



Mid-County
Expressway I-476
Express Bus
Feasibility Study



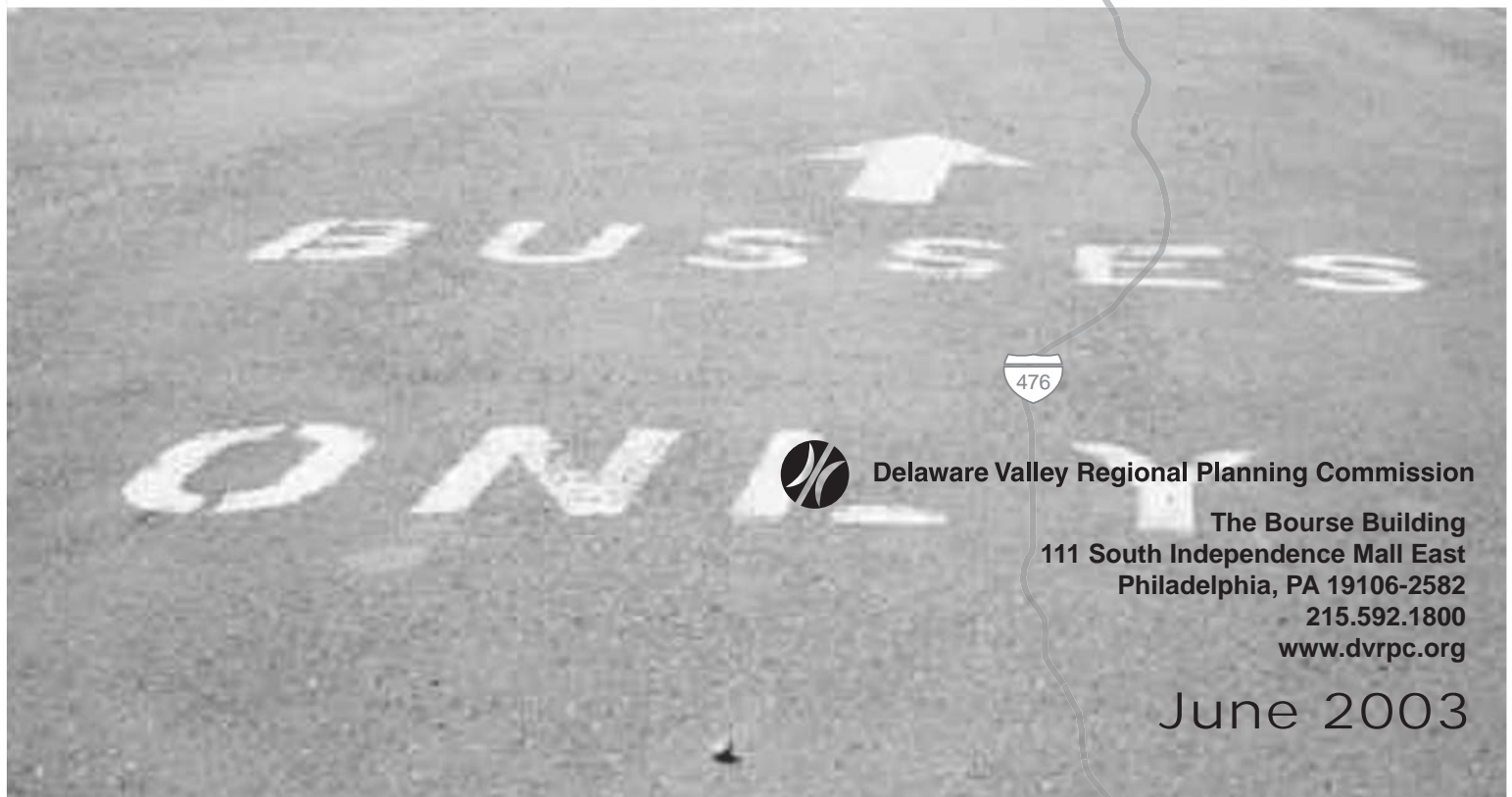
June 2003



Delaware Valley Regional Planning Commission



Mid-County
Expressway I-476
Express Bus
Feasibility Study

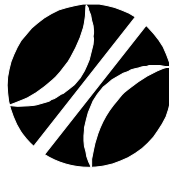


Delaware Valley Regional Planning Commission

The Bourse Building
111 South Independence Mall East
Philadelphia, PA 19106-2582
215.592.1800
www.dvrpc.org

June 2003

Created in 1965, the Delaware Valley Regional Planning Commission (DVRPC) is an interstate, intercounty, and intercity agency that provides continuing, comprehensive, and coordinated planning to shape a vision for the future growth of the Delaware Valley region. The region includes Bucks, Chester, Delaware, and Montgomery counties, as well as the City of Philadelphia in Pennsylvania; and Burlington, Camden, Gloucester, and Mercer counties in New Jersey. DVRPC provides technical assistance and services; conducts high priority studies that respond to the requests and demands of member state and local governments; fosters cooperation among various constituents to forge a consensus on diverse regional issues; determines and meets the needs of the private sector; and practices public outreach efforts to promote two-way communication and public awareness of regional issues and the Commission.



The DVRPC logo is adapted from the official seal of the Commission and is designed as a stylized image of the Delaware Valley. The outer ring symbolizes the region as a whole while the diagonal bar signifies the Delaware River flowing through it. The two adjoining crescents represent the Commonwealth of Pennsylvania and the State of New Jersey. The logo combines these elements to depict the areas served by DVRPC.

DVRPC is funded by a variety of funding sources including federal grants from the U.S. Department of Transportation's Federal Highway Administration (FHWA) and Federal Transit Administration (FTA) The Pennsylvania and New Jersey departments of transportation, as well as by DVRPC's state and local member governments. The preparation of this report was funded through federal grants from the U.S. Department of Transportation's Federal Highway Administration (FHWA) and the Pennsylvania Department of Transportation. The authors, however, are solely responsible for its findings and conclusions, which may not represent the official views of policies of the funding agencies.

TABLE OF CONTENTS

EXECUTIVE SUMMARY	1
I. INTRODUCTION.....	3
II. EXPRESS BUS STUDY AREA AND ISSUE IDENTIFICATION	5
Map 1. Study area.....	6
Table 1. Municipalities Included in the I-476 Corridor Analysis	7
III. POPULATION AND JOBS IN THE STUDY AREA	11
Population and Job Trends	11
Map 2. Population Forecast 1990 - 2010.....	13
Map 3. Job Forecast 1990 - 2010.....	15
IV. TRAVEL TIME IN THE STUDY AREA	17
Route 118 Bus.....	17
Table 2. Average Peak Travel Times for 118 Bus Service (in minutes).....	18
Vehicle Travel Time via I-476.....	19
Map 4. Highway and Transit Times (minutes).....	20
Table 3. Summary of I-476 Travel Times between Select Locations.....	21
V. EXPRESS BUS RIDERSHIP FORECAST	23
Service Planning Assumptions.....	23
Table 4. Express Bus Ridership Forecasts	24
Table 5. Comparison with Regional Shuttles	26
VI. CONCLUSIONS	27
VII. APPENDICES.....	A-1
Appendix A. 1990 & 2000 Population Figures and 2010 Population Forecast. A-3	
Appendix B. 1990 & 1997 Job Figures and 2010 Job Forecast.....	B-1

(page internally left blank)

EXECUTIVE SUMMARY

This report explores the feasibility of express bus service operating on I-476, the Mid-County Expressway, between Chester City and the King of Prussia and Plymouth Meeting Malls. Other alternatives including southbound park and ride shuttle service to the Philadelphia International Airport were assessed. Assessment of the four alternatives was based on demographics of the study area, comparative travel times and ridership forecasts using DVRPC's transportation simulation model. Specific operating details outside the scope of this report were also outlined as appropriate for Transportation management Associations to broker.

The major findings of this study are as follows:

- The population in the study area is forecast to decline about 1 percent or about 7,100 total people from 1990 to 2010. This loss is occurring simultaneously with the redistribution of the remaining population from the southern and eastern municipalities to the northern and western areas around I-476.
- Jobs in the study area are forecast to grow about 8 percent or about 30,300 total jobs from 1990 to 2010. This net gain is forecast largely in the northern municipalities near the King of Prussia and Plymouth Meeting Malls.
- Express bus service on I-476 would be faster than the current one-seat bus service. The one-way travel time from Chester City to King of Prussia Mall on I-476 was about 37 minutes and travel time on the local 118 bus was about 76 minutes. The alternative from King of Prussia Mall to Chester City via the Airport (59 minutes) is again quicker than the 118 bus (76 minutes). No comparable one-seat service exists from Chester City to Plymouth Meeting Mall.
- Ridership forecasts for the express bus service were small relative to current shuttle service in the region with annual boards from 4,900 to 8,300 riders, depending on the alternative. These ridership numbers put the proposed service near the bottom of comparable shuttle services operated in the region, especially when other shuttles carry similar numbers but require fewer trips.
- Express bus service on I-476 requires either more riders per shuttle than forecast or fewer shuttles to transport the forecast riders to be feasible. The job-employee match, scheduling to accommodate mall work hours, and guaranteed rides home all contribute to this issue. Coordination by the Transportation Management Associations between employees and employers are first steps toward a feasible express shuttle service.

