet the corridor's growing travel needs well into the 21st century. New commuter rail would maximize the utilization of existing transportation facilities by linking new transit service with selected established commuter rail operations in the region to provide one-seat ride service to both White Plains and New York City.

The evaluation process was designed to provide a preliminary comparative assessment of the effectiveness of a range of alternative strategies. The study made certain assumptions for all transit alternatives concerning the general route and the number and general location of stops. However, detailed studies of specific locations, route alignments, and environmental impacts were not performed for this early phase of the corridor needs study.

Chapter 1 Background And Overview

The Cross-Westchester Expressway and the Tappan Zee Bridge Corridor serve as the transportation lifeblood to the economic, employment and residential centers of Westchester and Rockland Counties. This travel corridor, which stretches from the New Jersey border along the New York State Thruway to the Connecticut state line along the Cross Westchester Expressway, is one of the most heavily congested east-west highway arteries in the lower Hudson Valley and constitutes a major interstate long-haul route.

During the past twenty years traffic volumes have grown significantly in this corridor --- by over fifty percent on the Cross Westchester Expressway and by more than seventy percent on the Tappan Zee Bridge. Moreover, the corridor exhibits a very high demand for automobile travel given the high proportion of trips (85 percent) being made in single occupant vehicles.

Past efforts to mitigate congestion and assure regional mobility have provided some measure of relief. These efforts include innovations such as the movable barrier on the Tappan Zee Bridge, the introduction of electronic toll collection, the implementation of variable pricing on the Bridge for commercial vehicles, and tremendous growth in express bus service. However, alternatives need to be developed to ameliorate systemic long-term congestion in the corridor.

In the wake of substantial opposition to a proposal to build a high occupancy vehicle lane along the Cross Westchester Expressway, Governor George E. Pataki recognized the importance of establishing a broad-based effort to address the long-term transportation needs of the I-287/Tappan Zee Bridge corridor. In 1998 the Governor formed a Task Force to develop recommendations on how to improve transportation, promote economic development and protect the region's environment. The five member Task Force is chaired by E. Virgil Conway, Chairman of the Metropolitan Transportation Authority (MTA) and includes the Executive Director of the New York State Thruway Authority, the Chairman of the Empire State Development Corporation, and the Commissioners of the New York State Department of Transportation and Department of Environmental Conservation. Additionally, to assist the Task Force, the Chairman appointed a twelve-member Advisory Committee, which includes representatives of affected local governments, members of the environmental community, business leaders and representatives of the building trades. The Task Force and the Advisory Committee met six times during the course of the study, discussing goals and objectives, proposing alternatives and discussing potential solutions.

The I-287 Task Force and its twelve-member Advisory Committee have adopted a two-pronged approach to developing transportation solutions to the problems of the lower Hudson Valley. This approach included both initiatives that can be started immediately and a longer-term study to identify additional transportation improvement strategies. Three initiatives have already been progressed to improve transportation in the corridor that will not compromise or preclude longer-term solutions:

- Physical improvements are currently being designed by the New York State Department of Transportation (NYSDOT) and the New York State Thruway Authority to promote the smooth flow of traffic and to address safety and operational deficiencies of the existing six-lanes of the Cross Westchester Expressway and the Thruway between the interchange with the Cross Westchester Expressway (Interchange 8) and the Tappan Zee Bridge. NYSDOT has developed an extensive plan to rehabilitate the pavement and bridge structures along an 8.5-mile stretch of the Cross Westchester Expressway and implement spot interchange improvements aimed at addressing specific choke points. The Thruway Authority has developed a series of improvements to the two-mile stretch of the Thruway mainline between the Tappan Zee Bridge and Exit 8 (the Cross Westchester Expressway). The combined impacts of these operational and safety improvements being made by NYSDOT and the Thruway Authority will address the immediate problems of weaving, merging and traffic bottlenecks.

  In conjunction with these construction improvements, NYSDOT will be providing an additional 2,400 park and ride spaces over the next three years. These will consist of two new lots (400 spaces) in Westchester County, three new lots (1,600 spaces) in Rockland County, four new lots (200 spaces) in Putnam County and one new lot (200 spaces) in Orange County.

- NYSDOT and NYSTA are advancing construction work on a commuter mobility and safety improvement project between the Thruway and I-84 in Newburgh which will also encourage commercial use of I-84 as an alternative route to the more heavily congested I-287 for New England-bound travel.

- Several "early action" measures are under development to manage the growing demand on the Cross-Westchester Expressway by single occupant vehicles. These measures, referred to as Transportation Demand Management (TDM) techniques, are low cost, non-capital intensive strategies that focus on providing alternatives for commuters or educating employers on travel options that are currently available or could be made available to their employees. These strategies have been successfully utilized in other regions as a tool to help reduce congestion. Within the I-287/Tappan Zee Bridge corridor, early action TDM measures include a commuter van pilot program; a pilot "like rail" service that was proposed by Westchester County and implemented by NYSDOT in September 1999 to provide limited-stop bus routes between FDR State Park and the White Plains bus terminal and downtown loop; and development of a program for aggressive promotion of employer-sponsored initiatives such as TransitChek, telecommuting and flexible work hours within the local business community.

The focus of this report is on the long-term study and preliminary analysis of many diverse alternatives aimed at reducing congestion in the region, including both capital and non-capital intensive solutions. This preliminary analysis was undertaken to narrow down a wide range of potential strategies to those that merited further evaluation. An outside consultant team performed this work. The study was managed, and technical

guidance provided, by staff from the agencies represented on the Task Force. Policy direction was provided by the Task Force, with input from its Advisory Committee. The study was performed over a nine-month period and, therefore, relied on existing source data (e.g. from NYSDOT, the Thruway Authority, and New York Metropolitan Transportation Council) wherever available.

This report summarizes the three major tasks of this study as follows:

- Define the problem
- Identify potential solutions and the goals and objectives to be achieved
- Evaluate alternatives in terms of their ability to meet Task Force goals and objectives

2.1 Introduction

Defining the problem was a multi-dimensional task. The objectives of this task were to provide a clear understanding of the nature, magnitude, and underlying causes of current and future traffic conditions in the corridor as the foundation for identifying appropriate solutions to address specific problems. The task included quantitative and qualitative components. On the quantitative side, "existing conditions" data were obtained on travel characteristics, highway and public transit system capacities, traffic volumes, and operating levels of service. Those data were used as the baseline from which future traffic conditions were projected.

On the qualitative side, public perceptions of existing and future transportation problems were drawn from two major sources:

- Interviews conducted by the study team with each member of the Advisory Committee
- Interviews conducted by the study team with a representative group of employers in Rockland and Westchester Counties

2.2 Existing Conditions

Detailed traffic data are included in **Appendix A**. Key observations are highlighted in the following sections.

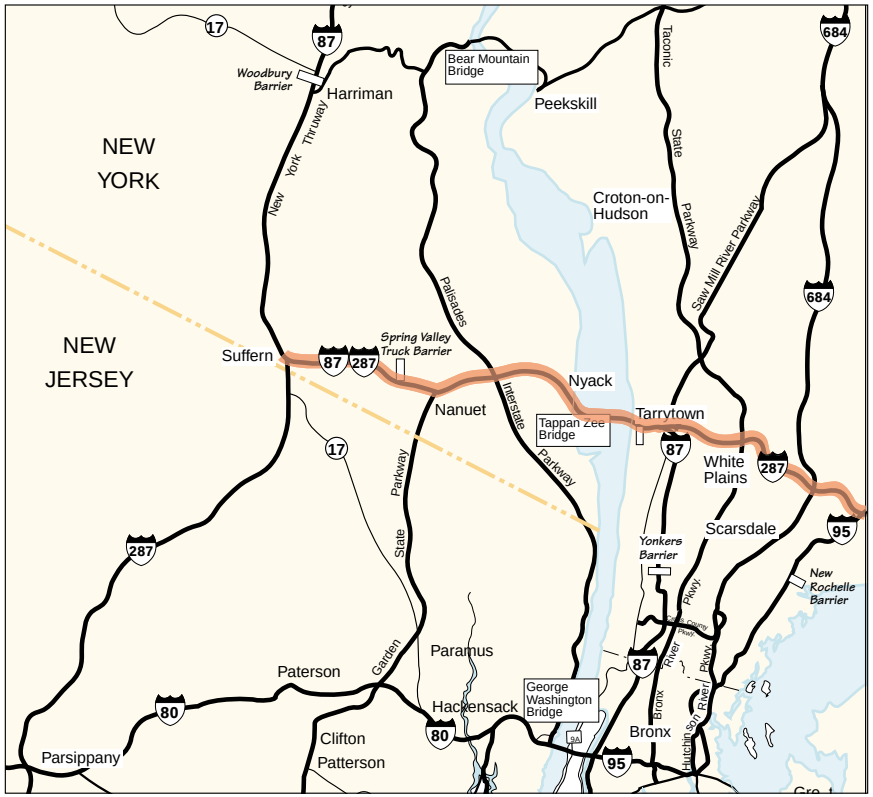
2.2.1 Corridor Overview

As shown in **Figure 2-1**, I-287 and the Tappan Zee Bridge provide the principal Hudson River crossing between the George Washington Bridge (I-95) and the Newburgh Beacon Bridge (I-84). (The Bear Mountain Bridge, between I-287 and I-84, primarily serves local traffic.) With interstate connections at both ends (I-287/I-87 at Suffern at the west end and I-95 at Port Chester at the east end), I-287 is a vital link in the regional transportation network. In addition to providing local service within and between both Rockland and Westchester, it is a segment of important north-south and east-west through routes. New York City area trips to and from upstate New York and beyond are served by the corridor, as are trips between New Jersey and New England.

2.2.2 I-287 Roadway Configuration

The I-287 corridor is separated by the Hudson River and connected by the Tappan Zee Bridge (TZB). Between Suffern and the I-87/CWE split, the roadway is referred to as the New York State Thruway, where it is officially I-87/I-287. East of the split, I-287 continues in Westchester County, where it is known as the Cross Westchester Expressway (CWE). The Thruway section has upgrades and downgrades of up to three percent, while the CWE is generally situated on flatter terrain but with numerous curved

I-287 Corridor Map



Regional Map

I-287 Regional Map

Figure 2-1

segments. Lane widths on both segments are 12 feet, except on the TZB where lane widths are 11 feet, eight inches. The area included in this study extends from Suffern in the west to Port Chester in the east, as shown in **Figure 2-1**. Within this area, I-287 is basically a three-lane route in each direction with a fourth lane added in the TZB and White Plains areas.

The TZB has a total of seven lanes and a moveable barrier that can facilitate four travel lanes in the peak direction. The barrier takes about one hour to move across the entire length of the TZB. In the AM commuter peak period, the barrier is positioned to provide four travel lanes in the peak eastbound/southbound direction and three lanes in the westbound/northbound direction. During the PM peak period, the barrier is moved to provide four travel lanes in the peak westbound direction. Section 2.2.14 provides more details on the physical conditions of the TZB.

All vehicles pay a toll to cross the Tappan Zee Bridge in the eastbound direction. No tolls are collected westbound. The base toll for passenger cars is $3.00 which can be paid with cash or collected electronically with E-ZPass. A commuter rate of $1.00 is available for regular E-ZPass users who cross the bridge a minimum of 17 times a month. Trucks pay proportionally higher tolls according to their size and classification. The toll plaza is located at the eastern end of the bridge where tolls are collected at thirteen cash and E-ZPass toll lanes and at six additional tandem tollbooths on busy Sundays.

I-287 provides a connection for New York City area traffic to and from the north-south parkways: the Palisades Interstate Parkway in Rockland and Saw Mill, Sprain Brook and Hutchinson River Parkways in Westchester. I-684 is a principal commuting route between the White Plains area and the northern residential area. The extension to the Garden State Parkway serves New Jersey residents commuting to Westchester as well as commuters from Rockland, Westchester and Connecticut working in Northern New Jersey.

2.2.3 Historical Trends

Between 1980 and 1996 population in Westchester and Rockland Counties increased by 4 percent; employment grew by 11 percent and traffic on the Tappan Zee Bridge jumped by about 60 percent. Since 1970, traffic volumes have grown by an average of two and a half to three percent a year in the I-287 corridor. In addition, many people are choosing to live farther away from their jobs and reverse commutation (westbound trips over the Tappan Zee Bridge in the morning) is growing twice as fast as travel in the peak direction. Finally, most people are driving alone. The vehicle occupancy rate for the corridor is between 1.15 and 1.18 persons per vehicle.

2.2.4 Current Travel Origins and Destinations

The corridor has a wide variety of origins and destinations. This travel diversity reflects local development patterns, where residential and commercial development is scattered throughout the corridor.

Travel patterns within the corridor are depicted graphically in **Figure 2-2**. The majority of trips on I-287 in the peak period are represented by intra-county travel. Specifically, of the 22,000 eastbound trips made during the AM peak hour, 46 percent enter and exit the 287 corridor within Westchester and 21 percent enter and exit the 287 corridor within Rockland.

One third of the trips in the corridor use the Tappan Zee Bridge. Of the trips using the bridge eastbound during the AM peak hour, 36 percent travel between Rockland and Westchester, accounting for one out of eight corridor trips. Almost 30 percent of Tappan Zee Bridge trips are Rockland to New York City trips. The remaining Tappan Zee Bridge trips are split equally between New Jersey-Westchester trips and through trips, such as New Jersey to Connecticut or New York City and Long Island to upstate.

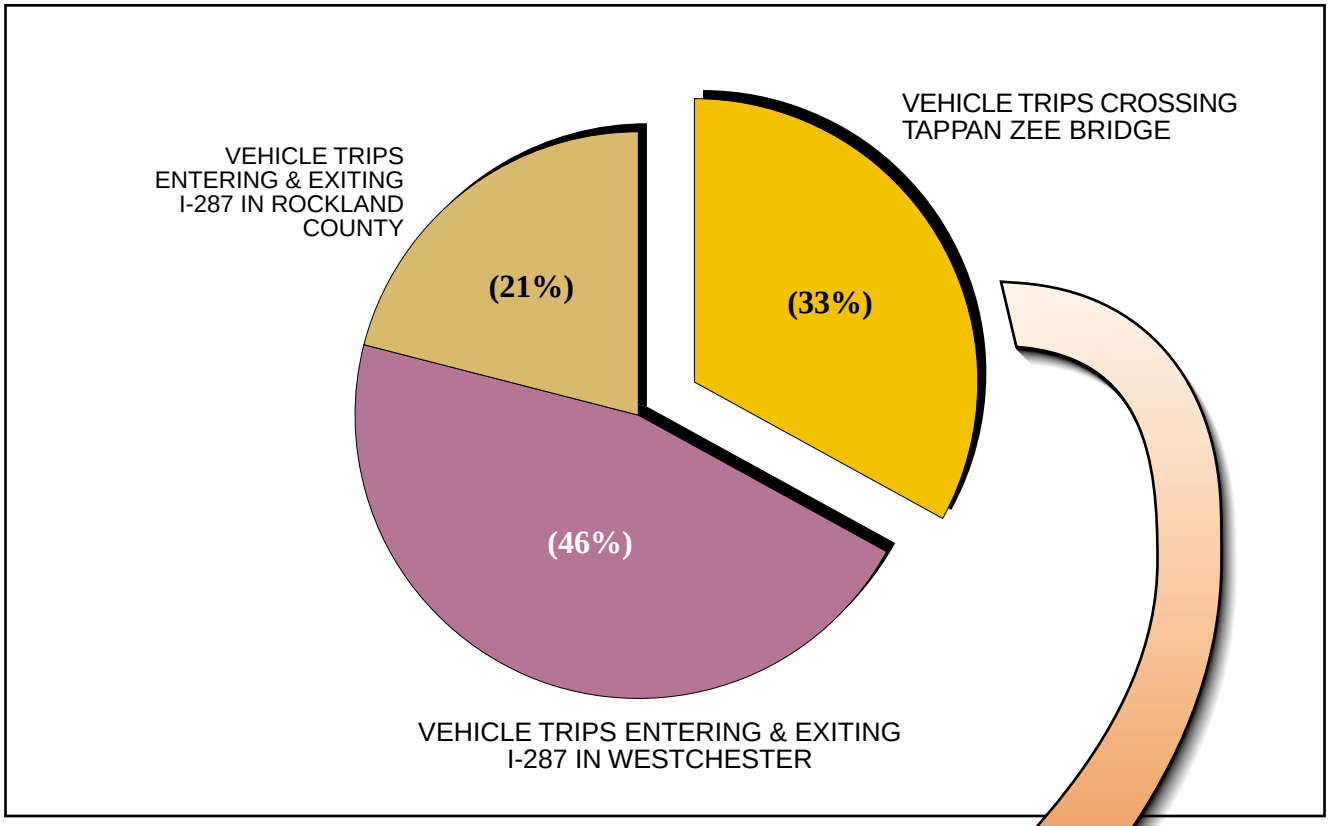
2.2.5 Current Trip Purpose

During the AM peak period, traffic is dominated by work trips with approximately 90 percent of vehicle trips in the peak hour being to the workplace and another 6 percent being business-related. In the afternoon peak, a smaller share of trips is for work purposes, particularly during the Friday PM peak with an increase of shopping, visiting or recreational trips. During the Sunday peak period, most trips are for recreation, shopping, or visiting.

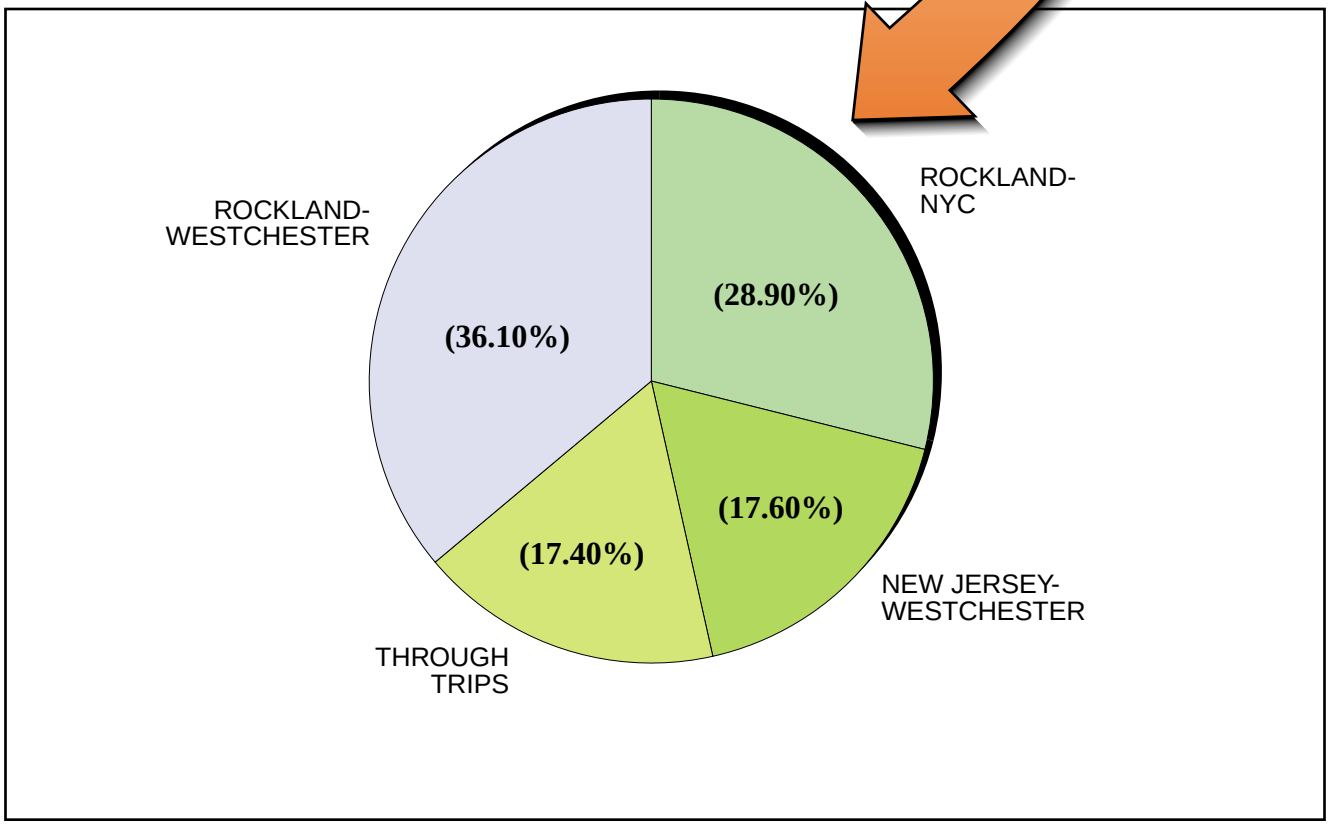
Over 80 percent of the trips in the AM peak hour represented trips made five or more times per week, and nearly 10 percent represented trips made two to four times per week. This clearly indicates that during the AM peak hour, the driver population consists mostly of commuters who are familiar with the roadways in the corridor.

2.2.6 Vehicle Types

Travel in the I-287 corridor is predominantly by auto. Even with the completion of I-287 in New Jersey, corridor truck traffic is relatively low, with large trucks and buses accounting for three to five percent of peak period traffic. Detailed results of an April 1999 traffic survey during the morning and evening peak periods are shown below in **Table 2-1**. Cars represent between 87 and 95 percent of all vehicle traffic. All trucks, large and small, and buses make up between 4 and 14 percent of the peak period volumes but, as noted above, large trucks, which have three or more axles, and buses represent only about four percent of all traffic.



I-287 TOTAL TRIPS



TRIPS CROSSING TAPPAN ZEE BRIDGE

AM Peak Hour Origins and Destinations

Figure 2-2

Table 2-1

VEHICLE TYPE, SELECTED SEGMENTS, PEAK PERIOD

Description	Car		Small Trucks		Large Trucks and Buses	
	AM	PM	AM	PM	AM	PM
I-287/I87 EB, East of Airmont Rd.	87%	90%	9%	6%	4%	4%
I-287/I87 WB, East of Airmont Rd	87%	90%	9%	7%	5%	3%
Tappan Zee EB	95%	95%	1%	2%	3%	4%
Tappan Zee WB	88%	90%	8%	6%	5%	4%
I-287 WB, East of I-87	89%	90%	6%	6%	5%	4%
I-287 EB, East of I-87	87%	87%	8%	9%	5%	5%

Note: Some totals do not equal 100% due to rounding

2.2.7 Current Eastbound Morning Peak Traffic Conditions

The morning peak period is defined as 6 to10 AM. On the Rockland side and on the Tappan Zee Bridge, the peak hour is between 7 and 8 AM while the peak hour in Westchester is between 8 and 9 AM. Shoulder hours are before and after the peak hour.

Eastbound available capacity in the AM peak hour is limited causing congestion and long travel times. Congestion is especially severe at the Rockland approach to the TZB, on the two-lane ramp to the CWE, and at the location where the Sprain Brook Parkway ramps join I-287. These bottleneck locations cause traffic problems at other points along the corridor. Queues extend back for some distance, causing stop and go conditions upstream of the bottlenecks even though these volumes are below capacity in those locations. Since the bottlenecks restrict the volume of traffic by metering it, removing the bottlenecks via improvements would not necessarily eliminate traffic problems. Higher traffic volumes may simply move the congestion problems further downstream.

One measure of the impact of these capacity constraints is the difference between uncongested travel time and actual travel time during the congested peak hour; this measure is shown below in **Table 2-2** for four selected trips along I-287: across the whole corridor from Suffern to Port Chester, from Route 303 to Route 100, from Spring Valley to the I-87/CWE Split, and between the I-87/CWE Split and Route 100A. Actual travel times presented were observed during a period with no incidents. Travel conditions worsen when incidents occur.

Table 2-2

AM PEAK HOUR EASTBOUND TRAVEL TIME

Segment	Uncongested Travel (min)	Congested AM Peak Travel (min)	Delays Due to Congestion (min)
1 – Suffern to Port Chester	30	70	40
2 – Route 303 to Route 100	11	48	37
3 – Spring Valley to I-87/CWE Split	11	27	16
4 – I-87/CWE Split to Route 100A	2	19	17

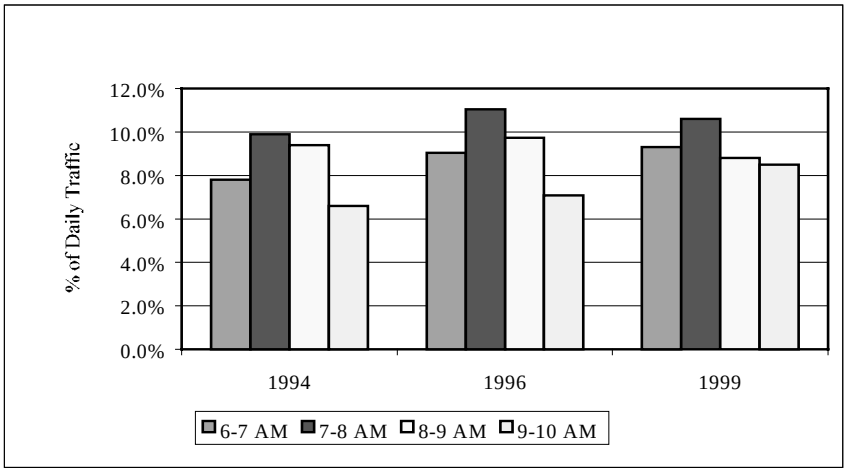
It is important to note that the Tappan Zee Bridge toll plaza is not a capacity constraint, particularly since the introduction of E-ZPass has facilitated traffic flow though the toll lanes.

