US 202 TRAFFIC ANALYSIS
SECTION 700
PA 309 TO DOYLESTOWN BYPASS

SUPPLEMENT NO. 3

SECTION 700

October 1993

Delaware Valley Regional Planning Commission

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Delaware Valley Regional Planning Commission
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Philadelphia, PA 19106

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Created in 1965, the Delaware Valley Regional Planning Commission (DVRPC) is an interstate, intercounty and intercity agency which provides continuing, comprehensive and coordinated planning for the orderly growth and development 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. The Commission is an advisory agency which divides its planning and service functions among the Office of the Executive Director, the Office of Public Affairs, and three line Divisions: Transportation Planning, Regional Information Services Center, which includes the office of Regional Planning, and Finance and Administration. DVRPC's mission for the 1990s is to emphasize technical assistance and services and to conduct high priority studies for member state and local governments, while determining and meeting the needs of the private sector.

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DELAWARE VALLEY REGIONAL PLANNING COMMISSION

Publication Abstract

TITLE	Date Published: October 1993
US 202 TRAFFIC ANALYSIS SECTION 700 PA 309 TO DOYLESTOWN BYPASS	
Supplement No. 3	**Publication No.** 93035

Geographic Area Covered:

The US 202 Corridor for Section 700 includes the following municipalities in Bucks County; New Britain, Doylestown and Warrington townships, Chalfont, Doylestown and New Britain boroughs; in Montgomery County: Montgomery Township

Key Words:

US 202, proposed expressway, existing traffic volumes, improvement alternatives, future traffic volumes

ABSTRACT

This supplement contains traffic forecasts for Year 2018 for an additional alternative to those presented in the March, 1992 DVRPC report entitled "US 202 Traffic Analysis Section 700 - PA 309 to Doylestown Bypass". This alternative - the construction of a full expressway between PA 309 and the Doylestown Bypass - contains two variations; one with an interchange at PA 152 and one without an interchange at that location. Traffic diversion in the new alignment alternatives is examined. Current and future K factors on facilities in the study area are presented. Current traffic counts at additional locations on County Line and Bristol roads are also included to supplement the appendix of the previous report.

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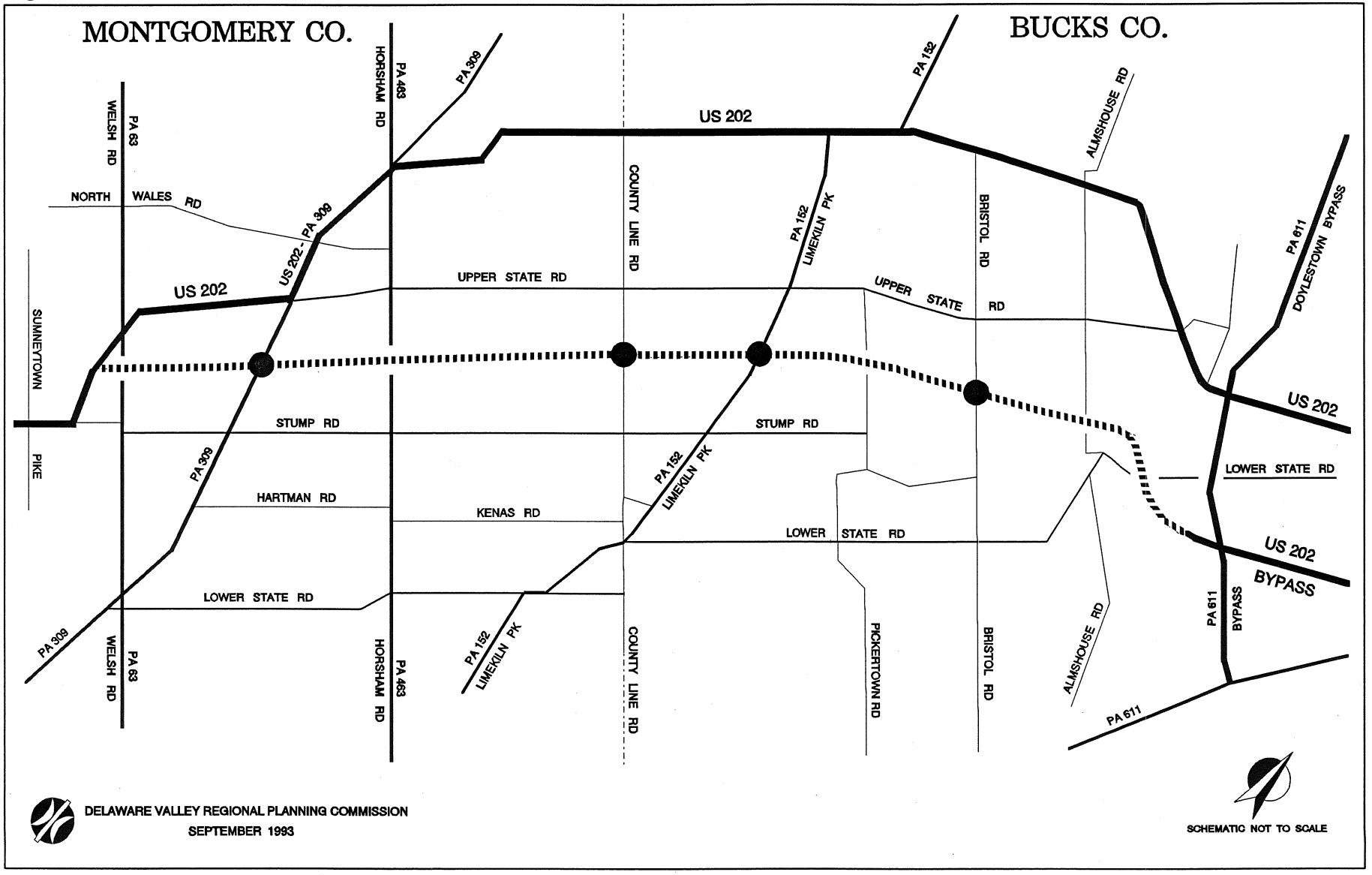
I. INTRODUCTION

As part of the US 202 traffic study, the Pennsylvania Department of Transportation (PennDOT) requested the Delaware Valley Regional Planning Commission (DVRPC) to undertake a traffic forecast study of a nine-mile portion of US 202 stretching from PA 309 to the Doylestown Bypass. This segment, which lies in Montgomery and Bucks counties, is known as Section 700. These forecasts will assist PennDOT consultants in the development of a need study, Environmental Impact Statement and traffic management strategies. They will also provide input to the design for the modernization and improvement of facilities in the US 202 corridor in Pennsylvania.

This supplement contains current traffic counts and Year 2018 traffic forecasts for an additional alternative in the US 202 Section 700 corridor. The forecasts reflect the effects of the construction of a full expressway on a new alignment between PA 63 and the Doylestown Bypass. Interchanges are assumed to be constructed at County Line Road, PA 152 and Bristol Road (PA 309 is currently being developed as an interchange)(See Figure 1). Previously examined as a controlled access arterial, the new expressway alternative involves two variations: one with an interchange at PA 152; the other without an interchange at that location. The original US 202 Section 700 report, dated March 1992, should be consulted for a description of the methods and assumptions used to prepare these detailed estimates.

The traffic forecasts presented herein incorporate the latest population and employment forecasts for municipal units in the study area. These forecasts are also based on recently released US Census Bureau 1990 statistics and journey to work data.

Figure 1 : US 202 EXPRESSWAY ALTERNATIVE WITH INTERCHANGES AT PA 309, COUNTY LINE ROAD, PA 152 AND BRISTOL ROAD



II. POPULATION AND EMPLOYMENT DATA REVISIONS

The original population and employment data for the traffic analysis prepared for Section 700 of US 202 were based on demographic forecasts at the municipal and county level for the year 2010[1]. These forecasts were based on 1980 census data and had been adopted by the DVRPC Board in July 1988. DVRPC staff split the 2010 forecasts to the zonal level and used a trend analysis to extend the data an additional eight years to 2018. Basically, this assumed that growth patterns will continue, but with some modification of the more extreme rates of change, ie., that rapid growth will moderate somewhat and decline will stabilize.

The release of municipal population figures from the 1990 census followed by journey-to-work data in the spring of 1993 allowed DVRPC to update its earlier forecasts and extend its planning horizon to 2020. The DVRPC Board adopted the 2020 municipal population and employment in June 1993, and these new numbers now serve as the data base for forecasting traffic. Table 1 presents the previously published and current population forecasts for municipalities in the study area. Also shown are the absolute and percentage difference between the two values. Table 2 displays these municipalities' employment forecasts.

Comparing the new figures with those previously used, it is seen that the differences are generally larger and more volatile at the smaller units of analysis, ie., differences at the zonal level tend to be larger than those at the municipal level, which in turn are larger than those at the county level. While differences as large as 60 percent were observed at the zonal level, neither of the county totals changed by more than six percent.

The largest population forecast differences in the Bucks County portion of the study area were observed in New Britain Township (+51%), Warrington Township (-21%), and the Borough of Doylestown (-10%). However, the upward and downward changes tended to cancel, and the overall change in the county portion of the study area was less than one percent. For Bucks County as a whole, the population was changed downward by six percent. In the Montgomery County portion of the study area municipalities experiencing significant changes were Montgomery Township (-20%) and North Wales (+16%). The change for Montgomery County's portion of the study area was a seven percent decline, although the difference for the entire county was close to zero.