(page intentionally left blank)

I. INTRODUCTION

This study of express bus feasibility on the Mid-County Expressway (I-476) was conceived by the Delaware County Planning Department and funded by Transportation Support Program through the Delaware Valley Regional Planning Commission. This study has its genesis in the *Delaware County Long-Range Bus Service Study* published in June 2001 by the DVRPC and Gannett Fleming, Inc. This report developed a vision of bus service to the year 2020 throughout the County of Delaware. One of the recommendations was for express bus service using I-476 to connect southern Delaware County, particularly Chester City, with employment destinations on the northern sections of I-476 in southern Montgomery County. This service would use I-476 as the direct north/south bus link where previously only local bus service or multiple seat rides on rail exists.

In order to determine the feasibility of express bus service on I-476, a number of analytical steps have been performed:

- First, the historic and forecast socioeconomic data of the I-476 corridor are examined, updating previous data. This provides a geographic context for the provision of mobility in the corridor. Maps will show the dynamic population and job environment surrounding the proposed express bus service and a comparable current service.
- Second, travel times for express bus service will be compared with parallel bus service provided by SEPTA's 118 bus from Chester to the King of Prussia Mall. These values are computed using Geographic Information Systems (GIS) incorporating the DVRPC travel simulation model and peak traffic times derived from the 1997 Highway and Transit Travel Time Study.
- Thirdly, travel alternatives between Chester and the two malls are explored using the DVRPC transportation simulation model. Ridership forecasts will be generated for each of the alternatives and extrapolated to annual ridership numbers and compared to other current services.
- Finally, a set of recommendations will be proposed for consideration.

(page intentionally left blank)

II. EXPRESS BUS STUDY AREA AND ISSUE IDENTIFICATION

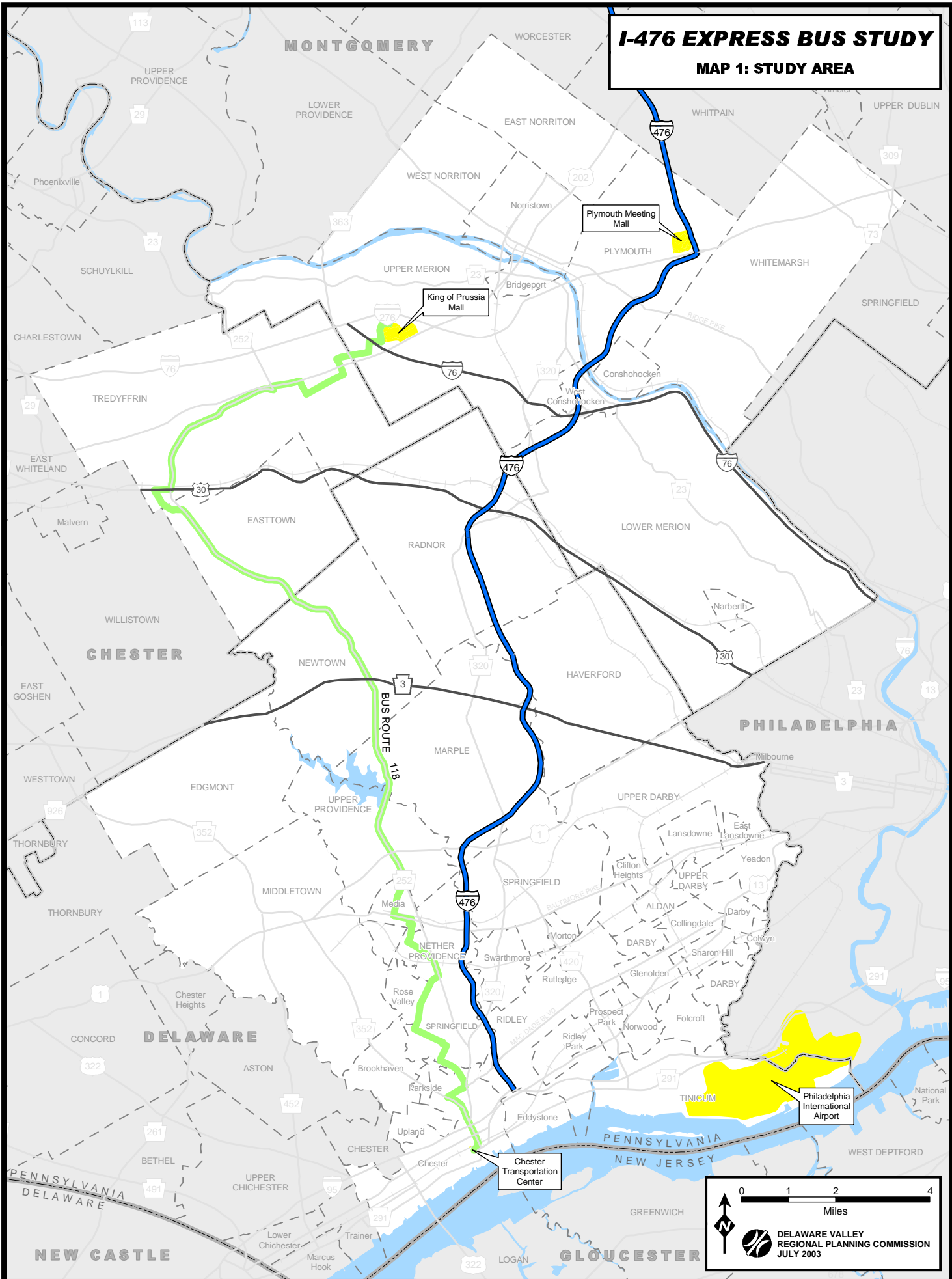
The Mid-County Expressway (I-476) was opened to automobile traffic in 1991 and completed between I-95 and the Pennsylvania Turnpike/Northeast Extension in December 1992. Winding its way northward from I-95 in Ridley Township, Delaware County, to PA 3, I-476 is a four lane expressway. Just north of the PA 3 interchange, the highway widens to six lanes and maintains that width to its termination at the Pennsylvania Turnpike and Northeast Extension. In total, I-476 covers 21.5 miles linking the Delaware County Waterfront with the Pennsylvania Turnpike providing area travelers with direct access to the greater Philadelphia area and western and northeastern Pennsylvania.

In October 1994 the DVRPC published *Traffic Impacts of I-476 (publication #94024)*, assessing the usage of the recently opened I-476. The DVRPC examined 1990 demographic data to evaluate future highway needs in the corridor. Fully completed in 1992, the expressway extends from I-95 in Ridley Township through the heart of the County of Delaware north to the Pennsylvania Turnpike in Plymouth Township in Montgomery County. The corridor was defined in the 1994 report as extending approximately five miles on either side of I-476 and from the Delaware River to the Pennsylvania Turnpike (**see Map 1**).

The five mile buffer provides a wide demographic context for the proposed bus service. The buffer, rather than representing the ride shed for any proposed service, updates the 1990 census information and permits projections 10 years into the future. The object is to assess population and employment shifts affecting the need for transit service in the corridor. This analysis assesses the opportunities, which exist for the north-south axis, which is I-476, in the Delaware Valley region. This corridor includes a large portion of Delaware County, as well as portions of Chester and Montgomery counties and is comprised of fifty municipalities (**see Table 1**). The “width” of the study corridor is critical for capturing the parallel 118 bus service and the commercial employment opportunities presented by the King of Prussia and Plymouth Meeting Malls.

I-476 EXPRESS BUS STUDY

MAP 1: STUDY AREA



0 1 2 4
Miles

DELAWARE VALLEY
REGIONAL PLANNING COMMISSION
JULY 2003

Table 1. Municipalities Included in the I-476 Corridor Analysis**Delaware County**

Aldan Boro.	Chester City
Brookhaven Boro.	Collingdale Boro.
Clifton Heights Boro.	Darby Twp.
Colwyn Boro.	Eddystone Boro.
Darby Boro.	Folcroft Boro.
East Lansdowne Boro.	Haverford Twp.
Edgmont Boro.	Media Boro.
Glenolden Boro.	Morton Boro.
Lansdowne Boro.	Newtown Twp.
Marple Twp.	Norwood Boro.
Middletown Twp.	Nether Providence Twp.
Parkside Boro.	Prospect Park Boro.
Ridley Park Boro.	Radnor Twp.
Rose Valley Boro.	Ridley Twp.
Sharon Hill Boro.	Rutledge Boro.
Swarthmore Boro.	Springfield Twp.
Upper Darby Twp.	Tinicum Twp.
Upper Providence Twp.	Upland Boro.
	Yeadon Boro.