The total peak period volume has grown approximately 10 percent between 1994 and 1999. During that time period, the peak two hour volume (7-9 AM) has remained relatively constant, while the growth in the shoulder hours of 6-7 AM and 9-10 AM has been over 15 percent and nearly 30 percent, respectively.

Figure 2-3 clearly illustrates this phenomenon of shoulder hour growth. While the peak hour of 7-8 AM has remained relatively consistent, between 10 and 11 percent of the day's traffic, the time periods that are becoming more congested are the shoulder hours around the peak. The total peak period has grown from 33.6 percent of the day's traffic in 1994 to 37.2 percent in 1999.

Figure 2-3

AM PEAK PERIOD HOURLY BREAKDOWN – TAPPAN ZEE BRIDGE



The "spreading" of the peak period indicates that, as congestion has increased in the corridor, many drivers have reacted by adjusting their travel to avoid the worst congestion. The heavy eastbound traffic volume in Rockland between 6:30 and 7:00 AM is evidence of these adjustments. In fact, the highest volume half-hour of the day occurs between 6:30 and 7:00 AM.

Similar patterns have been observed from 1995 to 1999 on the Cross Westchester Expressway segment of the corridor: peak hour traffic has remained constant while the shoulder hours have grown as much as 5 percent annually. (Overall, the AM peak period eastbound and PM peak period westbound traffic on the CWE has grown at annual rates of 1.1 and 0.6 percent, respectively, between 1995 and 1999.)

As a result of the significant traffic growth in the shoulder hours, eastbound available capacity in the AM shoulder periods is shrinking. On the Tappan Zee Bridge, the shoulder hours now experience traffic volumes almost as high as the peak hour. In 1994, traffic during the 6 to 7 AM hour was operating at 74 percent of capacity. In April 1999, it was operating at 87 percent of capacity. In 1994, the 9 to 10 AM hour was operating at 63 percent of capacity. In 1999, it is operating at 82 percent of capacity.

2.2.8 Current Westbound Evening Peak Traffic Conditions

The evening peak period is defined as 3 to 7 PM, with the peak hour occurring between 5 and 6 PM.

Westbound available capacity in the PM peak period is limited. Congestion levels during the westbound PM peak hour are usually lower than those experienced in the eastbound direction during the AM peak hour, except on Fridays when large numbers of recreational trips are made. However, two key bottlenecks exist: at the I-87/CWE split and at the west end of the Tappan Zee Bridge.

2.2.9 Reverse Commutation Trends

Reverse commutation traffic is growing rapidly. Between 1980 and 1990, the number of commutation trips from Westchester to Rockland grew by 80 percent. During the same period, the number of trips from Westchester to New Jersey rose by 78 percent. As a result, 73 percent of the westbound AM peak hour capacity on the Tappan Zee Bridge is now being used. Required maintenance is also impacting reverse commutation travel. One westbound lane is regularly taken out of service after 8:30 AM to perform maintenance work, reducing capacity for the growing reverse commutation travel market.

2.2.10 Current Weekend Traffic Conditions

Typically, Friday and Sunday traffic is congested in the afternoon and evening hours. Westbound traffic levels during the Friday PM peak period exceed those experienced during the rest of the week. This is largely due to an increase in the number of non-work related trips. During the summer, Friday volumes are even higher. On Sunday afternoons, traffic levels are comparable to weekday peak periods at many locations, especially during the summer. Since E-ZPass market share is considerably lower on Sundays, delays on the Tappan Zee Bridge can be longer on Sundays than on weekdays. However, these delays in effect meter traffic, reducing downstream congestion and as a result, travel times for the entire corridor on Sundays are often shorter than on weekdays.

2.2.11 Current Public Transit Usage

Westchester and Rockland Counties are served by a variety of public transit options, including:

- Tappan ZEExpress bus system
- Several other bus services, e.g. Orange Westchester Link (OWL)
- Vanpools, principally formed with the assistance of Metropool, a private, non-profit corporation founded in 1980 that serves commuters in both Connecticut and New York and is under contract to NYS DOT
- Park-and-ride lots that connect with rail or bus service
- "Bee Line" local, shuttle, and express bus services
- Metro-North commuter rail service

Although the level of east-west transit service has grown in recent years, the share of commuters using transit is still marginal. Overall, three percent of commuters use transit.

2.2.12 Current Transportation Demand Management (TDM) Programs

A number of existing Transportation Demand Management (TDM) programs are in place in the corridor. TDM seeks to shift the mode (from single occupant vehicles) or time of travel, or to eliminate the need to travel. TDM strategies are described further in Section 3.2.1.

Both Westchester and Rockland Counties have active TDM programs, supplemented by NYDOT-funded services provided by Metropool and complemented by programs offered by individual employers. Working together, these existing TDM programs have contributed to the following changes in peak hour traffic in the I-287 corridor:

- Carpools have reduced vehicle trips by between 1.5 and 2 percent
- Vanpools have reduced vehicle trips by almost one percent.
- Transit use has reduced vehicle trips by about 1.5 percent.
- Flexible work hours have shifted almost six percent of trips out of the peak hour.

These figures suggest that existing TDM programs have worked together to reduce the number of trips by four percent in the corridor. TDM in the form of flexible work hours has encouraged another six percent to shift out of the most congested peak hour of travel.

2.2.13 Accident Rates

According to the New York State Thruway Authority's data, the frequency of accidents per mile in 1999 in the I-287 corridor (42.3) is almost three times higher than the average on the entire Thruway system (15.0). On a typical day over three accidents occur in the corridor. Roughly 700 accidents occur annually in the eastbound direction and approximately 600 accidents in the westbound direction. On average, each incident minute causes seven minutes of delay. These incidents create congestion in both directions and if they occur in the peak period, they generate crippling delays. If an incident occurs on the Tappan Zee Bridge, the absence of shoulders there significantly lengthens response time, making the impacts of stoppages on the bridge particularly severe.

2.2.14 Physical Condition of the Tappan Zee Bridge

The Tappan Zee Bridge has been in service since December 15, 1955. In addition to the usual problems from normal wear and tear to be expected on a 44-year-old steel bridge, parts of the structure are nearing or have reached the end of their useful life. This is due, in part, to the location of the bridge and it's unique structure.

The Hudson riverbed between the Rockland and Westchester ends of the New York State Thruway is composed mainly of organic silt, sand, clay and gravel. Bedrock is located 300 to 800 feet below sea level, too deep to be used by construction techniques of the early 1950's. Consequently, most of the TZB structure (which is over three miles long), excluding the main span, is built on organic silt (the main span caissons are supported on steel piles driven into bedrock). As a result, the design incorporates a long causeway supported by timber piles, trusses supported by buoyant caissons and a main span supported by buoyant caissons and steel pipe piles. (In contrast, most other bridges in the region are shorter—one or two miles long—and of a more conventional design.)

To keep this essential crossing in service long-term, it will have to be extensively rehabilitated or replaced. Rehabilitation of the existing bridge over a thirteen year period will require the following investments, some of which are already underway:

- Replacement of 80 percent of the bridge's original 6¾" thick concrete bridge deck within ten years with a deck that meets the modern 8" to 10" thick standard (Thruway construction projects in 1996 and 1997 have already replaced the most deteriorated deck sections, about 20 percent of the bridge's total deck area.)
- Strengthening of the bridge to ensure its structural safety. Since the bridge was opened, a seventh lane was added to handle the growing traffic, and research has shown that the wind loads on bridges are actually greater than those that the Tappan Zee Bridge was designed to withstand. These increased load requirements have taxed the reserve strength built into the bridge.

- Installation of state of the art fender systems that protect the bridge's eight caisson-supported piers from vessel collisions and ice on the Hudson River. These new systems, already under contract for placement, are designed to reflect the site-specific risk analyses that were performed for the bridge and the new American Association of State Highway Transportation Officials (AASHTO) ship collision protection design standards.
- Replacement of the 8,000-foot long causeway on the west approach in Rockland County.
- Replacement of the deck and supporting beams and the concrete piers supporting the causeway.
- Seismic retrofitting of the bridge for earthquake preparedness, particularly its most vulnerable causeway segment and several foundations under the main span and other spans.

The Thruway Authority has identified the work needed to rehabilitate and strengthen the Tappan Zee Bridge for long-term service. The costs of completely rehabilitating the existing bridge, including replacing the causeway, has been estimated to be roughly $1.1 billion. However, rehabilitation would not address the bridge's functional shortcomings, including nonstandard lanes, no shoulders and the inability to provide for fixed route public transit.

2.3 Perceptions of Transportation Problems

Complementing the collection of quantitative data, more qualitative information on corridor transportation problems was sought from two sources: the 12 member Advisory Committee to the I-287 Task Force and a group of 18 employers chosen as a representative sampling of the businesses in Westchester and Rockland counties.

Perceptions of traffic problems in the corridor expressed by Advisory Committee members are consistent in most cases with the quantitative data. Specifically, most felt that the most severe traffic problems occur in the peak period in the peak direction (AM Eastbound, PM Westbound) and that these problems had contributed to highly variable travel times and expanded traffic peaks. Additionally, weekend traffic congestion was noted specifically, with concern expressed about recent development such as the Palisades Mall exacerbating these problems further. The Tappan Zee Bridge was perceived by some to be a particular problem.

In some cases, Advisory Committee perceptions of the underlying causes of traffic problems paralleled what traffic and demographic data show: traffic growth fueled by economic expansion and longer commutes without any new road expansion; low usage of public transit; and lack of roadway alternatives for east-west travel. However, the perception of growth in truck traffic as a major contributor to peak period corridor congestion problems, particularly after the opening of the New Jersey section of I-287, is not supported by traffic data which show a very low share of trucks during the peak period (see Section 2.2.6 above).

While the interviewed employers acknowledged awareness of traffic problems in the corridor, they did not see congestion as being a significant problem for their employees. The interviews suggested that employees have selected their job or residence to ease their commute, and as a result, can avoid the corridor and/or use alternate routes. Employers have widely adopted flexible work hours, allowing their employees to adjust their time of travel to avoid the worst traffic conditions; many employers noted this as a common practice among employees. Data showing the spreading of the peak period (presented in Section 2.2.7) are consistent with the increase in use of flexible work hours in recent years. Employers also noted the very low usage of alternate modes of travel (vanpools, public transit, carpools) which they attributed to a number of factors including lack of convenient public transit service and employees' desire for independence in setting their own work hours.

Many Advisory Committee members in both Westchester and Rockland counties expressed concern that continuing traffic congestion could stifle future economic and job growth. However, interviewed employers indicated that traffic problems have had no major effect to date on their business location or expansion decisions.

2.4 Future No-Build Conditions

The existing conditions described above were used as the baseline data for generating future conditions in 2020, the year selected for purposes of analysis of proposed alternatives. The year 2020 was chosen as a starting point for analyzing future impacts for several reasons. First, a twenty-year timeframe is a fairly standard long term planning horizon and would be sufficient for any contemplated transportation improvement to be in place and its impacts determined. Second, projecting traffic conditions beyond a twenty-year timeframe is very speculative.

Based on those future conditions, the resulting transportation system deficiencies and constraints were identified under a "no build" scenario that assumes that planned operational and safety improvements are made (as described in Chapter 1) but that no other significant transportation changes are made. In this "no build" scenario, it is assumed that the Tappan Zee Bridge is not replaced but, rather, rehabilitated and repaired to maintain the current structure at its current functional capacity.

2.4.1 Key Assumptions

Peak period traffic in the I-287 corridor is projected to increase at an overall rate of 20 (low growth forecast) to 30 (high growth forecast) percent from the present to the future 2020 analysis year. This projected rate of growth is lower than in the past and somewhat uneven. For example, high growth will occur between Orange County and Westchester and Rockland Counties and for reverse commuting while intra-Westchester markets are projected to experience lower growth.

2020 "no build" peak hour conditions are projected for comparison with the alternatives under analysis assuming unconstrained traffic growth, i.e., assuming all highway trips

that want to be made are on the highway. The estimates of mainline I-287 conditions assume that above-capacity ramp conditions will not constrain traffic on the mainline. It is also assumed that some traffic may move to less congested entrances and exits. The 2020 traffic projections have not assumed any toll increases. However, even if there were future toll increases, those would not affect the growth projections presented in this report. Historically, any reductions in traffic following toll increases have been temporary and offset quickly by traffic growth.

The basis for the detailed traffic forecast assumptions is included in **Appendix B**.

2.4.2 Critical Findings

Generally, despite the impacts of planned operational and safety improvements, future traffic levels from projected growth will result in I-287 carrying volume in excess of capacity in the peak periods. **Figure 2-4** depicts forecast traffic volume vs. capacity in the AM eastbound peak hour at three critical locations along the corridor.

These capacity constraints will result in lower speeds than at present and substantially greater travel times. **Figure 2-5** compares existing travel times in the AM eastbound peak hour with those projected under low and high growth forecasts in three segments of the I-287 corridor.

Other specific observations about future conditions are included below. Further details are included in **Appendix B**.

2.4.2.1 Distribution of 2020 Traffic Impacts

Traffic impacts from the projected growth are expected to be greater in Rockland County than in Westchester County. In Rockland County where the growth is forecast to be higher than the corridor average, traffic congestion is projected to deteriorate at a higher rate than elsewhere in the corridor. While certain stretches of roadway in Westchester will be carrying volumes in excess of capacity, the impacts will not be as extensive as in Rockland because of lower projected growth and the beneficial impacts of the operational and safety improvements programmed for corridor segments within Westchester County.

In the eastbound direction, new bottlenecks in Rockland County will occur in the AM peak period in the segment around the Palisades Interstate Parkway Interchange, the Tappan Zee Bridge (TZB) and its approach east of Interchange 10. On the Westchester County side, eastbound bottlenecks will occur at the I-87/CWE split and in the White Plains area.

Westbound in the PM, the added bottlenecks will include long mainline segments in Rockland County stretching from Interchange 11 to the Garden State Parkway (and beyond to Airmont Road in the high growth forecast), the westbound roadway of the Tappan Zee Bridge, and segments along the CWE between Westchester Avenue and the I-87/CWE split.

Figure 2-4
AM Eastbound Peak Hour

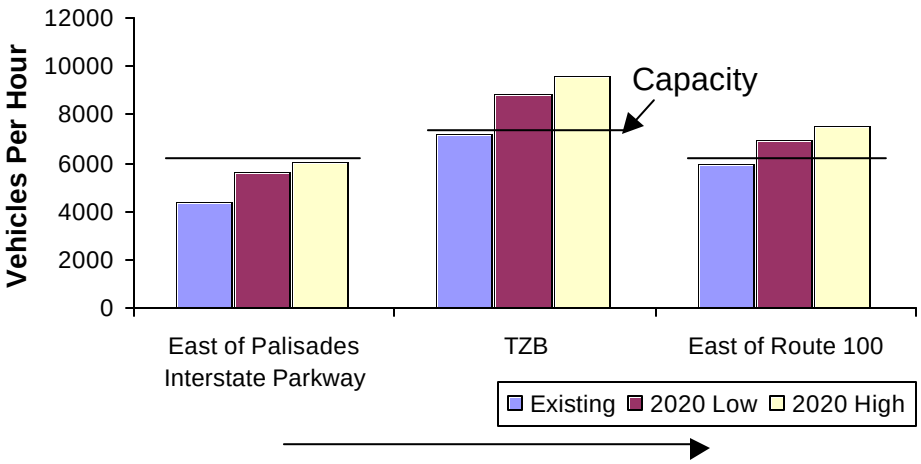
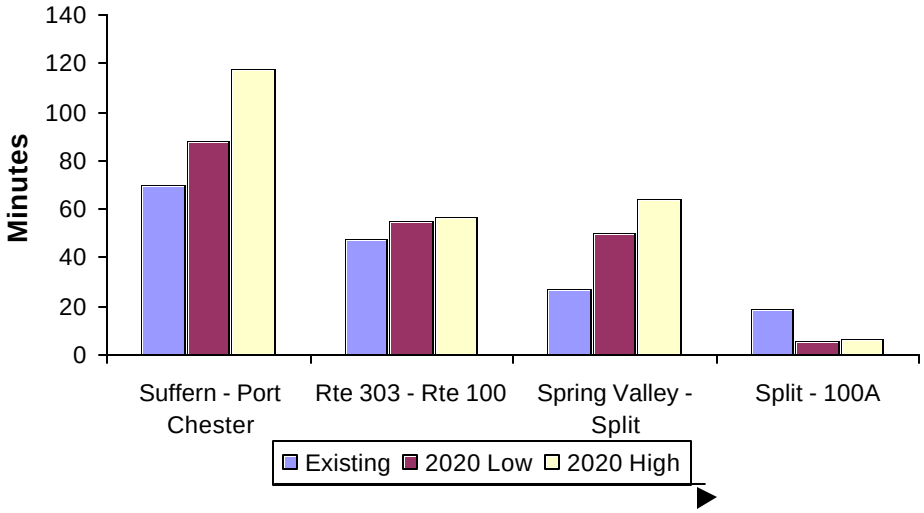


Figure 2-5
AM Eastbound Peak Hour Travel Times*



*Note: Existing times do not include Operational & Safety improvements; future times include these impacts. Some future times are shorter than existing times.

2.4.2.2 2020 Eastbound AM Peak Conditions

Eastbound travel conditions during the weekday AM peak will be worse than those experienced today. As compared to the existing conditions, the full corridor travel time will increase by approximately 25 percent (70 to 88 minutes) under the low growth scenario and by some 70 percent (70 to 118 minutes) in the high growth forecast. Under the low growth forecast, the increase in travel delay will be largely due to over-capacity of the eastbound roadway between the Palisades Interstate Parkway and the I-87/CWE split and between Route 100 and Westchester Avenue in White Plains. Should the higher growth occur, congested conditions in the eastbound direction will extend further upstream to Airmont Road in Rockland County and to the Sprain Brook Parkway in Westchester County.

2.4.2.3 2020 Westbound PM Peak Conditions

Westbound travel conditions during the weekday PM peak hour will be worse than those experienced today. In fact, they will also be worse than the eastbound AM peak conditions experienced today. As compared to existing 1999 conditions, the travel time required to traverse the entire corridor westbound in the peak hour will almost triple (from 33 to 88 minutes) under the low growth forecast and increase by over three and a half times (from 33 to 117 minutes) under the high growth forecast. Under the low growth forecast, the delays will occur between the I-87/CWE Split and the Palisades Interstate Parkway. Under the high growth forecast, virtually the entire length of the westbound roadway, between Westchester Avenue in Westchester County and Airmont Road in Rockland County will be completely over-saturated with traffic moving at stop-and-go pace.

2.4.2.4 2020 Traffic Impacts of Reverse Commuting

Volumes are projected to equal or exceed capacity along the entire corridor in the reverse commuting direction (Rockland-bound AM and Westchester-bound PM). During the AM peak hour, travel across the entire corridor westbound is projected to take about the same time for the low growth forecast but increase from the current 26 to 38 minutes for the high growth forecast. In the opposite eastbound direction in the evening, the trip is expected to take slightly longer for the low growth forecast (increasing from 29 to 32 minutes) and to increase from 29 to 45 minutes for the high growth forecast.

2.4.2.5 2020 Traffic Impacts on Connecting Roadways

Many of the ramps connecting I-287 to other highways and local streets will be over capacity in the future in a no-build scenario. Under the low growth forecast, 11 of the 42 eastbound ramps will endure above-capacity traffic levels, while under the high growth forecast, this figure would increase to a total of 16 ramps.

2.4.2.6 Continued Expansion of the Peak Period

Traffic congestion will spread over more hours in 2020, further expanding the peak travel periods. Many of the critical stretches of roadway, such as the Tappan Zee Bridge, will be over capacity in each hour of the four-hour morning and four-hour evening commuter peak periods as well as during peak Friday and Sunday periods. Thus, there will be a prolonged peak period in which traffic levels during the shoulder hours are not significantly different than those in the peak hours. As a result, employees will find it increasingly difficult to adjust their schedules to avoid the worst traffic conditions.

2.4.2.7 2020 Public Transit Usage

In their current configurations, east-west transit service will continue to draw a few trips off the highway. With no significant transit projects programmed, it is expected that a nominal three percent of the corridor's east-west trips will continue to be made using transit.

3.1 Introduction

The first step in identifying potential solutions to transportation problems in the I-287 corridor was to develop a clear definition of the corridor problems based on existing and future traffic conditions, as described in Chapter 2. The next step was to develop a set of goals and objectives that should be met by proposed solutions. The goals and objectives were designed to capture the long term benefits that should derive from transportation improvements in the corridor, in and beyond the 2020 timeframe chosen for purposes of analysis. The goals and objectives based on the problems in the corridor and future conditions and adopted by the I-287 Task Force are as follows (goals are italicized):

- *Improve Mobility in the I-287 Corridor*
  - Decrease highway travel during weekday peak periods
  - Increase public transit use
  - Accommodate growth in regional travel with no increase in congestion
  - Maintain or improve safety
  - Reduce through truck traffic

- *Minimize Environmental Impacts*
  - Improve air quality
  - Limit sprawl
  - Minimize adverse impacts in Rockland and Westchester
  - Minimize impacts on the Hudson River

- *Develop an Acceptable Corridor Wide Transportation Strategy*
  - Develop strategies that addresses problems throughout the corridor
  - Develop strategies that maximize use of existing I-287 corridor facilities and services

- *Develop Timely Solutions*
  - Ease of implementation

- *Develop Cost Effective Alternatives*
  - Estimate order of magnitude capital costs
  - Pursue alternatives with reasonable benefits/costs

- *Foster Growth in Regional Employment*
  - Ensure that the transportation system supports regional economic growth

Next, a comprehensive list of potential solutions was compiled from a variety of sources, including:

- Advisory Committee members' submitted comments
- Interviews with each of the 12 members of the Advisory Committee
- Interviews with 18 employers in the corridor
- Suggestions from Task Force member agencies
- Study team input

Potential solutions fell in two general categories: non-capital intensive and capital-intensive strategies.

3.2 Non-Capital Intensive Solutions

Solutions were considered to be non-capital intensive strategies if they would require relatively little time and cost to implement. While such strategies were suggested as stand-alone solutions to corridor problems, they could also be considered as short term improvements that could provide some interim congestion relief while longer term alternatives are being advanced.

Non-capital intensive strategies encompassed a number of potential solutions, including demand management programs such as carpooling, vanpooling, and alternate work arrangements; transit improvements; converting existing lanes for priority treatment of high occupancy vehicles (HOVs); transportation management strategies; intelligent transportation system (ITS) programs; commercial vehicle programs and variable tolls/congestion pricing.

Within these non-capital intensive strategies, two broad areas were the subject of detailed study:

- Transportation Demand Management (TDM) techniques
- Value or Congestion Relief Pricing strategies

These two subcategories of strategies are discussed below.

3.2.1 Transportation Demand Management

A literature review conducted as part of the study addressed Transportation Demand Management (TDM), broadly defined to include both demand and supply side initiatives to "maximize the people-moving capability of the transportation system by increasing the number of persons in a vehicle, or by influencing the time of, or need to, travel"[1].

[1] Implementing Effective Travel Demand Management Measures: Inventory of Measures and Synthesis of Experience, COMSIS Corporation, Institute of Transportation Engineers, Georgia Institute of Technology, K.T. Analytics, Inc., R.H. Pratt, Federal Highway Administration and Federal Transit Administration, Washington, D.C., September 1993, Section I, Page I-1.

TDM strategies can be classified in a variety of ways. The literature review included the following categories:

- Improved Alternatives to the Single Occupant Vehicle (SOV)
  - Transit Improvements
  - Park-and-Ride Lots
  - Ridesharing/Carpooling
  - Vanpooling
- Incentives/Disincentives to favor High Occupant Vehicles and/or disfavor SOVs
  - Parking Pricing and Management
  - Financial Incentives
- Alternate Work Arrangements that seek to shift or eliminate some work trips
  - Alternative Work Schedules
  - Telecommuting
- Institutional/Organizational Approaches to TDM
  - Transportation Management Associations
  - Employer-Based TDM Programs
  - Trip Reduction Ordinances
- Strategies to Improve the Flow of Traffic
  - Intelligent Transportation System Initiatives

A comprehensive search of major transportation databases and information sources was undertaken to identify relevant literature. The search was limited to the United States and the time period since approximately the mid-1980s. The goal of the literature review was to assess recent experience across the U.S. with TDM programs, addressing in particular the effectiveness, key success factors, and barriers/issues faced in implementing such programs.

The major general conclusions about TDM emerging from the literature review are:

- Packages of strategies are needed to meet diverse travel needs.
- Although it is difficult to disaggregate the impacts of TDM programs, financial incentives/disincentives that are clearly understood by individuals making travel choices appear consistently to be the most effective measures.
- Results of TDM programs are highly variable.
- Area-wide or regional impacts are lower than those that can be achieved at the individual employer level for two reasons:
  - TDM focuses primarily on work trips and work trips represent only a fraction of overall traffic volumes.
  - All work trips are not necessarily affected by TDM since full participation of all employers in any given region is not achievable. Even under mandated trip reduction programs, small employers (e.g. with fewer than 100 employees) have

typically been exempted and these small employers can represent a significant portion of the employment base.

- Intelligent Transportation System strategies can be used to complement TDM programs.
- The consensus in the literature, based on experience elsewhere, is that the areawide trip reduction benefits of effective TDM programs are in the two to eight percent range.