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[1] *US 202 Traffic Analysis, Section 700, PA 309 to Doylestown Bypass*, DVRPC, March 1992

Table 1: A COMPARISON OF PREVIOUS AND CURRENT YEAR 2018 POPULATION FORECASTS

Municipality	Traffic Analysis Zone(s)	Previous 2018 Population	Current 2018 Population	Absolute Difference	Percent Difference
Bucks County Study Area:					
Chalfont Borough	917	3,867	3,979	112	2.9
Doylestown Borough	953,954,955	10,013	9,015	- 998	- 10.0
Doylestown Township	951,952,1294	29,174	27,938	- 1,236	- 4.2
New Britain Borough	956	3,767	3,226	- 541	- 14.4
New Britain Township	918,918,1293	13,235	19,961	6726	50.8
Warrington Township	915,916,1292	22,321	17,625	- 4,696	- 21.0
Total Bucks County Study Area		82,377	81,744	- 633	- 0.8
Montgomery County Study Area:					
Lansdale Borough	711 - 717	15,158	15,670	512	3.4
Lower Gwynedd Township	721,722,723	11,054	10,869	- 185	- 1.7
Montgomery Township	706,707	23,032	18,470	- 4,562	- 19.8
North Wales Borough	720	3,166	3,660	494	15.6
Upper Gwynedd Township	718,719,1275	14,663	13,760	- 903	- 6.2
Total Montgomery County Study Area		67,073	62,429	- 4,644	- 6.9
Study Area Total		**149,450**	**144,173**	**- 5,277**	**- 3.5**
Bucks County Total		715,996	674,975	- 41,021	- 5.7
Montgomery County Total		753,005	756,238	3,233	0.4

Table 2: A COMPARISON OF PREVIOUS AND CURRENT YEAR 2018 EMPLOYMENT FORECASTS

Municipality	Traffic Analysis Zone(s)	Previous 2018 Employment	Current 2018 Employment	Absolute Difference	Percent Difference
Bucks County Study Area:					
Chalfont Borough	917	2,969	1,954	- 1,015	- 34.2
Doylestown Borough	953,954,955	10,671	11,147	476	4.5
Doylestown Township	951,952,1294	10,336	11,148	812	7.9
New Britain Borough	956	1,063	1,206	143	13.5
New Britain Township	918,918,1293	5,867	3,690	- 2,177	- 37.1
Warrington Township	915,916,1292	7,207	8,063	856	11.9
Total Bucks County Study Area		38,113	37,208	- 905	- 2.4
Montgomery County Study Area:					
Lansdale Borough	711 - 717	13,228	9,858	- 3,370	- 25.5
Lower Gwynedd Township	721,722,723	9,855	9,261	- 594	- 6.0
Montgomery Township	706,707	24,054	23,699	- 355	- 1.5
North Wales Borough	720	2,293	1,280	- 1,013	- 44.2
Upper Gwynedd Township	718,719,1275	17,519	18,841	1,322	7.5
Total Montgomery County Study Area		66,949	62,939	- 4,010	- 6.0
Study Area Total		**105,062**	**100,147**	**- 4,915**	**- 4.7**
Bucks County Total		311,002	300,513	- 10,489	- 3.4
Montgomery County Total		554,890	549,030	- 5,860	- 1.1

With respect to employment forecasts, the significant changes in Bucks County occurred in Chalfont (-34%), New Britain Township (-37%), and Warrington Township (+12%). The change for the county portion of the study area was a decline of two percent, with a decline of three percent for the county as a whole. In Montgomery County the significant changes were in Lansdale (-26%) and North Wales (-44%). Employment in the Montgomery County portion of the study area was adjusted down by six percent, while for the county as a whole the change was down one percent.

Comments received from the Montgomery County Planning Commission were incorporated in this traffic analysis. In particular, Montgomery and Lower Gwynedd townships sustained shifts of population and employment forecasts. These shifts occurred between traffic analysis zones within the affected townships, so that at the township level, there was no change in the population or employment forecasts. The shifts are not considered to affect the forecasts presented in this supplement or previous work. Both townships are located at the southern end of Section 700 and the movement of population and employment was along the alignment, not away from US 202.

The population and employment changes were used to adjust the previous traffic analysis, which had indicated that almost 79 percent of the traffic using the middle segment of Section 700, ie., between County Line Road and PA 152 (Limekiln Pike), originates from the study area, and that 96 percent comes from either Bucks or Montgomery counties[2]. This implies that most of the adjustment in traffic levels will arise from demographic changes within the study area, and that any changes arising from outside the two counties could be ignored.

The following steps were employed to estimate the factor for adjusting the projected traffic levels from the previous and current traffic analyses:

- The differences between the current and previous population and employment projections for 2018 were calculated for:

  a. the Bucks County portion of the study area
  b. the remainder of Bucks County
  c. the Montgomery County portion of the study area
  d. the remainder of Montgomery County

  Most of the differences produced a downward adjustment in the traffic projections, but none exceed six percent.

[2] See Table 3 in *US 202 Traffic Analysis, Section 700, PA 309 to Doylestown Bypass, Supplement No.1*, DVRPC, August 1992

- Weighted averages of population and employment were calculated, using the share of the traffic originating from each area as weights. The weighted change for population was -2.8 percent, and that for employment -3.3 percent.

- Recognizing that employment has more than twice the impact of population in determining traffic levels, a combined change that includes both variables was calculated. This yielded a result of -3.2 percent.

- Since experience indicates that the response of traffic to demographic shifts is 50 percent greater than the underlying changes, the final traffic adjustment was obtained by multiplying the combined change from Step 3 by 1.5. Traffic volumes projected for all alternative improvements, including the ones described in this supplement, may be decreased by 4.7 percent to account for the recent changes in population and employment forecasts.

III. PROJECTED TRAFFIC VOLUMES

Projected 2018 average daily traffic volumes for selected highway links under the Expressway Alternative are presented and analyzed in this part of the supplement. In Figure 2, the numbers above the line represent the build expressway alternative; the number on top represents the volume with the PA 152 (Limekiln Pike) Interchange, while the number immediately below it represents the volume without the PA 152 Interchange. The number below the line is the corresponding current traffic count. Figure 3 displays the same information for the roadway segments in the Doylestown area. Table 3 compares forecasts for the two variations of the Expressway Alternative with those for the controlled access arterial. In addition, the count and No-Build Alternative numbers are reprinted from previous work

1. New Alignment Expressway (with PA 152 Interchange)

The construction of a new alignment expressway in Section 700 from PA 63 to the Doylestown Bypass will have a significant impact on traffic patterns in the Section 700 corridor. Projected Year 2018 traffic volumes on the new expressway range from 45,100 daily vehicles between PA 63 and PA 309 to 55,800 daily vehicles between PA 309 and County Line Road. This represents increases of 29.2 to 71.7 percent over the controlled access Arterial Alternative assumed in the previous traffic analysis.

The majority of this traffic volume is diverted from parallel facilities. On existing US 202, volumes decline from 18,200 in the Arterial Alternative to 12,100 daily vehicles (33.5%) between PA 309 and County Line Road. The diversion is less significant on existing US 202 in the northern part of the study area. For instance, the segment between Upper State Road and the PA 611 Bypass (Doylestown Bypass) declines from 18,800 to 17,500 vehicles (a reduction of 6.9%). Traffic relief on Upper State Road is expected to be 3,700 vehicles (31.9%) between Horsham Road and County Line Road and a more moderate 1,900 vehicles (23.5%) between Almshouse Road and existing US 202. The decline on North Wales Road totals 1,800 vehicles (10.9%). On the other side of the proposed expressway alignment, Stump Road experiences a drop of almost a quarter (24.2%) of its volume between the Arterial and Expressway alternatives, declining from 9,500 to 7,200 vehicles. Lower State Road between PA 463, Horsham Road and PA 152, Limekiln Pike, shows no change in volume between the Arterial and Expressway alternatives; however, further north between