Montgomery County

Bridgeport Boro.	Conshohocken Boro.
East Norriton Twp.	Narberth Boro.
Lower Merion Twp.	Norristown Boro.
Upper Merion Twp.	Plymouth Twp.
West Norriton Twp.	West Conshohocken Boro.
	Whitemarsh Twp.

Chester County

Easttown Twp.	Tredyffrin Twp.
---------------	-----------------

The Technical Advisory Committee (TAC) identified two issues for express bus service on I-476. The first issue was a northbound express bus service for Chester City residents seeking employment at the King of Prussia Mall or Plymouth Meeting Mall. The second issue involves the elimination or amelioration of southbound deadheading from either of the malls through an alternate airport shuttle. These two issues are dealt with in turn.

Chester City, one of the most disadvantaged locations in the Delaware Valley Region, was identified as the primary origin for trips using I-476. Chester City is just west on I-95 from the southern terminus of I-476. Chester City has as its locus the Chester Transportation Center (CTC), with multiple bus and regional rail connections. Chester has been the focus of welfare to work transportation initiatives in the past, including the current Delaware County Transportation Management Association Quicksilver shuttles. The Quicksilver shuttles connect Chester City and employment at assisted living centers in western Delaware County where there is no transit service. An express shuttle using the I-476 expressway to major employment centers at the north end of I-476 may provide another job connection for those seeking employment.

Employment destinations at the northern end of I-476 are the King of Prussia Mall and the Plymouth Meeting Mall. Both of these major retail destinations are readily accessible from I-476, with King of Prussia to the west via I-76 and Plymouth Meeting to the east on I-476. Both locations have been expanding as commercial destinations for the region. They also have some bus connections and adjacent executive campuses expanding the already large potential as employment destinations.

The second issue involved eliminating deadheading on the return trip from either mall. Service would provide northbound service to employment in the morning and homeward trips in the afternoon, leaving empty vehicles on the return trips. One alternative is for morning southbound service collecting passengers at park and ride locations at the northern part of I-476 and driving them to the Philadelphia International Airport. In the afternoon, northbound trips would then pick up airport passengers delivering them back to the park and rides in the northern part of I-476. This service is a means to boost ridership by providing an ancillary airport service for residents in the northern area of I-476. This alternative is also assessed for its feasibility.

Four park and ride locations were identified as potential parking locations for a southbound trip to the Philadelphia International Airport (PHL). The use of existent facilities negates additional costs involved with finding and building a new park and ride site. The four sites initially considered include the park and ride at South Gulf Road built across from the King of Prussia Mall as part of the US 202 reconstruction. The Radnor regional rail station, the Radnor Route 100 station and the Matson Ford Road park and ride were also suggested. Park and ride locations which were considered are shown below.

<u>Parking Location</u>	<u>Capacity/Use</u>
South Gulf Road park and ride	200 spaces / NA
Radnor Route 100 Station,	20 spaces / 100% use
Radnor Regional Rail Station,	119 spaces / 64% use
Matson Ford Road park and ride,	91 spaces / 21% use

Additional park and ride locations were suggested at the WalMart in Eddystone Borough and at the Springfield Mall off I-476 on Baltimore Pike. Both locations had issues of additional time and miles, negating the speed advantages of an express bus. Consequently, the potential park and rides were found wanting and not included in the analysis.

The park and ride locations shown above indicate there is available capacity at the northern end of I-476. Obvious limitations on these locations include a lack of available parking capacity, ease of access to and from the malls, and the proximity to potential users. The South Gulf Road park and ride will not be in service until spring 2004 and is not an option for trips originating from Plymouth Meeting. The Matson Ford park and ride has flexibility for pick up from either mall enroute to the airport. It is accessible from either freeway and has about 70 spaces open on a daily basis. The two Radnor parking locations are close to one another, however, their capacity is limited and they are less accessible from the highway than Matson Ford. Consequently, the Matson Ford park and ride is the facility used for purposes of this study.

(page intentionally left blank)

III. POPULATION AND JOBS IN THE STUDY AREA

The I-476 corridor was defined in the 1994 report *Traffic Impacts of I-476 (publication #94024)*, as extending approximately five miles on either side of I-476 and from the Delaware River to the Pennsylvania Turnpike (**see Map 1**). These bounds were originally created to capture the automobile ridership shed for the expressway and are of limited utility for transit evaluation. This boundary is too wide to accurately describe potential transit ridership, particularly given that the service is a closed door from Chester City to the Malls.

This broad geographical context, however, serves a number of purposes in this study. First, as value added, it updates the 1994 report, extending some of the previous data regarding the I-476 corridor to 2010. Secondly, it permits assessment of shifts in population and jobs surrounding the north-south connection provided by the Mid-County Expressway. The wide buffer provides more information regarding potential riders and jobs which may influence or explain the performance of a shuttle bus service. Finally, the proposed express bus service requires a context large enough to compare parallel bus service in the region.

Population and Job Trends

The total population data was obtained from the 1990 and 2000 census, while job data was obtained from 1990 census and 1997 job tabulations. The 1997 job estimates were used in lieu of official 2000 figures from the Census Bureau, which were due after the publication of this report. The year 2010 regional numbers are from board approved DVRPC forecasts used for transportation and land use modeling. The complete data sets can be found in the Appendix A and B in the back of the report.

	<u>1990</u>	<u>2000</u>	<u>Forecast 2010</u>	<u>Absolute Change 90-10</u>	<u>% Change 90-10</u>
Population	711,459	711,193	704,370	(7,089)	-1.0%
Jobs	393,259	405,940*	423,570	30,311	7.7%

* 1997 job tabulation

The population total of about 711,193 people in 2000 is essentially unchanged from the 711,459 people in 1990. Population decline becomes evident, however, when numbers are forecast 10 years in the future. There is a forecast decline from year 2000

to year 2010 totaling about 6,800 people. The forecast is about a 1 percent decline from 1990 to 2010.

Map 2 illustrates the population trends in the I-476 corridor grouped by percent change. The four biggest gainers in population, Radnor, Whitemarsh, Middletown and Upper Merion townships combined for about 9,300 more people. Whitemarsh and Middletown each had about 16 percent increases, while Radnor and Upper Merion each posted about 8.5 percent population increases. The smaller increases occurred due to the relatively larger size of each township.