Contributing factors in successful regional TDM programs have included one or more of the following broad spectrum of measures:

- High levels of employer participation achieved by broad-based support from the business community for voluntary efforts or the use of mandates
- A single strong regional planning entity
- An emphasis on cooperation, featuring active partnerships between and within public and private sectors and public/employer involvement
- A long history of varied experience with transportation management programs
- The linkage of TDM efforts to land use/growth management policies (e.g. constrained parking) to address the roots (not just the symptoms) of transportation problems over a long-term planning horizon
- A strong cultural ethic of embracing protection and conservation of the environment

The literature suggests the following "lessons learned":

- All parties, local governments, the business community and employees, must agree upon the problem to be solved and be motivated to implement change for programs to be successful.
- Objectives must be realistic and defined clearly.
- Influencing commuter behavior must be seen as an acceptable, appropriate role for employers.
- Policy fragmentation can diminish TDM program effectiveness.
- Results may be difficult to sustain over time based on actual experience with highly successful TDM programs in other locations.
- Gains from TDM may be offset by latent/induced demand, i.e. from trips returning to a particular facility that had been previously made at other times or on other routes or foregone entirely when demand for that facility exceeded capacity
- Cultural factors at the employer and regional levels, such as strong environmental interest and commitment, can be a significant influence on program effectiveness.
- Proposed TDM solutions must recognize and address the constraints on individuals' ability to switch transportation modes.

Another important source of information on TDM strategies was the employer interviews conducted by the study team. Those interviews revealed a number of insights that need to

be considered in evaluating the benefits realistically achievable from TDM programs in the corridor.

- All interviewed employers already have some form of flexible work hours; many employees take advantage of flextime to commute during shoulder hours and avoid the most congested travel times in the corridor. This suggests that additional benefits from this strategy will be constrained. It should also be noted that 2020 traffic forecasts indicate that there will not be capacity in the shoulder periods to provide an incentive to shift trips out of the peak hours of travel.
- Half of the interviewed employers allow telecommuting but employers generally do not see this alternate work arrangement growing dramatically for their employees in the future. Even those who do expect a large number of employees to telecommute anticipate it will be on a maximum one day a week or one day a month basis.
- Many employers have TDM programs in place (e.g. 14 of the 18 have some type of carpool involvement; 6 have vanpools; 11 have working relationships with Metropool) but, with the exception of flexible work hours, actual employee usage of these programs is low.
- Similarly, while 13 of the interviewed employers are located within walking distance of commuter rail stations or on shuttle bus loops (e.g. Bee-Line service from the White Plains Transportation Center), according to employers, very few employees find transit to be an acceptable or convenient mode for commuting. While there is a sizeable reverse commuter rail and shuttle bus usage when an employer first moves into the area, that usage is viewed by employers as temporary, until employees relocate or leave the company. TransitChek is often introduced as part of relocation benefits for a limited (one or two years) time.
- Only two of the interviewed employers charge employees for parking and most employers have more parking than they need. In this context, it may be difficult to obtain business community support for the aggressive parking pricing or supply management strategies that may have been effective in other settings.
- Employer feedback on previously instituted Employee Commute Options (ECO) mandates (that were subsequently removed) indicates that any form of mandated employer participation in TDM programs would meet with great resistance from the business community. Employers did express a willingness to work cooperatively with public agencies to help find strategies in which they might voluntarily participate.

Based on the literature review and employer interviews, two possible levels of TDM were analyzed, as described further in Section 3.5.2.1.

3.2.2 Value Pricing

Analysis of the impact of value pricing in the I-287 corridor is based on a separate study conducted by the New York State Thruway Authority that assessed the potential traffic reduction impacts of increasing the cost of tolls during the peak hours and lowering them

during other hours. In theory, such toll changes would induce some people to switch their trip to transit, join a carpool, alter the time they choose to cross the bridge, divert to another route, or choose not to make the trip at all. (As a point of clarification, value pricing may also be referred to as variable pricing or congestion-relief pricing.) The Thruway study addressed the impacts of different pricing options for implementing such a strategy by:

- Conducting focus group and stated preference surveys to assess the level of willingness of drivers to alter travel patterns, and
- Determining the traffic and revenue impacts associated with several potential peak period toll schedule options at the Tappan Zee Bridge in the context of recent traffic conditions.

The I-287 Task Force study team used the results of the most effective toll schedule option considered by the Thruway study (see Section 3.5.2.2) and extrapolated those findings to the 2020 analysis year.

3.3 Capital Intensive Solutions

A number of solutions suggested by the identified sources would require significant time and cost to implement. These capital intensive solutions all require new investment exceeding what would be required to simply maintain the highway infrastructure in the corridor. Most notably, they require a replacement Tappan Zee Bridge, as the existing structure cannot accommodate the introduction of new rail service (or other fixed transit service) and cannot be widened to do so. The potential capital intensive solutions cover a range of travel modes in the corridor, including rail, bus, and auto.

3.4 Comprehensive List of Potential Solutions

Overall, the study team identified 60 separate alternatives to be evaluated as potential solutions to I-287 corridor transportation problems:

- 21 related to travel demand/system management (TDM/TSM)
- 11 represented non-capital intensive transit (bus or rail) improvements
- 3 involved toll adjustments
- 6 were associated with Intelligent Transportation System (ITS) measures
- 2 affected commercial vehicles
- 7 represented capital-intensive transit programs
- 10 involved capital-intensive highway/bridge programs

Figure 3-1 provides a complete list of these alternatives. Note that suggestions about specific financing mechanisms or implementation approaches are not included in this list because they fall beyond the scope of this study. In other words, this study addresses

only what should be done, not how it should be financed or implemented. While important issues, they are considerations that should be addressed in the context of proposed alternatives at a later point in time.

Figure 3-1

Comprehensive List of Strategies/Alternatives

Strategy/Alternative	Description
Demand Management/System Management	
• Alternative Work Schedules	Flextime, compressed workweek.
• Telecommuting	Eliminates trips.
Parking Pricing and Management	
• Cash out parking; parking preference	Provide employees with the option of taking the cash equivalent of the value of employer-provided parking in lieu of a parking space; provide priority spaces for High Occupancy Vehicles.
• Parking authority with controls	Create area-wide parking authority to oversee parking policies and provide information.
Parking	
• Increase the number of park and ride lots	Identify sites and provide funding for new park and ride lots.
• Expand rail station parking	Expand Metro-North station parking.

Strategy/Alternative	Description
Ridesharing/Vanpooling Expansion	Expand ridesharing/vanpooling programs and enhance their desirability/acceptability through promotion, financing, and by addressing insurance and other legislative issues that will minimize user costs. In addition, expand the guaranteed ride home program.
Financial Incentives to Enhance Transit and High Occupancy Vehicle Use	
• Expand/streamline TransitChek/create new transit discounts	Expand use of TransitChek or establish other discount programs to increase employer participation and achieve greater use.
• Vanpool assistance	See ridesharing/vanpooling above.
• Parking incentives	See parking pricing & management above.
• Tax incentives/toll discounts for off-peak users	Establish a "toll free" program for businesses that implement staggered hours; make off-peak toll expenses tax deductible, etc.
• Tax credit for on-site businesses	Tax credits for on-site businesses such as dry cleaning, etc.
• Eliminate bus fares	Provide free buses to attract new ridership.
Transportation Management	
• Establish management centers with "shuttle manager," Metropool partnerships, etc.	Establish organization(s) and locations with centralized authority to provide guidance, coordination and assistance with various programs and users.

Strategy/Alternative	Description
• Establish intermodal centers	Establish intermodal centers to provide convenient transfers between modes; for example a facility within the Nyack interchange of the Thruway for parking, bus service and ferry access.
Priority Treatment for High Occupancy Vehicles	
• Restrict existing TZB reversible lane to buses/vanpools (removes one general lane in peak direction)	Limit use of TZB reversible lane to buses/vanpools in peak period.
• Make TZB five lanes in peak directions at peak times with fifth lane for buses/vanpools (removes one lane in non-peak direction)	Take away one lane from non-peak direction on TZB and make it available in peak direction for buses/vanpools.
• Subsidize tolls for buses/vanpools on the TZB	Further subsidize tolls for buses/vanpools.
• Create I-287 contraflow lanes for buses/vanpools (removes one lane in non-peak-direction)	In locations other than TZB, create a contraflow lane in existing section to be used only by buses/vanpools. (Example, 4 lanes EB in AM on CWE between I-87 and White Plains with 2 lanes WB).
• Establish priority bypasses for buses/vanpools at toll plaza and at other critical locations (including use of shoulders)	Provide either physical means or signage for buses/vanpools to bypass congested areas (i.e. use shoulders for short distances, etc).
• Arterial priority bus lane	Establish priority bus lanes on feeder and or parallel arterial highways.
Transit Improvements	

Strategy/Alternative	Description
Bus	
• Expand TZB bus route	Provide increased service on Tappan ZEExpress.
• Expand other bus service including "Like Rail" program	Expand bus service locations and frequency on local lines.
• Expand/create additional shuttle service	Increase employer shuttle service to locations such as rail stations and add new shuttle services.
• Eliminate transfer cost	Eliminate current 35-cent bus transfer fee.
• Accept MetroCard on all buses, uniticket, E-ZPass	Accept MetroCard on all buses; implement a single fare/toll collection mechanism in place of a separate MetroCard and E-ZPass.
Improve Rail Service	
• Improve rail service on Hudson and Harlem lines	Increase frequency of service on rail lines.
• Add TZB stop to Hudson line	Add station under TZB to the Hudson line.
• Construct 3rd Track	Add a third track between Mt. Vernon and Crestwood to increase Metro-North capacity.
Ferry • Haverstraw – Ossining • Rockland – Tarrytown • Rockland – NYC	Ferries between locations noted with parking and bus connections.

Strategy/Alternative	Description
Variable Tolls/Congestion Pricing	
• Congestion pricing on TZB	Establish peak hour (period) congestion pricing on TZB.
• Discount for E-ZPass users (non-commuters) on the TZB	Provide current E-ZPass users with a toll reduction below the cash rate ($3) to encourage greater E-ZPass use, especially on weekends.
• Eliminate discounts for Single Occupant Vehicles on the TZB	Allow only High Occupancy Vehicles to receive the $1 commuter discount rate.
Intelligent Transportation System Related Programs	
• Collect better real time information on traffic conditions	Expand TRANSMIT (E-ZPass readers installed to detect speed of vehicles) and closed circuit television.
• Improve the distribution of customer information on traffic conditions	Improve and expand the use of electronic signs, highway advisory radio and the Internet.
• Improve integration of train and bus schedules	Improve connections between trains and buses by automatically notifying bus drivers to hold buses when trains are delayed.
• Implement a dynamic traffic management system	Optimize traffic using better real-time information and signage to promote more efficient use of highway capacity.
• Provide on-demand transit shuttle service	Enable travelers to use computers and telephones to reserve transit service and determine status of vehicles.

Strategy/Alternative	Description
• Provide real-time parking information	Use highway electronic signs to notify drivers where space is available at park-and-ride lots.
Commercial Vehicle Programs	
• Encourage use of alternative routings for trucks	Encourage use of the I-84/Newburgh Beacon Bridge.
• Improve I-84/I-87 connections	Construct new interchange.
Capital Intensive Programs – Transit	
<u>New Light Rail (all alternatives assume the TZB is replaced)</u>	
• Port Chester – Suffern light rail system (via TZB)	Light rail proposal across entire corridor.
• Other east-west light rail (via TZB)	A more modest LRT going only in a portion of the corridor such as White Plains-Palisades Mall.
• Monorail system, etc.	Assume a monorail system providing the same service as the light rail alternatives.
• Bus Guideway on TZB/I-287	Construct a guided bus lane on the TZB/I-287.
<u>New Commuter Rail (first two alternatives assume the TZB is replaced)</u>	
• Suffern – Hudson line • Suffern – Harlem line	New east-west commuter rail systems connecting one or more Metro-North lines and Stewart Airport.
• West Shore line for passenger service	Provide passenger service via West Shore line.
Highway/Bridge Expansion	

Strategy/Alternative	Description
TZB Replacement/Expanded	
• Seven lanes with additional lanes for transit (bus)	Widened (probably replacement) TZB bridge with same number of general use highway lanes plus lanes reserved for busses/vanpools/High Occupancy Vehicles.
• Additional highway lanes for general use	More general use highway lanes on the TZB.
• Add shoulders to bridge	Add shoulders to TZB. (Existing bridge)
I-287 Highway	
• Transition to expanded TZB	Modify I-287 approaches to TZB to transition between wider bridge and existing I-287 lanes.
• Additional lanes in selected sections	Additional lanes on selected sections of I-287 where congestion is currently the worst. (Example might be between Sprain Brook Parkway and Route 100 or between the current WB fourth lane drop at exit 11 and Palisades Mall – exit 12.)
• Additional lanes throughout	Widened I-287 throughout corridor (Possibly not east of Hutchinson River Parkway).
• Improvements at various interchanges and transition areas	Various proposals are included.
• Close down some interchanges	Close selected entries and/or exits.

Strategy/Alternative	Description
• Provide reversible lane with moveable barrier (in addition to the TZB)	Construct a new lane on I-287 to be operated as a reversible lane as now exists on TZB.
• Direct bus connection to Tarrytown Station	Construct a direct bus connection to the Tarrytown Station (new road).

3.5 Screening Process

The study team used a three-step process to analyze the proposed solutions shown in Figure 3-1:

- Step 1: Initial broad brush screening
- Step 2: Refine proposed solutions to define distinct alternatives
- Step 3: Evaluation of alternatives emerging from Step 2

The remainder of this chapter addresses Steps 1 and 2 of the screening process. The final step is covered in Chapter 4.

3.5.1 Broad Brush Screening

The study team established four criteria for eliminating proposals from further analysis:

- If a proposed alternative actually created or increased congestion
- If a proposed alternative is already underway or in the process of implementation
- If a proposed alternative is not safe or physically feasible
- If a proposed alternative is not as effective as other strategies in addressing the same issue

Using these criteria, 14 of the 60 alternatives were screened out. For example, four proposed alternatives involved reconfiguring the use of existing lanes in some way. These included the following:

1) Making the Tappan Zee Bridge 5 lanes (vs. the current 4) in the peak direction and using the fifth lane for buses/vanpools
2) Using contraflow lanes (taking one lane in the non-peak direction) on the Cross Westchester Expressway for buses/vanpools
3) Using contraflow lanes on the Cross Westchester Expressway for use by all vehicle types travelling in the peak direction
4) Restricting the reversible lane on the Tappan Zee Bridge to buses/vanpools

Because all lanes in the critical sections will be at or near capacity in 2020, any proposed alternative that takes away a lane from its current use will result in increased traffic congestion in the remaining lanes (and the associated negative environmental impacts) even after factoring in the benefits of increased transit usage. In the first three proposals above, one of the three lanes in the non-peak direction is taken away. However, volumes in the non-peak (reverse commuting) direction are growing at a faster rate than peak direction traffic and those non-peak direction volumes far exceed the capacity of a two-lane roadway. The fourth proposal takes away one general use lane in the peak direction on the Tappan Zee Bridge. Unless at least one out of four auto users were to switch to bus service, congestion will be worse in the three remaining lanes. A 25 percent

diversion to transit is far beyond what might be expected from the relatively limited benefits associated with an exclusive bus/vanpool lane available only on the length of the Tappan Zee Bridge. Thus, this proposed alternative was screened out as a stand-alone strategy.

A second group of alternatives was eliminated because they are either already in the process of implementation or under study and therefore do not require further evaluation. On that basis, four proposed alternatives are screened out:

1) A third track on Metro North's Harlem line between Mount Vernon and Crestwood, already in the Environmental Impact Study stage
2) Encouraging use of alternative routings for trucks, already included in programs being pursued by NYSDOT and the Thruway Authority via variable toll rates and improved connections between the Thruway and I-84 to divert truck traffic to the Newburgh-Beacon Bridge
3) Construction of an I-84/I-87 interchange, already in the design stage
4) Various improvements at specific interchanges and transition areas along the corridor, already incorporated in NYSDOT's ongoing operational and safety improvement program

Two other proposed alternatives were eliminated because they were determined not to be safe or physically feasible:

1) Establishing priority bypass lanes for buses/vanpools would require use of the shoulders along I-287. Use of the shoulders would not be safe because of the numerous entrances and exits that cross these shoulders; because all entering and exiting traffic would have to cross the priority bus lane; and drivers who are not regular users would not expect vehicles to be traveling on the shoulders. Further, studies quoted in the National Cooperative Highway Research Program (NCHRP) Report 369, "Use of Shoulder and Narrow Lanes to Increase Capacity", have shown that priority bypasses are only effective for short distances, not for the long stretches of congestion forecast within the I-287 corridor.
2) Adding shoulders to the Tappan Zee Bridge is not structurally feasible because extensive structural studies show that the existing bridge cannot be widened.

Two other alternatives were screened out as being less effective than other proposals in addressing specific problems:

1) Improved rail service on Metro North's Hudson and Harlem lines, which already provide frequent service, would not address the east-west commute as effectively as several other rail proposals under consideration.
2) An exclusive busway on the Cross Westchester Expressway would require a wider right-of-way than another proposed alternative (for bus guideway) that would be more effective.

Finally, two alternatives were not eliminated entirely but considered in the broader context of a value pricing alternative:

1) Discount for E-ZPass non-commuters on the Tappan Zee Bridge, with the objective of increasing E-ZPass market share during congested weekend travel periods
2) Eliminating the commuter discount on the Tappan Zee Bridge

3.5.2 Refining Proposed Solutions

The next step in the screening process was to reduce the number of solutions being considered by combining proposals that should be logically paired to achieve greater benefits. Combining TDM strategies, for example, reflects the literature review's finding that packages of strategies are needed to meet the diverse travel needs of commuters. TDM program alternatives encompass over twenty of the individual solutions. This process yielded a more manageable number of alternatives that covered the full range of possible solutions and could then be analyzed further:

1) TDM programs
2) Value pricing
3) Commuter rail
4) Light rail
5) Bus guideway
6) Highway/bridge expansion

Referring back to the initial categories of non-capital intensive and capital-intensive, the first two categories represent non-capital intensive strategies while the remaining four correspond to capital-intensive solutions.

Each of these six strategy areas is discussed in more detail in the following sections. While each alternative was defined for purposes of analysis in this study, refinements may be made at a later stage. However, these refinements would not change the relationships among the alternatives that emerged from the study's evaluation.

3.5.2.1 TDM Programs

The literature review showed that the impact of TDM programs around the country has been highly variable. The major question for this study, therefore, is how much impact can TDM have in the I-287 corridor. Drawing on the literature review findings and the employer interviews, it is assumed that any acceptable TDM program should be positive, based on incentives for both employers and employees, rather than mandates. A number of voluntary TDM programs and transportation system management strategies would appear to be applicable to the I-287 corridor, including the following elements:

- Expanded ridesharing and vanpooling

- Additional park-and-ride lots
- Expanded bus and shuttle service
- Intermodal centers
- Management centers
- Reduced transit fares
- Further availability of TransitChek
- Ferry service
- Tax incentives
- Parking cash-out
- Intelligent Transportation Systems (electronic signs, cameras, etc.)
- Increased alternative work schedules and telecommuting

Two different levels of TDM programs have been included for purposes of analyzing the impacts of TDM alone and the impacts of TDM when combined with other strategies. The first level, Aggressive TDM, would largely build on the significant base of TDM programs already in place, with some increase in governmental assistance and voluntary efforts by employers. A more aggressive program, Very Aggressive TDM, would require significant governmental assistance, policy changes, and financial support to implement such new ideas as employer tax incentives and state legislative changes to enhance van programs.

While this level of TDM could be considered as a stand-alone strategy, it would also be appropriate to implement this Very Aggressive TDM program in conjunction with value pricing and with any of the transit options. TDM would complement the impacts of value pricing by encouraging commuters to carpool, vanpool, or taking advantage of transit service improvements for travel within the higher-priced peak travel periods or removing work trips from peak travel periods. Similarly, a Very Aggressive TDM program would support any of the transit options by providing incentives and active encouragement for commuters to try newly available transit services.

In a highway expansion scenario, a Very Aggressive TDM program would not be effective because the additional roadway capacity makes diversion to alternate modes or times of travel less attractive from a commuter's perspective. Some TDM programs, building on the significant base of TDM programs already in place in the corridor, would be retained to take advantage of the increased highway capacity (i.e., vanpools). Accordingly, TDM strategies were evaluated as follows:

- Aggressive TDM was evaluated only in combination with the highway expansion alternative.
- Very Aggressive TDM was evaluated alone and in combination with the remaining alternatives, i.e., value pricing, commuter rail, light rail, and bus guideway.

Quantitative estimates of the incremental impacts of the two levels of TDM were developed by using the experience of TDM programs in other areas as benchmarks and shaped by the results of the employer interviews.

Mobility impacts of TDM were estimated in comparison with 2020 "no build" conditions. Impacts were generally twice as great with Very Aggressive TDM as compared to Aggressive TDM, with Very Aggressive TDM producing about a four percent trip reduction and Aggressive TDM producing less than two percent trip reduction. These trip reductions would be over and above the benefits achieved in the corridor through already-implemented TDM programs. As noted in Section 2.2.12, it is estimated that existing travel conditions reflect trip reductions of almost four percent in the peak period from ongoing carpool, vanpool, and transit usage and shifts of almost six percent out of the peak hour from employees' utilization of flexible work hours. As a point of comparison, the national experience with TDM programs has been in the four to eight percent range. Thus after considering the trip reduction benefits already achieved with existing TDM programs, the projected impacts of TDM alternatives in the corridor would be at or above the high end of the range of national experience.

3.5.2.2 Value Pricing

The dynamics of value pricing imply that travel shifts out of the peak hour can occur as long as shoulder hours can absorb those shifts. At some point, the shoulder hours fill up, theoretically reaching equilibrium at the point that traffic is distributed evenly over the entire peak period. In effect, there is a flattened peak period pattern. The extent of the change in traffic levels in each of the hours of the peak period (and therefore the effectiveness of variable pricing) will depend on the peak period traffic distribution pattern prior to the imposition of variable tolls. If a facility has peak period traffic volume that is evenly distributed across four hours, variable pricing will not be very effective. However, on a facility where peak period traffic volume is significantly higher in one peak hour than the other peak period hours, value pricing can be very effective.

This study used the technical results of the New York State Thruway Authority study (described briefly in Section 3.2.2) and applied them to the year 2020. The most effective value pricing toll schedule evaluated by the Thruway study, termed "Option 2", included changes in toll rates for both cash/non-commuter E-ZPass and commuter traffic.

The current distribution of traffic within the peak period at the time of the Thruway study was as follows:

6-7 AM	23.4 percent
7-8 AM	30.2 percent
8-9 AM	26.9 percent
9-10 AM	19.5 percent

The Thruway evaluation of congestion pricing indicated that by changing the toll for travel at various times in the peak period, current traffic after implementation of value pricing would be distributed more evenly as follows:

6-7 AM	26.0 percent
7-8 AM	27.7 percent
8-9 AM	24.9 percent
9-10 AM	21.4 percent

In the 2020 "no build" scenario (under either growth forecast), the distribution of traffic within the peak period *without value pricing* is forecast to be as follows:

6-7 AM	25.1 percent
7-8 AM	28.2 percent
8-9 AM	23.3 percent
9-10 AM	23.5 percent

Thus, even without variable pricing, 2020 traffic forecasts show a relatively flat pattern over the four hour peak period.

It is assumed that the same pattern of even distribution of traffic projected by the Thruway study can be achieved by the use of an appropriate variable toll schedule in the future. Drawing from the Thruway study, applying the 27.7 percent share of peak period traffic to 7 to 8 AM peak hour traffic volumes in 2020 yields a 1.8 percent reduction in traffic under either the low or high growth forecast as compared to the 2020 "no build" conditions.

Beyond the trip reductions associated with shifts within the peak period but out of the peak hour, the Thruway study showed that an effective value pricing strategy would shift some single occupant trips to carpool, transit, or alternative routes. The study also showed that some trips would be eliminated entirely. Collectively, those trips were estimated to represent a 0.9 percent trip reduction that would be added to the trip reduction noted above, for an aggregate impact of 2.7 percent reduction in trips as compared to the 2020 "no build" scenario.

This projected range of impacts in the 2020 "no build" scenario is substantially below the peak hour reduction[2] shown in the Thruway study under 1990's conditions. The lower impact is to be expected as by 2020 the shoulders of the peak period will be congested and, therefore, unable to absorb significant traffic shifts out of the peak hour. Therefore, the impacts attainable with variable pricing in the short term may be less feasible as traffic levels and congestion increase over a longer time horizon. Similarly, it is

[2] Tappan Zee Congestion Relief Study, Final Report, August 1999, Wilbur Smith Associates, pages 32 and 33 indicate that "there would be a net 9 percent reduction in peak-period traffic under Option 2".

important to note the following observation from the Thruway study of congestion-relief pricing:

> "Impacts are based on data collected during stated responses to hypothetical [pricing] scenarios. It is difficult to gauge, from these surveys, whether these travel choices represent only short-term responses that may erode over time without further reinforcement."[3]

3.5.2.3 Commuter Rail

The study evaluated two different alternatives for commuter rail:

- New east-west commuter rail systems connecting one or more Metro-North lines and Stewart Airport
- West Shore Rail Service currently under study by New Jersey Transit

A new east-west commuter rail alternative would provide commuter rail service complementing the existing Harlem, Hudson, and New Haven Lines. Depending on the passenger's boarding location, service would be provided every ten to fifteen minutes during the peak period. This commuter rail line would run from Suffern to Port Chester, as depicted in **Figure 3-2**. It would operate on a replacement Tappan Zee Bridge with two commuter rail tracks and eight highway lanes.