YEAR 2018 EXPRESSWAY WITH AND WITHOUT PA 152 INTERCHANGE
Figure 2 : AND CURRENT AVERAGE DAILY TRAFFIC VOLUMES

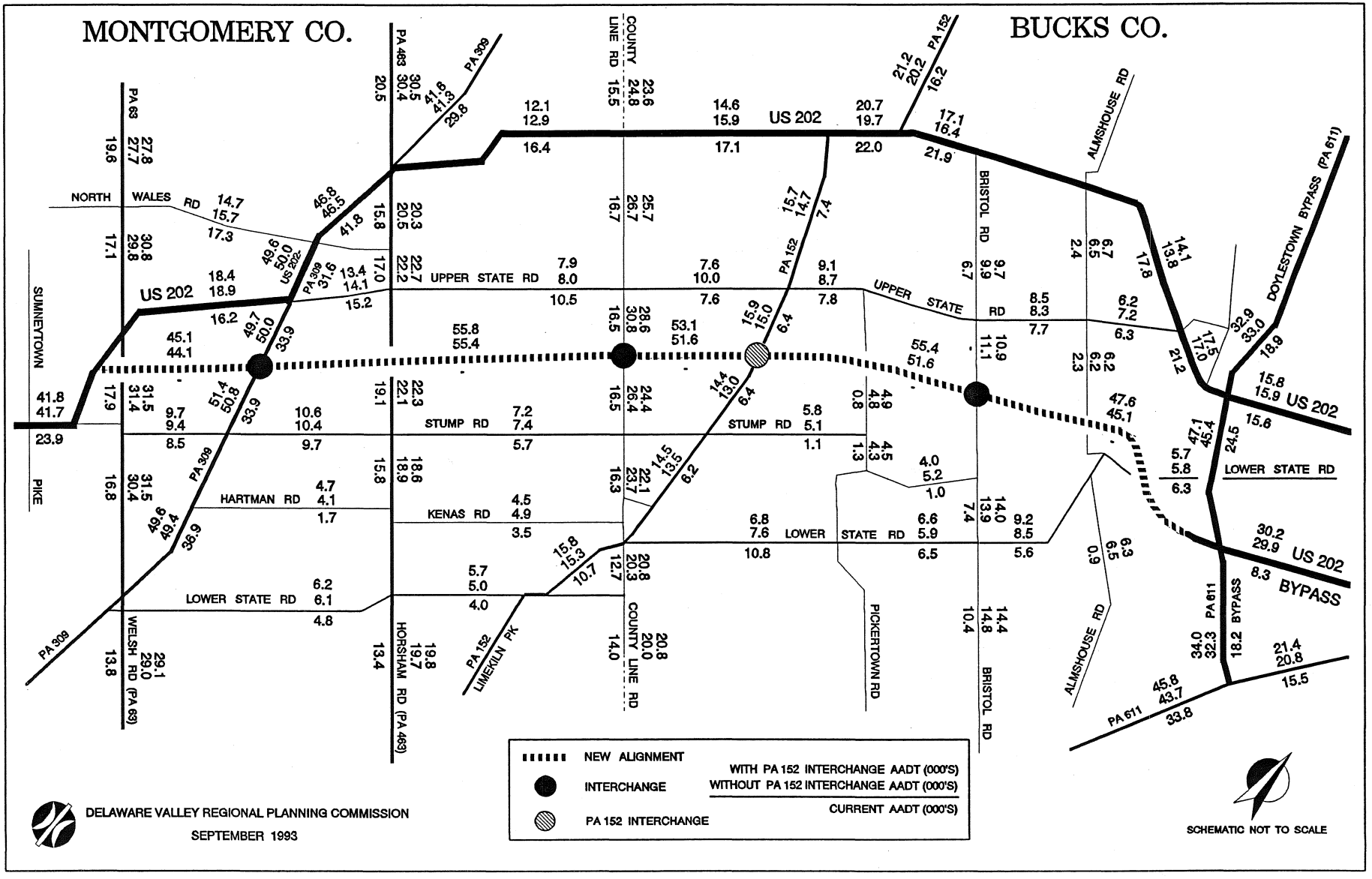

Figure 3: YEAR 2018 EXPRESSWAY WITH AND WITHOUT PA 152 INTERCHANGE AND CURRENT AVERAGE DAILY TRAFFIC VOLUMES (Doylestown Area)

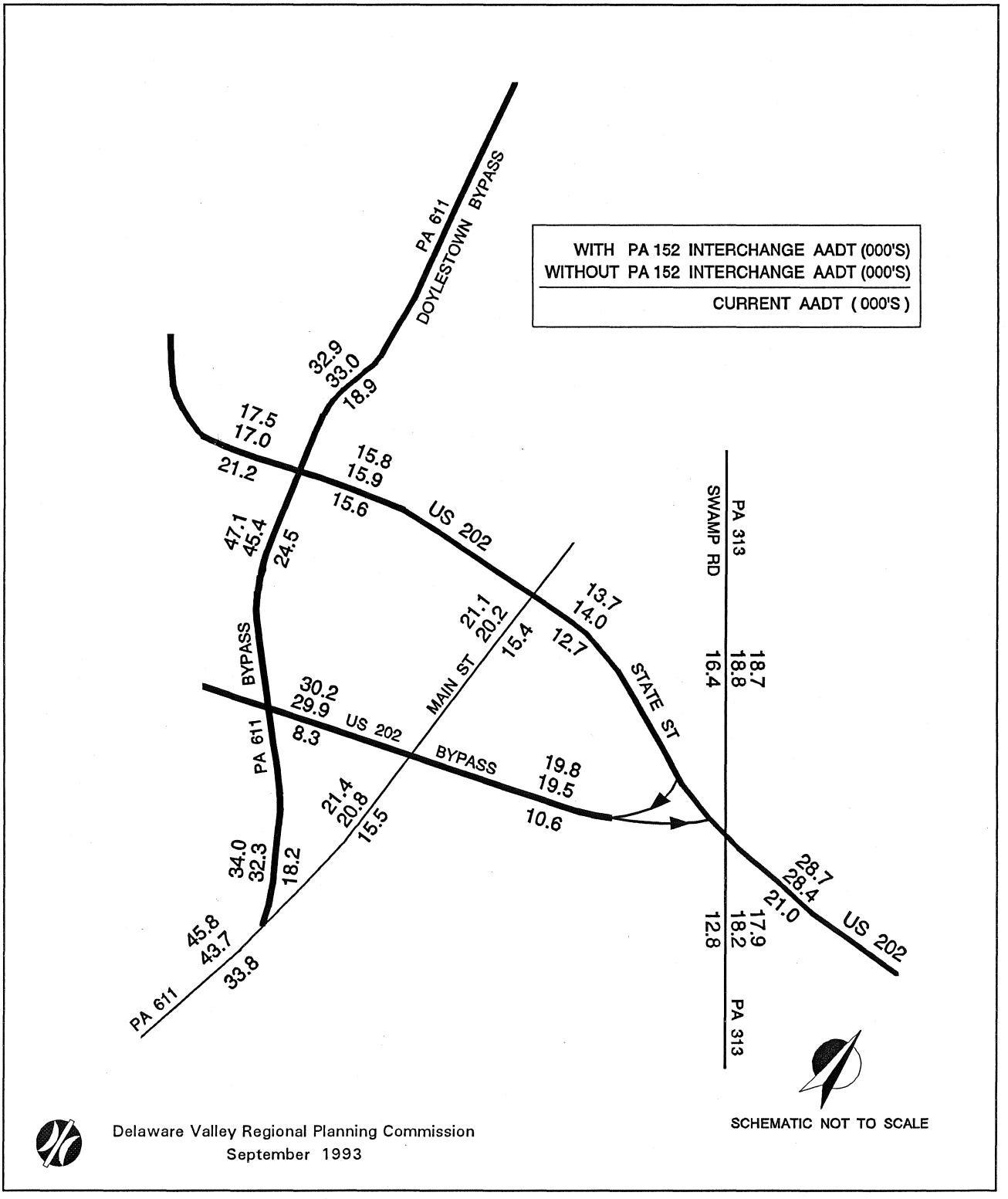

Table 3: A COMPARISON OF YEAR 2018 AVERAGE DAILY TRAFFIC VOLUMES (ADT) US 202 EXPRESSWAY WITH AND WITHOUT PA 152 INTERCHANGE

Roadway Segment	1991 Count	No-Build	Build Arterial	Without PA 152 Interchange	% Diff (Arterial)	With PA 152 Interchange	% Diff (Arterial)
US 202 AND PARALLEL ROADWAYS							
Proposed US 202 Expressway							
- PA 309 to County Line Road	-	-	32,500	55,400	70.5	55,800	71.7
- Bristol Road to PA 611 Bypass	-	-	35,600	45,100	26.7	47,600	33.7
Existing US 202							
- Sumneytown Pike to Welsh Road	23,900	28,900	38,300	41,700	8.9	41,800	9.1
- PA 309 to County Line Road	16,400	21,600	18,200	12,900	-29.1	12,100	-33.5
- Almshouse Road to Upper State Road	17,800	23,400	15,000	13,800	- 8.0	14,100	- 6.0
- Upper State Road to PA 611 Bypass	21,200	28,700	18,800	17,000	- 9.6	17,500	- 6.9
- PA 611 Bypass to Old PA 611 (US 202 Bypass)	8,300	13,600	23,000	29,900	30.0	30,200	31.3
Upper State Road							
- Horsham Road to County Line Road	10,500	16,400	11,600	8,000	-31.0	7,900	-31.9
- Almshouse Road to US 202	6,300	12,400	8,100	7,200	-11.1	6,200	-23.5
Stump Road							
- Horsham Road to County Line Road	5,700	11,500	9,500	7,400	-22.1	7,200	-24.2
Lower State Road							
- Horsham Road to Limekiln Pike	4,000	12,400	5,700	5,000	-12.3	5,700	-
- Almshouse Road to PA 611 Bypass	6,300	11,800	7,900	5,800	-26.6	5,700	-27.8
Kenas Road							
- Horsham Road to County Line Road	3,500	7,200	3,800	4,900	28.9	4,500	18.4
North Wales Road							
- Welsh Road to PA 309	17,300	23,300	16,500	15,700	- 4.8	14,700	-10.9

Table 3: A COMPARISON OF YEAR 2018 AVERAGE DAILY TRAFFIC VOLUMES (ADT) US 202 EXPRESSWAY WITH AND WITHOUT PA 152 INTERCHANGE (Continued)

Roadway Segment	1991 Count	No-Build	Build Arterial	Without PA 152 Interchange	% Diff (Arterial)	With PA 152 Interchange	% Diff (Arterial)
INTERSECTING ROADWAYS							
Welsh Road (PA 63)							
- US 202 to North Wales Road	17,100	26,600	29,000	29,800	2.8	30,800	6.2
- Stump Road to PA 309	16,800	28,000	30,000	30,400	1.3	31,500	5.0
PA 309							
- Horsham Road to North Wales Road	41,800	53,500	49,600	46,500	- 6.3	46,800	- 5.6
- Hartman Road to Welsh Road	36,900	46,200	46,500	49,400	6.2	49,600	6.7
Horsham Road (PA 463)							
- US 202 to North Wales Road	15,800	21,500	21,300	20,500	- 3.8	20,300	- 4.7
- Stump Road to Hartman Road	15,800	21,400	21,400	18,900	-11.7	18,600	-13.1
County Line Road							
- US 202 to Upper State Road	16,700	25,200	26,100	26,700	2.3	25,700	- 1.5
- Stump Road to Kenas Road	16,300	22,800	23,300	23,700	1.7	22,100	- 5.2
Limekiln Pike (PA 152)							
- US 202 to Upper State Road	7,400	14,000	14,300	14,700	2.8	15,700	9.8
- Stump Road to Lower State Road	6,200	14,300	16,200	13,500	-16.7	14,500	-10.5
Bristol Road							
- US 202 to Upper State Road	6,700	9,700	10,300	9,900	- 3.9	9,700	- 5.8
- Stump Road to Lower State Road	7,400	11,100	12,800	13,900	8.6	14,000	9.4
Doylestown (PA 611) Bypass							
- Broad Street to US 202	18,900	25,400	30,000	33,000	10.0	32,900	9.7
- PA 611 to US 202 Bypass	18,200	26,000	31,600	32,300	2.2	34,000	7.6
Easton Road (PA 611)							
- PA 611 Bypass to Edison Furlong Road	33,800	44,200	41,600	43,700	5.0	45,800	10.1