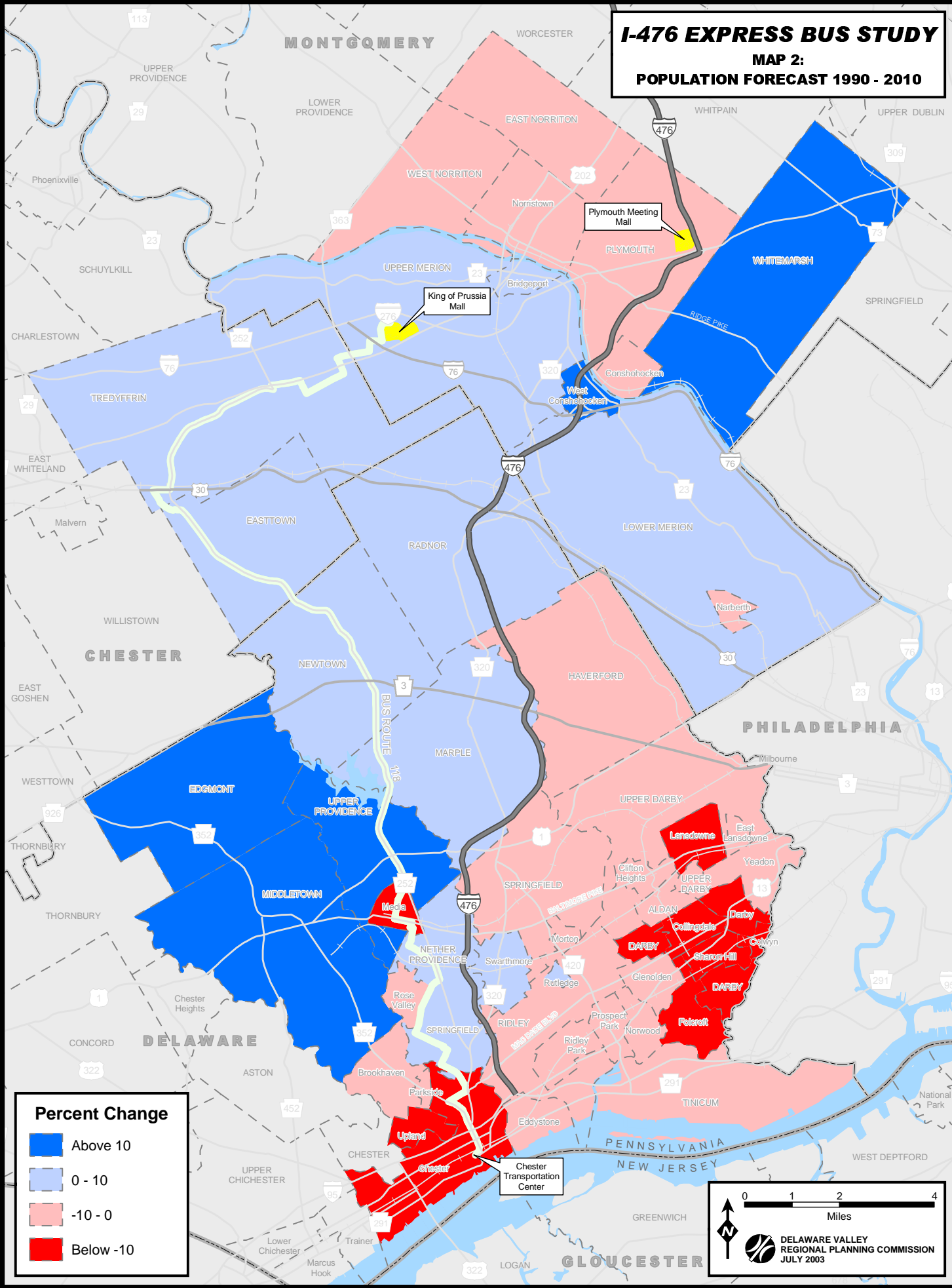
The four MCDs losing the most population include Chester City, Haverford, Darby and Springfield townships, which combined for a decrease of about 12,950 people. Darby Township is projected to lose about 17 percent of its population, and Chester City is forecast to lose about 16 percent of its population by 2010. Though these numbers may be misleading as Chester City's numbers are about four times the size of Darby's numbers in both population and population loss. Similarly, Haverford and Springfield Townships with respective losses of about 5.7 and 6.5 percent appear to be less affected by the loss since they are some of the larger MCDs in the study area.

From 1990 to 2010, 15 MCDs show population increases between 7 and 2,507 people while 33 MCDs show decreases from between (-39) and (-6,666) people. Conversely, the period of 1990 to 2010 shows job growth in 25 MCDs with increases ranging from 9 to 7,040 jobs and decreases ranging from (-2) to (-4,085). The question becomes a matter of where this growth and decline is taking place.

The trend as shown in Map 2 is the redistribution of population from the older first ring suburbs east of I-476 toward the west and north sections of the expressway. The population is shifting to the open land in western Delaware County and north to southern Montgomery County. It is the western areas where there is space to build new homes. Unfortunately, Chester City will continue to lose population as those who can move away do so, leaving only the most disadvantaged.

I-476 EXPRESS BUS STUDY

MAP 2: POPULATION FORECAST 1990 - 2010



Map 3 illustrates the forecast trend in jobs in the I-476 corridor grouped by percent change. The four largest MCDs with gains in jobs, Plymouth, Upper Merion, Tredyffrin, and Ridley townships are forecast to combine for an increase of about 25,100 jobs. Plymouth and Ridley Townships are forecast to grow about 36 and 35 percent respectively. Similarly Tredyffrin and Upper Merion are forecast to gain about 27 and 15 percent in jobs by 2010.

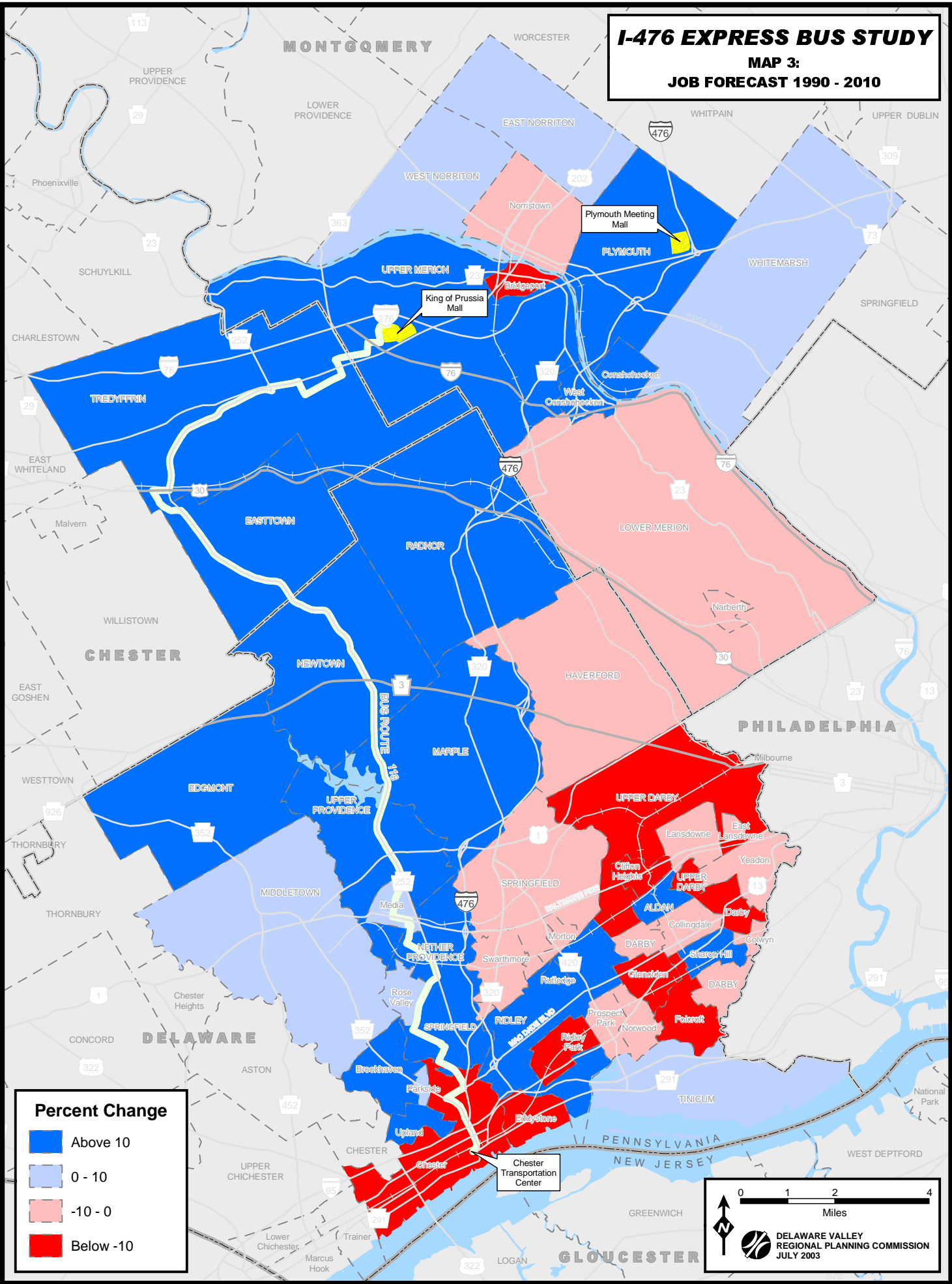
The greatest declines are forecast to occur in Chester City, and Upper Darby, Norristown, and Folcroft townships which combine for a decrease of about 9,400 jobs. These numbers are made even more striking by the fact that Folcroft, and Chester City with adjoining Eddystone Borough are forecast to lose over one quarter of their jobs by 2010 (decreases of about 29%, 28% and 27% respectively). Upper Darby and Norristown have larger job bases than the other MCDs mentioned, so their losses, while substantial represent a smaller percent change (about 12% and 9% respectively).

As the principal origin in this study, Chester City has fallen on hard times and is forecast to continue in that manner. The short run 2000 to 2010 outlook forecasts a slowing rate of decline. Population is expected to decrease by about 1,660 people and jobs are similarly expected to decrease by about 1,430.