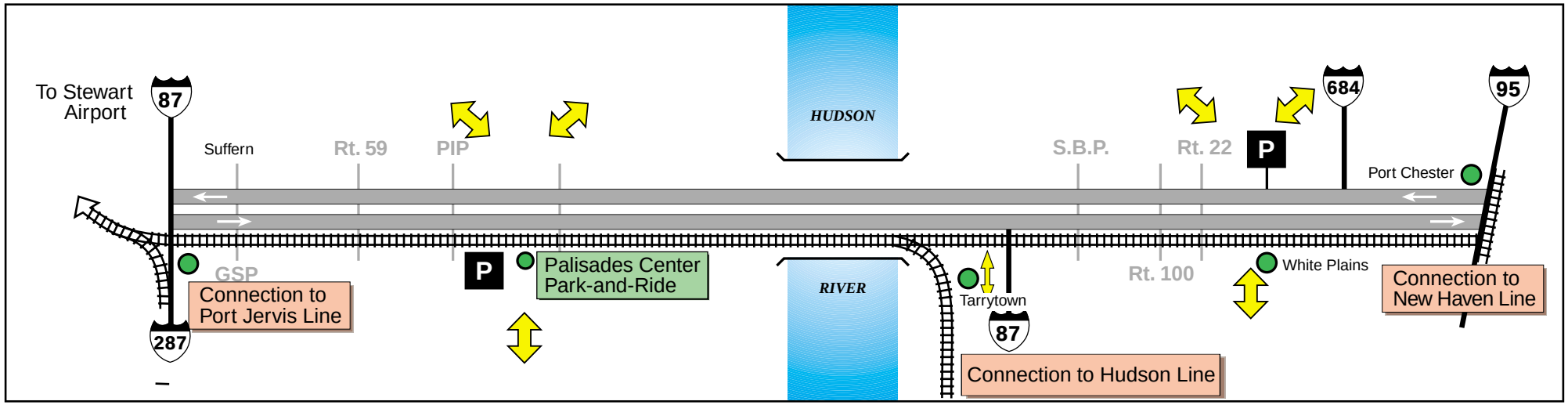
A new east-west commuter rail alternative would have a direct connection in Suffern to Metro North's Port Jervis Line. In addition, the Port Jervis line would be extended to provide service to Stewart Airport. There would also be connections to the Hudson Line for direct service to lower Westchester and Grand Central Terminal and to the New Haven Line in Port Chester.

Commuter rail trains would have a maximum speed of 100 mph; the average speed of the service would be 70 mph. Since the cars are heavy, the maximum grades that could be achieved would be lower than those for light rail.

A new east-west commuter rail alternative would require expanded and new feeder service between Westchester County stations and employers as well as between any station(s) in Rockland County and residential areas. While the number and general location of stops were assumed for developing the preliminary estimates of commuter rail ridership, no detailed studies of specific locations have been performed for this early phase of the corridor study. Potential stops could be at key locations such as Suffern, the Palisades Center Park and Ride at the Palisades Mall, and the Tarrytown, and White Plains areas.

[3] Tappan Zee Congestion Relief Study, Final Report, August 1999, Wilbur Smith Associates, page 21.

Commuter Rail



Legend

- Commuter Rail
- Distribution System
- Possible Station Locations
- P — Park and Ride

Figure 3-2

A West Shore rail line coupled with a rehabilitated Tappan Zee Bridge (see **Figure 3-3**), was also carried forward as a separate commuter rail option. Evaluation of a West Shore commuter rail alternative drew from information provided by New Jersey Transit (NJT) on its "proposed preferred alternative" for West Shore service. The NJT preferred alternative consists of a network of three separate rail lines; however, two lines are New Jersey branches that serve only localities in Northern New Jersey. The proposal's third line would originate in Hoboken, follow NJT's Bergen County line to the Secaucus Transfer Station, follow a new alignment through the Meadowlands with a new stop at the Sports Complex, and then connect via a new bridge over the Hackensack River with the West Shore right-of-way to its final destination in West Nyack (with a potential extension option to West Haverstraw). The proposed new West Shore line would, with a transfer, serve both midtown and downtown NYC-bound passengers, with transfers at the Secaucus Transfer Station to trains bound for Penn Station, New York and connections with PATH and trans-Hudson ferry service in Hoboken for service to Lower Manhattan.

West Shore Rail Service as currently proposed by NJT would serve a commuter market that partially overlaps the I-287 corridor. In fact, NJT data indicate that 30 percent or less of the total estimated ridership of the West Shore line would be drawn from New York State. In order to evaluate West Shore service on a comparable basis to other I-287 alternatives, only the impacts within the I-287 corridor were considered. It is recognized that West Shore rail service would provide benefits beyond the corridor. However, those benefits were not considered relevant for purposes of this study's evaluation of alternatives that would address transportation problems within the I-287 corridor.

Evaluation of these two new commuter rail service options in the corridor is covered in Chapter 4.

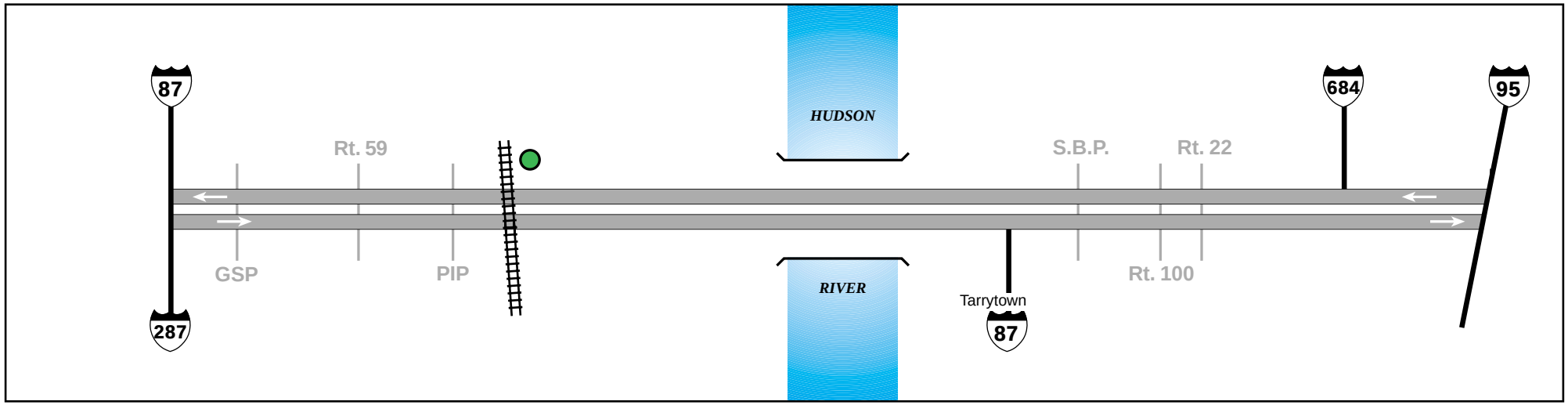
3.5.2.4 Light Rail

A light rail alternative would include four to six car trains, operating approximately every six minutes during the peak period. The light rail line would run from Suffern to White Plains within the Thruway's right-of-way, as depicted in **Figure 3-4**. It would run on a replacement Tappan Zee Bridge with eight highway lanes and two light rail tracks.

While the number and general location of stops were assumed for developing the preliminary estimates of light rail ridership, no detailed studies of specific locations have been performed for this early phase of the corridor study. Potential stops could be at key locations such as Suffern, the Palisades Center Park and Ride at the Palisades Mall, Tarrytown, Elmsford, and in White Plains; additional intermediate stops could be provided where needed.

A light rail alternative would provide a convenient transfer to the Hudson Line at either the existing Tarrytown Station or at an additional station closer to the Tappan Zee Bridge

West Shore



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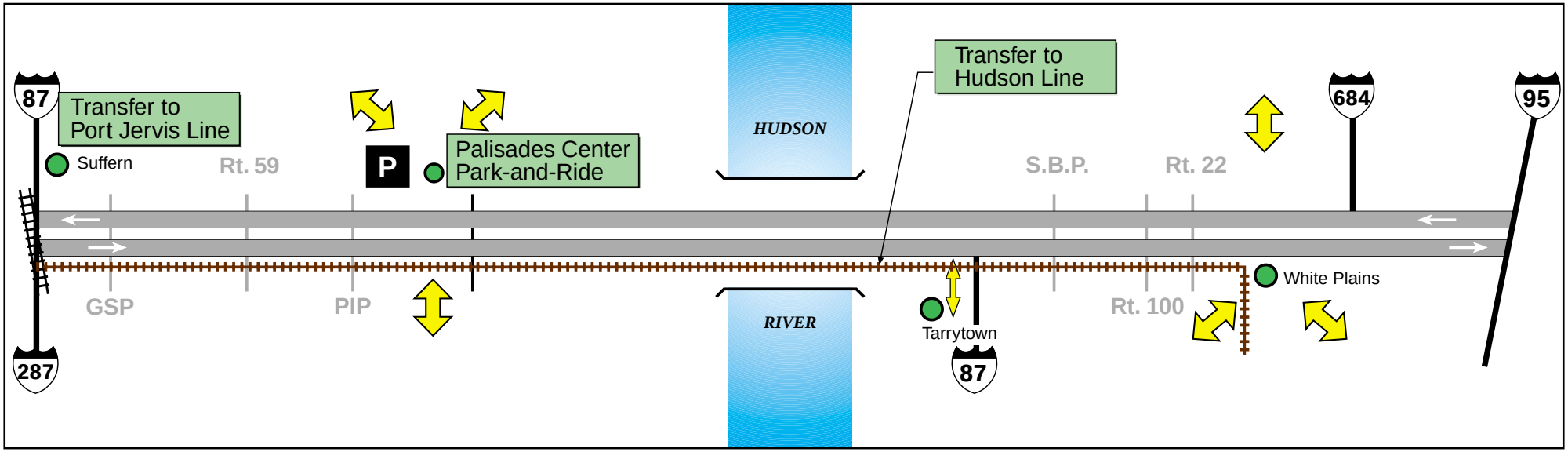
- West Shore Rail
- Possible Station Location
- P — Park and Ride

Figure 3-3

Light Rail



Legend

- Light Rail
- Commuter Rail
- Distribution System
- Possible Station Locations
- P — Park and Ride

Figure 3-4

(e.g. underneath the bridge). The light rail line would also have a transfer to Metro-North's Port Jervis Line in Suffern and the Harlem Line in White Plains.

Light rail cars would have a maximum speed of 50 mph and a weight slightly less than typical commuter rail cars. Thus, light rail can be constructed on steeper grades and sharper curves than commuter rail. As a result, the construction cost could be lower than for commuter rail. Service is generally slower but more frequent with more stops provided.

A light rail system would require expanded and new feeder service between Westchester County stations and employers as well as to/from the Palisades Center Park and Ride.

Evaluation of the light rail alternative is covered in Chapter 4.

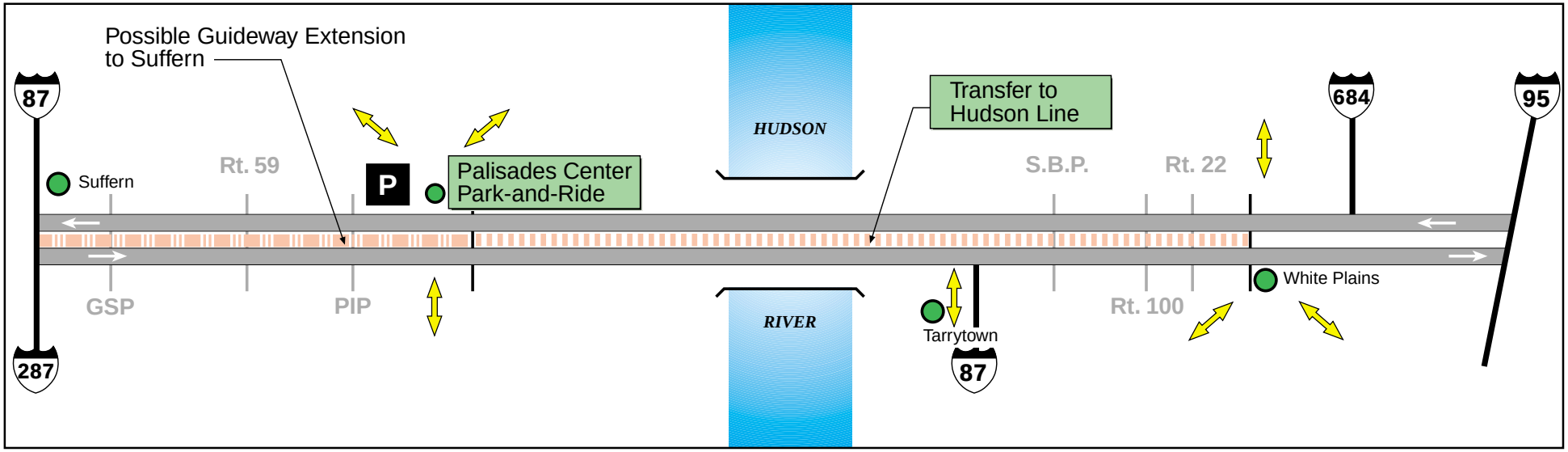
3.5.2.5 Bus Guideway

Bus guideways are in use in England, Australia, and Germany and being planned for many other locations. Buses operate within special guideways that bypass congestion in standard lanes and prevent access by unauthorized traffic. Specially designed vehicles allow for hands-free operation of the bus while on the guideway (using a curb or wire guided system) but these same vehicles can then exit the guideway and travel on any roadway to provide regular bus service. A bus guideway alternative would include service operating approximately every six minutes in the peak period. The buses would travel at 55 miles per hour while on the guideway. As depicted in **Figure 3-5**, a bus guideway would follow the same route and feature the same stops and rail connections as light rail. As with the other transit alternatives, the number and general location of stops were assumed for developing the preliminary estimates of bus guideway ridership. However, no detailed studies of specific locations have been performed for this early phase of the corridor study.

Since guideways require only 9 foot 6 inch wide right of way as opposed to a standard 12 foot highway lane, the guideway could be located in the median of I-287 roadways at a lower construction cost than light or commuter rail. The most concentrated employment centers could be served by direct service, with the vehicles exiting the guideway and travelling over regular roadways, thus providing some commuters with a one-seat ride. Commuters destined for less concentrated areas would require a bus transfer. Thus, the required distribution system would be less extensive than with a light rail alternative.

Evaluation of the bus guideway alternative is covered in Chapter 4.

Bus Guideway



Legend

- Bus Guideway
- Distribution System
- Possible Station Locations
- P — Park and Ride

Figure 3-5

3.5.2.6 Highway/Bridge Expansion

Expansion of highway/bridge capacity could take one of several forms:

- Additional lanes on and approaching the Tappan Zee Bridge, providing five lanes in each direction
- Additional lanes at critical corridor locations
- Additional lanes throughout the corridor

Preliminary evaluation of the impacts of these options on 2020 travel conditions revealed that the first option does not address the critical congested conditions in the White Plains area. The third option adds capacity in areas that are not forecast to have traffic congestion problems. Therefore, the second option (which, in fact, covers 85 percent of the corridor) was selected as the highway/bridge expansion alternative to be evaluated.

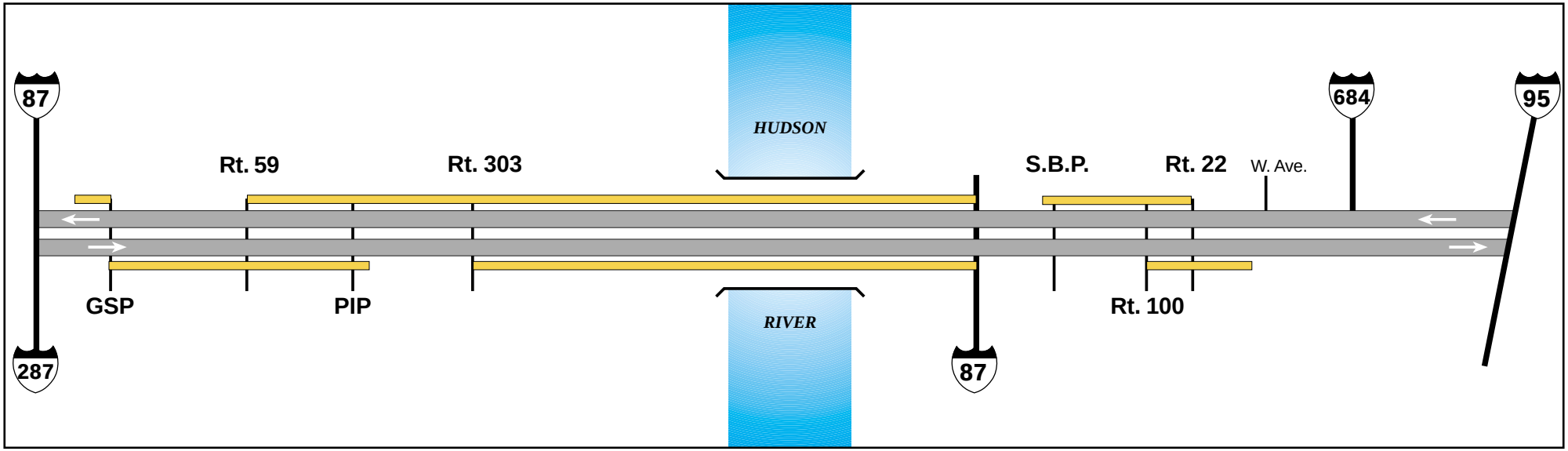
Specifically, as depicted in **Figure 3-6**, a highway/bridge expansion alternative would provide one additional lane at each of the following locations:

- Eastbound segments
  - From the Garden State Parkway to just east of the Palisades Interstate Parkway
  - From Route 303 in Rockland County across the Tappan Zee Bridge to the I-87/I-287 split in Westchester County
  - Between Route 100 and Westchester Ave in White Plains

- Westbound segments
  - From Route 22 in the White Plains area to just west of the Sprain Brook Parkway
  - Between the I-87/I-287 split and Route 59 in Rockland County
  - From just west of the Garden State Parkway to the Airmont Road exit

Evaluation of the highway/bridge expansion alternative is covered in Chapter 4.

Highway / Bridge Expansion



Legend

Additional Lane

Figure 3-6

The screening process described in Section 3.5 in Chapter 3 identified "what" should be evaluated as the following six alternatives:

1) TDM, evaluated as two levels:
   - Aggressive TDM (only in combination with Highway/Bridge Expansion alternative)
   - Very Aggressive TDM (alone and in combination with the remaining alternatives)
2) Value Pricing
3) Commuter Rail, including two options:
   - New East-West Commuter Rail Service
   - West Shore Commuter Rail Service
4) Light Rail
5) Bus Guideway
6) Highway/Bridge Expansion

This chapter describes the nature and limitations of the evaluation, the criteria and process used, and the results.

4.1 Nature and Limitations of Evaluation

The basic objective of this study's evaluation was to provide a preliminary comparison of the relative effectiveness of the range of alternatives currently under consideration. The results of this preliminary evaluation will be used by the I-287 Task Force to recommend which potential strategies warrant more in-depth analysis.

The focus of the evaluation was on the long-term value of alternative transportation improvement strategies within the I-287 corridor. As a starting point, alternatives were compared to 2020 "no build" conditions under a low growth and high growth forecast. (These conditions are described in Section 2.4 of this report.) However, given the long-term horizon over which any transportation improvement should be evaluated, the study team considered the effectiveness of each alternative beyond the year 2020 on a more qualitative basis.

Due to the preliminary nature and short timeframe of the evaluation process and the study's reliance on existing data, two factors were not fully evaluated in this study phase:

- The impacts of diverted and induced trips
- Constraints on travel demand.

Although these factors are not incorporated in the estimated impacts, the study team believes that these exclusions are reasonable for purposes of a preliminary comparative assessment of alternative strategies. The relative effectiveness among the alternatives is

not expected to be significantly different than indicated by the preliminary evaluation results presented here. A more detailed quantitative evaluation of the impacts of trip diversions and demand constraints will occur in a subsequent study phase. **Appendix C** provides a qualitative explanation of the potential influence of these two factors.

More detailed examination of alternatives in subsequent phases of study may well result in some modifications to the geographical limits and physical and operating characteristics assumed in this preliminary comparative evaluation. For example, the study team made certain assumptions for all transit alternatives concerning the general route and the number and general location of stops for purposes of developing preliminary estimates of transit ridership. However, no detailed studies of specific station locations, route alignments or ramp and connecting roadway improvements have been performed for this early phase of the corridor study. Thus, for instance, while the light rail alternative in this preliminary study has a western terminus in Suffern and an eastern terminus in White Plains, subsequent analysis may suggest that its western terminus should be at the Palisades Mall or that implementation across the entire I-287 corridor should be phased in over time.

This preliminary study assessed impacts within a more narrowly defined geographic area than would be required in an environmental impact statement. Any selected alternative, for example, would require a much broader and more detailed evaluation for such purposes as assessing conformity with State Implementation Plans for meeting federal Clean Air standards. Future evaluations of effectiveness may show some differences from the results in this preliminary study. Nonetheless, no substantial variations are anticipated that would invalidate the basic results of this preliminary evaluation.

4.2 Performance Measures For Preliminary Evaluation

As noted in Section 3.1, the I-287 Task Force adopted goals and objectives to guide the overall study. Those goals and objectives form the basis for the criteria used to evaluate each of the alternatives. The focus of the evaluation process was on impacts within the corridor. While corridor-wide impacts were the principal concern, it was appropriate to assess impacts for different segments within the overall corridor in some cases.

In general, the study team made every effort to be consistent in the assumptions made; this consistency ensured that each alternative was evaluated in a comparable manner. For each objective, the study team developed quantitative or qualitative performance measures, as described below and shown in the far left column of **Figure 4-1**.

4.2.1 Mobility Performance Measures

One of the adopted goals was to improve mobility in the I-287 corridor. Mobility can be measured in many ways. The study's specific mobility objectives and the performance measures associated with them were as follows:

- Decrease highway travel during weekday peak periods, as measured by
  - Vehicle trips removed from I-287 in the eastbound peak AM hour
- Increase public transit use, as measured by
  - Increased transit trips in the eastbound peak AM hour
  - Availability of a one-seat transit ride from Rockland County to White Plains
  - Availability of a one-seat transit ride from Rockland County to New York City
- Accommodate growth in regional travel, as measured by
  - Travel times in the eastbound peak AM hour between Spring Valley and White Plains
  - Ability to meet demand beyond 2020
- Maintain or improve safety, as measured by
  - Change in annual vehicle miles traveled (VMT) from "no build" scenario
  - Incident response time on the Tappan Zee Bridge
- Reduce through truck traffic, as measured by
  - Change in truck trips from "no build" scenario

4.2.2 Environmental Impact Performance Measures

The I-287 Task Force adopted an overall goal of minimizing environmental impacts. At this early phase of the corridor study, alternatives have not been defined in enough detail to allow a complete Environmental Impact Study. Therefore alternatives were subjected to a preliminary evaluation of how effective they were in meeting the following four environmental objectives:

- Improve air quality, as measured by the reductions in regional levels of carbon monoxide, nitrogen oxides, and volatile organic compounds from the no-build scenario
- Minimize sprawl
- Minimize impacts in Westchester and Rockland Counties, both during construction and longer term, with these impacts considered on a qualitative basis
- Minimize impacts on sensitive areas throughout the corridor both during construction and longer term, with the key consideration being a qualitative evaluation of impacts on the Hudson River

4.2.3 Corridor-Wide Effectiveness Performance Measures

Another important study goal was to develop strategies that address problems throughout the corridor. Two qualitative evaluation measures were considered for each alternative in this context: the various user groups served and the geographical areas served. Also considered in evaluating each alternative for corridor-wide effectiveness was its ability to maximize use of existing facilities.

4.2.4 Time Effectiveness Measures

The ease of implementation is clearly an important consideration in evaluating the extent to which available alternatives can provide relief in the short, medium, or long term. Therefore, the study team estimated the time required to implement each alternative as another performance measure for comparative evaluation.

4.2.5 Cost Effectiveness Performance Measures

Clearly, alternatives should be reasonably cost effective. The overall order-of-magnitude capital cost was estimated for each alternative. Additionally, a cost effectiveness index was calculated to compare the quantifiable benefits – reduced auto trips, increased transit trips, improved air quality, faster transit and highway travel times and reduced vehicle miles of travel – with the capital cost of each alternative, exclusive of any potential right of way requirements. As noted in Section 4.1, the preliminary nature of this effort precluded the development of a comprehensive cost-benefit evaluation (for example, operating costs were excluded because detailed service plans were not developed for each alternative). This index was used to provide a preliminary indication of cost effectiveness. A detailed explanation of the cost effectiveness index calculations is included in **Appendix C**.

4.2.6 Regional Employment Growth Performance Measures

One study goal was to ensure that the transportation system supports regional economic growth in the I-287 corridor. As a measure to evaluate each alternative's effectiveness in meeting this goal, the study team projected the change in the number of jobs in the corridor as compared to the "no build" 2020 scenario, utilizing the Regional Economic Model (REMI) as described in Appendix C.

4.3 Preliminary Evaluation Process

Using the goal-specific performance measures identified above, the study team developed the data for each alternative and generated the comparison matrix shown as **Figure 4-1**. Note that wherever quantitative results are cited, they are based on the data shown in **Figure 4-1** and represent an average of the high and low growth estimates. It should be noted that for each alternative, the number of vehicle trips removed by applicable TDM elements are shown separately in the matrix.