Table 3: A COMPARISON OF YEAR 2018 AVERAGE DAILY TRAFFIC VOLUMES (ADT) US 202 EXPRESSWAY WITH AND WITHOUT PA 152 INTERCHANGE (Continued)

Roadway Segment	1991 Count	No-Build	Build Arterial	Without PA 152 Interchange	% Diff (Arterial)	With PA 152 Interchange	% Diff (Arterial)
			DOYLESTOWN AREA				
Main Street (PA 611 BUS)							
- US 202 Bypass to State Street	15,400	17,400	19,200	20,200	5.2	21,100	9.9
State Street (US 202)							
- Main Street to Swamp Road	12,700	14,200	13,000	14,000	7.7	13,700	5.4
- Swamp Road to Mechanicsville Road	21,000	24,000	25,100	28,400	13.1	28,700	14.3
Swamp Road (PA 313)							
- North Easton Road (Main Street) to US 202	16,400	18,400	18,700	18,800	0.5	18,700	-
- US 202 to Spring Valley Road	12,800	16,400	16,400	18,200	11.0	17,900	9.1
US 202 Bypass							
- State Street to Main Street	10,600	13,800	15,700	19,500	24.2	19,800	26.1

Almshouse Road and the PA 611 Bypass the decline is more pronounced at 2,200 vehicles (27.8%). The only facility to depart from this trend is Kenas Road, which shows an increase in vehicular traffic of 18.4 percent, or 700 vehicles.

A comparison between the Expressway Alternative and the current count for parallel facilities reveals these same trends. At the southern end of the study area, existing US 202 grows from 16,150 to 18,400 daily vehicles between PA 63 and PA 309, even with the parallel expressway open to traffic. However, further north on existing US 202, volumes decline below the current count. For instance, a reduction from the current 16,400 to 12,100 vehicles (26.2%) is forecast between PA 309 and County Line Road, while on the segment between PA 152 and Bristol Road traffic declines from 21,900 current vehicles to 17,100 vehicles (21.9%). In Doylestown, the effect on US 202 is almost negligible, with the Expressway Alternative generating only approximately 300 more vehicles over the current count of 15,600. Upper State Road sustains a decline in traffic from 10,500 vehicles per day currently to 7,900 vehicles (24.8%) between Horsham Road and County Line Road. Stump Road shows increases in traffic volumes all along its alignment in the study area. These are greatest on the northern segments of the facility; for instance, traffic between PA 152 and Pickertown Road grows from 1,078 to 5,800 daily vehicles (438.0%). Lower State Road generally shows growth in traffic volumes between the current count and Expressway Alternative. The segment between Horsham Road and PA 152 grows from 3,950 vehicles currently to 5,700 a day in the Year 2018, a 44.3 percent increase. Further north, however, diversion to the new alignment is evident. At that point, north of where traffic has the option to travel from Lower State Road west along County Line Road or PA 152 to the expressway, volumes decline from a current count of 10,800 to 6,800 (37.0%). North of Bristol Road volumes again increase on Lower State Road, growing from 5,550 currently to 9,200 in the future (65.8%).

In contrast to the major differences effected on parallel roadways between the Arterial and Expressway alternatives, intersecting roadway traffic volumes are only moderately higher than in the Arterial Alternative. The facilities which intersect the middle portion of the new alignment, PA 463 (Horsham Road), County Line Road, PA 152 (Limekiln Pike), and Bristol Road, all show declines in volume east of existing US 202 with a few exceptions. The first of these is the segment of County Line Road directly west of its intersection with the new US 202 facility; a second is the segment of Bristol Road between Stump and Lower State roads. At the outer edges of the alignment the growths on intersecting roads are mixed, with some increases as well as declines. On the southern end PA 309, for instance, declines between the arterial and expressway options west of the alignment (5.5%) while east of the proposed facility an increase (10.1%) is forecasted. At the north end, the Doylestown Bypass experiences growth both east and west of the proposed alignment, although it is larger to the west (9.7%) than to the east (7.6%).

Partly due to the background growth and partly due to the presence of the expressway, all intersecting roads show traffic increases between the current count and the Expressway Alternative. These increases are greatest on segments adjacent to interchanges on facilities intersecting the expressway. This is evident, for instance, on County Line Road, where immediately west of the interchange volumes grow from 16,500 to 28,600 (73.3%) and east of the interchange traffic grows to 24,400 vehicles (47.9%). This is also true at the PA 152 interchange. West of the expressway traffic increases from 6,400 to 15,900 vehicles per day (148.4%) while to the east the growth is to 14,400 vehicles (125.0%). The opposite is true on roads without interchanges with the expressway; the smallest growth on the facility is on segments near the expressway. Horsham Road, for instance, only increases from 19,100 to 22,300 vehicles (16.8%) immediately adjacent to the expressway alignment, while west of Upper State Road the growth is 28.5 percent and east of Lower State Road the change is 47.8 percent. At the northern and southern extent of the study area, growth rates are much higher. Along PA 63, for instance, growth rates of 76.0 and 80.1 percent are forecast east and west, respectively, of the expressway alignment. A similar pattern is evident on the Doylestown Bypass, where growth is forecast to be 86.8 and 92.2 percent east and west, respectively, of where the expressway intersects the Bypass.

In the Doylestown area, all major facilities experience growth in traffic between the Arterial and Expressway alternatives. The US 202 Bypass grows by approximately one quarter (26.1%) between PA 611 Business (Main Street) and State Street. This is expected, as much of the increased volume on the proposed alignment could be expected to travel on this continuation of the facility. Main Street experiences an increase in traffic volume of approximately one tenth (9.9%), presumably because of its access to the US 202 Bypass and hence, the proposed expressway facility. The effect of the new alignment on existing US 202 is the opposite of the experience south of the Doylestown Bypass. Rather than declining in volume, US 202 traffic increases, although a modest 5.4 percent north of Main Street. This may be due to the facility having a character of a local arterial at this point, feeding local traffic to the US 202 Bypass; the latter facility handling the through traffic.

Comparing the Expressway Alternative to the current traffic counts, the largest increases are sustained on the US 202 Bypass. Between the PA 611 Bypass and Main Street growth is large due to the traffic flowing onto this segment from the expressway; a current count of 8,300 increases to a 2018 volume of 30,200 vehicles (263.9%). On the northern side of Main Street the growth tends to moderate. At this point the growth has subsided to 86.8 percent. Main Street itself experiences growth rates of 38.1 and 37.0 percent east and west, respectively of the US 202 Bypass. Existing US 202 shows an increase of only 1,000 vehicles (7.9%) south of its intersection with US 202 Bypass; however, north of these ramps the growth is 7,700 (36.7%) over the current count.

2. Traffic Impacts of a PA 152 Interchange

Table 3 also presents a comparison of the traffic volumes for the proposed expressway with and without an interchange at PA 152, Limekiln Pike. The difference in expressway volumes with and without a PA 152 Interchange are greatest on the segments adjacent to the proposed interchange and dissipate as distance from the interchange increases. Immediately south of the interchange site, the difference in volume is only 1,500 vehicles (2.9%). Further south, between County Line Road and PA 309, the effect is a growth of only 400 vehicles (0.7%). Immediately north of the proposed interchange, there are 3,800 more vehicles in the alternative with the PA 152 Interchange, an increase of 7.4 percent. This increase declines, however, north of the Bristol Road Interchange. Here, there are 2,500 more vehicles (5.5%) in the interchange alternative. This traffic dissipates both east and west onto the Doylestown Bypass where increases of 5.3 and 3.7 percent, respectively, are recorded.

The effects of the interchange on facilities which parallel the proposed alignment are mixed. Upper State Road, for instance, shows a growth of 400 vehicles (4.6%) and a decline of 2,400 vehicles (24.0%) north and south, respectively, of PA 152. On the other side of the interchange, Stump Road north of PA 152 exhibits an increase of 700 vehicles (13.7%) with the interchange in place; while south of County Line Road the volume declines by 200 vehicles (2.7%). Traffic reductions in the interchange alternative are also present on Kenas Road (400 vehicles, 8.2%) and Lower State Road north of PA 152 (800 vehicles, 10.5%).

A PA 152 Interchange also produces disparate results on highway facilities which intersect the new alignment. Due to diversion to the PA 152 Interchange, volumes on County Line Road decline by 2,000 and 2,200 vehicles east and west, respectively, of the expressway. A decrease is also realized on Bristol Road west of the expressway, where traffic declines by 200 vehicles (1.8%). Traffic volumes on PA 152 itself increase modestly with the new interchange. This is due to the effects of lowered circuity being almost as great as the additional traffic attracted to the interchange. West of the interchange, PA 152 registers an increase of 900 vehicles (6.0%). The difference is more evident immediately east of the interchange site, where PA 152 volumes total 1,400 vehicles (10.8%) more with the interchange than without it. Further east, the difference is smaller; between County Line and Lower State roads, for instance, the difference only totals 500 vehicles (3.3%).

3. Impacts of a PA 152 Interchange on County Line Road and Bristol Road

The construction of an interchange between an expressway on the new alignment and PA 152, Limekiln Pike, will have effects beyond the immediate vicinity of PA 152. In particular, the interchanges on either side of the one proposed would sustain the greatest volume changes. These changes to County Line Road and Bristol Road in the study area are shown on Figure 2 (page 10); changes to these facilities east of the study area, closer to PA 611, are given in the table below.