In contrast, the areas north along the I-476 and onto I-76 around Plymouth Meeting and King of Prussia malls are forecast to have large job growth. Plymouth and Upper Merion townships, the respective MCDs surrounding the Plymouth Meeting and King of Prussia malls, are forecast to see absolute job increases totaling 6,450 for the decade from 2000 to 2010. This makes the Mall areas a desirable destination for job seekers from Chester City.

Job growth as shown in Map 3, presents a more dynamic pattern than population. While population in the study area was largely unchanged, the number of jobs increased by about 12,700 between 1990 and 2000. There is a population decrease of about 6,800 people and an accompanying job increase of about 17,600 in the study area forecast from 2000 to 2010. Jobs are forecast to grow in the areas at the northern part of the I-476 where business has been booming. The successful King of Prussia and Plymouth Meeting Malls have been thriving and the forecasts attest to their attractive nature. The converse of this is Chester City, which is forecast to continue losing jobs. Consequently, I-476 is in the role of north-south link between the most impoverished area in the study area (Chester City) and the two areas with strong job growth.

I-476 EXPRESS BUS STUDY
MAP 3:
JOB FORECAST 1990 - 2010



Percent Change

- Above 10
- 0 - 10
- 10 - 0
- Below -10

0 1 2 4
Miles

DELAWARE VALLEY REGIONAL PLANNING COMMISSION
JULY 2003

(page intentionally left blank)

IV. TRAVEL TIME IN THE STUDY AREA

The previous data analysis provided some socioeconomic context for the study area. The next step analyzes the transportation connections between the identified origins and destinations. This analysis uses travel times between local bus service and travel times on the I-476 expressway.

Route 118 Bus

The 118 bus service provides a comparison with express bus service to the King of Prussia mall. The Route 118 bus originates from the Chester Transportation Center serving the Pennsylvania Institute of Technology, Delaware County Community College, Westlakes Corporate Center, and the Valley Forge Office Park, following local roads and arterials north to the King of Prussia Mall. No comparable bus service exists between Chester City and Plymouth Meeting Mall.

The 118 bus is a local service with many possibilities for transfers and pick ups. It has a number of rail connections: the R2 Marcus Hook/Wilmington train at the Chester Transportation Center, the R3 Media-Elwyn regional rail train at the Wallingford Station, the 101 Media trolley in Media, and the R5 regional rail train at the Paoli Station. The 118 has connections with bus routes: 99, 104, 105, 109, 110, 112, 114, 116, 117, 118, 119, 120, 123, 124, 125, 133, and 208. There are also connections at the King of Prussia Mall with the Suburban Link, providing weekday peak hour service to a number of Collegeville employers.

The service operates on 60 minute peak headways between Chester Transportation Center and King of Prussia Mall. There are 3 trips in the morning peak and 3 trips in the afternoon peak period. While there are more trips leaving Chester, only the 6 peak period round trips occurring between CTC and King of Prussia Mall will be considered in this analysis.

The 118 bus has weekday boardings of 643 passengers in FY 2002, which is a 29 percent decline from 911 passengers in FY 2001 and a 46 percent decline from 1,188 passengers in 1995. Since 2001, the service between Chester Transportation Center and King of Prussia Mall runs only during the peak hours to King of Prussia. During the off-peak, service now runs to West Chester Pike and Newtown Street Road in Newtown Square. This was in response to low ridership to the Mall during the off-peak. In many respects, the 118 bus now serves as a circulator between Chester City and the County seat of Delaware County, Media. Many government, social service and legal resources offered by the county are available in Media for the denizens of Chester City.

Table 2 summarizes the differences in average peak travel time for each of the trips by direction and time of day. The average A.M. northbound commute is about 10 minutes longer than the average A.M. southbound commute to Chester City. The afternoon peak commutes shows less variation between north and southbound direction with only about 1 minute separating the average times. The two P.M. average times, however, are about 5 minutes slower than the fast A.M. southbound trips and 5 minutes faster than the northbound A.M. trips.

Table 2. Average Peak Travel Times for 118 Bus Service (in minutes)

<u>Route 118 Trip Links</u>	<u>North AM</u>	<u>North PM</u>	<u>South AM</u>	<u>South PM</u>
Chester Transportation Center to Edgmont Ave. / 22nd St.	6.0	7.0	5.3	5.5
Edgmont Ave. / 22nd St. to Brookhaven / Rose Valley Rds.	10.3	10.3	10.3	10.0
Brookhaven / Rose Valley Rds. to Wallingford Ave. / Vernon St.	3.7	4.0	4.0	4.8
Wallingford Ave. / Vernon St. to Jackson / State Sts.	6.0	5.0	5.0	5.3
Jackson / State Sts. to Providence / Kirk Rds.	6.3	6.0	4.0	4.8
Providence / Kirk Rds. to Delaware County Comm. College	5.3	4.6	6.3	7.3
Delaware Co. Comm. College to W. Chester Pike / Newtown St.	7.3	6.3	4.6	5.8
W. Chester Pike / Newtown St. to Darby Rd. / Lancaster Ave.	11.0	9.7	10.7	10.3
Darby Rd. / Lancaster Ave. to Swedesford / Old Eagle School Rds.	7.7	12.0	10.7	10.8
Swedesford / Old Eagle School Rds. to King of Prussia Plaza	<u>9.0</u>	<u>11.0</u>	<u>11.0</u>	<u>12.0</u>
Average (in minutes)	81.7	78.0	72.0	76.5

The travel times vary by direction, with the average northbound trip taking about 80 minutes, while the average southbound trip takes about 75 minutes. These times can be further broken down AM or PM trips. The average northbound trip in the morning is almost 10 minutes longer than the average southbound trip in the morning. The specific links do not reveal any large differences.

The transit alternatives are aggregated into links and shown in **Map 4**. The 118 bus times and vehicular times on the expressway are broken into three sections: from Chester to the crossing of Route 3, West Chester Pike; from Route 3 to Route 30, Lancaster Avenue; and from Route 30 to King of Prussia. These points provide north-south divisions comparable with the I-476. The section from CTC to Route 3, West Chester Pike, is the slowest section, with over 40 minutes of travel time by time of day or direction. The middle section operates the quickest with about 10 or 11 minutes travel times. The final section northward, from Route 30 to the Mall takes about 20 minutes to travel.

The slower southern section of the 118 bus route travels residential areas with multiple stops or transfer points. These stops include: Pennsylvania Institute of Technology, Delaware County Community College, Media Borough Government Center and the Wallingford train station. The middle section is relatively undeveloped and the bus passes through quickly. The northern most section is not as long as the other sections, but it stops throughout office parks and must negotiate Mall traffic to reach the bus berths in the back of the King of Prussia Mall.

There are two points to this analysis: First, peak travel time north to King of Prussia Mall from Chester Transportation Center takes about an hour and twenty minutes. This is too long for most workers going to work at King of Prussia, and too long by current welfare to work regulation to accommodate job seekers coming off welfare. Those using the 118 bus to commute from Chester must be chasing jobs which pay enough to warrant such a commute. This also suggests a need for more rapid transport between these two points.