These detailed findings were converted into Consumer Reports-like ratings to provide a more straightforward comparative evaluation of the alternatives for each major goal and objective. **Figure 4-2** depicts graphically, in a Consumer Reports-like format, how effective the alternatives were in meeting the study's goals and objectives. As in a typical Consumer Reports format, the "best" symbol is a solid green circle; the "worst" symbol is a solid red circle; and the other circles represent varying levels of positive or negative effects.

4.4 Preliminary Evaluation Results

Figure 4-2 summarizes the end results of the study team's preliminary evaluation of alternative long-term transportation improvement strategies for the I-287 corridor. A brief discussion of these results is presented below for each goal.

4.4.1 Effectiveness in Improving Mobility

The most effective alternatives for improving mobility in the I-287 corridor are east-west commuter rail, light rail and bus guideway. These alternatives are rated highest among the alternatives in improving mobility because they remove the largest number of trips from I-287. The range of vehicle trips removed in the peak hour eastbound ranges from 1430 to 1770, with the high end of this range virtually equivalent to the capacity of one additional lane on the Tappan Zee Bridge. As a result, they also provide the largest reduction in VMT and the largest increase in transit use. Of these three alternatives, east-west commuter rail is the most effective, producing an annual reduction of almost 100 million VMT as compared to the 2020 "no build" conditions.

All three of these transit alternatives would provide a much faster trip for users. For example, as compared to a peak period highway travel time of one hour and ten minutes along the segment between Spring Valley and White Plains in the peak hour under 2020 "no build" conditions, travel time, including average waiting time, for commuter rail would be 16 minutes; light rail would be 21 minutes; and bus guideway would be about one half hour. (Note that these travel times do not include time to reach the I-287 access location or to complete the trip after leaving the I-287 corridor. The data are presented in order to provide an "apples-to-apples" comparison with travel between the same two points under the highway expansion alternative.)

The highway/bridge expansion alternative rates highly in terms of highway travel time, with the Spring Valley to White Plains trip requiring only 16 minutes, the same time required for travel along the same segment via commuter rail. For the same trip, the east-west transit alternatives reduce highway travel time on I-287 by one-half hour from the no-build time (1 hour and 10 minutes to about 40 minutes). The West Shore, TDM and Value Pricing alternatives are less effective, with the highway travel time on I-287 between Spring Valley and White Plains requiring one hour or more. However, as noted previously, these highway travel time improvements will diminish over time with the

"filling up" of available capacity. (The "filling-up" will occur for any alternative, but the amount is far greater for the highway/bridge expansion alternative). Further, any short-term positive impacts of the highway/bridge expansion are far outweighed by this alternative's inability to achieve two key objectives: reduce peak period highway travel and encourage transit trips. With added capacity, the highway expansion alternative may also encourage through truck trips, in direct conflict with another study goal.

The West Shore commuter rail alternative by itself (excluding the impacts of TDM) is roughly 20 percent as effective as the new east-west commuter rail alternative in removing trips from I-287. This lower effectiveness reflects the fact that West Shore would serve only a limited segment of current I-287 users (those going to and from Manhattan) and provide no effective service between Rockland and Westchester.

Neither TDM nor value pricing in combination with TDM are as effective as the transit alternatives in removing trips from I-287. These alternatives result in travel times of an hour or more from Spring Valley to White Plains during the peak hour, approximately 50 to 60 percent longer than any of the transit alternatives. Also, since TDM and value pricing, along with West Shore, do not include a replacement TZB bridge, they do not provide any improvement in TZB incident response time.

The east-west transit alternatives would also produce the greatest reductions in vehicle miles of travel (VMT). On an annual basis, it is estimated that commuter rail would reduce VMT by 95 million miles, light rail by 82 million miles and bus guideway by 88 million miles. The VMT reduction associated with highway/bridge expansion is an estimated 26 million miles, all of which is attributable to this alternative's TDM component. TDM, value pricing and West Shore would result in estimated VMT reductions of between 39 million and 50 million miles.

Apart from evaluating the differences in mobility impacts in quantitative terms, it is important to consider each alternative's ability to meet demand beyond 2020 on a more qualitative basis. In this context, only east-west commuter rail, light rail, and bus guideway are effective. Under each of these alternatives, increasing the equipment and/or frequency of transit service could provide increases in people handling capacity even beyond 2020. Commuter rail would provide the most expansion capability of the these three transit alternatives (followed by light rail and then bus guideway) by both adding cars to each train and increasing the number of trains in service. In contrast, TDM , value pricing, and highway expansion have no significant ability to meet demand after 2020 and increases in capacity achievable with West Shore rail apply only to trips to/from Manhattan and New Jersey.

4.4.2 Effectiveness in Minimizing Environmental Impacts

The alternatives were reviewed to identify the relative potential impacts on the environment. Because the detailed definition of the alternatives, including such elements as the specific alignment and station locations, will be made in a subsequent EIS phase,

the review in this preliminary evaluation was generally qualitative. In addition, the evaluation focused on a narrower geographic area than is required by the Clean Air Act Amendments of 1990 for purposes of assessing conformity of transportation projects with National Ambient Air Quality Standards of the State Implementation Plan (SIP). Conformity with SIP will also be addressed in a subsequent phase of study.

Air quality is generally more significantly affected by VMT than speed. Since they remove more trips from the highway, the transit alternatives other than West Shore rate more favorably than TDM and value pricing, providing greater improvements in air quality. The commuter rail alternative would remove an estimated 263 tons of carbon monoxide, 78 tons of nitrogen oxide and 112 tons of volatile organic compounds annually. The air quality benefits for the light rail and bus guideway alternatives are lower, but still significant. In contrast, the benefits associated with the highway expansion alternative are estimated to be less that one third of those realized with the commuter rail option, and the benefits for the TDM, Value Pricing and West Shore alternatives are one-half to two thirds of the commuter rail option.

The east west rail alternatives are rated most effective in discouraging urban sprawl as historically development is generally concentrated in the station areas along transit routes. The bus guideway, with its ability to serve adjacent areas, is less effective. Increased highway capacity tends to encourage diverse geographic development and therefore is rated negatively.

While the location and extent of potential impacts cannot be determined in this early phase, it is clear that the expansion of the highway would result in some noise and traffic impacts adjacent to I-287. Similarly, the addition of any transit system along the corridor would also have impacts adjacent to I-287 as well as at station areas.

The three east-west transit and the highway/bridge expansion alternatives would be constructed within the existing right-of-way for much of the length of the I-287 corridor. As a result, property takings would be limited. As this process moves forward and potential alignments are developed, specific impacts will be identified and appropriate measures can be taken to minimize them. The ratings reflect these conditions.

Both the rehabilitation of the Tappan Zee Bridge, which would require the complete replacement of the bridge's 1.5 mile causeway, and the reconstruction of the bridge would have impacts on the Hudson River. Although the extent cannot be determined until a full analysis is undertaken, the impacts would be greater with a replacement structure. The impact would be greatest with the commuter rail alternative which is assumed to include a viaduct connection to the Hudson Line at the eastern end of the Tappan Zee Bridge.

While TDM, value pricing, and West Shore rail would have minimal environmental impacts in the long term, it is important to note that the need to rehabilitate the Tappan Zee Bridge in the absence of a replacement structure would create significant ongoing

disruption in the shorter term to perform the rehabilitation work identified in Section 2.2.14 as necessary over a 13 year period.

4.4.3 Corridor-Wide Effectiveness

The east-west transit and highway options are all effective in serving all user groups and geographic areas. The highway expansion would be an effective corridor-wide strategy because it would serve virtually all user groups and geographic areas in all time periods, providing additional capacity for commuting, commercial and recreational travel. East-west commuter rail, light rail and bus guideway rate slightly less favorably in terms of addressing problems throughout the corridor, with commuter rail's superior service for trips to New York City making it the most favorable of these three transit options. TDM would be moderately effective; it can be utilized throughout the corridor but largely serves peak period commuters making east-west trips, not off peak, Rockland to NYC, or through trips. Value pricing would only benefit those traveling eastbound across the Tappan Zee Bridge in the peak hours. Value pricing would financially affect peak hour users and increase congestion for all travelers in the shoulder and off-peak hours. West Shore rail only serves travelers to and from Manhattan, providing no significant corridor-wide benefit.

With regard to maximizing use of existing corridor transportation facilities, commuter rail is rated the most effective because it provides direct connections to three existing Metro North rail lines (Port Jervis, Hudson, and New Haven) and Stewart Airport. Light rail and bus guideway are rated moderately effective since they both provide transfers to one or more Metro North rail lines. TDM and value pricing are rated slightly effective; TDM would enhance existing corridor TDM programs and value pricing would build on the existing E-ZPass system. While West Shore rail would provide links with existing north-south rail infrastructure, these lines are not in the I-287 corridor. The highway alternative does not maximize the use of transit or other alternative travel modes in the corridor.

4.4.4 Time Effectiveness

TDM and Value Pricing can be effective in the short-term. Both can be implemented relatively quickly. However, toll changes require New York State Thruway Authority board approval and compliance with the state Administrative Procedures Act, including opportunities for public comment. TDM can build on the success of existing TDM programs in the corridor (see Section 2.2.12), but full implementation may take longer than value pricing because certain legislative and policy changes would be necessary to assure the maximum effectiveness. In addition, employer involvement would take time to develop. Benefits from both of these alternatives may be difficult to sustain over time based on "lessons learned" from the study's TDM literature review and the Thruway study of congestion relief pricing, particularly given the shrinking available capacity in the shoulder hours to absorb traffic shifts. Over time, therefore, the effectiveness of these alternatives may diminish. Thus, these alternatives may represent only shorter-term

solutions to corridor transportation problems and therefore alternatives that have longer lasting benefits must also be developed.

West Shore rail, based on NJ Transit's preferred alternative, would require five to ten years to implement. The remaining alternatives (commuter rail, light rail, bus guideway, and highway/bridge expansion) would require more than ten years to implement. Implementation times for these alternatives are longer due to the need for significant design, review, permitting and construction activities.

4.4.5 Cost Effectiveness

Total estimated capital costs include either the rehabilitation or replacement of the Tappan Zee Bridge, as applicable for each alternative. TDM, Value Pricing, and West Shore commuter rail are the lowest capital cost alternatives (between $1.2 and $1.4 billion), requiring only minor costs (when considering just the New York State portion of the West Shore proposal) beyond those required to rehabilitate the existing Tappan Zee Bridge. Highway/bridge expansion and bus guideway have roughly comparable capital costs of under $2 billion. New east-west commuter rail would have the highest capital cost ($4 billion) if it served Stewart Airport and Port Chester in addition to the Suffern-White Plains segment. (Tunneling on the west side of the Hudson River is one contributing factor in the costs of this alternative.) The portion of the commuter rail alternative between Suffern and White Plains, the area served by the light rail option, is estimated to be $3.4 billion, compared with the $2.6 billion estimated capital cost for light rail service along the same segment.

Cost effectiveness ratings reflect the ratio of the quantifiable benefits to costs for each alternative, as noted in Section 4.2.5 and described in **Appendix C**. The three east-west transit alternatives rate the highest, with bus guideway the most effective because it has relatively strong levels of benefit and low capital costs. East-west commuter rail and light rail have slightly lower, but relatively comparable, cost effectiveness indices; they have high benefit levels and high capital costs. West Shore rail, TDM and Value Pricing have modest benefits and costs, while highway/bridge expansion has similar modest benefits and slightly higher costs.

4.4.6 Effectiveness in Supporting Regional Employment Growth

There was no significant measurable difference among the alternatives in meeting this goal. In all cases, the impact on corridor jobs would be small, generally less than one percent. This finding is consistent with the information gained in the employer survey. The employers interviewed generally did not see congestion as a major problem for their employees. Many of them also noted that only a small percentage of their employees used the Tappan Zee Bridge or other critical portions of the I-287 corridor. Since the analysis only addressed the impacts of congestion on I-287, which carries only a portion of the travel within the region, and did not consider future problems on other routes, the overall impact on corridor jobs is relatively minor.

While this performance measure turned out not to be a useful criteria in distinguishing among the alternatives, it is important to note that any of the alternatives would be acceptable in terms of the ability to support regional economic growth.

4.5 Concluding Observations

While the evaluation of alternatives suggests that there is no single preferred solution for addressing the transportation needs of the I-287 corridor, this preliminary study suggests that a combination of strategies could be effective. For example, implementing an aggressive TDM program and value pricing could provide some improvement in mobility in the I-287 corridor in a relatively short timeframe, at modest cost, and with minimal adverse environmental impacts[1]. Value pricing would address only the Tappan Zee Bridge segment of the corridor and, therefore, should be recognized as not providing a complete corridor-wide solution to traffic problems. Further, growing capacity constraints throughout the corridor in the shoulder hours of travel are likely to limit the long-term effectiveness of TDM and value pricing strategies. Thus, longer-term capital improvements in the corridor are still likely to be needed.

All of the longer term alternatives evaluated in this preliminary study require replacement of the Tappan Zee Bridge. This is because rehabilitating the existing structure to keep it in good working condition, which would involve years of ongoing traffic disruption and cost an estimated $1.1 billion, would not result in additional mobility enhancements and meaningful congestion relief. In addition, additional fixed transit cannot be accommodated by the existing structure. The ability to offer transit as a viable travel option to the single occupant auto would enhance greatly the corridor's people-handling capacity and would contribute to a more successful value pricing program. While highway/bridge expansion without the introduction of transit service would provide additional roadway capacity, it is anticipated, based on past experience, that capacity will eventually "fill up", leaving no additional flexibility within the transportation infrastructure to handle traffic growth in the corridor over the long term.

Restoration of West Shore rail would have limited benefits within the I-287 corridor because it offers no effective east-west service between Rockland and Westchester counties. Of the three transit options that could serve the corridor, new east-west commuter rail is projected to yield slightly greater benefits than light rail or bus guideway. Although its costs are greater than the other options, commuter rail would provide the greatest improvements in mobility corridor-wide with the flexibility to expand capacity to meet additional travel demand well into the 21st century. It would maximize the utilization of existing transportation facilities by linking new transit service with established commuter rail operations in the region to provide one-seat ride service to

[1] According to the Tappan Zee Congestion Relief Study, Final Report, August 1999, Wilbur Smith Associates, page 32, the travel time savings would be approximately 2 to 3 minutes for trips across the Tappan Zee Bridge during the AM peak two hour period (7-9AM)

both White Plains and NYC. A more detailed study of commuter rail and the other two east-west transit alternatives is required to fully evaluate alignments, service levels, benefits and costs.

Figure 4-1: 2020 I-287 Alternatives Analysis Matrix

Goals & Objectives	No-Build	TDM *incl. rehab. TZB*	Value Pricing *incl. rehab. TZB, TDM*	West Shore *incl. rehab. TZB, TDM*	Commuter Rail *incl. repl. TZB, TDM*	Light Rail *incl. repl. TZB, TDM*	Bus Guideway *incl. repl. TZB, TDM*	Highway/Bridge Expansion *incl. repl. TZB, TDM*
IMPROVE MOBILITY IN THE I-287 CORRIDOR								
Decrease Highway Travel During Weekday Peak								
- Vehicle trips removed from I-287 pk hr EB								
Removed by alternative	0	835	235	192	935	595	685	0
Total removed, including TDM	0	835	1070	1032	1770	1430	1515	500
Increase Public Transit Use								
-Increased trips, pk hr EB - from I-287 cars	0	Under 100	Under 100	100	1100	700	810	0
-One seat Rockland-White Plains trip available	No	No	No	No	Maybe*	Maybe*	Yes**	n/a
-One seat Rockland-NYC trip available	No	No	No	Transfer required	Yes	Transfer required	Transfer required	n/a
Accommodate Growth in Regional Travel								
Transit Travel times, pk hr EB - S. Valley to W. Plains (min)	-	-	-	-	16	21	31	-
-Highway travel times, pk hr EB - S.Valley to W. Plains (min)	70	65	60	67	41	42	41	16
-Ability to meet demand beyond 2020	No significant ability to meet demand after 2020	No significant ability to meet demand after 2020	No significant ability to meet demand after 2020	Only for trips to/from Manhattan, NJ	Yes-has significant capacity to increase the number of cars & trains	Yes-has capacity to increase the number of cars & trains	Yes-has capacity to increase the number of buses	No significant ability to meet demand after 2020
Maintain or Improve Safety								
-Annual Vehicle Miles Traveled - change from No Build	0	-39 million	-39 million	-50 million	-95 million	-82 million	-88 million	-26 million
-TZB incident response time	No Improvement	Minimal improvement	Minimal improvement	Minimal improvement	Modest improvement	Modest improvement	Modest improvement	Significant improvement
Reduce Through Truck Traffic								
-Change in truck trips during peak period	No change	No measurable change	No measurable change	No measurable change	No measurable change	No measurable change	No measurable change	Modest increase
MINIMIZE ENVIRONMENTAL IMPACTS								
Improve Air Quality (Reduction, Tons per Year)								
Carbon Monoxide	n/a	108	107	139	263	216	243	71
Nitrogen Oxides	n/a	32	31	41	78	64	71	21
Volatile Organic Compounds	n/a	46	45	59	112	92	103	30
Minimize Sprawl Throughout the I-287 Corridor	Base condition	Does not significantly discourage sprawl	Does not significantly discourage sprawl	Could discourage sprawl in Rockland	Could discourage sprawl in Rockland & Westchester	Could discourage sprawl in Rockland & Westchester	Could discourage sprawl in Rockland & Westchester to a lesser degree than Commuter Rail & Light rail	Will encourage sprawl
Minimize Impacts on Properties & Sensitive Areas								
Westchester/Rockland								
-During construction	Significant traffic impacts during TZB rehabilitation	Significant traffic impacts during TZB rehabilitation	Significant traffic impacts during TZB rehabilitation	Noise, traffic impacts in Rockland County near station areas; significant traffic impacts during TZB rehabilitation	Noise, traffic impacts adjacent to ROW; Significant I-287 traffic impacts	Noise, traffic impacts adjacent to ROW; Significant I-287 traffic impacts	Noise, traffic impacts adjacent to ROW; Significant I-287 traffic impacts	Noise, traffic impacts adjacent to ROW; Significant I-287 traffic impacts
-Long Term	Minimal impacts	Minimal impacts	Minimal impacts	Noise, traffic impacts in Rockland County station areas & along ROW	Noise and visual impacts adjacent to ROW and stations. Traffic impacts on station access roads	Noise and visual impacts adjacent to ROW and stations. Traffic impacts on station access roads	Noise and visual impacts adjacent to ROW and stations. Traffic impacts on station access roads	Noise and visual impacts adjacent to ROW.
Hudson River								
-During construction	Significant impacts due to TZB causeway reconstruction, west of the main span structure	Significant impacts due to TZB causeway reconstruction, west of the main span structure	Significant impacts due to TZB causeway reconstruction, west of the main span structure	Significant impacts due to TZB causeway reconstruction, west of the main span structure	Very significant impacts surrounding new piers & footings for new bridge & causeway. Demolition impacts near existing bridge.	Very significant impacts surrounding new piers & footings for new bridge & causeway. Demolition impacts near existing bridge.	Very significant impacts surrounding new piers & footings for new bridge & causeway. Demolition impacts near existing bridge.	Very significant impacts surrounding new piers & footings for new bridge & causeway. Demolition impacts near existing bridge.

Figure 4-1: 2020 I-287 Alternatives Analysis Matrix

Goals & Objectives	No-Build	TDM *incl. rehab. TZB*	Value Pricing *incl. rehab. TZB, TDM*	West Shore *incl. rehab. TZB, TDM*	Commuter Rail *incl. repl. TZB, TDM*	Light Rail *incl. repl. TZB, TDM*	Bus Guideway *incl. repl. TZB, TDM*	Highway/Bridge Expansion *incl. repl. TZB, TDM*
-Long term	Minimal Impacts	Minimal Impacts	Minimal Impacts	Minimal Impacts	Slight impact along entire length of new bridge due to increased size & shadow areas. Visual impacts to residences & viewsheds closest to bridge approach & Hudson Line connection.	Slight impact along the entire length of the new bridge due to increased size and shadow areas.	Slight impact along the entire length of the new bridge due to increased size and shadow areas.	Slight impact along the entire length of the new bridge due to increased size and shadow areas.
DEVELOP AN ACCEPTABLE CORRIDOR-WIDE STRATEGY								
Develop Strategies that Address Problems Throughout the Corridor								
-User groups served	n/a	Largely serves peak period commuters	Serves only EB peak hour commuters; negatively impacts commuters in shoulder hours	Serves peak & off peak travelers	Serves peak & off peak travelers	Serves peak & off peak travelers	Serves peak & off peak travelers	Serves all travelers
-Geographical areas served	n/a	Serves east-west trips; does not serve Rockland to NYC or through trips	Serves EB trips only; does not serve intracounty or NYC trips	Serves NYC/NJ trips, does not serve Rockland-Westchester or intracounty trips	Serves all areas: Stewart to Pt. Chester & NYC	Serves Suffern to White Plains; transfer required for NYC	Serves Palisaides Mall or Suffern to White Plains; transfer required for NYC	Serves all areas: Suffern to Pt. Chester
Maximize Use of Existing I-287 Corridor Facilities & Services	n/a	Enhances existing TDM programs	Builds upon the existing E-ZPass system	Does not add value to any exisitng facilities in the I-287 corridor	Provides direct connections to Pt. Jervis, Hudson, New Haven lines, Stewart Airport	Provides transfers to Pt. Jervis & Hudson lines	Provides transfers to Hudson line	Does not maximize existing facilities
TIME EFFECTIVENESS **Ease of Implementation**	n/a	Less than 5 yrs	Less than 1 year	5 to 10 years	More than 10 years	More than 10 years	More than 10 years	More than 10 years
DEVELOP COST EFFECTIVE ALTERNATIVES								
Pursue Alternatives with Reasonable Benefits/Costs								
-Capital costs(millions) -Suffern to White Plains	$1,200***	$1,200***	$1,200***	$1,400 (NYS portion)	$3,400	$2,600	$1,900	$1,700
-Capital Costs(millions) White Plains to Port Chester	$0	$0	$0	$0	$390	$0	$0	$0
-Capital Costs(millions) - Stewart Airport	$0	$0	$0	$0	$260	$0	$0	$0
Cost Effectiveness		61	84	86	136	167	240	59
FOSTER GROWTH IN REGIONAL EMPLOYMENT								
Ensure the Transp. System Supports Regional Economic		Minimal increase	Minimal increase	Minimal increase	Minimal increase	Minimal increase	Minimal increase	Minimal increase
-Jobs in corridor - % change from No Build	n/a	+0.2%	+0.2%	+0.3%	+0.6%	+0.4%	+0.5%	+1.0%

Notes:

* Some riders will be able to walk to their job locations

** A larger number than commuter rail or light rail riders will be able to walk to their job locations

*** Includes cost to improve ramps

Figure 4-2: 2020 Alternatives Analysis Summary

GOALS & OBJECTIVES	TDM	Value Pricing	West Shore	Commuter Rail	Light Rail	Bus Guideway	Highway/ Bridge Expansion
Improve Mobility in the I-287 Corridor							
Decrease highway travel during weekday peak periods	◔	◔	◔	●	◔	●	○
Increase public transit use	○	○	◔	●	◔	●	○
Accommodate growth in regional travel with no increase in congestion	◔	◔	◔	●	●	◔	◔
Maintain or improve safety	◔	◔	◔	●	●	●	◔
Reduce through truck traffic	○	○	○	○	○	○	◔
Minimize Environmental Impacts							
Improve air quality	◔	◔	◔	●	●	●	○
Limit sprawl	○	○	○	●	●	◔	◔
Minimize impacts in Rockland and Westchester	◔	◔	◔	◔	◔	◔	◔
Minimize impacts on the Hudson River	◔	◔	◔	◔	◔	◔	◔
Develop an Acceptable Corridor Wide Transportation Strategy							
Develop strategies that address problems throughout the corridor	◔	◔	○	◔	◔	◔	●
Develop strategies that maximize use of existing I-287 corridor facilities	◔	◔	◔	●	◔	◔	○
Time Effectiveness							
Ease of implementation	◔	●	◔	○	○	○	○
Develop Cost Effective Alternatives							
Capital cost	◔	◔	◔	◔	◔	◔	◔
Cost effectiveness	◔	◔	◔	◔	◔	●	◔
Foster Growth in Regional Employment							
Ensure that the transportation system supports regional economic growth	◔	◔	◔	◔	◔	◔	◔

Legend: Effectiveness in Meeting Goals & Objectives

● = Effective		◔ =Slight Negative Effect	
◔ = Moderately Effective	○ = No Effect	◔ = Moderately Negative Effect	
◔ =Slight Effect		● =Negative Effect	

APPENDIX A

1999 Existing Conditions and Historic Data

Traffic data reflect 1999 conditions

Table A-1
County Level Resident Population

County	1970	1975	1980	1985	1990	1995	1996	1997 (1)	1998 (1)
Rockland	229,903	248,000	259,530	264,364	265,985	277,034	278,136	278,708	281,338
Westchester	894,104	874,300	866,599	873,022	875,232	891,044	893,412	894,022	897,920
Subtotal	1,124,007	1,122,300	1,126,129	1,137,386	1,141,217	1,168,078	1,171,548	1,172,730	1,179,258
Dutchess	222,295	238,000	245,055	252,443	259,982	261,512	262,675	263,758	265,317
Orange	221,657	245,300	259,603	279,432	308,792	322,349	324,422	326,265	329,220
Putnam	56,696	70,800	77,193	79,989	84,220	90,138	90,983	92,201	93,358
Bergen (2)	898,012	871,600	845,385	842,541	825,432	843,338	846,498	852,448	858,529
Fairfield (2)	792,814	794,600	807,143	830,396	827,895	830,702	833,761	833,967	838,362
Total	3,315,481	3,342,600	3,360,508	3,422,187	3,447,538	3,516,117	3,529,887	3,541,369	3,564,044

Source: NYMTC Transportation Models and Data Initiative Technical Memoranda 7.3 and 8.13 (Resident Population - Estimated July 1)
(1) Population Estimates Program, Population Division, U.S. Bureau of the Census, Washington D.C., Internet Release Date March 12, 1999.
(2) For Bergen and Fairfield Counties, 1990 MCD Resident Population Data: Census Bureau STFIA, Census Bureau Estimates.