Table 4: A COMPARISON OF YEAR 2018 AVERAGE DAILY TRAFFIC VOLUMES (ADT) EAST OF THE STUDY AREA

Location	1993 Count	Without PA 152 Interchange	With PA 152 Interchange	# Diff (Arterial)	% Diff (Arterial)
County Line Road					
PA 611 to Titus Rd	14,484	22,600	22,800	200	0.9
Park Rd to Keith Valley Rd	13,362	20,200	20,400	200	1.0
Bristol Road					
PA 611 to Pickertown Rd	10,364	14,400	14,000	- 400	- 2.8
Pickertown Rd to Turk Rd	7,841	10,900	10,400	- 500	- 4.6

County Line Road has an interchange with the proposed expressway slightly less than 1 mile south of where PA 152 crosses the alignment. The segments of County Line Road immediately east and west of the interchange incur the greatest changes due to the construction of the PA 152 interchange; the traffic volume on each are forecast to decline by 2,000 vehicles (from 26,400 to 24,400 on the east and 30,800 to 28,600 on the west). Further west, closer to US 202, the difference declines to only one thousand vehicles. In the other direction, a substantial drop in the difference occurs to the east of the intersection of County Line Road and PA 152; here only 500 vehicles per day separate the forecasts for the alternatives with and without the PA 152 interchange. This is expected, as most traffic would use this segment whether it was proceeding west on County Line Road to the proposed expressway or whether it would divert west on PA 152 to the expressway. Between this

point and PA 611 only local roads intersect County Line Road, including Lower State Road, Folly Road and Kansas Road. Nearer to PA 611 the variation is only 200, with the interchange scenario generating 22,800 vehicles per day while the alternative without the interchange generates 22,600 vehicles.

Approximately 1.35 miles north of the proposed PA 152 interchange is an interchange with Bristol Road. Here the effects of constructing a PA 152 interchange are far less pronounced than on County Line Road. Immediately west of the interchange, Bristol Road is forecast to carry only 200 fewer vehicles per day (10,900 versus 11,100) with the PA 152 interchange in place. This difference remains constant all the way to existing US 202, although the overall volumes are smaller at 9,700 and 9,900 vehicles per day in the two alternatives. The effect of the interchange is somewhat more evident to the east of the expressway alignment. East of Lower State Road the traffic reduction is 400 vehicles per day (14,400 versus 14,800) with the interchange in place. This is also the case at PA 611, with daily volumes of 14,000 and 14,400 vehicles with and without the interchange, respectively.

4. Traffic Diversion

The diversion impacts of constructing an expressway versus a controlled access arterial on the new alignment were examined. DVRPC defined four screenlines for this analysis. Traffic crossing these screenlines in the simulation were totalled and compared for the Expressway and Arterial alternatives. To the north, a screenline was selected which parallels the Doylestown Bypass on the south side of that facility. On the south, a screenline was established just north of PA 463, Horsham Road. The east side of the study area was bounded by a screenline following the alignment of Lower State Road and east of the US 202 Bypass in Doylestown. Finally, on the west a screenline was established west of North Wales Road and existing US 202. The volumes crossing the screenlines are presented in Table 5 below.

The southern screenline shows the largest percentage increase in traffic volume between the Expressway and Arterial alternatives. The expressway generates volumes 14.6 percent larger than the controlled access arterial. The largest absolute increase is encountered on the northern screenline. Here, volumes are 12,700 vehicles (12.2%) greater in the Expressway versus the Arterial alternative. Unlike the other screenlines, however, the presence of an interchange at PA 152 does affect the magnitude of the difference. If the interchange is not included, the screenline volume is only 7.4 percent greater in the Expressway Alternative. The screenline along the eastern side of the study area shows traffic 6.1 percent higher in the Expressway Alternative. The western

Table 5: A COMPARISON OF YEAR 2018 AVERAGE DAILY TRAFFIC VOLUMES (ADT) CROSSING SCREENLINES IN THE STUDY AREA

Screenline	Build Arterial	With PA 152 Interchange	# Diff (Arterial)	% Diff (Arterial)
North of PA 463, Horsham Rd	81,300	93,200	11,900	14.6
South of PA 611, Doylestown Bypass	103,900	116,600	12,700	12.2
Lower State Rd / East of US 202 Bypass	203,300	215,800	12,500	6.1
West of N Wales Rd / Existing US 202	212,500	217,400	4,900	2.3

screenline appears least affected by the choice of an expressway or arterial for the new alignment. Traffic volumes are only 2.3 percent higher in the expressway versus the arterial alternative.

As the above screenline totals show, the construction of the expressway causes additional traffic to be diverted into the US 202 corridor. In order to analyze the impacts of this diversion on individual facilities, the highway assignment results for a series of roadways parallel to US 202 were examined along the screenline north of Horsham Road (PA 463) under the No-Build, Arterial and Expressway alternatives. Table 6 displays results of these facility level comparisons along this screenline. This table has been divided into two parts; the upper portion shows the detailed roadways within the study area, while the lower portion the roadways outside of the study area.

The construction of the new US 202 highway facility causes many changes in travel patterns in the highway network. As discussed previously, parallel roadways within the study area show significant traffic relief in both the Arterial and Expressway alternatives, with the traffic relief under the Expressway Alternative being significantly higher, particularly on existing US 202. Here the Expressway Alternative reduces no-build traffic projections by 44.0 percent (21,600 to 12,100 daily vehicles). However, the traffic relief on parallel roadways within the study areas does not total the projected volumes on the new facility. There is a projected net screenline increase within the study area of 14,700 daily vehicles occurring under the Arterial Alternative and an additional 9,000 vehicle trips being attracted by the expressway option.

Table 6: YEAR 2018 AVERAGE DAILY TRAFFIC VOLUMES (ADT) ON US 202 PARALLEL FACILITIES JUST NORTH OF PA 463 (HORSHAM ROAD)

Inside the US 202 Corridor

Facility	1991 Count	No-Build	Build Arterial	Difference (No-Build)	Expressway with PA 152 Interchange	Difference (Arterial)
PA 309	29.8	42.0	44.5	2.5	41.6	-2.9
US 202	16.5	21.6	18.2	-3.4	12.1	-6.1
Upper State Road	10.5	16.4	11.6	-4.8	7.9	-3.7
US 202 New Facility	-	-	32.5	32.5	55.8	23.3
Stump Road	5.7	11.5	9.5	-2.0	7.2	-2.3
Kenas Road	3.5	7.2	3.8	-3.4	4.5	0.7
Lower State Road	4.0	12.4	5.7	-6.7	5.7	-
Total:	70.0	111.1	125.8	14.7	134.8	9.0

Outside the US 202 Corridor

Facility	No-Build	Build Arterial	Difference (No-Build)	Expressway with PA 152 Interchange	Difference (Arterial)
East Broad St / Unionville Rd	11.3	11.1	-0.2	10.4	-0.7
Orvilla Road	8.1	6.2	-1.9	5.5	-0.7
N. Broad Street	9.2	6.9	-2.3	6.4	-0.5
Line Street	7.7	5.6	-2.1	5.1	-0.5
PA 152	15.5	16.4	0.9	14.0	-2.4
Park Rd	4.5	3.8	-0.7	3.7	-0.1
PA 611	39.9	35.6	-4.3	34.2	-1.4
PA 263	27.6	24.9	-2.7	24.2	-0.7
Total:	123.8	110.5	-13.3	103.5	-7.0

Outside of the study area, almost all roadways in the simulation network show traffic decreases as a result of the construction of the arterial and expressway option for US 202. Only Limekiln Pike (PA 152) shows a traffic increase, resulting from its intersection with the proposed facility within the study area. The largest relief under both the arterial and expressway options occurs on PA 611 where traffic is relieved by 4,300 daily vehicles under the arterial option and an additional 1,400 vehicles by the proposed US 202 Expressway. PA 263 also receives large relief from these US 202 improvements - 2,700 daily vehicles by the proposed arterial and another 700 daily vehicles by the expressway.

Local roadways included in the network outside of the study also receive some relief, although these traffic volumes must be interpreted carefully. Outside of the detailed study area, many local roads are not included in the simulation network. In these areas the network is limited to the major roadways and selected local streets which serve as a proxy for the local streets that are not included. Therefore, the 2,100 vehicle relief for Line Street under the Arterial Alternative, for instance, represents the combined relief for Line Street and a series of missing parallel neighborhood streets includeing Bonnie Lane, Taylor Road, Woodland Avenue, and possibly Mary and Morgan streets. Similarly, the traffic relief shown for East Broad Street, North Broad Street, Orvilla Road and Park Road may also include the effects on missing local streets.

In total, the traffic relief on the streets included in Table 6 does not account for all of the traffic on the proposed US 202 facility. There is a net increase of 1,400 daily vehicles occurring under the arterial configuration and another net increase of 2,000 vehicles under the Expressway Alternative. Not all diversions in the highway network occur between a given roadway and the proposed US 202 expressway or arterial. When a major facility is constructed, traffic patterns throughout the surrounding area are affected. Traffic diversion to the new facility occurs, as well as diversions to all roads inside as well as outside the corridor. These remaining differences are small diversions spread over a large number of facilities not included in Table 6.

5. Impacts of the Proposed Expressway on Section 600 Projected Traffic Volumes

The proposed US 202 expressway will also have an impact on the projected 2018 traffic volumes for US 202 and parallel facilities in Section 600. Traffic forecasts for these Section 600 facilities assuming a new alignment arterial in Section 700 were presented in the commission report entitled "US 202 Traffic Analysis Section 600 - Johnson Highway to PA 309, Supplement No. 1", dated August 1992.