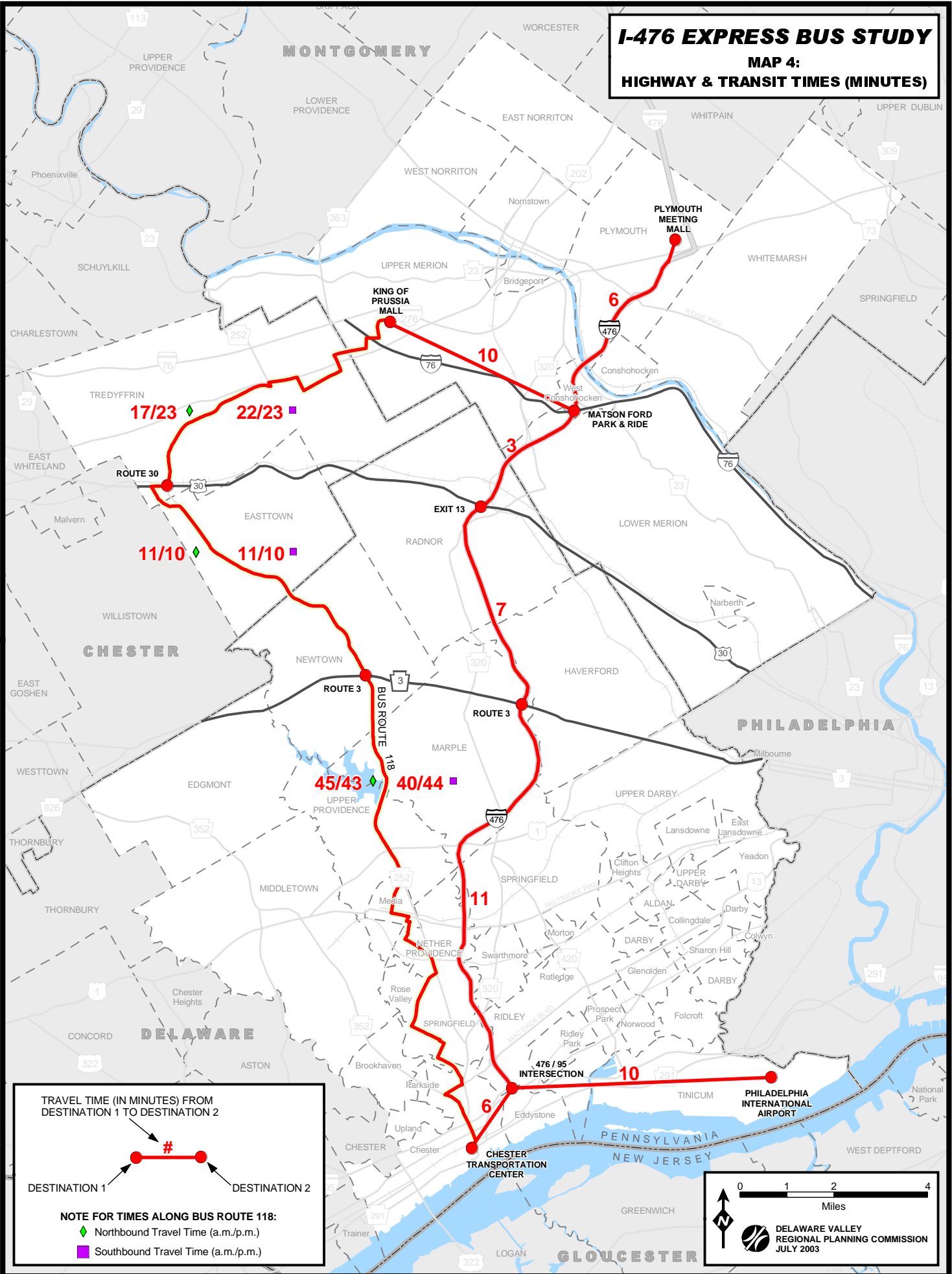
Second, the hours of operation do not fully accommodate workers traveling to the mall (the last bus is out at 6:35 p.m. and the Mall closes at 9:30 p.m.) making that service inappropriate for many workers requiring transit in the first place. An employee taking the 118 bus might be limited in certain opportunities based on scheduling limitations. A transit dependent employee could not go home on the 118 bus in the middle of the day if that was necessary. The only trips available occur during the traditional peak travel hours. Looking ahead, the same peak hour conditions are applied to the travel simulation model, though the simulation results do not limit the operational recommendations.

Vehicle Travel Time via I-476

In 1997, a survey of travel time and speed was conducted by DVRPC in the Delaware Valley Region. Highway travel time was gathered on nearly every regional link in Pennsylvania and New Jersey. Using specially equipped vehicles, all the major routes in the region were driven during peak and off peak times. Information runs were designed to produce real time travel time for all types of roadways at different times of

I-76 EXPRESS BUS STUDY

MAP 4: HIGHWAY & TRANSIT TIMES (MINUTES)



day. This data was collected and then downloaded into advanced software packages for aggregation and analysis.

The DVRPC travel simulation model was employed as an analysis tool for this data. Each link in the highway network was supplied with an average travel time derived from the actual driving times, the time of day, and the facility type. This information was then integrated with a GIS and it became possible to know travel times on nearly any link in the regional highway network. By clicking on highway links in an ArcView program, time may be computed by peak or by off peak periods during the day.

Table 3 summarizes the travel times between Chester Transportation Center (CTC) and both King of Prussia and Plymouth Meeting Malls. These are broken down by individual link. The airport/park and ride alternative begins from either mall, stops at the Matson Ford park and ride, continues on to the Philadelphia International Airport (PHL), and then returns to CTC. The computed times are peak hour travel times rounded to the minute and are valid in both northbound and southbound directions.

Table 3. Summary of I-476 Travel Times between Select Locations

<u>Origin</u>	<u>Destination</u>	<u>Travel Time (in minutes)</u>
Chester Transportation Center	I-476 (Int with I-95)	6
I-476 (Int with I-95)	Philadelphia International Airport	10
I-476 (Int with I-95)	I-476 (Int with Route 3)	11
I-476 (Int with Route 3)	I-476 (Int Exit #13/ Route 30)	7
I-476 (Int Exit #13/ Route 30)	Exit 16a/b (Phila-Conshohocken)	3
I-476 (Int with I-95)	Exit 16a/b (Phila-Conshohocken)	21
Exit 16a/b (Phila-Conshohocken)	Matson Ford park and ride	1
Exit 16a/b (Phila-Conshohocken)	King of Prussia Mall	10
Exit 16a/b (Phila-Conshohocken)	Plymouth Meeting Mall	6
Chester Transportation Center	King of Prussia Mall	37
Chester Transportation Center	Plymouth Meeting Mall	33
King of Prussia Mall	Chester Transportation Center	37
Plymouth Meeting Mall	Chester Transportation Center	33
King of Prussia Mall	CTC via Matson Ford P& R and PHL	59
Plymouth Meeting Mall	CTC via Matson Ford P& R and PHL	55

The comparable north/south local bus and expressway links created by the east/west roads Route 3 and Route 30 are shown in Map 4. The 118 bus route is shown with travel times divided by direction (north and south) as well as travel times by time of day (a.m. and p.m.) As stated previously, the I-476 travel times are for the a.m./p.m. peak, and they are valid in either a north or southbound direction. These divisions, while not exact, do permit compilations and comparisons of disaggregated travel times.

Comparing the travel times reveals that from Chester City to Route 3, West Chester Pike, on 118 bus takes about three times as long as a trips on I-476 (about 40-45 minutes versus about 17 minutes). The southern bus link is slower due to the number of stops through the relatively dense pattern of neighborhoods, while travel on I-476 is impeded only by traffic. Media, as the County seat, with its government complex is a destination where riders may be picked up or dropped off for business. Considerable time is spent collecting riders going to Media, which serves as a major intermediate destination on this route.

The travel times between the two routes are different on the middle segment between Route 3 and Route 30. The times are 10 to 11 minutes on the 118 bus and about 7 minutes on the expressway. The 118 bus local segment is longer than that on the expressway, but it passes through areas relatively undeveloped and without many stops for passengers. North of Newtown Square, this segment acts more as a pass-through, rather than a collector, to the final segment of the route.

There are three alternative segments north of Route 30, the local and the I-76 segments with destinations at King of Prussia Mall and the other following the I-476 to Plymouth Meeting Mall. Looking at Map 4 and proceeding left to right, their times are as follows: about 23 minutes for the 118 bus, 13 minutes on I-76 to King of Prussia, and 9 minutes to Plymouth Meeting. The 118 bus runs through adjacent office parks and around the mall, while the I-76 route to King of Prussia must wind around the mall to bus bays in the back. The trip on the expressway to Plymouth Meeting is most direct and is consequently the fastest.

V. EXPRESS BUS RIDERSHIP FORECAST

The Express Bus Study used the DVRPC regional travel simulation process to develop transit ridership projections. The DVRPC Travel Simulation Model follows a four-step procedure consisting of the following activities:

- trip generation
- trip distribution
- modal split
- assignment

The process utilizes the TRANPLAN transportation planning software package and special programs developed by the DVRPC. DVRPC staff has recently implemented a new “nested modal split” model for use in planning studies. This model differs from previous versions in that the model structure is now nested by mode of approach; walk/bus approach transit trips are modeled separately from auto approach transit trips in the modal split/transit assignment model each using separate transit networks. Following the separate transit assignments, the transit volumes are merged together and summarized to reflect total transit riding.

The DVRPC provided socioeconomic data inputs which were modified to take into account current development in the areas surrounding Chester City, King of Prussia and Plymouth Meeting Malls, the Matson Ford park and ride, and Philadelphia international Airport. The 1997 base simulation was used to explore the current and short term potential ridership an express shuttle might capture. Trip productions and attractions for each of the appropriate traffic zones were then determined and distribution runs were performed, resulting in new person trip tables for modal choice and assignment.

Once the new person trip tables were generated, the remaining steps in the modeling process (modal choice and assignment), involving a straightforward application of the DVRPC models was performed, using a transit network modified with the service plan described in the next section. It is worth noting that the travel simulation travel was not designed to forecast such small travel ridership and numbers assigned by the model may best provide an indication of the magnitude to be expected.

Service Planning Assumptions

For purposes of travel simulation, a service plan was developed for the area where the simulation applies. The express bus service plan includes the following specific assumptions:

- Northbound service originates at the Chester Transportation Center, incorporating the bus and rail transit ridership transferring there, and proceeds to

- I-476, then I-76 and on to the King of Prussia Mall, stopping at the current bus stop locations at the mall, which includes transit transfers there.
- Alternative northbound bus service also originates at Chester Transportation Center incorporating the bus and rail transit ridership transferring there, and proceeds to I-476 to the Plymouth Meeting Mall stopping at the current bus stop locations at the mall, which includes transit transfers there.
- Two southbound alternatives originate from either Mall and follow I-476 directly back to the Chester Transportation Center.
- Two other southbound alternatives also originate at the Malls, but stop at the Matson Ford park and ride, and then proceed south down I-476 to the Philadelphia International Airport (PHL) and then back to Chester Transportation Center.
- Northbound alternatives for the Airport trip originate at Chester Transportation Center incorporating the bus and rail transit service arriving there, proceed to the Airport, then back out to I-476 and north to the respective Mall.
- Hours of service were simulated for the morning and evening peak times (6 a.m. to 9 p.m. and 4 p.m. to 7 p.m.) with hourly headways in each period. Consequently, there were 3 round trips made in the morning and 3 round trips made during the evening hours.

Table 4. Express Bus Ridership Forecasts

<u>Route</u>	<u>Weekday Boards</u>	<u>Annual Boards</u>
CTC to King of Prussia	13	---
King of Prussia to CTC Direct	6	4,940
King of Prussia to CTC via PHL	9	5,720
CTC to Plymouth Meeting	17	---
Plymouth Meeting to CTC Direct	8	6,500
Plymouth Meeting to CTC via PHL	15	8,320

Table 4 shows the weekday person trips for each express bus service alternative. Average weekday boards for each alternative are reported by direction and represent 6 trips in each respective direction per day. This means that the 13 weekday boards from Chester Transportation Center to King of Prussia are gathered from six one way trips per day. A round trip from CTC to King of Prussia and back directly is 19 boards

derived from six round trips. The annual boards add the northbound ridership with the respective southbound alternative for a total of six round trips per day. The annual boards also assume six round trips a day, five days a week, 52 weeks a year.

Ridership for the express bus service leaving CTC and arriving at the King of Prussia Mall is forecast to be about 13 total boards. The direct return trip is forecast to have 6 boards, for a total of 19 daily boards. The alternative southbound trip to the Matson Ford park and ride and then to the Philadelphia International Airport (PHL) is forecast to have 9 boards. When added to the 13 northbound boards, this is a daily total of 22 boards from six round trips.

The trip from CTC to Plymouth Meeting Mall is forecast to have 17 boards, while the direct return trip to CTC from the mall is forecast to have 8 boards for 25 total boards. The trip via the Matson Ford park and ride to PHL is forecast to have 15 boards, added to the northbound 17 equals 32 weekday boards. The Plymouth Meeting express is forecast to accommodate a slightly greater number of riders. Shorter travel times and slightly greater projected growth in Plymouth Township contribute to the larger number of boards.

The projected weekday ridership may be summarized into two categories, trips to King of Prussia (19 direct and 22 via PHL) and trips to Plymouth Meeting (25 direct and 32 via PHL). These number represent passenger boards north to the respective malls, each then coupled with a southbound alternatives. Multiplied out to a years worth of weekday trips, the King of Prussia trip might expect 4,940 direct or 5,720 via PHL annual riders, while Plymouth Meeting might expect 6,500 direct or 8,320 via PHL annual riders. These are modest weekday numbers for a bus service providing 6 round trips per day and 30 round trips per week. The trips incorporating the Matson Ford park and ride clearly produce greater forecast boards, though these trips represent about 20 minutes additional travel time versus a direct trip.

Table 5 shows ridership on comparable current shuttles includes the Lansdale HOP (5,000) and the Community Coaster (4,000), the Quicksilver IV (4,600), the Phoenixville Phlyer (4,619), and the Abington Link (8,069). The days of service per week on the current shuttles is very similar to the proposed express services. The number of round trips per week differs between the proposed shuttles and the current shuttles. Only the Phoenixville Phlyer has similar service characteristics with 32 round trips per week, though the ridership is lower than the forecast ridership for the proposed shuttles. This comparison is not a positive one, since the Phoenixville Phlyer operates with one of the largest cost per riders of the current shuttles (above \$30 per rider), situating it near the bottom of the services in the region.

Table 5. Comparison with Regional Shuttles

<u>Shuttle</u>	<u>Days of Service per Week</u>	<u>Round Trips per Week</u>	<u>Estimated Annual Ridership</u>
King of Prussia Direct	5	30	4,940
King of Prussia via PHL	5	30	5,720
Plymouth Mtg Direct	5	30	6,500
Plymouth Mtg via PHL	5	30	8,320
Community Coaster	5	20	4,000
Lansdale HOP	5	20	5,000
Quicksilver IV	6	6	4,600
Phoenixville Phlyer	5	32	4,619
Abington Link	5	20	8,069

The principle difference between the current and proposed services is that current shuttle services operate with fewer trips so they are operating with a greater number of riders per trip. Clearly the current shuttles have similar ridership as the proposed shuttles, only they are taking fewer trips to do this, making for more efficient services. This suggests the need to strategically develop and market the shuttle service to employers for it to be successful. The simulation numbers are low, but not out of the question. What is required to bring the express service into line with other acceptable services is either greater ridership or serviced focused in a manner to reduce the number of trips required to move the riders. If specific subscription service in conjunction with merchants at the malls were arranged, then ridership could be better coordinated.

VI. CONCLUSIONS

This analysis of a potential new 'Express Bus Service' using the I-476, the Mid-County Expressway has identified a ridership of about 19 daily or 4,900 annual riders. Another estimate with differing service characteristics posited 32 daily and about 8,300 annual riders. When compared with current shuttle services, these ridership levels would be some of the lowest in the region. The express service, however, would be faster than any current one-seat bus service between Chester City and either King of Prussia or Plymouth Meeting Mall.

The most important issue for this service to be a success is the job-employee match. Operating ratios for successful shuttles in the region require either fewer trips or greater ridership, than used to model the I-476 express buses. While jobs are forecast to grow in the north, there is no current information as to the 'fit' between people and jobs. The service can not be run speculatively, potential employees and employers need to be matched before a connective service is established. An agreement between mall employers, the operating agency, and job placement agencies could provide critical information to realize acceptable operating ratios.

The issue of an airport park and ride shuttle also needs to be examined further. While airport runs had greater ridership than the direct runs, the extra travel time involved (scheduled layover times at the P&R and PHL were not figured into the times) might alter fleet requirements negatively. There could also be issues with mixed ridership on the shuttles, convenience, and the appropriate promotion for such a service. As mentioned in the text, it is also possible that increased ridership may reflect employee trips between PHL and CTC, rather than suburban travel plans.

Another issue is whether a shuttle service is necessary. In the absence of 2000 journey to work data, proxies were used to determine whether a shuttle connection between north and south presents and ideal worthy of pursuit. Service on the 118 was cut back due to low ridership to King of Prussia. The low ridership forecast for the express bus service suggests only marginal demand for the service. The hope remains, however, that express bus service will spur demand if it is provided.

Ancillary issues such as emergency ride home or hours of operation would also need to be negotiated. Since service would likely operate only in the peaks, an alternative way home in case of family emergency would need to be determined. Also, it is important to determine what service hours best match with mall work hours. Traditional AM and PM peak service may not be best for employees who do not begin work until 10 AM or are done with a shift at 9 PM. Shuttles to the malls would need to be thoughtfully scheduled. Precedent exists to resolve all of these issues, but they require considerable coordination between the County Transportation Management Associations and the employers.

(page intentionally left blank)

APPENDIX A and B
MCD Population and Job Data
for 1990, 1997, 2000, and 2010

(page intentionally left blank)

APPENDIX A. 1990 & 2000 Population and 2010 Population Forecast

<u>Municipality</u>	<u>1990</u>	<u>2000</u>	<u>2010</u>	<u>1990-2010 Abs. Change</u>	<u>1990-2010 % Change</u>
Aldan borough	4,549	4,313	4,160	(389)	-8.6%
Bridgeport borough	4,292	4,371	4,320	28	0.7%
Brookhaven borough	8,567	7,985	7,920	(647)	-7.6%
Chester City	41,856	36,854	35,190	(6,666)	-15.9%
Clifton Heights borough	7,111	6,779	6,480	(631)	-8.9%
Collingdale borough	9,175	8,664	8,220	(955)	-10.4%
Colwyn borough	2,613	2,453	2,300	(313)	-12.0%
Conshohocken borough	8,064	7,589	7,500	(564)	-7.0%
Darby borough	11,140	10,299	9,750	(1,390)	-12.5%
Darby township	10,955	9,622	9,080	(1,875)	-17.1%
East Lansdowne borough	2,691	2,586	2,440	(251)	-9.3%
East Norriton township	13,324	13,211	13,160	(164)	-1.2%
Easttown township	9,570	10,270	10,450	880	9.2%
Eddystone borough	2,446	2,442	2,340	(106)	-4.3%
Edgmont township	2,735	3,918	4,790	2,055	75.1%
Folcroft borough	7,506	6,978	6,630	(876)	-11.7%
Glenolden borough	7,260	7,476	7,180	(80)	-1.1%
Haverford township	49,848	48,498	47,010	(2,838)	-5.7%
Lansdowne borough	11,712	11,044	10,490	(1,222)	-10.4%
Lower Merion township	58,003	59,850	59,220	1,217	2.1%
Marple township	23,123	23,737	23,830	707	3.1%
Media borough	5,957	5,533	5,330	(627)	-10.5%
Middletown township	14,130	16,064	16,370	2,240	15.9%
Morton borough	2,851	2,715	2,800	(51)	-1.8%
Narberth borough	4,233	4,233	4,180	(53)	-1.3%
Nether Providence township	13,229	13,456	13,760	531	4.0%
Newtown township	11,366	11,700	12,000	634	5.6%
Norristown borough	30,749	31,282	30,710	(39)	-0.1%
Norwood borough	6,162	5,985	6,030	(132)	-2.1%
Parkside borough	2,369	2,267	2,200	(169)	-7.1%
Plymouth township	15,958	16,045	15,850	(108)	-0.7%
Prospect Park borough	6,764	6,594	6,400	(364)	-5.4%
Radnor township	28,703	30,878	31,210	2,507	8.7%
Ridley Park borough	7,592	7,196	7,160	(432)	-5.7%
Ridley township	31,169	30,791	30,450	(719)	-2.3%
Rose Valley borough	982	944	940	(42)	-4.3%
Rutledge borough	843	860	850	7	0.8%
Sharon Hill borough	5,771	5,468	5,150	(621)	-10.8%
Springfield township	24,160	23,677	22,590	(1,570)	-6.5%

Swarthmore borough	6,157	6,170	6,230	73	1.2%
Tinicum township	4,440	4,353	4,360	(80)	-1.8%
Tredyffrin township	28,028	29,062	30,050	2,022	7.2%
Upland borough	3,334	2,977	2,830	(504)	-15.1%
Upper Darby township	81,177	81,821	80,650	(527)	-0.6%
Upper Merion township	25,722	26,863	27,860	2,138	8.3%
Upper Providence township	9,727	10,509	11,050	1,323	13.6%
West Conshohocken borough	1,294	1,446	1,500	206	15.9%
West Norriton township	15,209	14,901	14,850	(359)	-2.4%
Whitemarsh township	14,863	16,702	17,260	2,397	16.1%
Yeadon borough	<u>11,980</u>	<u>11,762</u>	<u>11,290</u>	<u>(690)</u>	<u>-5.8%</u>
Total	711,459	711,193	704,370	(7,089)	-1.0%

Appendix B. 1990 & 1997 Job and 2010 Job Forecast

<u>Municipality</u>	<u>1990</u>	<u>1997</u>	<u>2010</u>	<u>1990-2010 Abs. Change</u>	<u>1990-2010 % Change</u>
Aldan borough	599	760	850	251	41.9%
Bridgeport borough	1,616	1,450	1,400	(216)	-13.4%
Brookhaven borough	2,237	2,370	2,600	363	16.2%
Chester city	14,765	12,110	10,680	(4,085)	-27.7%
Clifton Heights borough	3,321	3,190	2,990	(331)	-10.0%
Collingdale borough	1,966	1,870	1,790	(176)	-9.0%
Colwyn borough	331	320	300	(31)	-9.4%
Conshohocken borough	5,435	6,000	7,800	2,365	43.5%
Darby borough	3,441	3,020	2,900	(541)	-15.7%
Darby township	833	810	770	(63)	-7.6%
East Lansdowne borough	498	490	460	(38)	-7.6%
East Norriton township	7,737	7,400	7,950	213	2.8%
Easttown township	5,418	6,200	6,050	632	11.7%
Eddystone borough	3,464	2,790	2,540	(924)	-26.7%
Edgmont township	1,203	1,520	1,920	717	59.6%
Folcroft borough	4,041	3,150	2,880	(1,161)	-28.7%
Glenolden borough	2,505	2,260	2,140	(365)	-14.6%
Haverford township	14,428	13,980	13,700	(728)	-5.0%
Lansdowne borough	2,989	2,890	2,740	(249)	-8.3%
Lower Merion township	42,889	42,850	42,450	(439)	-1.0%
Marple township	9,866	11,840	13,460	3,594	36.4%
Media borough	11,210	11,360	11,790	580	5.2%
Middletown township	10,726	10,710	11,480	754	7.0%
Morton borough	1,348	1,260	1,220	(128)	-9.5%
Narberth borough	1,602	1,550	1,600	(2)	-0.1%
Nether Providence township	4,015	4,090	4,830	815	20.3%
Newtown township	7,195	8,090	9,230	2,035	28.3%
Norristown borough	16,559	15,300	15,000	(1,559)	-9.4%
Norwood borough	783	770	740	(43)	-5.5%
Parkside borough	184	190	200	16	8.7%
Plymouth township	19,460	22,850	26,500	7,040	36.2%
Prospect Park borough	1,621	1,590	1,550	(71)	-4.4%
Radnor township	28,446	29,450	31,800	3,354	11.8%
Ridley Park borough	2,576	2,370	2,120	(456)	-17.7%
Ridley township	11,839	13,860	15,970	4,131	34.9%
Rose Valley borough	121	130	130	9	7.4%
Rutledge borough	96	100	130	34	35.4%
Sharon Hill borough	2,137	2,690	3,260	1,123	52.6%
Springfield township	11,419	11,300	11,230	(189)	-1.7%
Swarthmore borough	3,222	3,250	3,100	(122)	-3.8%

Tinicum township	6,013	6,100	6,250	237	3.9%
Tredyffrin township	25,206	29,200	32,150	6,944	27.5%
Upland borough	4,036	4,170	4,530	494	12.2%
Upper Darby township	21,275	20,090	18,640	(2,635)	-12.4%
Upper Merion township	46,428	50,600	53,400	6,972	15.0%
Upper Providence township	2,881	3,080	3,390	509	17.7%
West Conshohocken borough	1,756	2,800	3,050	1,294	73.7%
West Norriton township	6,856	7,000	7,250	394	5.7%
Whitemarsh township	11,282	11,350	11,350	68	0.6%
Yeadon borough	<u>3,385</u>	<u>3,370</u>	<u>3,310</u>	<u>(75)</u>	<u>-2.2%</u>
Total	393,259	405,940	423,570	30,311	+7.7%

I-476 Express Bus Feasibility Study

Publication No.: 03008

Date Published: June 2003

Geographic Area Covered: I-476 Mid-County Expressway, including 50 Minor Civil Divisions within a five mile buffer east and west of the highway.

Key Words: Express Bus, I-476, Mid-County Expressway, King of Prussia Mall, Plymouth Meeting Mall, Chester City, 118 Bus Route, Philadelphia International Airport, Matson Ford Park and Ride, Travel Time, Ridership Forecasts.

ABSTRACT:

This report explores the feasibility of express bus service operating on I-476, the Mid-County Expressway, between Chester City and mall centers at King of Prussia or Plymouth Meeting. Four service alternatives were assessed by study area demographics, comparative travel times, and ridership forecasts using DVRPC's transportation simulation model. Based on this data, express service was found to be faster than any current one-seat service, though low ridership forecasts make this a marginally feasible venture. Defined employee-employer matching, hours of operation, guaranteed ride home, and airport service were some of the issues to resolve. Transportation Management Associations may be best to examine and coordinate many of these points if a successful operation were to be developed.

Delaware Valley Regional Planning Commission
8th Floor – The Bourse Building
111 South Independence Mall East
Philadelphia, PA 19106-2582

Phone: 215-592-1800
Fax: 215-592-9125
Internet: www.dvrpc.org

Staff contact: Joseph F. Hacker, Ph.D., AICP
Direct phone: 215-238-2935
Email: jhacker@dvrpc.org



Delaware Valley Regional Planning Commission

**The Bourse Building
111 South Independence Mall East
Philadelphia, PA 19106-2582
215.592.1800
www.dvrpc.org**