Table A-2
County Level Non-Agricultural Employment

County	1970	1975	1980	1985	1990	1995	1996
Rockland	62,400	72,700	81,500	93,300	102,000	98,800	98,600
Westchester	304,000	306,400	352,200	393,000	406,700	379,200	382,900
Subtotal	366,400	379,100	433,700	486,300	508,700	478,000	481,500
Dutchess	82,500	87,300	97,600	114,600	121,100	103,500	105,800
Orange	68,655	72,591	80,900	92,300	108,000	109,770	110,523
Putnam	8,830	10,500	12,300	16,100	18,900	19,400	19,500
Bergen, NJ	324,000	346,300	394,900	436,000	452,500	435,700	443,900
Fairfield, CT	302,852	303,640	372,430	416,410	419,940	398,930	401,990
Total	1,153,238	1,199,431	1,391,830	1,561,710	1,629,140	1,545,300	1,563,213

Source: NYMTC Transportation Models and Data Initiative Technical Memoranda 7.3 and 8.13.

Table A-3
Historic One-Way Passenger Car Toll Traffic (thousands)

Year	Spring Valley	Tappan Zee Bridge	Yonkers	New Rochelle
1980	6,279	12,991	4,968	10,993
1981	6,464	13,230	4,227	10,982
1982	6,775	13,656	4,317	11,244
1983	7,051	14,204	4,508	11,812
1984	7,658	14,823	4,729	12,587
1985	8,256	15,411	4,824	12,730
1986	9,023	15,895	5,009	12,844
1987	9,767	16,706	5,177	13,534
1988	10,138	17,921	5,349	13,814
1989	10,061	18,079	5,426	14,916**
1990	10,402	18,986	5,492	12,919
1991	10,086	19,583	5,558	12,485
1992	9,820	19,787	5,885	12,627
1993	10,024	19,790	6,045	13,245
1994	11,144	20,005	6,899	13,341
1995	11,682	20,459	6,730	13,688
1996	11,995	20,728	6,796	13,213
1997	*	21,264	7,295	14,198
1998		22,088	7,883	16,154
Avg. Annual Growth***	4.13%	2.99%	3.73%	2.16%
Recent Avg. Growth (since 1991)	3.53%	1.73%	5.12%	3.75%

All volumes are shown as one-way volumes for comparison

* Spring Valley passenger car toll removed July 1997.

** New Rochelle one-way toll collection instituted 2/89; a portion of 1989 volumes includes two-way traffic.

*** Spring Valley growth is from 1980-1996; Yonkers growth is from 1981-1998.

Table A-4
Historic One-Way Commercial Vehicle Toll Traffic (thousands)

Year	Spring Valley	Tappan Zee Bridge	Yonkers	New Rochelle
1980	402	513	776	1,886
1981	402	526	846	1,855
1982	414	539	926	1,800
1983	441	579	1,049	1,808
1984	468	631	1,112	1,967
1985	502	676	1,230	1,983
1986	541	669	1,222	2,188
1987	615	749	1,176	2,296
1988	643	794	1,110	2,368
1989	633	794	1,103	2,628*
1990	626	787	1,063	2,292
1991	626	795	1,030	2,215
1992	642	818	1,074	2,185
1993	685	858	1,039	2,254
1994**	1,149	1,323	916	2,140
1995	1,289	1,449	945	2,210
1996	1,352	1,462	964	2,273
1997***	1,967	1,410	995	2,522
1998	1,017	1,355	996	2,797
Avg. Annual Growth	5.30%	5.54%	1.40%	2.22%
Recent Avg. Growth (since 1994)****	-2.99%	0.60%	2.13%	6.92%

All volumes are shown as one-way volumes for comparison

* New Rochelle one-way toll collection instituted 2/89; a portion or 1989 volumes includes two-way traffic.

** 1994 is the first full year with the I-287 New Jersey connection opened.

*** SV and TZB implemented variable pricing in July 1997 with SV also changing to one-way toll collection.

**** SV and NR levels adjusted to eliminate impact of one-way collection; SV total includes two-way traffic.

Table A-5
Tappan Zee Bridge Toll Plaza AM Peak Period Traffic Volumes

Time Period	1994	1996	1999
6-7 AM	5,313	5,784	6,276
7-8 AM	6,773	7,070	7,042
8-9 AM	6,191	6,229	5,818
9-10 AM	4,537	4,534	5,876
Peak Period Total	22,814	23,617	25,012

Note: Volumes are not averages

Table A-6
PM Peak Hour Westbound Travel Time

Segment	Uncongested Travel (min)	Congested PM Peak Travel (min)	Delays Due to Congestion (min)
1 – Port Chester to Suffern	29	33	4
2 – Route 100 to Route 303	11	12	1
3 – I-87/CWE Split to Spring Valley	11	14	3
4 – Route 100A to I-87/CWE Split	2	4	2

Table A-7
Eastbound Peak Hour Volumes

Location	AM	Midday	PM	Friday	Sunday
1 west of GSP	4,200	2,200	3,100	3,250	3,650
2 west of Rt.304	4,500	3,050	4,800	5,050	5,050
3 bet. PIP & Rt.303	4,400	3,050	4,100	4,500	4,900
4 west of Rt.9W	4,500	2,600	3,900	3,900	4,700
5 TZB	7,200	2,850	4,350	4,750	4,550
6 bet. Rt.9A & SBP	3,800	3,150	4,200	3,750	3,800
7 west of I-684	5,250	4,250	4,500	5,250	4,150
8 bet. I-684 & HRP	5,250	3,050	3,600	3,750	3,350
9 west of Rt.1	4,000	2,600	3,400	3,600	2,600
10 west of Midland	2,300	1,250	1,400	1,600	1,500

Table A-8
Westbound Peak Hour Volumes

Location	AM	Midday	PM	Friday	Sunday
1 west of GSP	3,000	2,650	4,900	5,400	3,100
2 west of Rt.304	4,150	3,150	5,100	5,250	4,050
3 bet. PIP & Rt.303	4,200	3,700	5,550	5,450	4,800
4 west of Rt.9W	3,800	3,450	5,400	4,500	4,600
5 TZB	3,950	3,000	6,500	6,650	4,600
6 bet. Rt.9A & SBP	4,400	3,300	4,700	3,900	3,600
7 west of I-684	5,100	3,350	5,300	5,900	3,450
8 bet. I-684 & HRP	4,150	2,950	5,000	4,250	3,050
9 west of Rt.1	4,200	2,750	4,100	3,950	2,450
10 west of Midland	2,150	1,500	2,600	2,350	1,500

Figure A-1
I-287 Existing AM Peak Hour Eastbound Traffic

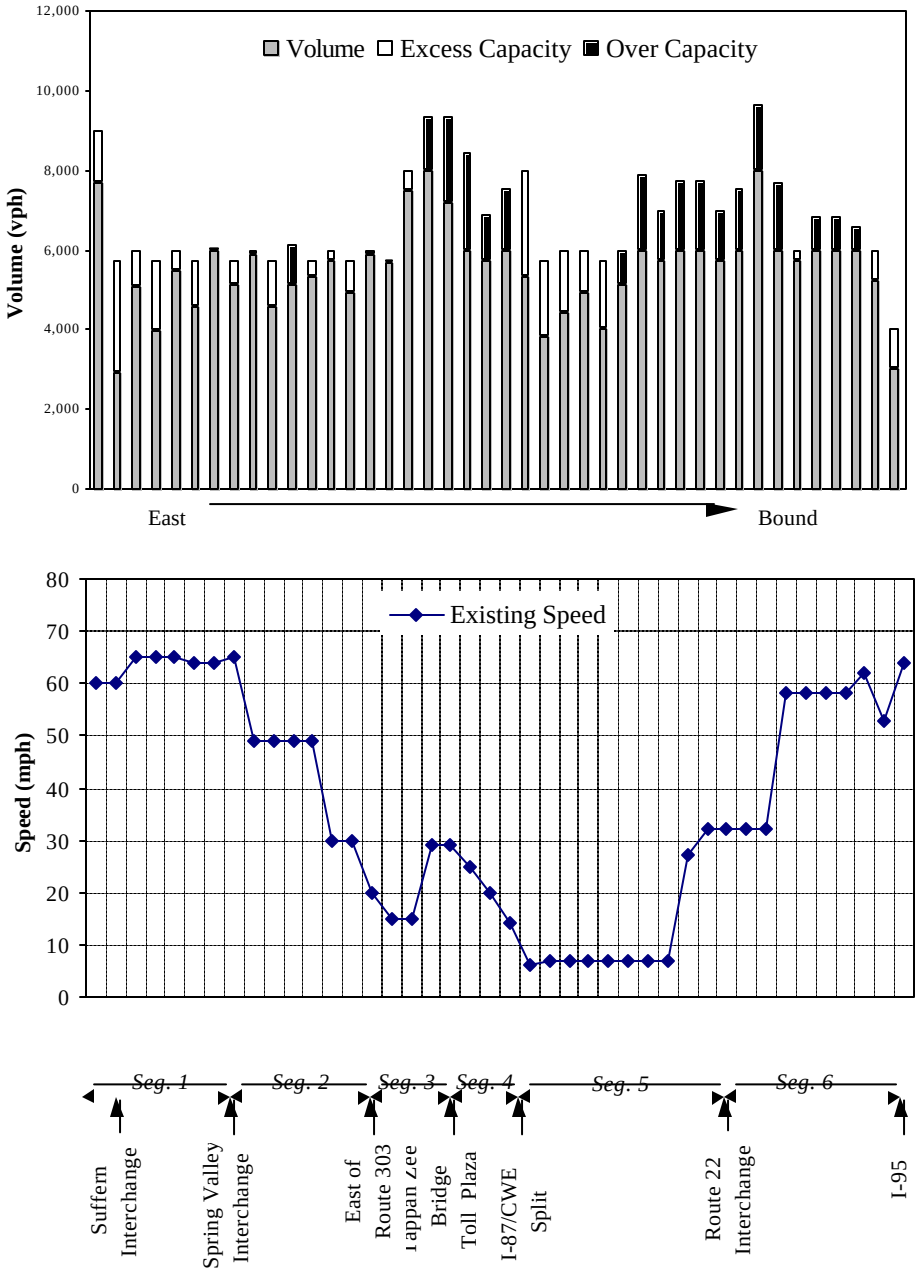


Figure A-2
I-287 Existing AM Peak Hour Westbound Traffic

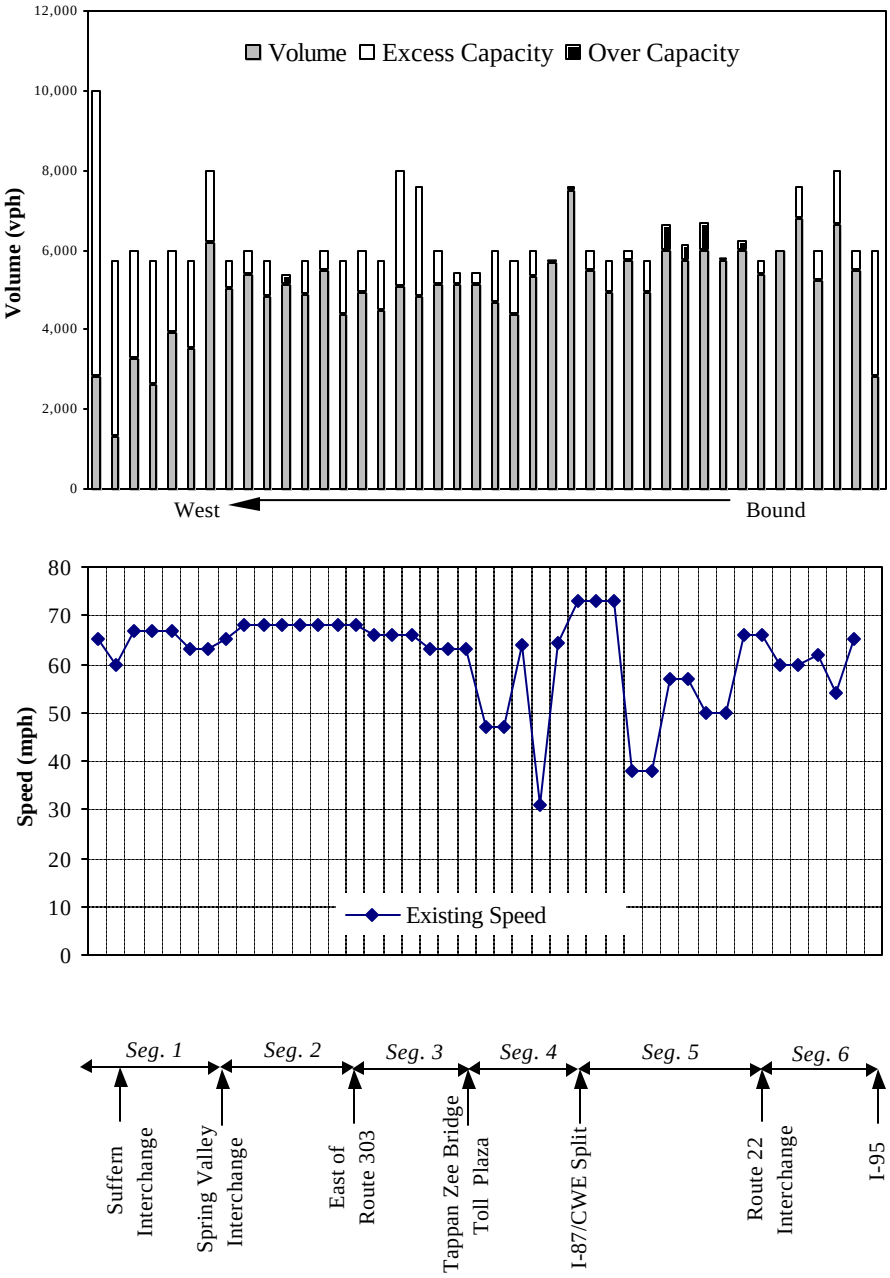


Figure A-3
I-287 Existing PM Peak Hour Eastbound Traffic

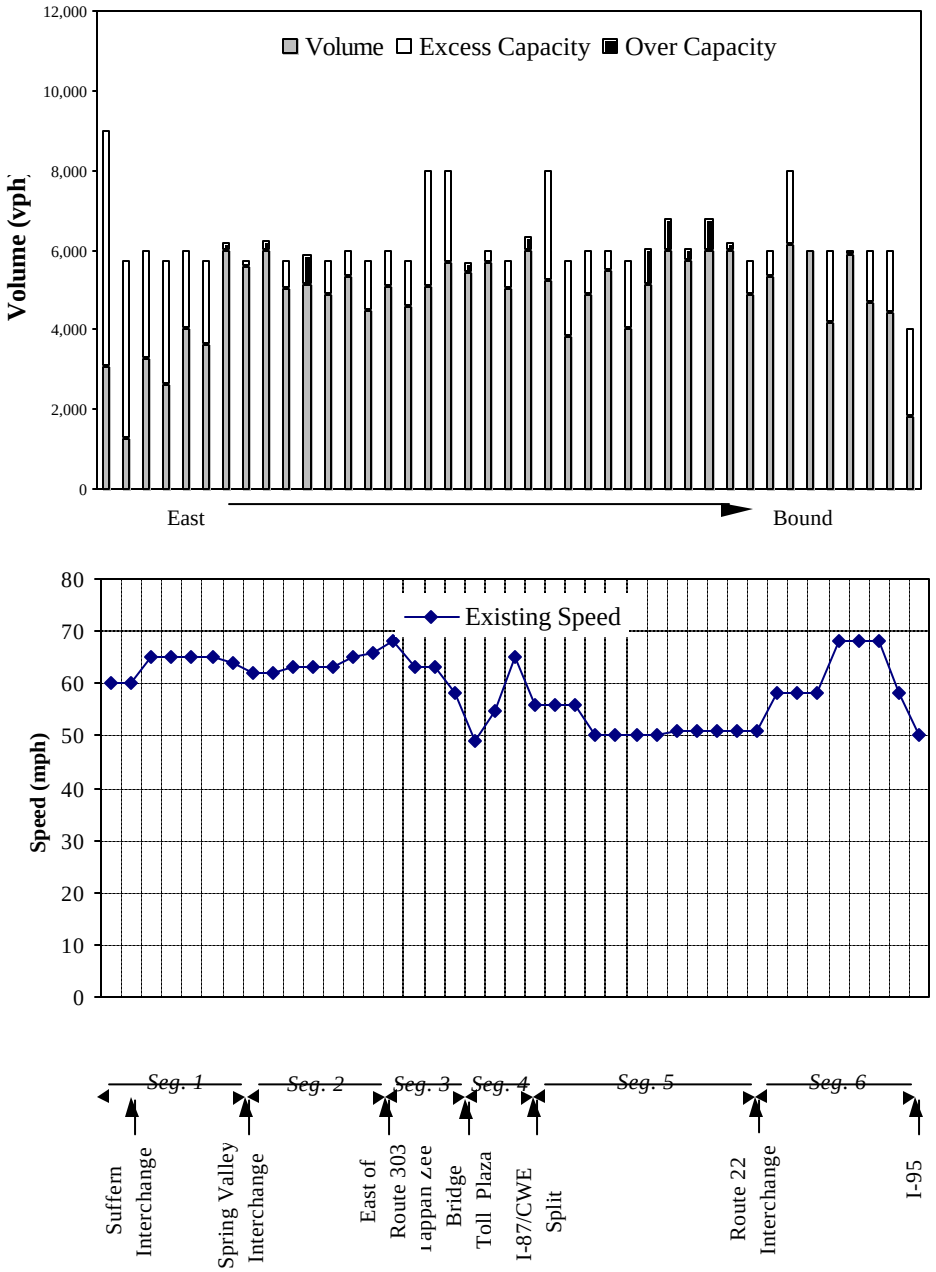


Figure A-4
I-287 Existing PM Peak Hour Westbound Traffic

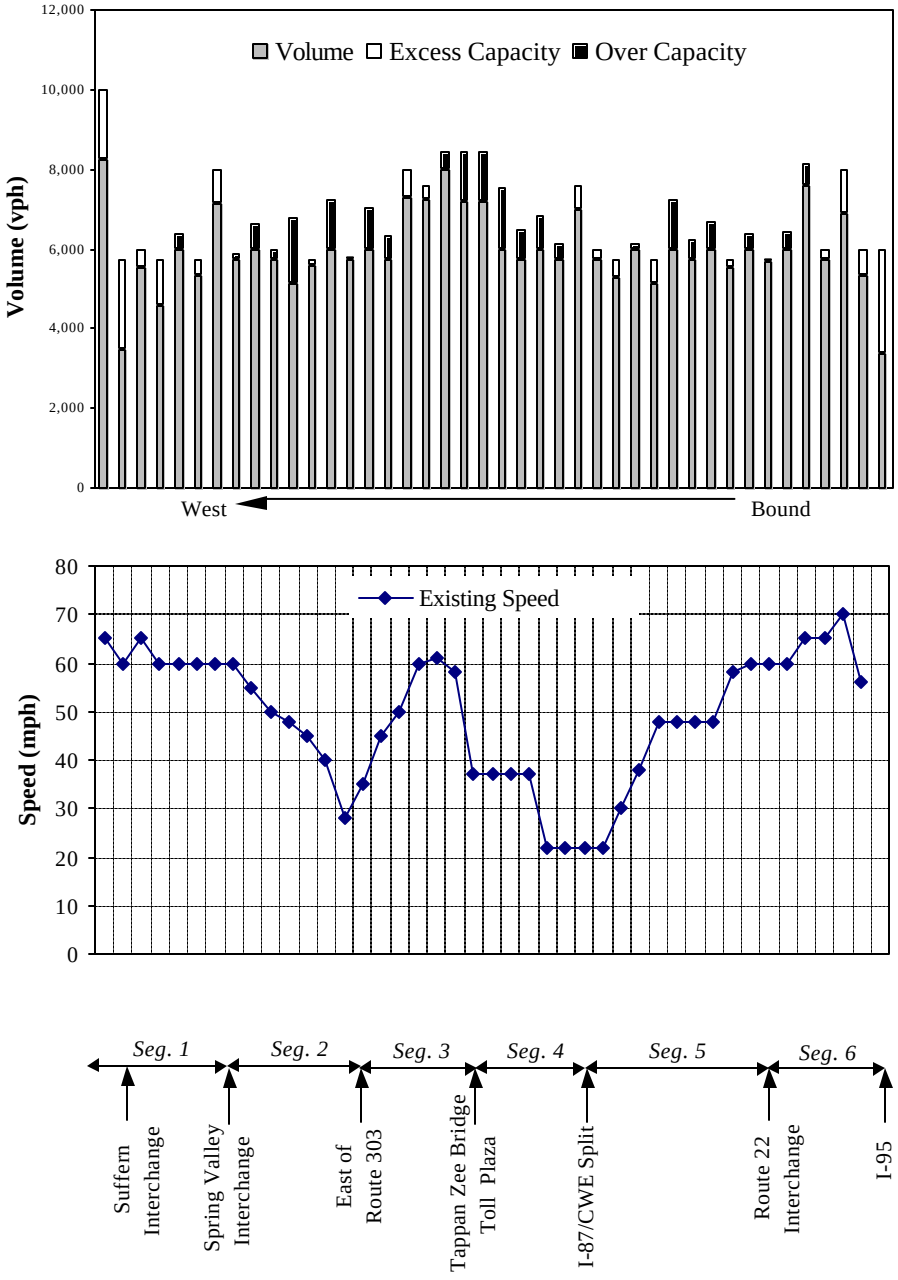


Figure A-5
Accidents, Injuries and Fatalities (1996-1998)
Eastbound NYS Thruway and Cross Westchester Expressway

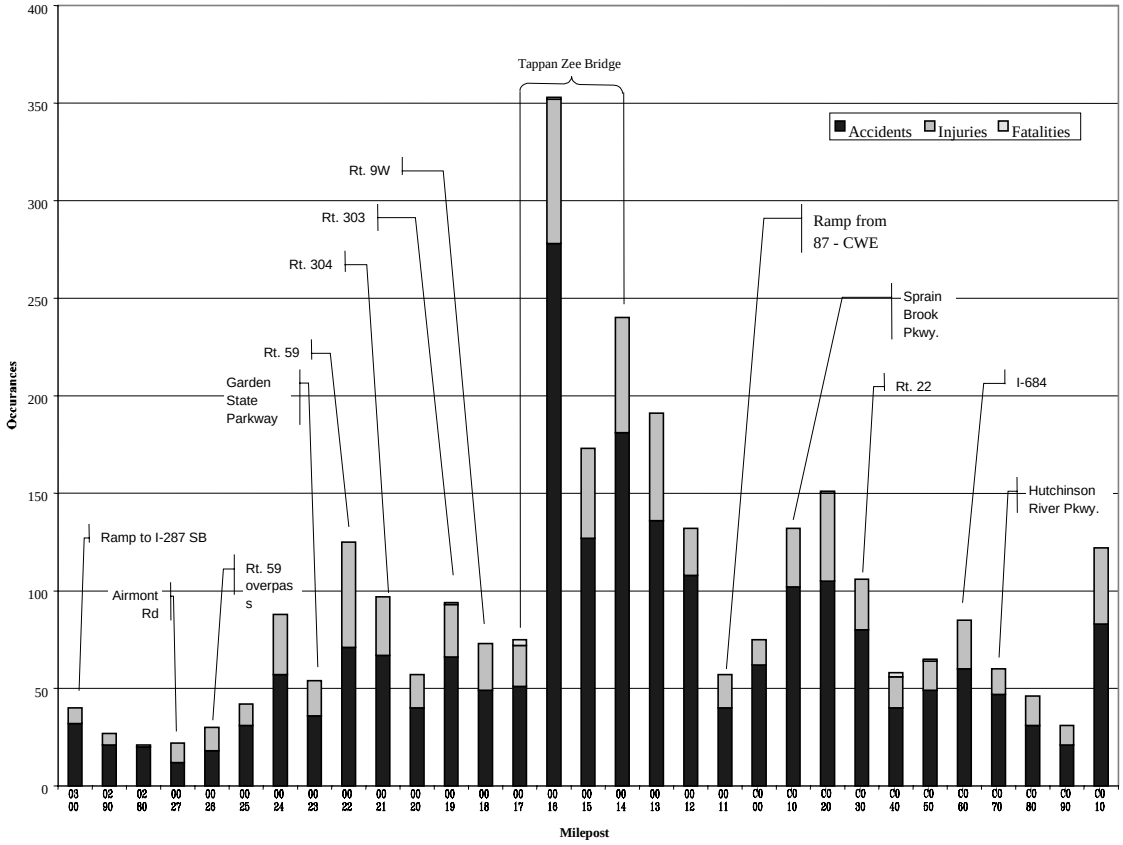
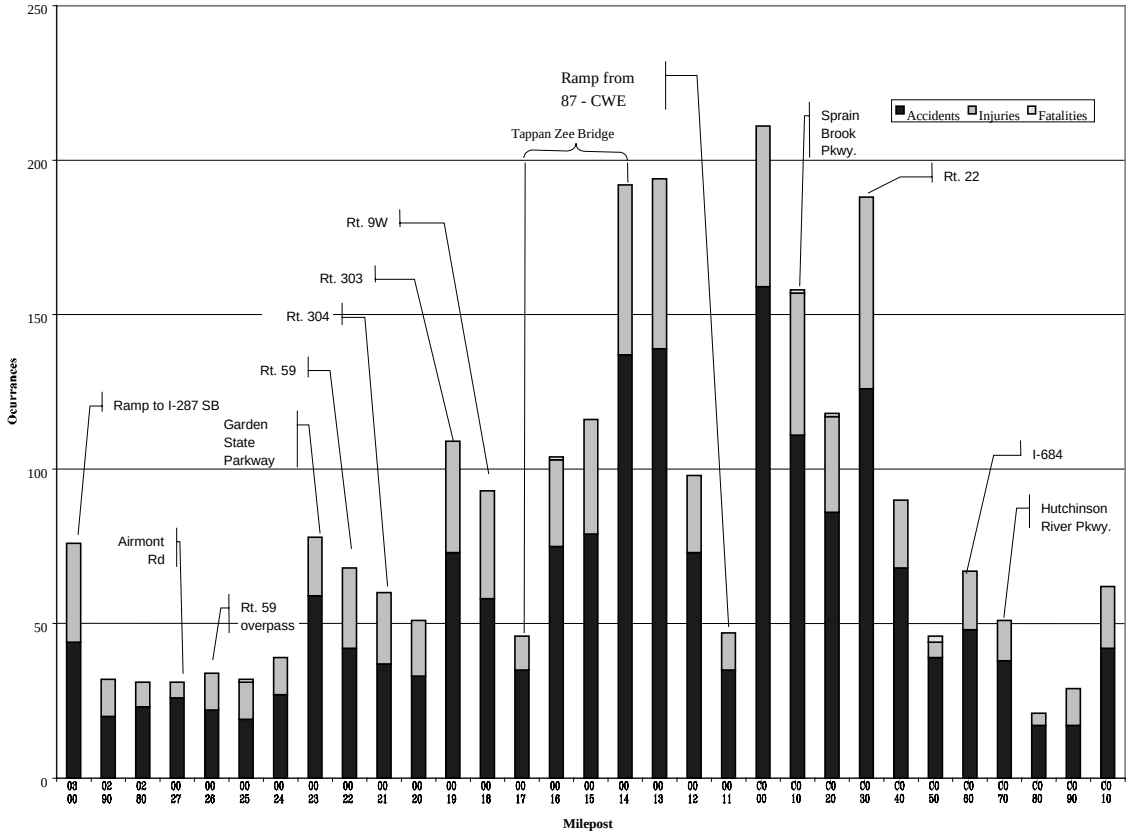


Figure A-6
Accidents, Injuries and Fatalities (1996-1998)
Westbound NYS Thruway and Cross Westchester Expressway



APPENDIX B

2020 Conditions Data and Forecast Assumptions

Table B-1
Projected Average Annual Population and Employment Growth

County	Population		Employment	
	1995-2005	2005-2020	1995-2005	2005-2020
Rockland	+0.35%	+0.62%	+1.16%	+0.92%
Orange	+1.15%	+1.19%	+1.86%	+1.25%
Westchester	+0.02%	+0.09%	+0.29%	+0.66%
Source: 1999 Urbanomics Estimates				

Table B-2
Relative Rate of Growth for Trip Pairs

Travel Group	Peak Direction	Non-Peak Direction
A – High Growth	Orange – Westchester Orange – Connecticut Orange – Rockland New Jersey – Westchester New Jersey – Connecticut Rockland – Connecticut	Connecticut – Orange Connecticut – Rockland Connecticut – New Jersey
B – Moderately High Growth	Orange – New York City New Jersey – Rockland	Westchester – Orange Westchester – New Jersey Westchester – Rockland Rockland – New Jersey Rockland – Orange New York City – Rockland New York City – Orange New York City – Westchester
C – Moderate Growth	Rockland – Westchester Rockland – Rockland	Rockland – Rockland
D – Low Growth	Rockland – New York City Westchester – Westchester Westchester – New York City	Westchester – Westchester

Table B-3
1999 to 2020 Growth Factors

Travel Group	Low (20%) Growth		High (30%) Growth	
	Peak Direction	Non-Peak Direction	Peak Direction	Non-Peak Direction
A – High Growth	+40%	+45%	+50%	+55%
B – Moderately High Growth	+30%	+30%	+40%	+40%
C – Moderate Growth	+15%	+20%	+25%	+30%
D – Low Growth	+14%	+16%	+23%	+26%

Table B-4
Corridor Trips for 1999 and 2020 and Projected Future Conditions

Peak Hour	Dir.		Trips Staying West of the Hudson River			Trips Crossing the Tappan Zee Bridge			Trips Staying East of the Hudson River		
			1999	Low Growth	High Growth	1999	Low Growth	High Growth	1999	Low Growth	High Growth
AM	EB	Vol.	8,250	10,550	11,350	7,200	8,850	9,600	10,050	11,450	12,350
		% Inc.		28%	38%		23%	33%		14%	23%
	WB	Vol.	5,100	6,550	7,050	3,950	5,250	5,650	8,750	10,150	11,050
		% Inc.		28%	38%		33%	43%		16%	26%
PM	EB	Vol.	5,400	6,900	7,450	4,350	5,700	6,150	9,000	10,250	11,050
		% Inc.		28%	38%		31%	41%		14%	23%
	WB	Vol.	9,350	12,050	13,000	6,500	8,450	9,100	8,650	10,050	10,900
		% Inc.		29%	39%		30%	40%		16%	26%

Table B-5
AM Peak Hour Eastbound Travel Time and Speed Comparisons

Segment	Travel Time			Average Speed		
	1999	2020 Low Growth	2020 High Growth	1999	2020 Low Growth	2020 High Growth
1 - Suffern to Port Chester	70	88	118	25	20	15
2 - Route 303 to Route 100	48	55	57	13	12	11
3 - Spr. Val. to I-87/CWE Split	27	50	64	23	13	10
4 - I-87/CWE Split to Rte 100A	19	6	7	8	26	20

Table B-6
AM Peak Hour Westbound Travel Time and Speed Comparisons

Link	Travel Time			Average Speed		
	1999	2020 Low Growth	2020 High Growth	1999	2020 Low Growth	2020 High Growth
1 - Port Chester to Suffern	26	27	38	62	60	42
2 - Route 100 to Route 303	10	10	15	59	58	41
3 - Spr. Val. To I-87/CWE Split	10	10	12	65	62	53
4 - I-87/CWE Split to Rte 100A	3	2	3	48	62	56

Table B-7
I-287 Ramp Locations with 2020 Capacity Problems during the AM Peak Hour

Eastbound			Westbound		
Location	Amount Over Capacity		Location	Amount Over Capacity	
	Low Growth	High Growth		Low Growth	High Growth
Int. 14B (Airmont Rd) on-ramp	1%	10%	Sprain Brook NB off-ramp	--	2%
Int. 14A (GSP) on-ramp	--	6%	Saw Mill SB on-ramp to N C-D	21%	31%
Int. 13 (PIP) SB on-ramp	16%	26%	Int. 14 (Spring Valley) on-ramp	--	4%
Int. 11 (Rte 59) on-ramp	16%	26%	Int. 14A (GSP) off-ramp	--	3%
Int. 10 (Rte 9W) on-ramp	41%	52%			
Int. 9 (Rte 9) off-ramp	6%	15%			
I-87 SB off-ramp	14%	23%			
South C-D Road off-ramp	7%	16%			
Sprain Brook SB on-ramp	32%	42%			
Sprain Brook NB on-ramp	18%	27%			
Central Westchester on-ramp	30%	41%			
I-95 SB off-ramp	--	8%			

Table B-8
PM Peak Hour Eastbound Travel Time and Speed Comparisons

Link	Travel Time			Average Speed		
	1999	2020 Low Growth	2020 High Growth	1999	2020 Low Growth	2020 High Growth
1 - Suffern to Port Chester	29	32	45	59	53	38
2 - Route 303 to Route 100	12	13	16	55	48	41
3 - Spr Val to I-87/CWE Split	11	14	23	58	46	28
4 - I-87/CWE Split to Rte 100A	3	2	2	52	60	60

Table B-9
PM Peak Hour Westbound Travel Time and Speed Comparisons

Link	Travel Time			Average Speed		
	1999	2020 Low Growth	2020 High Growth	1999	2020 Low Growth	2020 High Growth
1 - Port Chester to Suffern	33	88	117	50	19	14
2 - Route 100 to Route 303	12	47	60	40	13	10
3 - Spr Val to I-87/CWE Split	14	59	64	45	11	10
4 - I-87/CWE Split to Rte 100A	4	3	14	30	43	10

Table B-10
I-287 Ramp Locations with 2020 Capacity Problems during the PM Peak Hour

Eastbound			Westbound		
Location	Amount Over Capacity		Location	Amount Over Capacity	
	Low Growth	High Growth		Low Growth	High Growth
Int. 14B (Airmont Rd) on-ramp	8%	16%	North Westchester on-ramp	5%	14%
Int. 14A (GSP) on-ramp	60%	72%	Central Westchester off-ramp	--	2%
Sprain Brook SB off-ramp	--	2%	Sprain Brook NB off-ramp	16%	26%
Sprain Brook SB on-ramp	36%	47%	Int. 10 (Rte 9W) off-ramp	--	4%
I-95 SB off-ramp	35%	46%	Int. 11 (Rte 59) off-ramp	13%	23%
			Int. 12 (Rte 303) off-ramp	15%	24%
			Int. 12 (Rte 303) on-ramp	--	5%
			Int. 13 (PIP) NB off-ramp	8%	17%
			Int. 13 (PIP) NB on-ramp	--	2%
			Int. 14 (Spring Valley) on-ramp	9%	18%
			Int. 14B (Airmont Rd) off-ramp	19%	29%

Table B-11
Tappan Zee Bridge AM Peak Period Volumes

Hour	1999 Existing	2020	
		Low Growth	High Growth
6-7 AM	6,276	7,908	8,533
7-8 AM	7,042	8,873	9,575
8-9 AM	5,818	7,331	7,911
9-10 AM	5,876	7,404	7,990
Four-Hour Total	25,012	31,515	34,009

Table B-12
Eastbound Peak Hour Volumes for 2020 Low Growth Scenario

Screenline Location	Capacity	AM	Midday	PM	Friday	Sunday
1 west of GSP	*6,000*	5,400	2,850	4,000	4,200	4,700
2 west of Rt.304	*6,000*	5,850	3,950	6,250	6,550	6,550
3 bet. PIP & Rt.303	*6,000*	5,650	3,950	5,300	5,800	6,300
4 west of Rt.9W	*6,000*	5,750	3,350	5,100	5,050	6,050
5 TZB	*7,200/5,400*	8,850	3,600	5,700	6,000	5,750
6 bet. Rt.9A & SBP	*6,000*	4,550	3,800	5,150	4,550	4,600
7 west of I-684	*8,000*	6,100	5,000	5,300	6,150	4,850
8 bet. I-684 & HRP	*8,000*	6,100	3,550	4,250	4,400	3,900
9 west of Rt.1	*6,000*	4,650	3,000	3,900	4,150	3,000
10 west of Midland	*4,000*	2,750	1,450	1,600	1,850	1,750

Over capacity

Table B-13
Eastbound Peak Hour Volumes for 2020 High Growth Scenario

Screenline Location	Capacity	AM	Midday	PM	Friday	Sunday
1 west of GSP	*6,000*	5,800	3,050	4,350	4,500	5,100
2 west of Rt.304	*6,000*	6,300	4,250	6,750	7,050	7,050
3 bet. PIP & Rt.303	*6,000*	6,050	4,250	5,750	6,250	6,800
4 west of Rt.9W	*6,000*	6,150	3,600	5,500	5,400	6,500
5 TZB	*7,200/5,400*	9,600	3,900	6,150	6,450	6,200
6 bet. Rt.9A & SBP	*6,000*	4,950	4,100	5,500	4,900	4,950
7 west of I-684	*8,000*	6,600	5,350	5,750	6,650	5,250
8 bet. I-684 & HRP	*8,000*	6,550	3,850	4,600	4,750	4,200
9 west of Rt.1	*6,000*	5,050	3,250	4,200	4,500	3,250
10 west of Midland	*4,000*	2,950	1,550	1,700	2,000	1,900

Over capacity

Table B-14
Westbound Peak Hour Volumes for 2020 Low Growth Scenario

Screenline Location	Capacity	AM	Midday	PM	Friday	Sunday
1 west of GSP	*6,000*	3,900	3,500	6,500	7,100	4,100
2 west of Rt.304	*6,000*	5,450	4,200	6,900	7,000	5,400
3 bet. PIP & Rt.303	*6,000*	5,500	4,850	7,350	7,150	6,300
4 west of Rt.9W	*6,000*	5,000	4,550	7,150	5,950	6,050
5 TZB	*5,400/7,200*	5,250	3,950	8,450	8,700	6,050
6 bet. Rt.9A & SBP	*6,000*	5,400	4,150	5,950	4,900	4,500
7 west of I-684	*8,000*	6,150	4,050	6,450	7,150	4,200
8 bet. I-684 & HRP	*6,000*	4,900	3,550	6,100	5,100	3,650
9 west of Rt.1	*6,000*	4,850	3,200	4,750	4,600	2,850
10 west of Midland	*6,000*	2,500	1,750	3,000	2,750	1,750

Over capacity

Table B-15
Westbound Peak Hour Volumes for 2020 High Growth Scenario

Screenline Location	Capacity	AM	Midday	PM	Friday	Sunday
1 west of GSP	*6,000*	4,200	3,750	7,000	7,650	4,400
2 west of Rt.304	*6,000*	5,850	4,500	7,400	7,500	5,800
3 bet. PIP & Rt.303	*6,000*	5,900	5,250	7,900	7,700	6,800
4 west of Rt.9W	*6,000*	5,400	4,900	7,700	6,400	6,550
5 TZB*	*5,400/7,200*	5,650	4,250	9,100	9,400	6,500
6 bet. Rt.9A & SBP	*6,000*	5,850	4,450	6,450	5,250	4,850
7 west of I-684	*8,000*	6,650	4,400	7,000	7,750	4,550
8 bet. I-684 & HRP	*6,000*	5,300	3,850	6,600	5,550	3,950
9 west of Rt.1	*6,000*	5,300	3,450	5,150	5,000	3,100
10 west of Midland	*6,000*	2,700	1,900	3,300	2,950	1,900

Over capacity

Figure B-1
I-287 No Build AM Peak Hour Eastbound Traffic (2020 Low Growth Scenario)

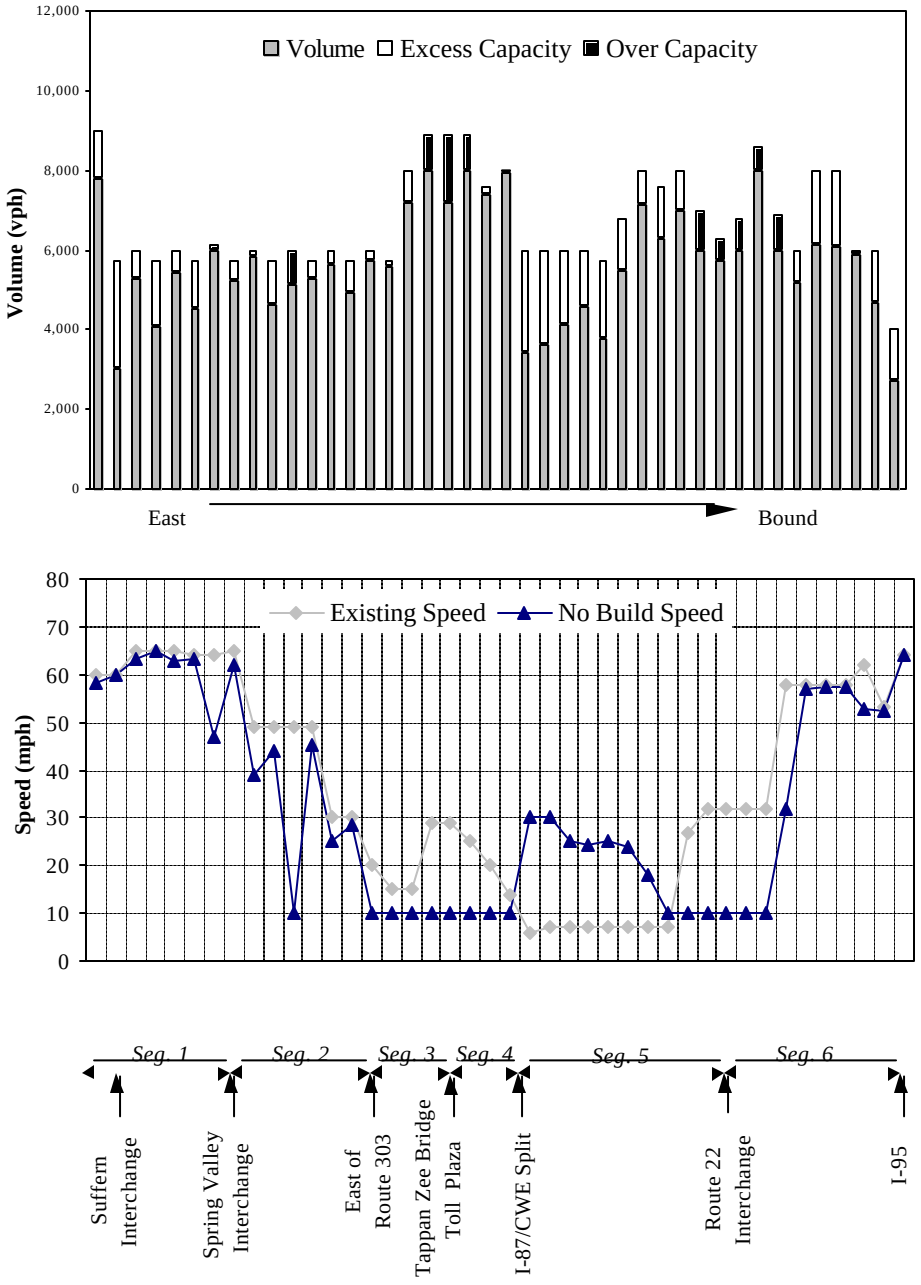


Figure B-2
I-287 No Build AM Peak Hour Eastbound Traffic (2020 High Growth Scenario)

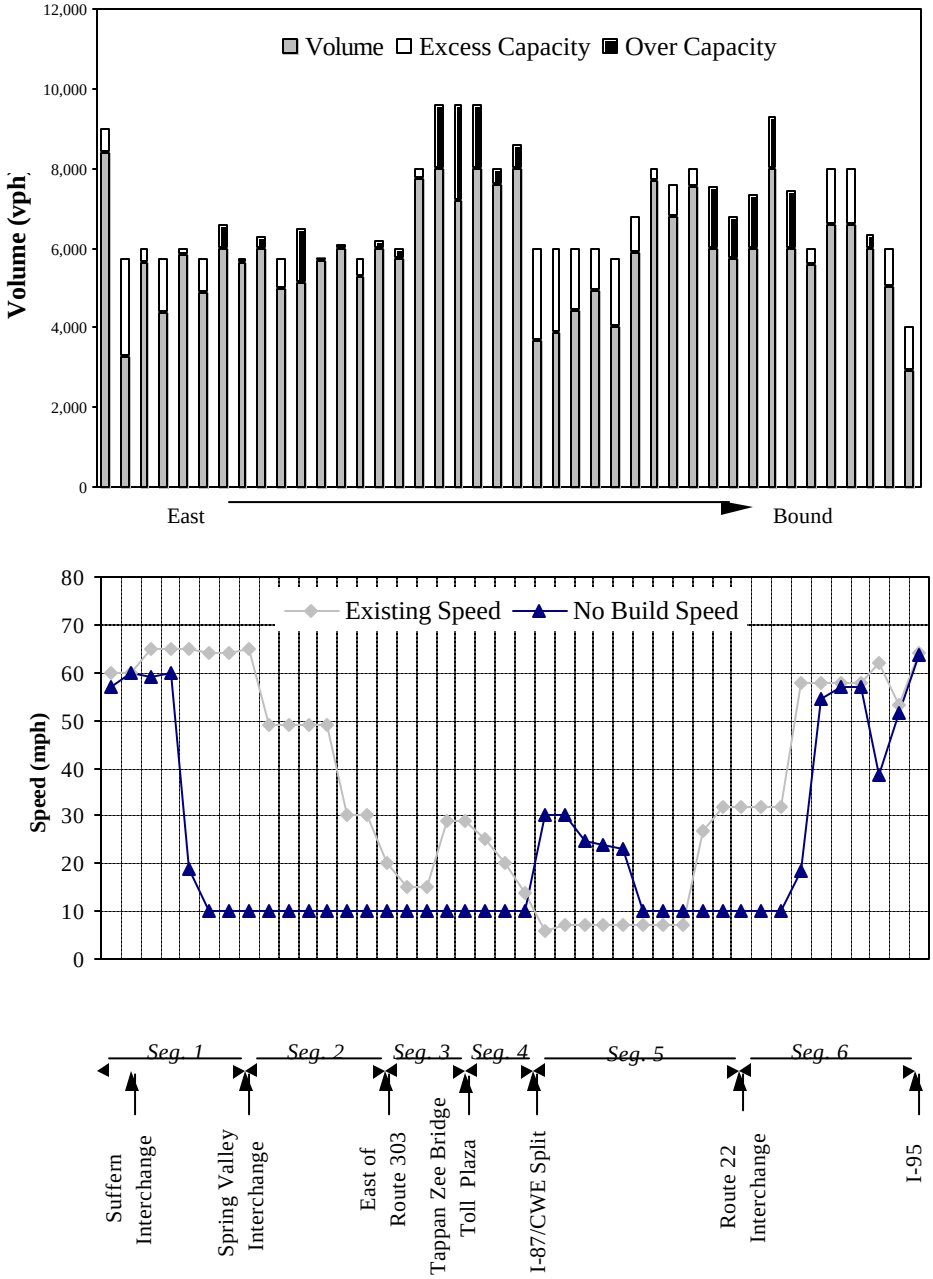


Figure B-3
I-287 No Build AM Peak Hour Westbound Traffic (2020 Low Growth Scenario)

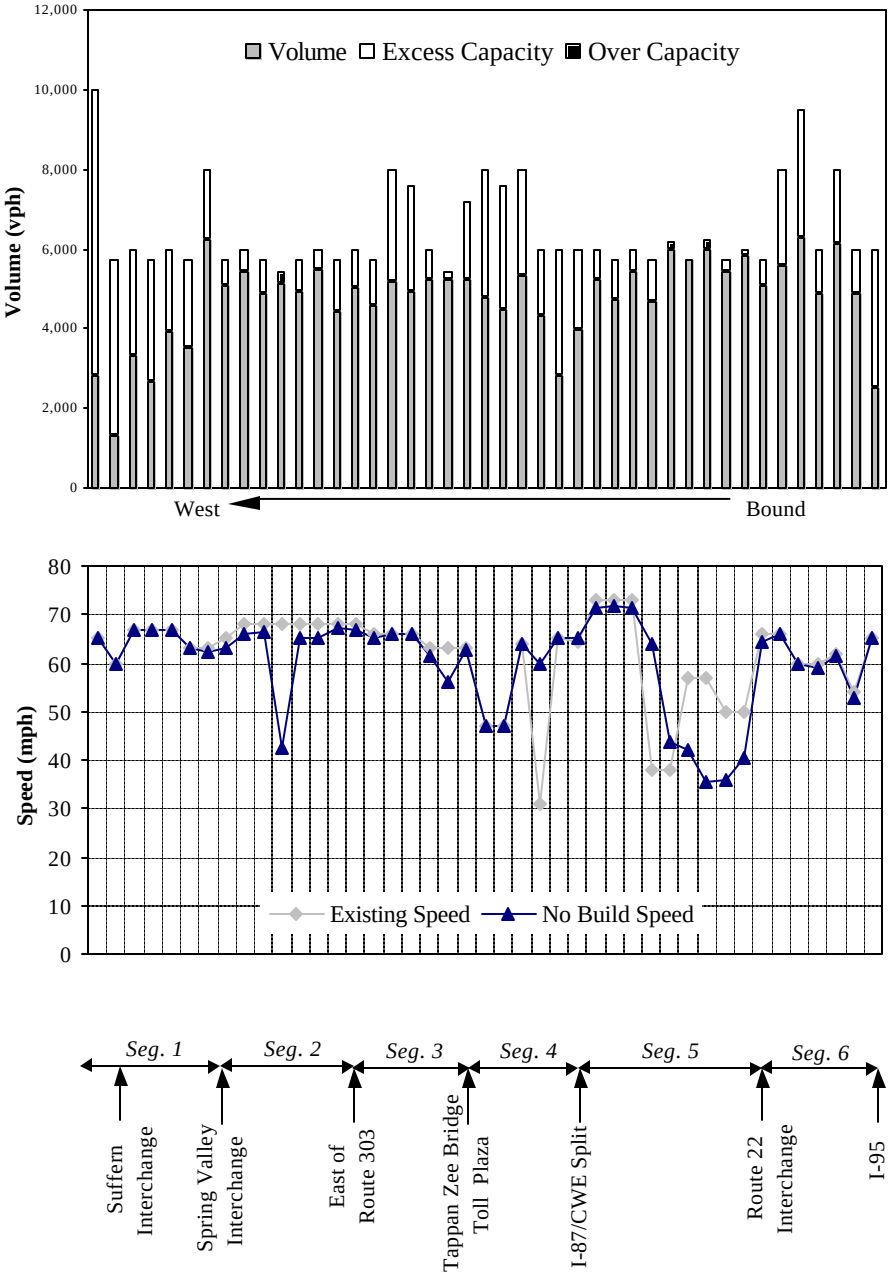


Figure B-4
I-287 No Build AM Peak Hour Westbound Traffic (2020 High Growth Scenario)

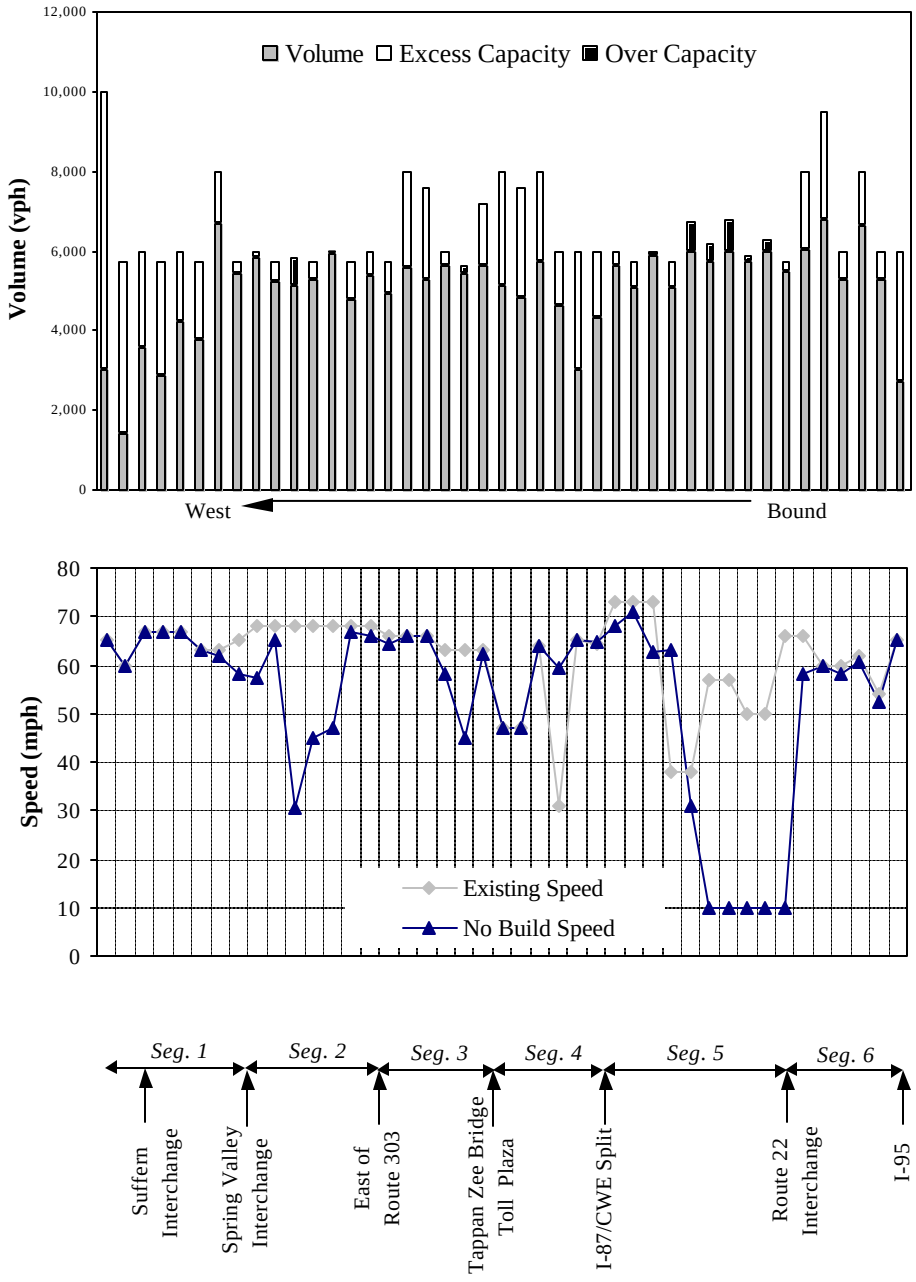


Figure B-5
I-287 No Build PM Peak Hour Eastbound Traffic (2020 Low Growth Scenario)

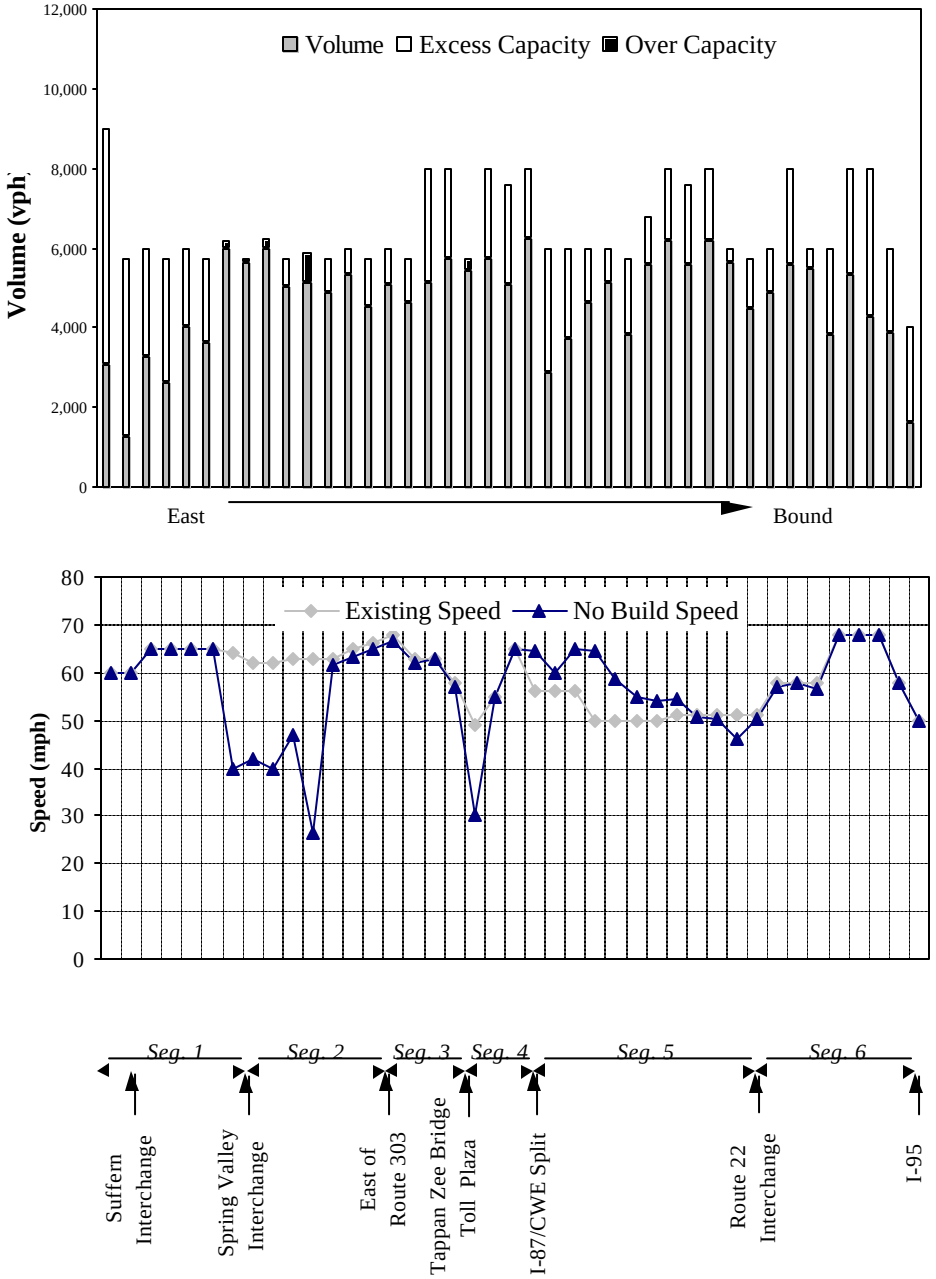


Figure B-6
I-287 No Build PM Peak Hour Eastbound Traffic (2020 High Growth Scenario)

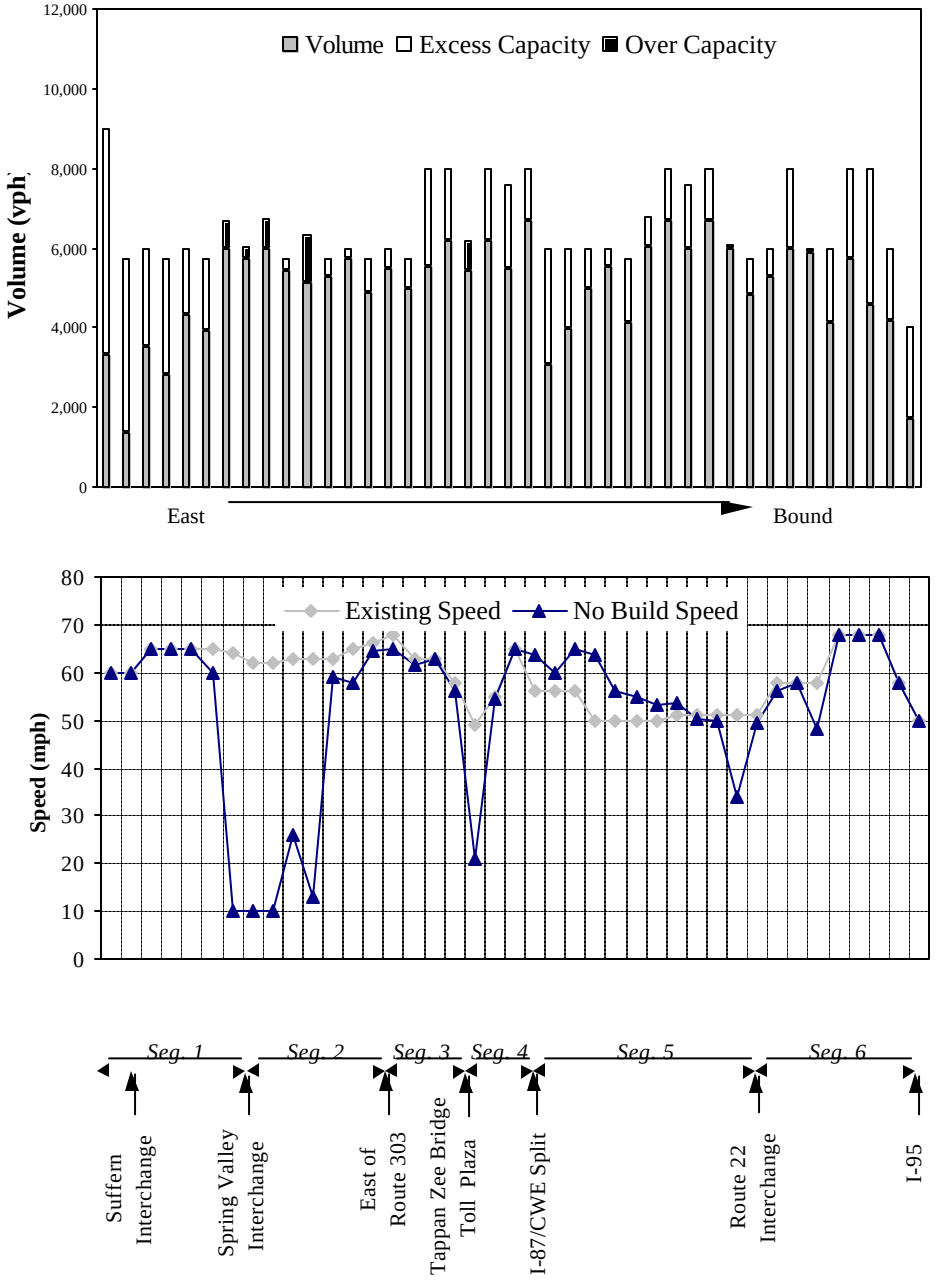


Figure B-7
I-287 No Build PM Peak Hour Westbound Traffic (2020 Low Growth Scenario)

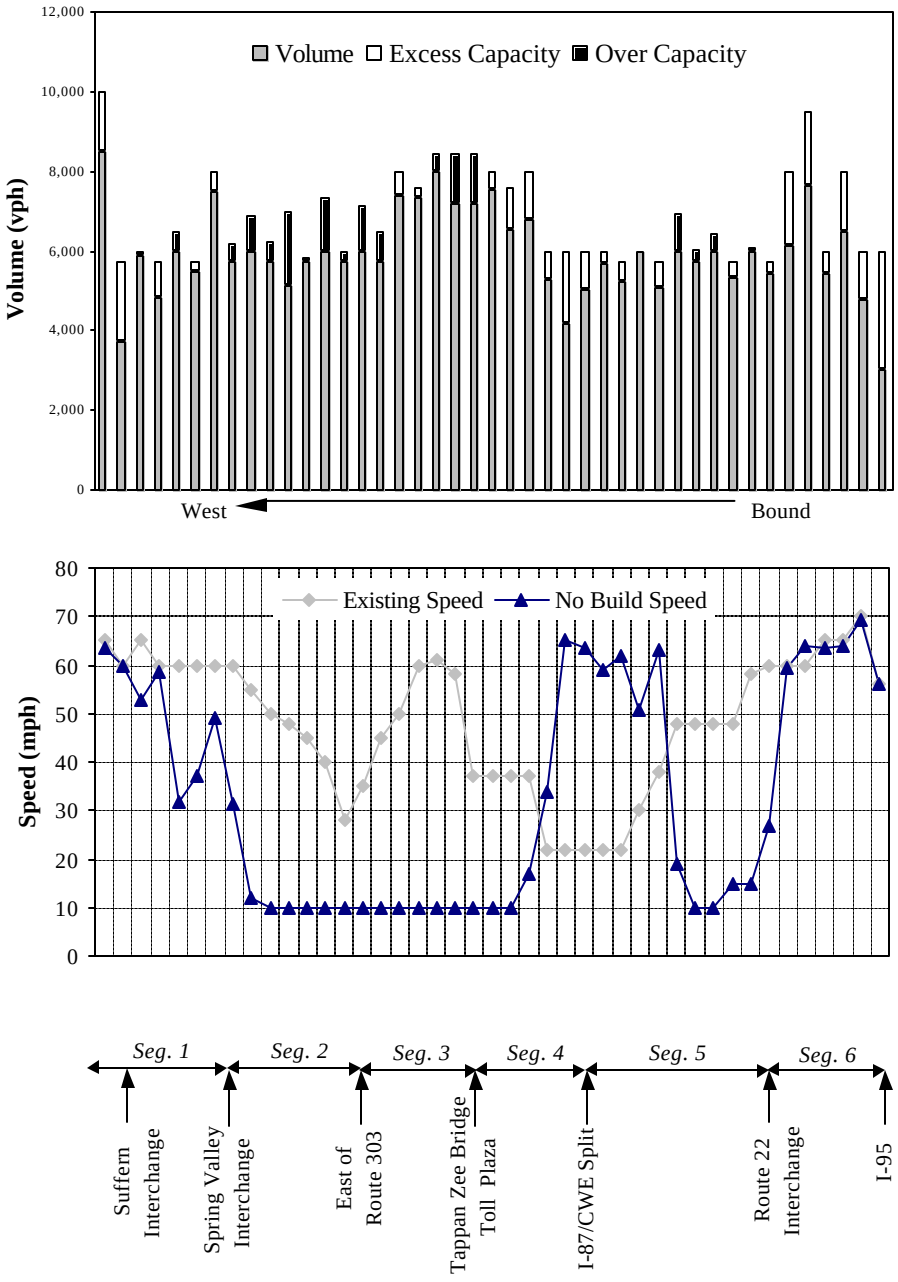
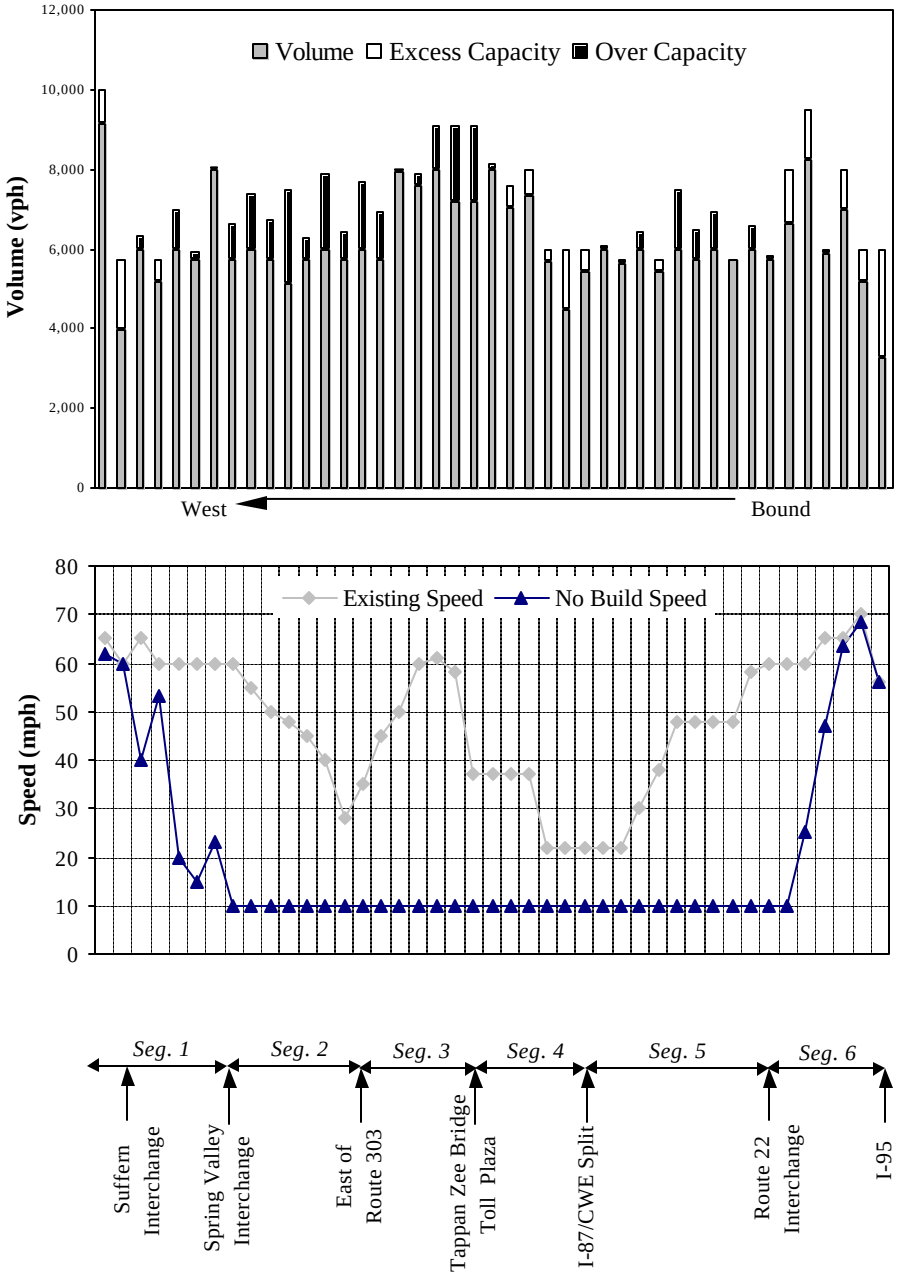


Figure B-8
I-287 No Build PM Peak Hour Westbound Traffic (2020 High Growth Scenario)



APPENDIX C

Technical Notes on the Evaluation Process

Appendix C Technical Notes on the Evaluation Process

This appendix includes technical information related to the preliminary evaluation process described in Chapter 4, as follows:

- A qualitative discussion of two factors that were not specifically included in the preliminary evaluation process:
  - The impacts of trips diverted back to the corridor
  - Constraints on travel demand
- An explanation of the cost effectiveness index calculations used as one performance measure in the preliminary evaluation process
- A description of the model customized by Regional Economic Models, Inc. (REMI) to project jobs in the corridor for the "no build" 2020 scenario and each alternative

Impacts of Diverted and Induced Trips

The addition of new transportation options or wider/additional lanes would result in increased capacity along the I-287 corridor including the Tappan Zee Bridge (TZB) and the Cross Westchester Expressway (CWE). It is anticipated that much or all of this additional roadway capacity would be "filled up" by motorists currently using other facilities, travelling at other times, or not making trips in the I-287 corridor. These additional auto trips would likely affect both the transit and highway alternatives in the ways described below.

Transit Alternatives. The bus guideway and rail alternatives would shift some vehicle trips to the new transit services. However, it is anticipated that less crowded highway conditions would attract some motorists who may have been travelling during less congested times, may have been using other routes, or may have previously foregone travel because of congested conditions. With additional auto trips, automobile travel times would become slower. The relative advantages of alternative travel modes, particularly the new transit lines, would be greater since transit travel time would be unaffected by the increased I-287 congestion. This greater relative advantage may induce additional transit trips as a result. Because the preliminary evaluation did not account for an increase in auto congestion (and the resulting induced additional transit trips), the benefits of the transit alternatives may be underestimated.

Highway Alternative. The expanded highway alternative would provide additional capacity for much of the length of I-287. With improved travel conditions at all times including the peak hours, some drivers would switch from the shoulders to the peak times and others would divert from other routes, including the George Washington Bridge; and still others would come back who had previously foregone travel because of congested conditions. Total travel on the I-287 corridor associated with the highway alternative, therefore, is likely to be greater than shown in the evaluation, with resulting negative

impacts on air quality and travel time in the I-287 corridor. (Air quality and travel time benefits could accrue on the facilities from which these trips were diverted)

Transit and Highway Alternatives. The bus guideway, rail, and highway alternatives include a replacement TZB which would be built with standard width lanes and shoulders. This would remove some constrictions on travel across the TZB and reduce delays associated with incidents when compared with the existing TZB (which has narrow lanes and no shoulders). These improvements could attract some motorists who may have been traveling during less congested times, may have been using other routes or travel modes, or may have foregone trips entirely due to congested conditions. As a result, the increased highway congestion may lead to additional transit trips since transit travel time would not be affected by the increased I-287 congestion (see above discussion on Transit Alternatives). The benefits for the alternatives with a rehabilitated structure, TDM/Value Pricing and West Shore, are not likely to be underestimated because the current nonstandard lanes and shoulders would remain.

Impact of Constraints on Travel Demand

As noted previously, this study's analysis assumed that travel demand in the future would be unconstrained, i.e., that everyone who wants to travel would travel regardless of the level of congestion. However, as demand exceeds capacity and congestion on I-287 increases, some drivers would change their travel habits to avoid the extensive peak period delays. They may shift to less congested times, take alternative routes, use carpools or vanpools or elect not to make some trips. As a result, some of the estimated impacts shown in the preliminary evaluation in this study that have been attributed to TDM measures and value pricing are likely to actually occur in the "no build" scenario without any outside intervention. As a result, the estimated effects of TDM and value pricing may be overstated.

An assumption of unconstrained demand may also result in overstating the impacts of the three transit alternatives. As noted above, because actual "no build" future traffic levels can be expected to be lower than forecast assuming unconstrained demand, the extent of congestion would be somewhat less and travel speeds would be slightly higher. The relative advantages of the transit alternatives, therefore, would be slightly less than calculated with the unconstrained demand and the effectiveness of these alternatives may be somewhat lower than indicated in terms of trips removed from I-287, decreased VMT and improvements to air quality.

These potential overestimates, however, are not likely to be significant and may be more than offset by the effect of "filling up" of any room available on I-287, as discussed above.

Cost Effectiveness Index Calculations

Cost effectiveness index calculations were used to provide a relative quantitative measure of the cost effectiveness of the alternatives. All benefits that have been quantified were used in the calculations:

- Decreases in highway trips/travel
- Increases in public transit usage
- Decreases in transit travel time
- Decreases in highway travel time
- Decreases in vehicle miles traveled
- Reductions in total pollutants

For each of these benefits, a numerical value was assigned to each alternative based on the alternatives' relative rankings. The alternative with the smallest benefit was assigned a "0" and the alternative with the highest benefit was assigned "100". Using the 0 to 100 values as the upper and lower limits, the remaining alternatives were scaled based on the magnitude of their benefits. The resulting ratings for each benefit were added together to obtain the total quantifiable benefit rating for each alternative. The cost effectiveness index was then derived by dividing the benefit rating by the cost of each alternative.

Overview of the (REMI) Model

The impacts of traffic growth in the I-287/TZB corridor on the economy of Westchester and Rockland counties were simulated using the Regional Economic Model (REMI). The REMI model (developed by Regional Economic Models, Inc.) forecasts economic changes on a year-by-year basis. REMI can be customized for specific geographic areas and includes all sectors of a local economy – producers, consumers, investors, government and export/import trade – and replicates the interactions that take place between markets, production, labor, capital, energy, wages, productivity and prices, consumer spending and business profits. The model's logic is based on two underlying assumptions: that households will maximize utility and producers will maximize profits.

The REMI model used for this study consisted of three geographic submodels – Westchester South, Westchester North, and Rockland County – and was calibrated using data from the Bureau of Economic Analysis, the Bureau of Labor Statistics, the Department of Energy, the Census Bureau and other federal sources.

The REMI model forecasts how changes in the economy will occur on a year by year basis as a result of changes in a number of transportation and economic factors, such as productivity, travel time and accident rates.