Table 7 presents the impact of the Section 700 expressway on three alternative roadway configurations in Section 600; widen US 202 to five lanes from Johnson Highway to PA 309; widen US 202 to three lanes from Johnson Highway to Swede Road and to five lanes from Swede Road to PA 309; and no widening of US 202 in Section 600. This table analyzes the impact of the proposed expressway on US 202 and selected parallel facilities along three cutlines; north of Sumneytown Pike; north of PA 73, Skippack Pike; and north of Johnson Highway.

The impact of the Section 700 expressway on US 202 under the five-lane widening alternative diminishes rapidly as one proceeds south through Section 600. At Sumneytown Pike, the proposed expressway increases US 202 traffic volumes by 3,500 daily vehicles (about 9 percent). North of PA 73 this increase is reduced to 2,900 daily vehicles, or 7.4 percent. When one reaches Johnson Highway, the traffic impacts of the Section 700 expressway are reduced to about 1,100 daily vehicles, or 3.2 percent.

The proposed expressway may cause small increases or decreases in traffic volumes on roadways parallel to US 202 in Section 600 under the five-lane alternative depending on congestion levels relative to US 202 and the directness of the connection between a given roadway and the expressway. North of Sumneytown Pike, North Wales Road is projected to sustain a small traffic increase (500 vehicles per day) while a small decline in volume is forecasted for Evans Road (300 vehicles per day) as a result of the US 202 expressway. At PA 73, Skippack Pike, the expressway reduces travel by 400 daily vehicles on North Wales Road and by 300 vehicles per day on School Lane. At Johnson Highway, Swede Road traffic is increased by 800 daily trips (3.8 percent).

Reducing the widening of US 202 in Section 600 to three lanes between Johnson Highway and Swede Road has little effect on the traffic volume fluctuations caused by the expressway in Section 700. Except on US 202 and Swede Road, all of these differences are less than or equal to 500 cars per day. The impacts of the expressway are similar when US 202 is not widened in Section 600 except that travel volumes on roadways parallel to US 202 are somewhat increased.

Table 7: THE IMPACTS OF THE PROPOSED US 202 SECTION 700 EXPRESSWAY ON SECTION 600 ALTERNATIVE FORECASTS

		Section 600 - 5 lanes [1]			Section 600 - 3 lanes / 5 lanes [2]			Section 600 No Widening		
Roadway Segment	Count	Sect. 700 Arterial	Sect. 700 Expwy	% Diff.	Sect. 700 Arterial	Sect. 700 Expwy	% Diff.	Sect. 700 Arterial	Sect. 700 Expwy	% Diff.
North of Sumneytown Pike:										
North Wales Road	15.9	18.0	18.5	2.8	18.1	18.6	2.8	21.4	21.9	2.3
US 202	23.9	38.3	41.8	9.1	37.9	41.1	8.4	33.8	36.9	9.2
Evans Road	1.8	2.5	2.2	- 12.0	2.1	2.5	19.0	2.8	2.9	3.6
North of PA 73, Skippack Pike:										
North Wales Road	5.1	7.2	6.8	- 5.6	7.4	7.0	- 5.4	10.4	11.4	9.6
US 202	23.9	39.1	42.0	7.4	38.8	41.2	6.2	31.7	33.6	6.0
School Lane	5.9	6.3	6.0	- 4.8	6.4	6.1	- 4.7	6.5	7.4	13.8
North of Johnson Highway:										
US 202	24.1	33.9	35.0	3.2	32.7	33.7	3.1	29.0	30.4	4.8
Swede Road	17.7	20.8	21.6	3.8	20.9	21.7	3.8	23.0	24.2	5.2

1. US 202 widened to 5 lanes from Johnson Highway to PA 309
2. US 202 widened to 3 lanes from Johnson Highway to Swede Road and 5 lanes from Swede Road to PA 309

IV. HIGHWAY CAPACITY

Two independent methods were used to estimate generalized Level of Service E hourly capacities for the highway facilities in the US 202 corridor. First, a theoretical estimate based on the 1985 Highway Capacity Manual (HCM) procedures was made. A second estimate of roadway capacity was determined by searching the Commission's traffic count files to locate the largest recorded per lane hourly traffic counts. This maximum count data provides a local comparison with the HCM capacities for traffic conditions in the Delaware Valley. In order to standardize the results, all capacities are given per lane.

Following the AASHTO manual, hourly capacities are stratified by the facility type of the roadway. This classification - freeway, multi-lane arterial, two lane arterial, and collector - categorizes roadways based on the treatment of cross traffic and the degree of access control from abutting land uses. Freeways restrict access to ramps within grade separated interchanges, both multi-lane (two or more lanes per direction) and two lane (one per direction) arterials have at-grade intersections with cross streets and usually do not restrict access from adjacent land uses. However, the provision of two or more operating lanes per direction increases per-lane capacity by allowing drivers to more easily change lanes to avoid stoppages and slow moving vehicles. Collectors typically have lower capacities because they do not receive preferential treatment at intersections with arterial roadways.

The results of this analysis are summarized in Table 8 on the next page. Per lane capacities vary significantly by highway type, ranging from the well known 2000 vehicles per hour per lane capacity for freeways to as little as 400 vehicles per lane per hour for collectors. For arterial and collector facilites, the HCM estimate of hourly per lane capacities varies significantly with local conditions including lane width, the percentage of trucks, roadway grade, the amount of on street parking activity, the proportion of right turns and especially the percentage of signal green time and the proportion of left turns combined with the volume of opposing traffic. As these factors vary significantly from intersection to intersection, the HCM generates a range of results. For this exercise, characteristics of the corridor alternatives were used for each factor. The HCM capacities correspond to the standard ideal saturation flows of 1800 vehicles per hour per lane for two lane roadways and 1950 vehicles per hour per lane for multi-lane arterials.

Table 8: GENERALIZED LEVEL OF SERVICE E PEAK HOUR, PER LANE CAPACITIES FOR HIGHWAY FACILITIES IN SUBURBAN AREAS

Highway Type	Default Guidelines* Highway Capacity Manual	Observed Counts	# Diff	% Diff
Freeway	2,000	2,100	100	5.0
Multi-Lane Arterial	1,150	1,150	0	0.0
Two Lane Arterial	1,050	1,150	100	9.5
Collector	750	800	50	6.7

* Assumes a base saturation flow rate of 2000 vph for freeways, 1950 vph for multi-lane arterials, and 1800 vph for 2-lane arterials. Also assumes typical suburban conditions including 6% trucks, no parking, 20% right turns from a shared lane with through movements, low pedestrian activity, and 20% left turns from an exclusive lane with protected phasing.

DVRPC's traffic count files generally confirm the theoretical capacities, although actual counts in excess of the theoretical maximum were found for all highway classifications except for multi-lane arterials.

V. FUTURE PEAK HOUR TRAFFIC FACTORS (K)

The design of highway facilities, particularly intersections, requires information from those periods with heaviest usage. The peak hour factor, known as the "K" factor, is used to represent the amount of traffic during the hour of greatest traffic volumes compared to the daily volume. As part of the evaluation process, DVRPC was asked to develop forecasts of K factors in the study area. This section of the supplement presents both current and 2018 peak hour volumes and K factors for selected road segments in the study area. Table 9 on the following pages displays the volumes and K factors for the morning peak hour.

The current peak hour traffic volumes were obtained from traffic counts which have been reprinted in the appendices of the US 202 Section 700 report and the supplements issued since the original report was published. The K factors for these road segments were obtained by dividing the highest hourly morning volume into the total daily traffic volume. The following steps were employed to estimate the K factor and peak hour volume for the forecast year.

- By reviewing historical data of the last thirty years, a relationship between overall growth in traffic volume on a facility and the peak hour volume can be developed.

- Based on this relationship, the current K factor was adjusted (or left intact) to reflect 2018 conditions.

- The 2018 K factor was multiplied by the 2018 ADT to achieve a peak hour traffic volume for the particular road segment.

This examination of historical data led to several conclusions. Where there is no growth in traffic or where growth is minimal, the K factor tends to remain stable over time. In cases where there is large growth in traffic volume or where congestion becomes a problem, there tends to be a marginal decrease in the peaking effect, that is, the K factor.

The changes in the K factor between the current situation and the 2018 forecast are minimal, with no change greater than seven percent. For the most part, the differences between the Ks are insignificant, in the range of one to two percent. On parallel roadways, there was very little change to the K factors. Aside from the US 202 Bypass in Doylestown, only Stump Road is forecast to

Table 9: A COMPARISON OF CURRENT AND YEAR 2018 PEAK HOUR FACTORS (K) WITH THE EXPRESSWAY WITH A PA 152 INTERCHANGE ALTERNATIVE

Roadway Segment	Existing Highway Type*	1991 Peak Hour Volume (2-way)	1991 Peak Hour Factor	2018 Peak Hour Factor	2018 Peak Hour Volume (2-way)
		US 202 AND PARALLEL ROADWAYS			
Existing US 202					
- Sumneytown Pike to PA 63	T	1,647	6.9	6.7	2,800
- PA 63 to PA 309	T	1,164	7.2	7.2	1,320
- US 202 to N. Wales Rd	M	2,411	7.6	7.4	3,670
- N. Wales Rd to Horsham Pike	M	2,664	6.4	6.4	3,000
- Cnty Line Rd to PA 152	T	988	5.8	5.8	850
- PA 152 to Bristol	T	1,193	5.4	5.4	920
- Almshouse Road to Upper State Rd	T	1,473	6.9	6.9	970
- PA 611 Bypass to Memorial Dr	M	1,118	7.2	7.2	1,140
Upper State Road					
- PA 309 to Horsham Rd	T	961	6.3	6.3	840
- Horsham Rd to Cnty Line Rd	T	824	7.8	7.8	620
- PA 152 to Pickertown Rd	T	735	9.5	9.5	860
- Bristol Rd to Almshouse Rd	T	671	8.7	8.7	740
Stump Road					
- PA 63 to PA 309	T	752	8.9	8.9	860
- PA 309 to Horsham Rd	T	840	8.7	8.7	920
- Horsham Rd to Cnty Line Rd	T	513	9.1	9.0	650
- PA 152 to Pickertown Rd	T	118	10.9	10.4	600
- Pickertown Rd to Bristol Rd	T	106	10.8	10.3	410
Hartman Road					
- PA 309 to Horsham Rd	C	153	8.8	8.8	410

* F = Freeway, M = Mulit-Lane Arterial, T = Two Lane Arterial, C = Collector

Table 9: A COMPARISON OF CURRENT AND YEAR 2018 PEAK HOUR FACTORS (K) WITH THE EXPRESSWAY WITH A PA 152 INTERCHANGE ALTERNATIVE (Continued)

Roadway Segment	Existing Highway Type*	1991 Peak Hour Volume (2-way)	1991 Peak Hour Factor	2018 Peak Hour Factor	2018 Peak Hour Volume (2-way)
US 202 AND PARALLEL ROADWAYS (Continued)					
Kenas Road					
- Rose Twig Rd to Horsham Rd	C	316	8.9	8.8	400
Lower State Road					
- PA 63 to Horsham Rd	T	453	9.4	9.3	580
- Horsham Rd to PA 152	T	377	9.5	9.4	540
- Cnty Line Rd to Pickertown Rd	T	937	8.7	8.7	590
- Bristol Rd to Almshouse Rd	T	480	8.6	8.4	770
US 202 Bypass					
- PA 611 Byp to PA 611 Bus	F	562	8.1	7.6	2,300
- PA 611 Bus to E State St	F	810	7.6	7.1	1,410
INTERSECTING ROADWAYS					
PA 63, Welsh Rd					
- west of N Wales Rd	T	1,008	5.1	5.1	1,420
- N Wales Rd to US 202	T	1,236	7.3	6.8	2,090
- US 202 to Stump Rd	T	1,419	7.9	7.4	2,330
- Stump Rd to PA 309	T	1,437	8.5	8.0	2,520
- east of PA 309	T	1,199	8.7	8.2	2,390
PA 309 (other than section shared w/ US 202)					
- PA 63 to Stump Rd	M	2,684	7.3	7.2	3,570
- Stump Rd to US 202	M	2,451	7.2	7.0	3,600
- west of Horsham Rd	M	1,943	6.5	6.4	2,660

* F = Freeway, M = Mulit-Lane Arterial, T = Two Lane Arterial, C = Collector

Table 9: A COMPARISON OF CURRENT AND YEAR 2018 PEAK HOUR FACTORS (K) WITH THE EXPRESSWAY WITH A PA 152 INTERCHANGE ALTERNATIVE (Continued)

Roadway Segment	Existing Highway Type*	1991 Peak Hour Volume (2-way)	1991 Peak Hour Factor	2018 Peak Hour Factor	2018 Peak Hour Volume (2-way)
		INTERSECTING ROADWAYS (Continued)			
PA 463, Horsham Road					
- west of PA 309	T	1,377	6.7	6.6	2,010
- PA 309 to N Wales Rd	T	1,001	6.3	6.2	1,260
- N Wales Rd to Upper State Rd	T	1,416	8.3	8.2	1,860
- Upper State Rd to Stump Rd	T	1,483	7.8	7.8	1,740
- Stump Rd to Kenas Rd	T	1,211	7.7	7.7	1,430
- Lower State Rd to Chestnut Ln	T	1,070	8.0	7.9	1,560
County Line Road					
- US 202 to Upper State Rd	T	1,313	7.8	7.6	1,950
- Upper State Rd to Stump Rd	T	1,323	8.0	7.8	2,230
- Stump Rd to PA 152	T	1,320	8.1	8.0	1,770
- PA 152 to Lower State Rd	T	1,086	8.6	8.4	1,750
- east of Lower State Rd	T	1,262	9.0	8.9	1,850
PA 152, Limekiln Pike					
- Lower State Rd to County Line Rd	T	1,144	10.7	10.6	1,670
- County Line Rd to Stump Rd	T	559	9.0	8.5	1,230
- Upper State Rd to US 202	T	615	8.3	7.8	1,220
- west of US 202	T	1,529	9.5	9.4	1,990
Pickertown Road					
- Upper State Rd to Stump Rd	C	70	8.9	8.9	440
- Stump Rd to Lower State Rd	C	153	12.2	11.7	530
Bristol Road					
- US 202 to Upper State Rd	T	598	8.9	8.8	850
- Upper State Rd to Stump Rd	T	731	10.1	9.9	1,080
- Stump Rd to Lower State Rd	T	677	9.2	8.7	1,220
- east of Lower State Rd	T	763	7.4	7.3	1,050

* F = Freeway, M = Mulit-Lane Arterial, T = Two Lane Arterial, C = Collector

Table 9: A COMPARISON OF CURRENT AND YEAR 2018 PEAK HOUR FACTORS (K) WITH THE EXPRESSWAY WITH A PA 152 INTERCHANGE ALTERNATIVE (Continued)

Roadway Segment	Highway Type	1991 Peak Hour Volume	1991 Peak Hour Factor	2018 Peak Hour Factor	2018 Peak Hour Volumes
		INTERSECTING ROADWAYS (Continued)			
Almshouse Road					
- east of Lower State Rd	C	74	8.1	8.1	510
PA 611 Bypass					
- US 202 to US 202 Byp	F	1,973	8.0	7.5	3,530
PA 611					
- east of PA 611 Byp	M	2,600	7.7	7.6	3,480
- PA 611 Byp to US 202 Byp	M	1,025	6.7	6.6	1,410
- US 202 Byp to US 202	M	1,022	6.6	6.5	1,370
PA 313, Swamp Road					
- west of US 202	T	1,218	7.4	7.4	1,380
- east of US 202	T	1,038	8.2	8.1	1,450

* F = Freeway, M = Mulit-Lane Arterial, T = Two Lane Arterial, C = Collector

have a decline in K greater than three percent. Several facilities, including Upper State Road and US 202 north of North Wales Road, are not forecast to experience any change in the K factor. Intersecting roadways show more variation in the changes between the current and 2018 K factor, although even here the maximum change is only 6.8 percent. The greatest change occurs on PA 63 (at the southern end of the study area), where the K factor declines between 5.7 and 6.8 percent at different points in the study area. Other declines are registered on County Line and Bristol roads, where the decrease is between one and three percent except for that portion of Bristol Road between Stump and Lower State roads where the decline is 5.4 percent. The K factor on PA 152 is forecast to remain relatively stable south of County Line Road while north of that facility moderation of the K factor by almost six percent is forecast.

The peak hour factor is discussed in detail above. The directional split and truck factors, derived from traffic counts, are presented below. The directional split on a highway is known as D for the peak period. The directional factor is derived by dividing the directional volumes by the highway's total two-way traffic. It is expressed as a percent. The truck factor on a highway is known as T for the peak period and TF for a 24-hour period. This factor is derived by dividing the number of trucks on the highway by the total vehicles counted, and is also expressed as a percent. The definition of trucks excludes 2-axle light trucks and buses shorter than 11.5 ft. In general, the following factors may also be used for US 202 alternatives in the future.

Peak Hour Factor (K) - 8.0%
Peak Hour Directional Split (D) - 57.0%
Peak Hour Truck Factor (T) - 6.0%
Daily Truck Factor (TF) - 9.0%

APPENDIX A

24-HOUR MACHINE TRAFFIC COUNTS

TABLE OF CONTENTS

DELAWARE VALLEY REGIONAL PLANNING COMMISSION
24-HOUR TRAFFIC COUNT RECORD

COUNTY: BUCKS
MUNICIPALITY: WARRINGTON

ROAD COUNTED ON: BRISTOL RD
BETWEEN: TURK RD & PICKERTOWN RD
DIRECTION: BOTH

RECORDER NO: 1308
SET BY: AC
DATE: 08/11/93
DAY MACHINE SET: WED

COUNTS

DAY: / DATE:	MON.	TUES.	WED. 08/11	THURS. 08/12	FRI. 08/13
12:00- 1:00 AM	0	0	0	86	87
1:00- 2:00 AM	0	0	0	55	37
2:00- 3:00 AM	0	0	0	30	24
3:00- 4:00 AM	0	0	0	19	22
4:00- 5:00 AM	0	0	0	22	24
5:00- 6:00 AM	0	0	0	72	70
6:00- 7:00 AM	0	0	0	342	339
7:00- 8:00 AM	0	0	0	547	530
8:00- 9:00 AM	0	0	0	531	0
9:00-10:00 AM	0	0	0	357	0
10:00-11:00 AM	0	0	0	366	0
11:00-12:00 PM	0	0	390	374	0
12:00- 1:00 PM	0	0	399	363	0
1:00- 2:00 PM	0	0	375	347	0
2:00- 3:00 PM	0	0	391	418	0
3:00- 4:00 PM	0	0	510	455	0
4:00- 5:00 PM	0	0	573	615	0
5:00- 6:00 PM	0	0	727	699	0
6:00- 7:00 PM	0	0	517	568	0
7:00- 8:00 PM	0	0	426	484	0
8:00- 9:00 PM	0	0	408	455	0
9:00-10:00 PM	0	0	253	294	0
10:00-11:00 PM	0	0	194	214	0
11:00-12:00 AM	0	0	144	128	0
TOTALS	0	0	5307	7841	1133
WEATHER:	F	F	F	F	F

(F)air
(R)ain
(S)now
(H)oliday

REMARKS:

DELAWARE VALLEY REGIONAL PLANNING COMMISSION
24-HOUR TRAFFIC COUNT RECORD

COUNTY: BUCKS
MUNICIPALITY: WARRINGTON

ROAD COUNTED ON: BRISTOL RD
BETWEEN: PICKERTOWN RD & TR 611
DIRECTION: BOTH

RECORDER NO: 13825
SET BY: AC
DATE: 08/11/93
DAY MACHINE SET: WED

COUNTS

DAY: / DATE:	MON.	TUES.	WED. 08/11	THURS. 08/12	FRI. 08/13
12:00- 1:00 AM	0	0	0	105	109
1:00- 2:00 AM	0	0	0	62	38
2:00- 3:00 AM	0	0	0	36	34
3:00- 4:00 AM	0	0	0	20	31
4:00- 5:00 AM	0	0	0	26	29
5:00- 6:00 AM	0	0	0	94	93
6:00- 7:00 AM	0	0	0	462	431
7:00- 8:00 AM	0	0	0	763	743
8:00- 9:00 AM	0	0	0	742	0
9:00-10:00 AM	0	0	0	535	0
10:00-11:00 AM	0	0	0	456	0
11:00-12:00 PM	0	0	509	468	0
12:00- 1:00 PM	0	0	530	496	0
1:00- 2:00 PM	0	0	483	472	0
2:00- 3:00 PM	0	0	523	516	0
3:00- 4:00 PM	0	0	702	625	0
4:00- 5:00 PM	0	0	793	836	0
5:00- 6:00 PM	0	0	964	955	0
6:00- 7:00 PM	0	0	691	735	0
7:00- 8:00 PM	0	0	554	626	0
8:00- 9:00 PM	0	0	492	559	0
9:00-10:00 PM	0	0	327	361	0
10:00-11:00 PM	0	0	231	265	0
11:00-12:00 AM	0	0	169	149	0
TOTALS	0	0	6968	10364	1508
WEATHER: (F)air (R)ain (S)now (H)oliday	F	F	F	F	F

REMARKS:

DELAWARE VALLEY REGIONAL PLANNING COMMISSION
24-HOUR TRAFFIC COUNT RECORD

COUNTY: BUCKS
MUNICIPALITY: WARRINGTON

ROAD COUNTED ON: COUNTY LINE ROAD
BETWEEN: PARK RD & KEITH VALLEY RD
DIRECTION: EAST

RECORDER NO: 6333
SET BY: AC
DATE: 08/11/93
DAY MACHINE SET: WED

COUNTS

DAY: / DATE:	MON.	TUES.	WED. 08/11	THURS. 08/12	FRI. 08/13
12:00- 1:00 AM	0	0	0	49	60
1:00- 2:00 AM	0	0	0	25	26
2:00- 3:00 AM	0	0	0	11	22
3:00- 4:00 AM	0	0	0	18	18
4:00- 5:00 AM	0	0	0	32	25
5:00- 6:00 AM	0	0	0	147	136
6:00- 7:00 AM	0	0	0	515	467
7:00- 8:00 AM	0	0	0	548	516
8:00- 9:00 AM	0	0	0	417	0
9:00-10:00 AM	0	0	0	320	0
10:00-11:00 AM	0	0	293	284	0
11:00-12:00 PM	0	0	319	312	0
12:00- 1:00 PM	0	0	332	292	0
1:00- 2:00 PM	0	0	347	320	0
2:00- 3:00 PM	0	0	314	340	0
3:00- 4:00 PM	0	0	367	389	0
4:00- 5:00 PM	0	0	418	427	0
5:00- 6:00 PM	0	0	415	420	0
6:00- 7:00 PM	0	0	359	352	0
7:00- 8:00 PM	0	0	269	307	0
8:00- 9:00 PM	0	0	271	270	0
9:00-10:00 PM	0	0	232	226	0
10:00-11:00 PM	0	0	145	151	0
11:00-12:00 AM	0	0	96	103	0
TOTALS	0	0	4177	6275	1270
WEATHER:	F	F	F	F	F

(F)air
(R)ain
(S)now
(H)oliday

REMARKS:

DELAWARE VALLEY REGIONAL PLANNING COMMISSION
24-HOUR TRAFFIC COUNT RECORD

COUNTY: BUCKS
MUNICIPALITY: WARRINGTON

ROAD COUNTED ON: COUNTY LINE ROAD
BETWEEN: PARK RD & KEITH VALLEY RD
DIRECTION: WEST

RECORDER NO:
SET BY: AC
DATE: 08/11/93
DAY MACHINE SET: WED

COUNTS

DAY: / DATE:	MON.	TUES.	WED. 08/11	THURS. 08/12	FRI. 08/13
12:00- 1:00 AM	0	0	0	86	82
1:00- 2:00 AM	0	0	0	36	36
2:00- 3:00 AM	0	0	0	36	34
3:00- 4:00 AM	0	0	0	25	35
4:00- 5:00 AM	0	0	0	33	37
5:00- 6:00 AM	0	0	0	103	81
6:00- 7:00 AM	0	0	0	266	256
7:00- 8:00 AM	0	0	0	443	441
8:00- 9:00 AM	0	0	0	398	374
9:00-10:00 AM	0	0	237	329	0
10:00-11:00 AM	0	0	344	312	0
11:00-12:00 PM	0	0	299	381	0
12:00- 1:00 PM	0	0	333	373	0
1:00- 2:00 PM	0	0	352	320	0
2:00- 3:00 PM	0	0	378	372	0
3:00- 4:00 PM	0	0	552	524	0
4:00- 5:00 PM	0	0	625	698	0
5:00- 6:00 PM	0	0	728	679	0
6:00- 7:00 PM	0	0	438	509	0
7:00- 8:00 PM	0	0	338	372	0
8:00- 9:00 PM	0	0	275	287	0
9:00-10:00 PM	0	0	257	207	0
10:00-11:00 PM	0	0	174	167	0
11:00-12:00 AM	0	0	114	131	0
TOTALS	0	0	5444	7087	1376
WEATHER:	F	F	F	F	F

(F)air
(R)ain
(S)now
(H)oliday

REMARKS:

DELAWARE VALLEY REGIONAL PLANNING COMMISSION
24-HOUR TRAFFIC COUNT RECORD

COUNTY: BUCKS
MUNICIPALITY: WARRINGTON

ROAD COUNTED ON: COUNTY LINE ROAD
BETWEEN: TITUS RD & TR 611
DIRECTION: EAST

RECORDER NO:
SET BY: AC
DATE: 08/11/93
DAY MACHINE SET: WED

COUNTS

DAY: / DATE:	MON.	TUES.	WED. 08/11	THURS. 08/12	FRI. 08/13
12:00- 1:00 AM	0	0	0	56	79
1:00- 2:00 AM	0	0	0	27	29
2:00- 3:00 AM	0	0	0	22	29
3:00- 4:00 AM	0	0	0	15	18
4:00- 5:00 AM	0	0	0	38	27
5:00- 6:00 AM	0	0	0	135	132
6:00- 7:00 AM	0	0	0	433	400
7:00- 8:00 AM	0	0	0	468	444
8:00- 9:00 AM	0	0	90	379	390
9:00-10:00 AM	0	0	324	326	0
10:00-11:00 AM	0	0	308	320	0
11:00-12:00 PM	0	0	356	377	0
12:00- 1:00 PM	0	0	384	351	0
1:00- 2:00 PM	0	0	375	369	0
2:00- 3:00 PM	0	0	349	366	0
3:00- 4:00 PM	0	0	406	432	0
4:00- 5:00 PM	0	0	392	397	0
5:00- 6:00 PM	0	0	410	489	0
6:00- 7:00 PM	0	0	388	398	0
7:00- 8:00 PM	0	0	295	320	0
8:00- 9:00 PM	0	0	264	301	0
9:00-10:00 PM	0	0	226	243	0
10:00-11:00 PM	0	0	170	164	0
11:00-12:00 AM	0	0	101	113	0
TOTALS	0	0	4838	6539	1548
WEATHER:	F	F	F	F	F

(F)air
(R)ain
(S)now
(H)oliday

REMARKS:

DELAWARE VALLEY REGIONAL PLANNING COMMISSION
24-HOUR TRAFFIC COUNT RECORD

COUNTY: BUCKS
MUNICIPALITY: WARRINGTON

ROAD COUNTED ON: COUNTY LINE ROAD
BETWEEN: TITUS RD & TR 611
DIRECTION: WEST

RECORDER NO:
SET BY: AC
DATE: 08/11/93
DAY MACHINE SET: WED

COUNTS

DAY: / DATE:	MON.	TUES.	WED. 08/11	THURS. 08/12	FRI. 08/13
12:00- 1:00 AM	0	0	0	90	84
1:00- 2:00 AM	0	0	0	39	34
2:00- 3:00 AM	0	0	0	36	37
3:00- 4:00 AM	0	0	0	21	31
4:00- 5:00 AM	0	0	0	33	37
5:00- 6:00 AM	0	0	0	110	92
6:00- 7:00 AM	0	0	0	367	353
7:00- 8:00 AM	0	0	0	652	635
8:00- 9:00 AM	0	0	0	532	491
9:00-10:00 AM	0	0	404	373	0
10:00-11:00 AM	0	0	376	354	0
11:00-12:00 PM	0	0	330	414	0
12:00- 1:00 PM	0	0	375	430	0
1:00- 2:00 PM	0	0	408	371	0
2:00- 3:00 PM	0	0	399	403	0
3:00- 4:00 PM	0	0	594	568	0
4:00- 5:00 PM	0	0	625	694	0
5:00- 6:00 PM	0	0	693	734	0
6:00- 7:00 PM	0	0	467	502	0
7:00- 8:00 PM	0	0	347	367	0
8:00- 9:00 PM	0	0	294	303	0
9:00-10:00 PM	0	0	266	248	0
10:00-11:00 PM	0	0	183	173	0
11:00-12:00 AM	0	0	113	131	0
TOTALS	0	0	5874	7945	1794
WEATHER:	F	F	F	F	F

(F)air
(R)ain
(S)now
(H)oliday

REMARKS: