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US 202 TRAFFIC IMPROVEMENT STUDY
(DELAWARE STATE LINE TO WEST CHESTER BYPASS)

JUNE 1988



DELAWARE VALLEY REGIONAL PLANNING COMMISSION

THE BOURSE BUILDING

21 SOUTH 5TH STREET, PHILADELPHIA, PA 19106

(215) 592-1800

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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 four line Divisions: Transportation Planning, Regional Information Services Center, Strategic Planning, and Finance and Administration. DVRPC's mission for the 1980s 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.

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.

DELAWARE VALLEY REGIONAL PLANNING COMMISSION

Publication Abstract

TITLE US 202 TRAFFIC IMPROVEMENT STUDY	Date Published: June 1988 Publication No. 88518
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Geographic Area Covered:

US 202 in Delaware County and a Portion of Chester County, Pennsylvania

Key Words:

US 202, Painters Crossroads, Existing Conditions, Alternatives Analysis, Projected Traffic, Road Widening, Jug Handles, Grade Separated Intersection, Right-of-Way, Zoning

ABSTRACT

Analyzed US 202 between the Delaware State Line and West Chester. An alternatives analysis compared a four lane versus a six lane roadway using Year 2008 projected traffic volumes. Recommendations included widening the road to six lanes, improving intersections, and building a grade separated intersection at Painters Crossroads.

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EXECUTIVE SUMMARY

The US 202 Corridor, from the Delaware state line to West Chester, is one of the most rapidly developing areas in Chester and Delaware Counties. Since 1980, over 5,300 residential units and approximately 1 million square feet of office space have been constructed in the study area. These development trends are expected to continue. The occurrence of this amount of development brings with it increased levels of traffic and congestion creating the need to plan for traffic management. This study is one part of a larger effort being conducted by the Chester County Planning Commission, the Delaware County Planning Department and the Brandywine Conservancy to effectively plan for and coordinate growth in the Brandywine Region.

This report documents the traffic analysis prepared by the Delaware Valley Regional Planning Commission for the US 202 Corridor. The study identifies and analyzes the existing conditions of the study area. These conditions include the socio-economic characteristics and the highway network characteristics. The study proceeds by presenting an analysis of future traffic conditions in the corridor. Meetings were held with each municipality to estimate the magnitude of development for a 20 year time frame. It is estimated that by the year 2008 anticipated development in the study area will include over 10,000 new residential units, over 1.5 million square feet of commercial space and almost 3 million square feet of office space.

A focused traffic simulation model was used to estimate year 2008 traffic volumes on the highway network. Two alternatives were modeled and traffic projections were developed for each alternative. The alternatives consist of a four lane scenario and a six lane scenario for US 202. The four lane alternative assumes the existing four lane roadway with jug handles at signalized intersections in lieu of left turn lanes. The six lane alternative assumes an additional through lane in each direction and jug handles at signalized intersections.

Both the four lane and six lane scenario show a significant increase in traffic volumes by the year 2008. Traffic volumes on US 202 are generally 15-18% higher for the six lane scenario than for the four lane scenario. However, the year 2008 traffic on roads parallel to US 202 are generally 30% lower under the six lane scenario than for the four lane scenario. The future level of service analysis indicates that the six lane scenario will provide a better level of service on US 202 in most instances.

A travel time analysis was prepared for US 202 and for Briton Lake Road/Matlack Street. This analysis indicates that the six lane scenario will provide a 22.7% time savings on US 202 when traveling from the Delaware state line to Matlack Street. The six lane scenario will

provide a 26.1% time savings for vehicles traveling on Brinton Lake Road/Matlack Street from Marshall Rd to US 202 Bypass when compared to the four lane scenario.

The traffic simulation model projected that by the year 2008, over 105,000 vehicles would traverse the Painters Crossroads intersection on a daily basis. Due to this significant increase in traffic and the fact that this intersection is currently experiencing severe congestion in the AM and PM peak periods, it was necessary to look for some major physical improvements to this intersection. The recommendation is a combination of a grade separated intersection and a ring road system. Neither of these alternatives alone is sufficient, but together they should provide enough relief to adequately handle this large volume of traffic.

The report presents a series of findings which are a result of the analysis of the existing and future conditions. The major findings are summarized below.

- . Construction of a new expressway on a new alignment is not feasible due to environmental and fiscal considerations.
- . The intersections along US 202 will experience congestion under both the four lane and six lane scenarios, however the congestion will be less severe with six lanes.
- . The six lane scenario provides faster travel times on US 202 and reduces the traffic volumes on parallel roads.
- . It is necessary to widen US 202 to three lanes in each direction.
- . Jug handles should be constructed at all signalized intersections to facilitate left turn movements.
- . Steps must be taken to prevent development from encroaching on the right-of-way needed to construct the improvements.
- . At Painters Crossroads, a grade separated intersection would provide maximum benefits for the through traffic but only minimum benefits for the local access traffic.
- . At Painters Crossroads, a ring road system would provide maximum benefits for local access traffic but only minimum benefits for through traffic.

The findings represent the basis for the recommendations. The recommendations are separated into short-term and long-term improvements. The major recommendations include: closing median openings, constructing jug handles at the signalized intersections and taking steps to reserve right-of-way along the highway in order to construct the improvements. Implementing a zoning overlay district along the corridor is an example of the necessary steps to reserve right-of-way. The major long-term

recommendations include: a 150 foot right-of-way to widen US 202 to six lanes, widening the approaches of the cross streets at the signalized intersections, constructing a grade separated intersection at Painters Crossroads and constructing a ring road system at Painters Crossroads to compliment the grade separated intersection.

INTRODUCTION

The US 202 corridor, located in the historic Brandywine Valley of Chester and Delaware Counties (see Figure 1), is currently undergoing a very noticeable change caused by commercial development adjacent to the highway, residential development in the municipalities along the corridor, and mounting pressure to continue these development patterns. Simultaneously with these increases in development, the corridor is experiencing increases in traffic volume and congestion. Due to this trend, drivers are now seeking quicker alternate or bypass routes parallel to US 202. Many rural roads have become high speed alternatives used to bypass the expanding traffic volumes and congestion on US 202. The signalized intersections along the highway are becoming choke points of traffic flow and contribute heavily to the congestion along the highway.

The purpose of this study is to identify existing traffic flow and safety problems along the corridor, develop and evaluate alternative improvement scenarios and prepare a set of short-range and long-range recommendations. The study methodology used to complete these tasks is presented in Figure 2.

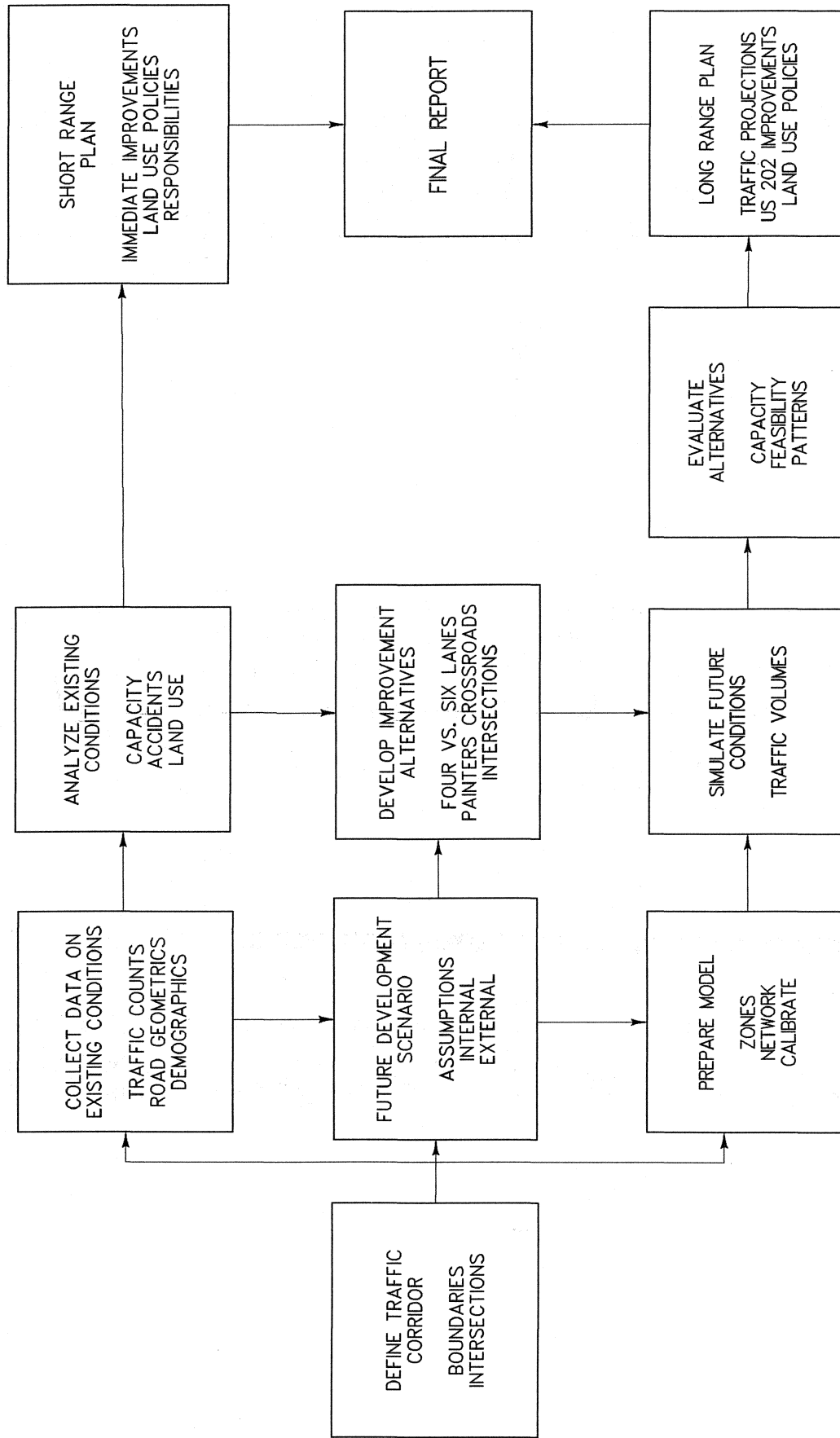
This study was prepared at the request of the Chester County and Delaware County Planning Commissions. A technical steering committee was established to guide this effort. The group consisted of representatives from the following agencies: Chester County Planning Commission, Delaware County Planning Department, Pennsylvania Department of Transportation (PennDOT), Delaware Valley Regional Planning Commission (DVRPC) and The Brandywine Conservancy.

This report documents the existing conditions, including both the highway network and traffic operating conditions. An alternatives analysis of the Painters Crossroads intersection and a traffic demand analysis for the year 2008 using a focused traffic simulation model are also presented. The report concludes with a series of highway improvement projects and policy recommendations to manage highway access. The improvement program is divided into short-range and long-range plans reflecting the time frame needed to construct the improvements.

FIGURE 1



FIGURE 2 **US 202 TRAFFIC IMPROVEMENT STUDY** **METHODOLOGY**



EXISTING CONDITIONS

STUDY AREA CHARACTERISTICS

In this section, the non-traffic characteristics of the study area will be reviewed. This includes demographics, land use and the physical characteristics of the highway network.

Study Area

The segment of US 202 under study extends from the Delaware State line to Matlack Street in West Goshen Township.

The study area for the report encompasses the municipalities listed below, and can be found on a map of the study area in Figure 3.

Delaware County-

- Bethel Township
- Birmingham Township
- Concord Township
- Thornbury Township

Chester County-

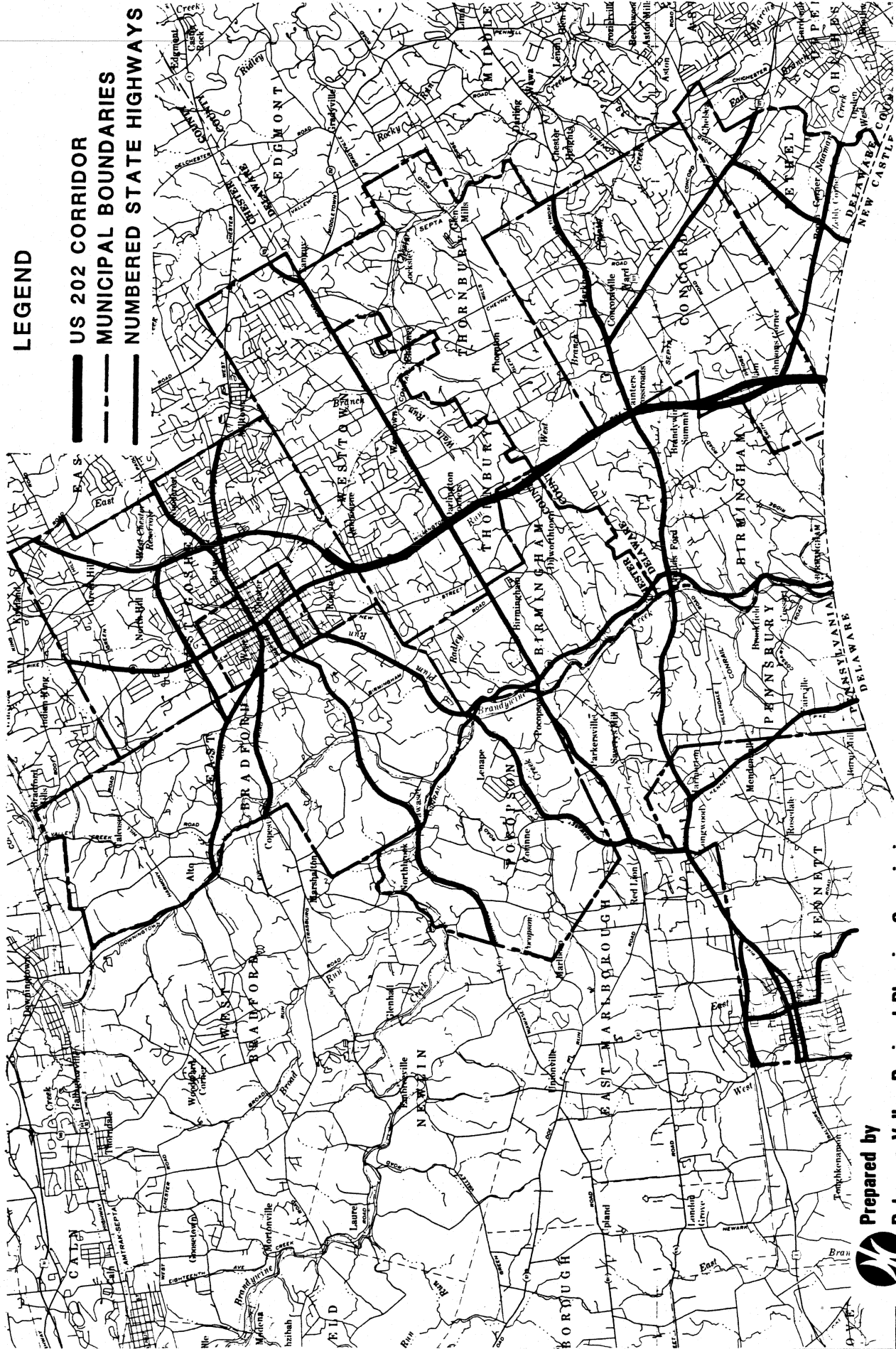
- Birmingham Township
- East Bradford Township
- Kennett Township
- Pennsbury Township
- Pocopson Township
- Thornbury Township
- West Goshen Township
- Westtown Township

These municipalities were chosen because they are located adjacent to or in close proximity to US 202. Since the State of Delaware is not within the DVRPC region, it is not listed; however the efforts of this study have been coordinated with New Castle County and the Delaware Department of Transportation. All of the municipalities have experienced growth since 1980 and are expected to continue growing by varying degrees for the next 20 years causing an increase in traffic volumes and congestion throughout the US 202 corridor.

Demographics

Population, employment and auto ownership are predictors of trip generating potential. Recent growth trends, 1980-1987, are presented below. In general, the 1980 data were obtained from the US Census and the 1987 data are DVRPC estimates. Independently, as part of the study

FIGURE 3 STUDY AREA



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process, representatives from the technical steering committee met individually with representatives from each municipality to discuss the types and magnitude of the development which had taken place in their municipalities since 1980.

Population

The study area population increased from 46,253 in 1980 to 53,389 in 1987 an increase of 7,134 for a 15.4% growth rate. This is equivalent to a 2.2% increase per year. West Goshen experienced the highest absolute growth, gaining 2,191 new residents, while Concord experienced the highest growth rate of 30.6%.

From the meetings with municipal officials, it was determined that the study area had experienced a growth of over 3,600 single family residential units and over 1,700 multi-family residential units for the period between 1980 and 1987.

Employment

Employment refers to the number of jobs located in a specific municipality independent of where the workers actually live. Employment in the study area has increased from 20,054 in 1980 to 24,770 in 1987. This change represents an increase of 4,716 jobs and a growth rate of 23.5% (3.4 percent per year). Consistent with national trends, employment in the study area is growing at a higher annual percentage rate than the population. West Goshen, again, had the highest absolute growth with the creation of 2,488 new jobs while Birmingham, Chester County had the highest growth rate (40.4%).

From the meetings with each municipality in the study area, it was determined that at least 200,000 square feet of commercial space and approximately 1 million square feet of office space had been constructed between 1980 and 1987. The commercial and office developments had a tendency to locate close to US 202.

Auto Ownership

The total number of autos owned by the households in the study area in 1980 was 26,146. There were 14,335 households in the study area in 1980 producing an average of 1.82 autos per household. Data for auto ownership for 1987 was not available; however DVRPC has forecasted an auto ownership rate for the year 2000 of 1.92 autos per household. If the year 2000 rate is conservatively used to estimate the number of autos in the study area, the approximately 30,000 future households in the year 2008 will own more than 57,000 autos.

Land Use

In aggregate, the land use along US 202 can be characterized as predominantly strip commercial development with numerous access and

egress points, however large vacant parcels and farmland still exist along with small pockets of single family residential units.

From the Delaware state line to the area where the highway splits to form a one-way couplet, the predominant land use is commercial; however, there are a number of vacant parcels interspersed among the commercial uses. From the southern end of the one-way couplet to approximately 1/4 mile north of Smithbridge Road, single family residential units dominate the land use; however, a few commercial uses do exist in this area.

From north of Smithbridge Road to Greentree Drive, commercial uses are the most common land use along the corridor. There are also quite a few vacant parcels and a couple of office developments along this portion of the highway. Although the number of office uses is small, one office in particular, State Farm in the northeast quadrant of the US 202 and US 1 intersection, has a considerable effect on traffic volumes in its immediate area.

From Greentree Drive to the West Chester Bypass, the east side of the highway has a high incidence of single family residential units with some additional vacant parcels and an occasional commercial establishment. The west side of the highway through this section is dominated by farm land with a few residential and commercial uses in the northern part of this section. The Stetson Middle School is also located on the west side of the highway in this section.

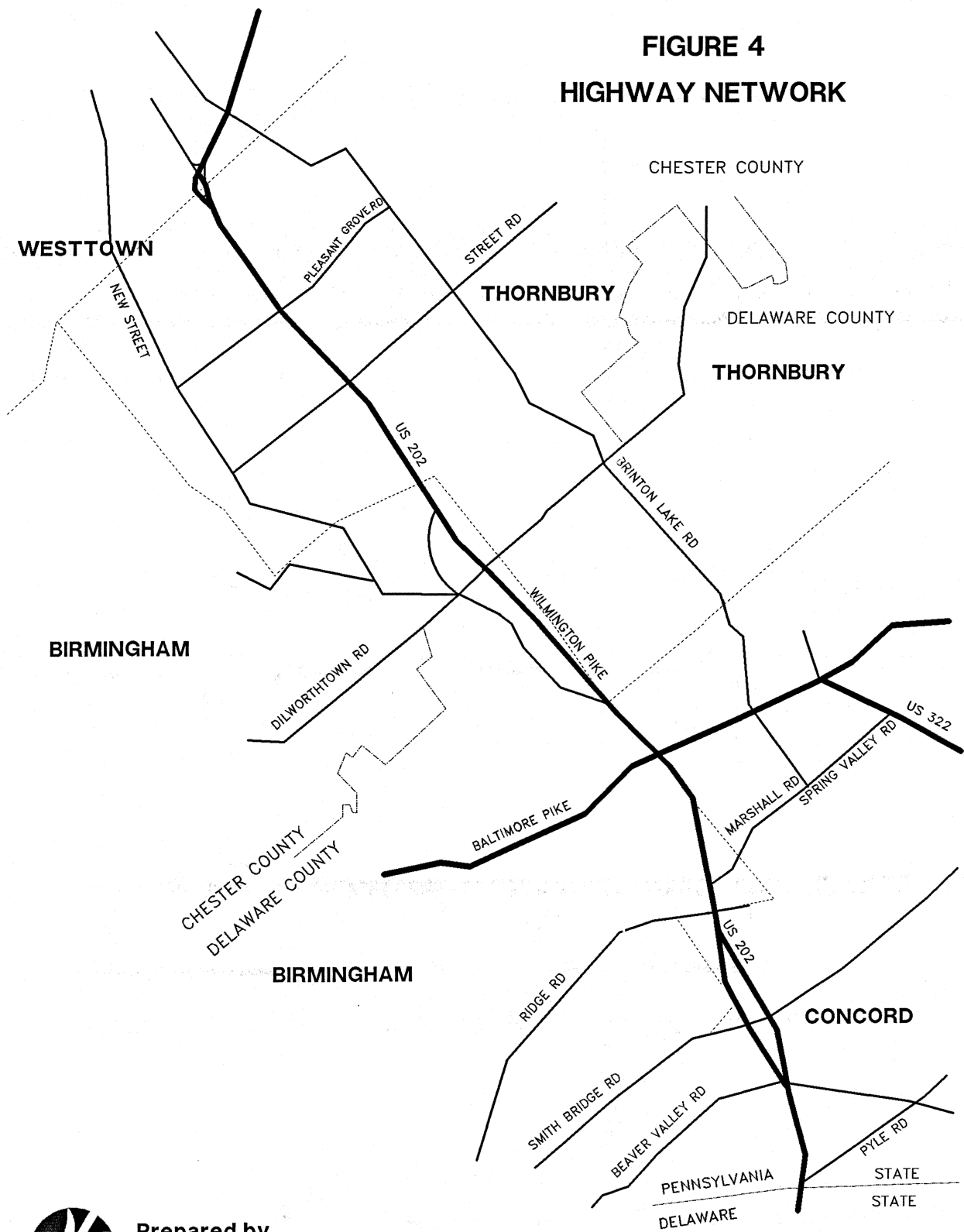
The study area surrounding US 202 can be characterized as a rural setting. Although noticeable development has occurred since 1980, it is still largely undeveloped and has not reached the magnitude which would cause the study area to be classified as suburban. Many municipalities have large areas of low density residential zoning, typically minimum 1-2 acre lots. Much of the study area is located in the historic Brandywine Valley. This area contains many historical sites and buildings which date back to the American Revolution, most notably the Brandywine Battlefield State Park. The Brandywine Valley is also full of many environmentally sensitive areas such as the Brandywine Creek and its tributaries.

Highway Network

This section will review the physical characteristics of the roadway system, such as cartway widths or traffic controls and important non-physical attributes such as roadway ownership and functional classification.

The study and its recommendations focus on the roads and intersections delineated in Figure 4. They represent the major roads carrying the bulk of the traffic. The remaining roads and intersections are local in nature and impact mainly those residents who reside along them.

**FIGURE 4
HIGHWAY NETWORK**



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US 202 is a principal arterial highway traveling in a north-south direction through the study area. Regionally it connects I-95 in Wilmington, Delaware with Doylestown in Bucks County and provides access to the Pennsylvania Turnpike in King of Prussia, Montgomery County. For most of the 7.5 mile distance through the study area, US 202 is a four lane divided highway. Although the type of median divider differs, the majority of the highway is divided by a box beam guide rail. In the southern section of the highway from the Delaware state line to Naamans Creek Road, the highway is divided by a 15 foot grass median. There are nine median openings in this section to allow for left turns into the commercial uses. From Naamans Creek Road to Ridge Road, the northbound and southbound movements are separated as the highway becomes a one-way couplet. The section north of Ridge Road to approximately 0.25 mile south of US 1 is the only section that does not have a physical divider. This section has a 5 lane cross section, 2 travel lanes in each direction and a two-way continuous center left turn lane. A raised concrete median and a grass median comprise the divider for the next 0.25 mile to US 1. North of US 1 to the West Chester Bypass the median is the box beam guide rail type.

Traffic control along US 202 is via signalized and unsignalized at-grade intersections. There are currently eight signalized intersections along the corridor. They are: Naamans Creek Road, US 1 (Painters Crossroads), State Farm Drive, Oakland Road, Dilworthtown Road, Greentree Drive, Street Road and Stetson Middle School. The unsignalized intersections include: Pyle Road, Smithbridge Road, Ridge Road, Marshall Road, Old Wilmington Pike and Pleasant Grove Road. During the course of the study the intersection at Ridge Road became signalized. In addition to the intersections there is a seemingly unlimited number of driveways which access the commercial and residential uses adjacent to the road.

The grade of US 202 is gently rolling and the speed limit is posted at 45 miles per hour. A typical cross section of the road contains two twelve foot travel lanes and a 6 foot shoulder in each direction.

The highway network in the study area (see Figure 4) contains roads that are parallel to US 202 as well as cross roads that serve as access routes to US 202. The majority of the roads in the network can be described as rural, narrow (9 foot lanes), one lane by direction and having no shoulders. Horizontal and vertical sight distance problems are common. The two exceptions to these characteristics are US 1 and US 322. The former is four lane divided highway with shoulders; the latter is a two lane undivided road with shoulders.

The majority of roads in the highway network are state owned and maintained. They are listed below with their respective state route (SR) numbers.

- US 202 Wilmington-West Chester Pike (SR 0202)
- US 1 Baltimore Pike (SR 001)
- US 322 Conchester Highway (SR 0322)
- US 322 BUS. High Street (SR 0322)

PA 100 Creek Road (SR 0100)
PA 491 Naamans Creek Road (SR 0491)
PA 926 Street Road (SR 0926)
Pyle Road (SR 3042)
Beaver Valley Road (SR 3044)
Smith Bridge Road (SR 3046)
Ridge Road (SR 3048)
Dilworthtown Road (SR 4016)
Brintons Bridge Road (SR 2002)
Birmingham Road (SR 2001)
Concord Road (SR 2006)
Brinton Lake Road (parts) (SR 4021)

There are also a number of township owned roads in the network and they are listed below:

Marshall Road/Spring Valley Road
Oakland Road
Old Wilmington Pike
Pleasant Grove Road
Matlack Street
New Street
Brinton Lake Road (parts)

For planning and design purposes, highways are classified by function. Although highways have two functions: 1) to provide mobility and 2) to provide land access, there is an incompatibility between these two objectives. Mobility requires high speeds for sustained travel while land access mandates low speeds for frequent turning movements. The functional classification categories are described in Table 1. The Federal Highway Administration through PennDOT has developed a state-wide functional classification system as part of the National Highway Functional Classification. The highway network in the study area is classified as follows:

Principal Arterials-

US 202 (Wilmington- West Chester Pike)
US 1 (Baltimore Pike)
US 322 (Conchester Highway)
US 322 BUS. (High St)

Minor Arterials-

PA 926 (Street Road) east of US 202

Major Collectors-

PA 100 (Creek Road)
PA 491 (Naamans Creek Road)
PA 926 (Street Road) west of US 202
Beaver Valley Road
Smith Bridge Road

Table 1

FUNCTIONAL CLASSIFICATION SYSTEM CATEGORIES

PRINCIPAL ARTERIAL - Serves statewide and interstate travel, major activity centers in the urbanized area, through movements bypassing the central city, and most of the trips entering and leaving the urbanized area. In addition, significant intra-region travel, such as between central business districts and outlying residential areas or between major suburban centers is served by this class of facilities. Land access is subordinate to mobility.

MINOR ARTERIAL - Interconnects and augments the principal arterial system. Carries trips of moderate length. Places more emphasis on land access than the principal arterial and carries less traffic. Accommodates intra-community travel but does not penetrate identifiable neighborhoods.

COLLECTOR - Provides both land access service and traffic circulation within residential neighborhoods and commercial and industrial areas. The collector system may penetrate residential neighborhoods distributing trips from arterials to their ultimate destinations. Conversely, collects traffic from local streets and channels it onto the arterial system. Carries less traffic than arterials. May carry a minor amount of through traffic.

LOCAL - Primarily permits direct access to abutting land uses and connections to the higher categories. Carries very low volumes and offers lowest level of mobility, usually deliberately discouraging through traffic.

Minor Collectors-

- Dilworthtown Road
- Brinton's Bridge Road
- Birmingham Road
- Matlack Street/Concord Road (Rosedale Avenue to PA 926)
- New Street (Rosedale Avenue to PA 926)

Local Roads-

- Pyle Road
- Ridge Road
- Marshall Road/Spring Valley Road
- Concord Road/Brinton Lake Road (PA 926 to Marshall Road)
- Oakland Road
- Old Wilmington Pike
- Pleasant Grove Road
- New Street (PA 926 to Birmingham Road)

EXISTING TRAFFIC CONDITIONS

In this section roadway, traffic volumes and turning movements at intersections will be presented. A level of service analysis of existing conditions will then be reviewed. Lastly, a review of traffic accident statistics and trends along US 202 will also be presented.

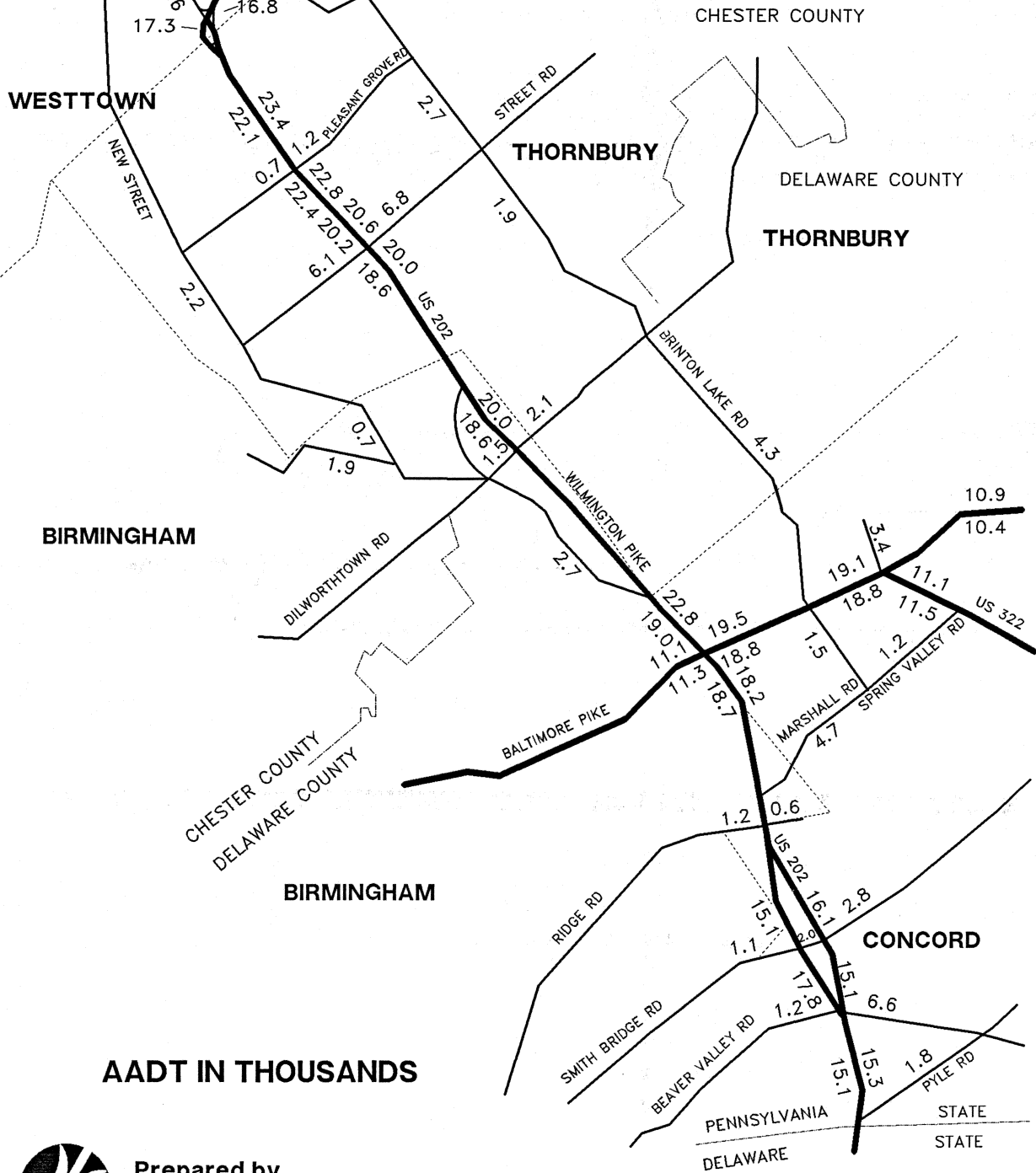
Traffic Volumes

The DVRPC staff, assisted by local and county governments, has collected and analyzed the existing traffic volumes and travel patterns for the US 202 study corridor. Three types of traffic data have been collected during this phase of the study: Average Annual Daily Traffic (AADT), peak hour turning movements, and travel patterns between US 322 and US 202.

AADT counts were obtained by reviewing previous traffic counts taken by DVRPC for the years 1984-1986. Many counts were taken in 1986 as part of DVRPC's Growth Monitoring Program of 33 high growth corridors in the region. New automatic traffic recorder counts (tube counts) were taken where data was either missing or found to be of questionable value. The raw daily traffic volumes were converted to AADTs to account for day of week and seasonal fluctuation in traffic levels. AADT volumes represent the average daily traffic over the course of an entire year.

The existing AADT counts are posted in Figure 5. Referring to this figure, the volumes on northbound US 202 range from a low of 15,300 vehicles per day at the southern end of the study area to a high of 23,400 vehicles per day just north of Pleasant Grove Road. Just south of the intersection of US 202 and US 1 the northbound volume on US 202 is 18,200 vehicles per day while the volume just north of US 1 jumps to 22,800 vehicles per day. Studying the southbound volumes on US 202, the

FIGURE 5
EXISTING AVERAGE ANNUAL
DAILY TRAFFIC



AADT IN THOUSANDS



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volumes range from a low of 15,100 vehicles per day at the southern terminus of the study corridor to a high of 22,400 vehicles per day just south of Pleasant Grove Road.

By adding the posted northbound and southbound volumes, the two-way volumes range from a low of 30,400 vehicles per day at the southern end of the study corridor to a high of 45,500 vehicles per day just north of Pleasant Grove Road. The two-way volume on US 202 just south of US 1 is 36,900 vehicles per day while just north of US 1 it is 41,800 vehicles per day.

The two-way volumes on US 1 vary from 21,300 vehicles per day east of US 322 to approximately 38,000 vehicles per day between US 322 and US 202 and to 22,400 vehicles per day west of US 202. The two-way volume on US 322 south of US 1 is 22,600 vehicles per day while the volume on US 322 BUS. north of US 202 is 14,800 vehicles per day.

The AADT volumes on the roads parallel to US 202, namely Brinton Lake Road and New Street, generally range between 1,900-2,700 vehicles per day. The one major exception is a segment of Brinton Lake Road between Street Road and US 1 where the volume is 4,300 vehicles per day. The roads intersecting US 202 generally carry fewer than 3,000 vehicles per day. The exceptions are Naamans Creek Road with 6,600 vehicles per day and Street Road with 6,800 and 6,100 vehicles per day east and west of US 202 respectively.

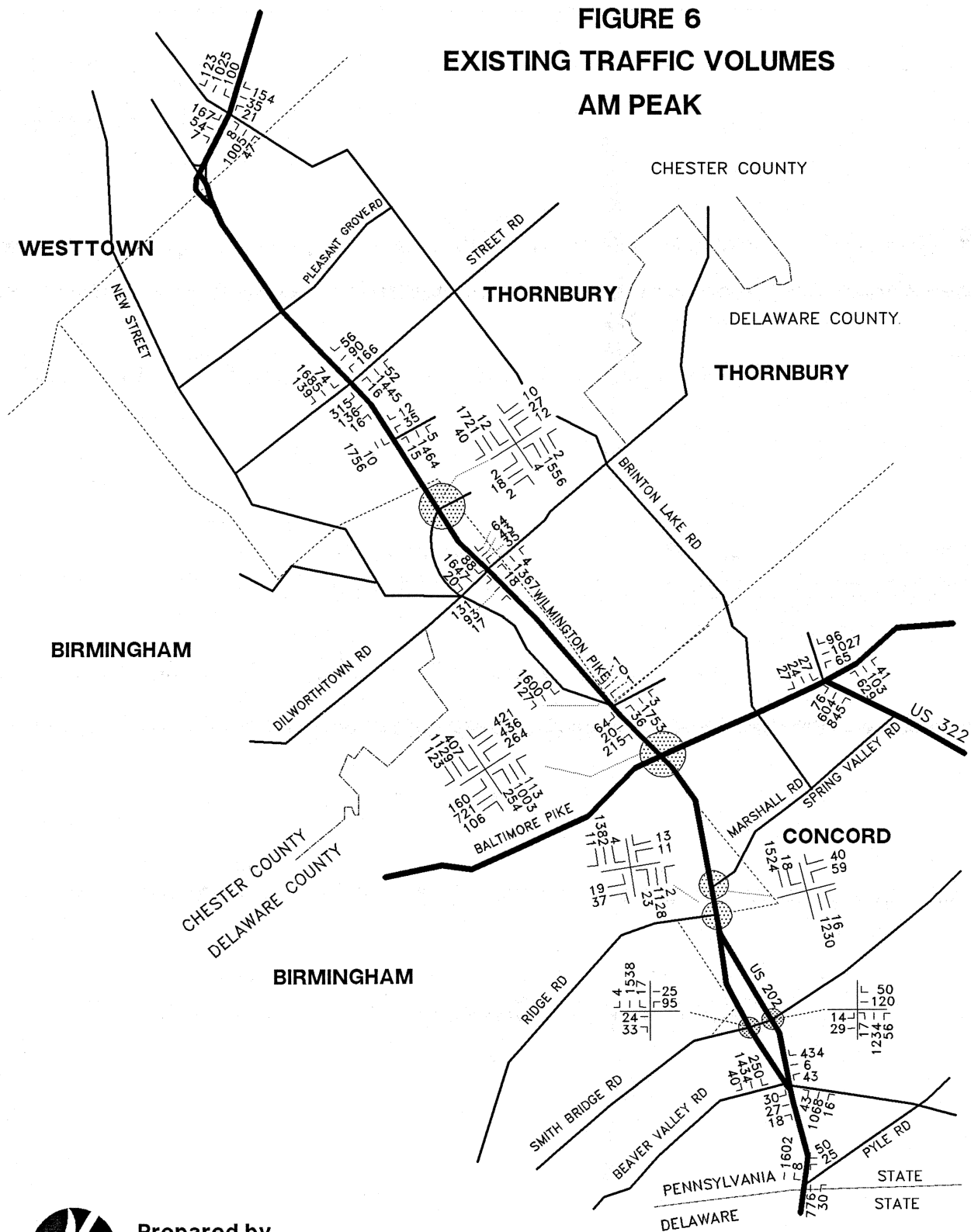
Manual turning movement counts were collected at 14 intersections during May 1987. The counts were conducted between 7-9 AM and 4-6 PM. Peak hour traffic volumes (the four highest consecutive 15-minute periods) are presented in Figures 6 and 7 for the AM and PM peak periods, respectively.

In order to evaluate the benefits of a connector road between US 202 and US 322, a "floating car" study was conducted to determine travel patterns between these two road segments. These patterns are graphically displayed in Figure 8. This figure shows that 48% of the traffic which turned left from US 322 onto US 1 westbound subsequently turned right onto US 202 northbound. This figure also shows that 72% of the traffic which turned left from US 202 southbound onto US 1 eastbound subsequently turned right on to US 322.

Level of Service

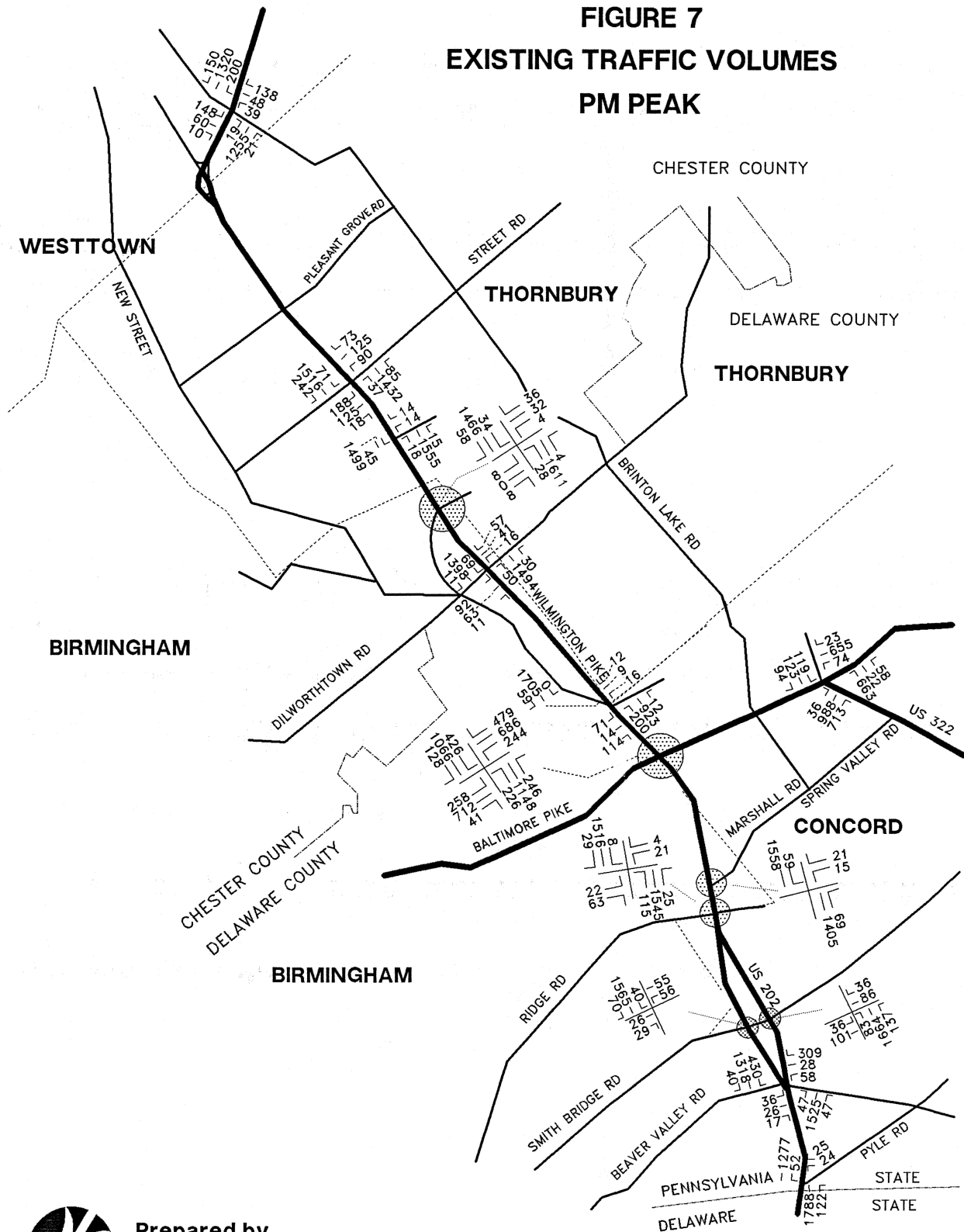
The concept of level of service is a qualitative measure describing operational conditions within a traffic stream and their perception by motorists in terms of speed and travel time, traffic interruptions, freedom to maneuver, comfort, and convenience. Six levels of service are defined; they are given letter designations, A to F, with level of service A representing the best operating conditions and level of service

FIGURE 6
EXISTING TRAFFIC VOLUMES
AM PEAK



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**FIGURE 7
EXISTING TRAFFIC VOLUMES
PM PEAK**

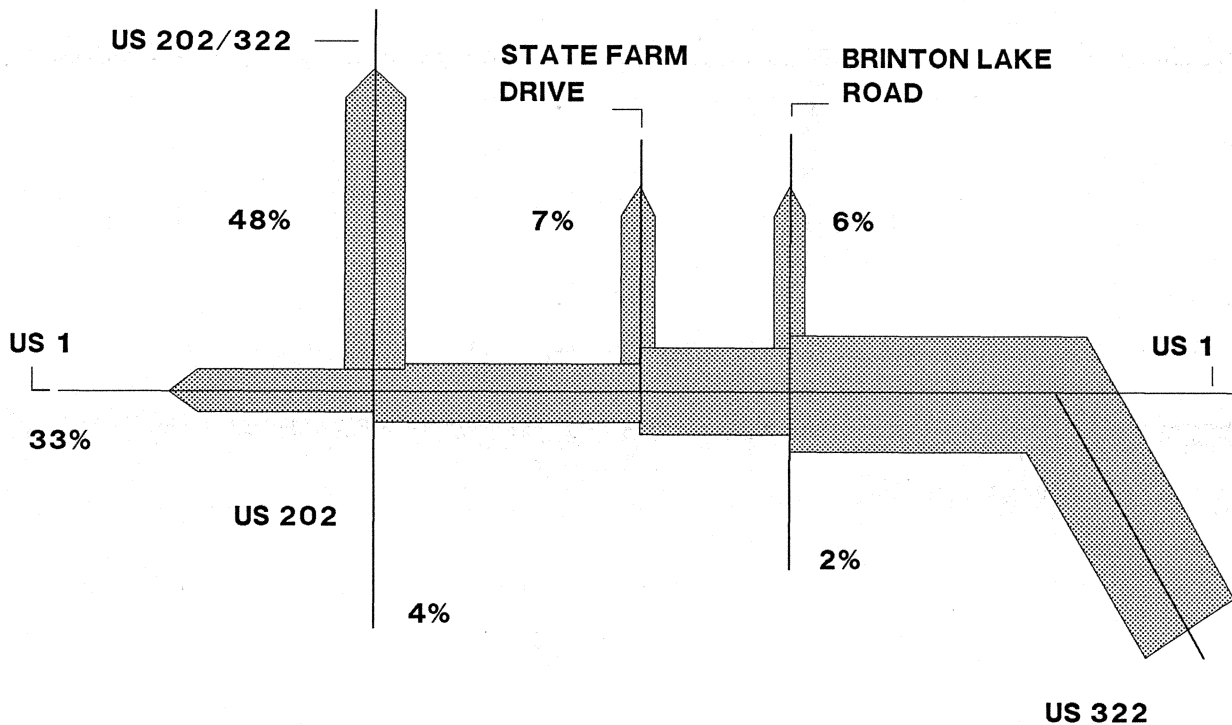


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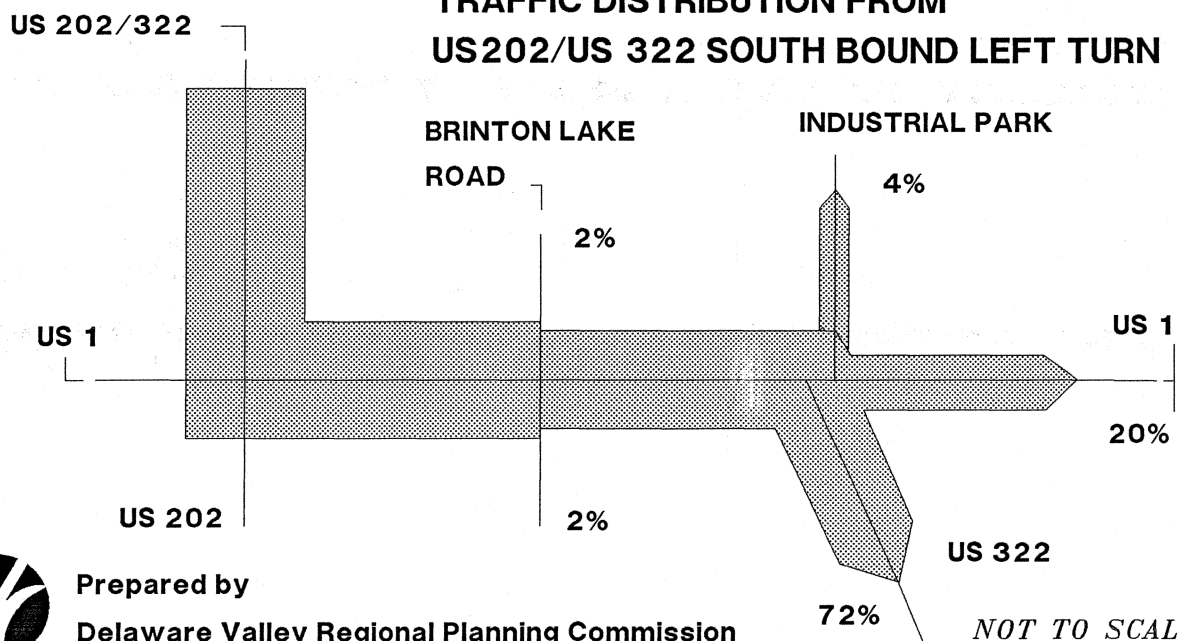
FIGURE 8

TRAFFIC DISTRIBUTION BETWEEN US 202 AND US 322

TRAFFIC DISTRIBUTION FROM
US 322 WEST BOUND LEFT TURN



TRAFFIC DISTRIBUTION FROM
US202/US 322 SOUTH BOUND LEFT TURN



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NOT TO SCALE

F the worst. Level of service C is the minimum desirable condition; however, jurisdictions frequently tolerate level of service D when the cost to upgrade the highway facility becomes prohibitive.

Methodology to determine level of service is presented in the Highway Capacity Manual, Transportation Research Board Special Report 209. Different methodologies are specified for two lane roadways, signalized and unsignalized intersections.

Two lane highways operate under uninterrupted flow conditions when the distance between traffic signals or stop signs exceeds two miles. When the roadway segment is less than two miles in length the intersection where flow is interrupted is the primary determinant of level of service. When uninterrupted flow conditions occur, the level of service for a two lane highway is defined in terms of average travel speed or, more frequently, utilization of capacity, namely the ratio of the demand volume to the capacity of the roadway (V/C ratio). The capacity of a highway is a function of a number of factors including lane and shoulder widths, percent "no passing zone," percent trucks, directional split in traffic flow, and roadway grade. A subjective description of each level of service is given in Table 2. It is important to note that because of the complex relationship between travel speed, percent "no passing zone", roadway grade and level of service, it is not possible to simply list a V/C ratio for each level of service. Service flows at each service level are expressed for ideal conditions. Any deviation from these conditions, for example a lane width of less than 12 feet, will reduce the service flow volume.

The existing levels of service on various road segments are shown in Figure 9. Reviewing this figure we see that the existing levels of service vary from level of service B down to level of service E on several local roads.

Level of service for signalized intersections is defined in terms of delay. Delay is a measure of driver discomfort, frustration, fuel consumption, and lost travel time. Delay is a complex measure dependent upon a number of variables, including the quality of signal progression, cycle length, and the volume to capacity (V/C) ratio. Level of service criteria is stated in terms of the average stopped delay per vehicle on an approach or lane basis. Table 3 gives a subjective description of each level of service and its delay range. It is important to note that delay (i.e., level of service) is not related to capacity in a simple fashion. Thus, the designation of level of service F does not automatically imply the approach is overloaded. Long cycle length and poor signal progression can result in excessive delays. Conversely, an overloaded approach with a short cycle length may result in a high level of service.

Existing levels of service for signalized intersections are shown for the AM and PM peak periods in Figure 10 and 11, respectively. The majority of the signalized intersections show some deficiencies during both peak periods.

Table 2

LEVEL OF SERVICE CRITERIA
TWO LANE HIGHWAYS

LEVEL OF SERVICE A - Average speeds at or above speed limit. The passing frequency required to maintain these speeds has not reached a demanding level. Passing demand is well below passing capacity, almost no platoons of three or more vehicles are observed. A maximum flow rate of 420 vehicles per hour, total in both directions, may be achieved under ideal conditions.

LEVEL OF SERVICE B - Passing demands needed to maintain desired speeds becomes significant and approximately equals passing capacity at the lower boundary of Level of Service B. The number of platoons forming in the traffic stream begins to increase dramatically. Service flow rates of 750 vehicles per hour, total in both directions, can be achieved under ideal conditions.

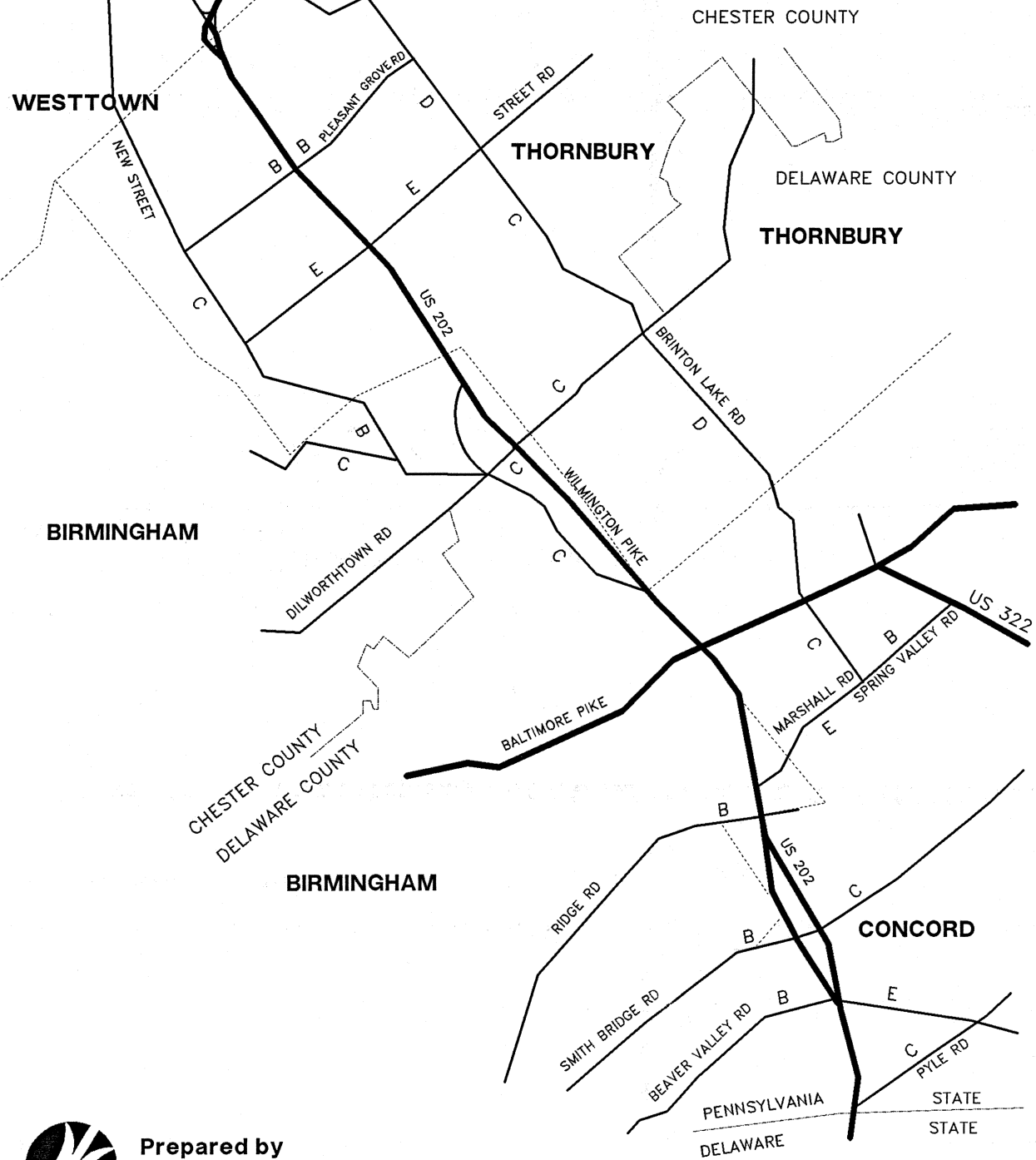
LEVEL OF SERVICE C - Noticeable increase in platoon formation, platoon size, and frequency of passing impediment. Unrestricted passing demand exceeds passing capacity. At higher volume levels, chaining of platoons and significant reductions in passing capacity begin to occur. While traffic flow is stable, it is becoming susceptible to congestion due to turning traffic and slow-moving vehicles. A service flow rate of up to 1,200 vehicles per hour, total in both directions, can be accommodated under ideal conditions.

LEVEL OF SERVICE D - Unstable flow is approached. The two opposing traffic streams essentially begin to operate separately at higher volume levels, as passing becomes extremely difficult. The fraction of no passing zones along the roadway usually has little influence on passing. Turning vehicles and/or roadside distractions cause major shock waves in the traffic stream. This is the highest flow rate that can be maintained for any length of time without a high probability of a breakdown. A service flow rate of up to 1,800 vehicles per hour, total in both directions, can be accommodated under ideal conditions.

LEVEL OF SERVICE E - Passing is virtually impossible and platooning becomes intense when slower vehicles or other interruptions are encountered. The highest volume attainable under Level of Service E defines the capacity of the highway. Under ideal conditions, capacity is 2,800 vehicles per hour total in both directions. For other conditions, capacity is lower.

LEVEL OF SERVICE F - Represents heavily congested flow with traffic demand exceeding capacity. Frequently, perturbations in traffic flow as level E is approached cause a rapid transition to Level of Service F.

FIGURE 9
EXISTING LEVEL OF SERVICE
ON LOCAL ROADS



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Table 3

LEVEL OF SERVICE CRITERIA
SIGNALIZED INTERSECTIONS

LEVEL OF SERVICE A - Very low delay, good progression; most vehicles do not stop at intersection. Delay less than 5 seconds per vehicle.

LEVEL OF SERVICE B - Generally good signal progression and/or short cycle length; more vehicles stop at intersection than Level of Service A. Delay range 5-15 seconds per vehicle.

LEVEL OF SERVICE C - Fair progression and/or longer cycle length; significant number of vehicles stop at intersection. Delay range 15-25 seconds per vehicle.

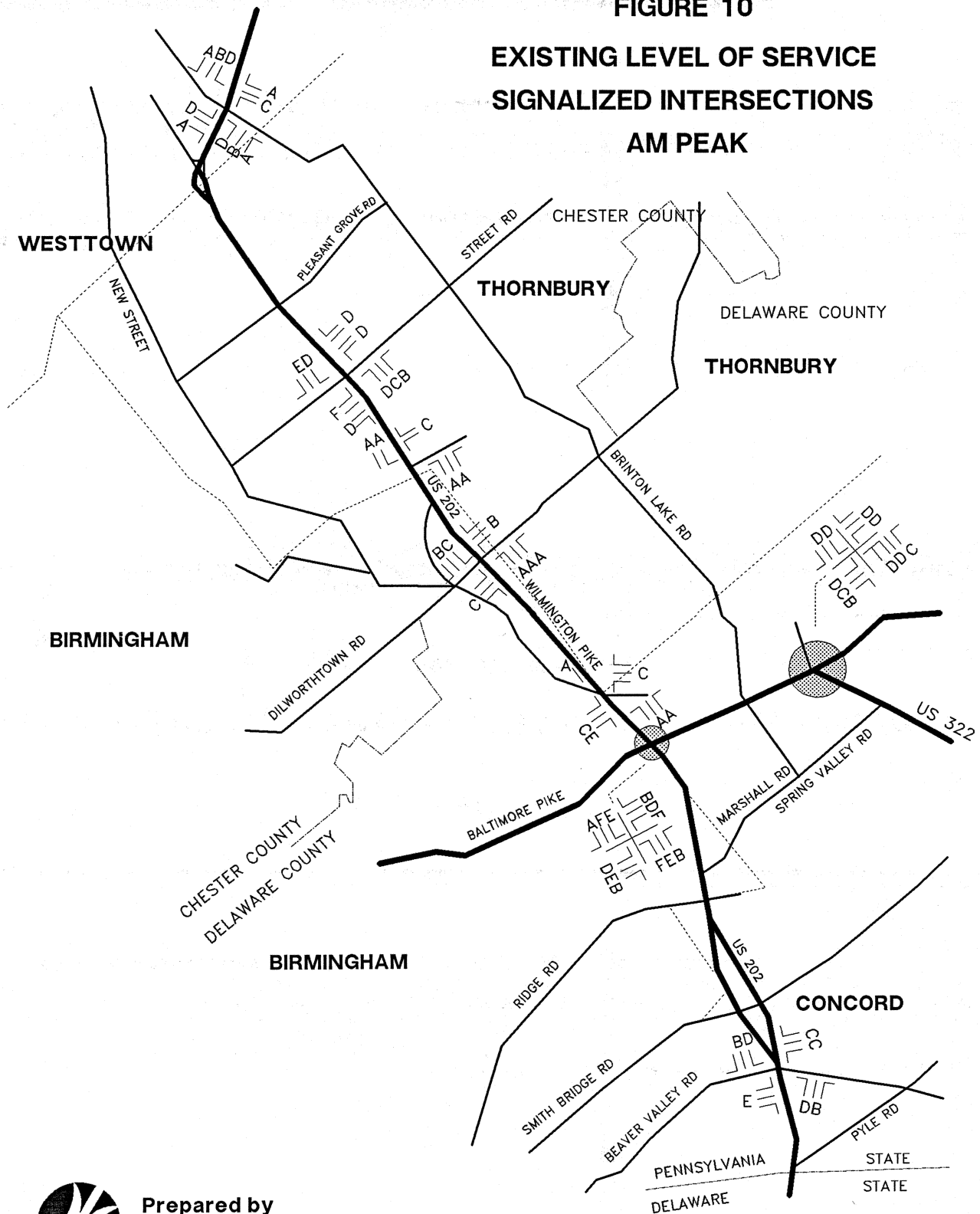
LEVEL OF SERVICE D - Congestion becomes noticeable; individual cycle failures; longer delays from unfavorable progression, long cycle length, or high volume/capacity ratios; many vehicles stop at signal. Delay range 25-40 seconds per vehicle.

LEVEL OF SERVICE E - Considered limit of acceptable delay, indicative of poor progression, long cycle length, high volume/capacity ratio; frequent individual cycle failures. Delay range 40-65 seconds per vehicle.

LEVEL OF SERVICE F - Unacceptable delay, indication of oversaturation (i.e., arrival flow exceeds capacity). Average delay exceeds 60 seconds per vehicle.

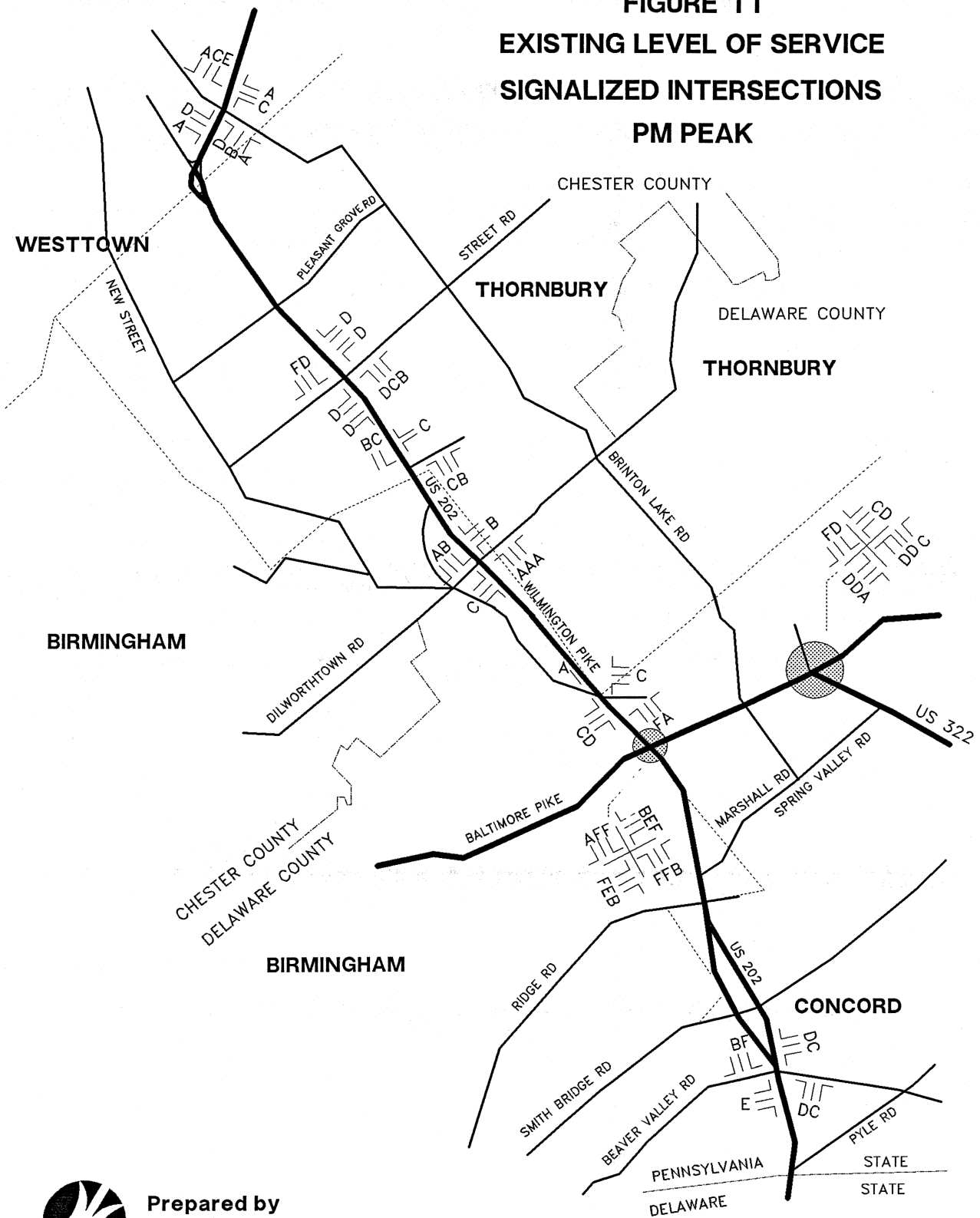
FIGURE 10

**EXISTING LEVEL OF SERVICE
SIGNALIZED INTERSECTIONS
AM PEAK**



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FIGURE 11
EXISTING LEVEL OF SERVICE
SIGNALIZED INTERSECTIONS
PM PEAK



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- . US 202-Beaver Valley/Naamans Creek Road: Eastbound Beaver Valley Road is oversaturated during both peak periods, experiencing level of service E while northbound and southbound left turns from US 202 experience level of service D in the AM peak and D and F respectively in the PM peak.
- . US 202-US 1: This intersection experiences severe congestion during both peak periods. All through and left turn traffic experience levels of service E or F in the PM peak. In the AM peak, both approaches of US 202 operate at level of service E or F, US 1 experiences less congestion with some movements at level of service D.
- . US 1-US 322: All approaches experience significant congestion during both peak periods. The free flow right from US 1 onto US 322 operates well as does the exclusive right turn lane on US 322.
- . US 202-Oakland Road: The eastbound right turn movement experiences level of service E during the morning peak period.
- . US 202-Dilworthtown Road: This intersection operates in a satisfactory manner.
- . US 202-Greentree Drive: This intersection operates at an acceptable level of service.
- . US 202-Street Road: Delays are experienced on southbound US 202 and eastbound and westbound Street Road during both peak periods with these approaches operating at levels of service D, E, or F.

Level of service criteria for unsignalized intersections are defined in terms of reserved or unused capacity. Reserve capacity is related to general delay ranges (see Table 4). Since delay is stated in general terms, without specific numeric values, it is not possible to compare or associate unsignalized level of service with signalized level of service. The potential capacity of a lane is based upon two factors: (1) distribution of gaps in the cross traffic stream and (2) driver judgement in selecting gaps through which to execute the desired maneuvers. Reserve capacity represents the difference between the approach volume and potential capacity. The analysis focuses on lanes on the minor stopped street and left turn maneuvers from the major street.

The existing levels of service for unsignalized intersections are shown in Figures 12 and 13 for the AM and PM peak periods, respectively.

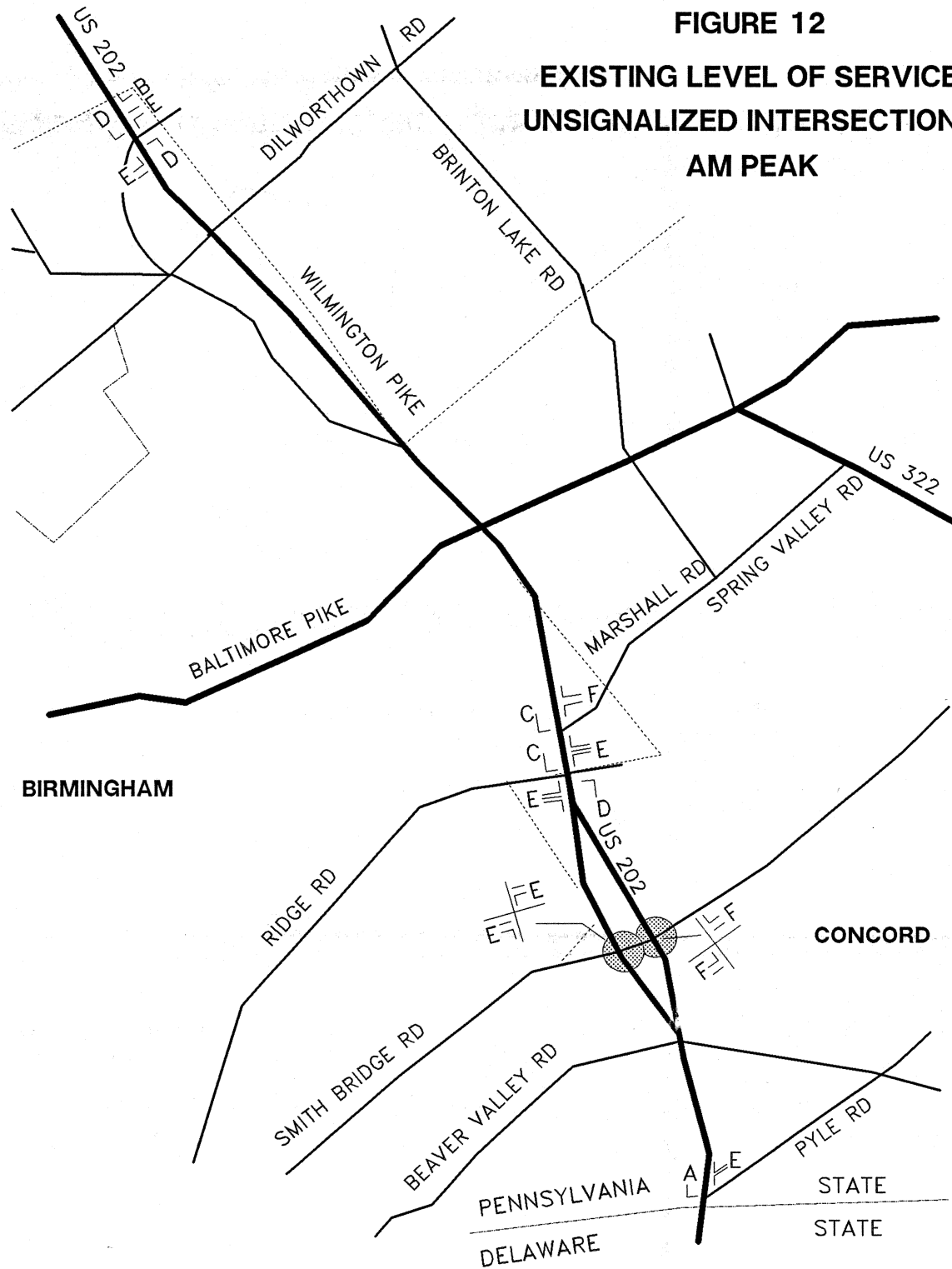
Table 4

LEVEL OF SERVICE CRITERIA
UNSIGNALIZED INTERSECTIONS

<u>Level of Service</u>	<u>Reserve Capacity</u>	<u>Expected Delay to Minor Street Traffic</u>
A	Greater than 400	Little or no delay
B	300-400	Short traffic delays
C	200-299	Average traffic delays
D	100-199	Long traffic delays
E	0-99	Very long traffic delays
F	*	*

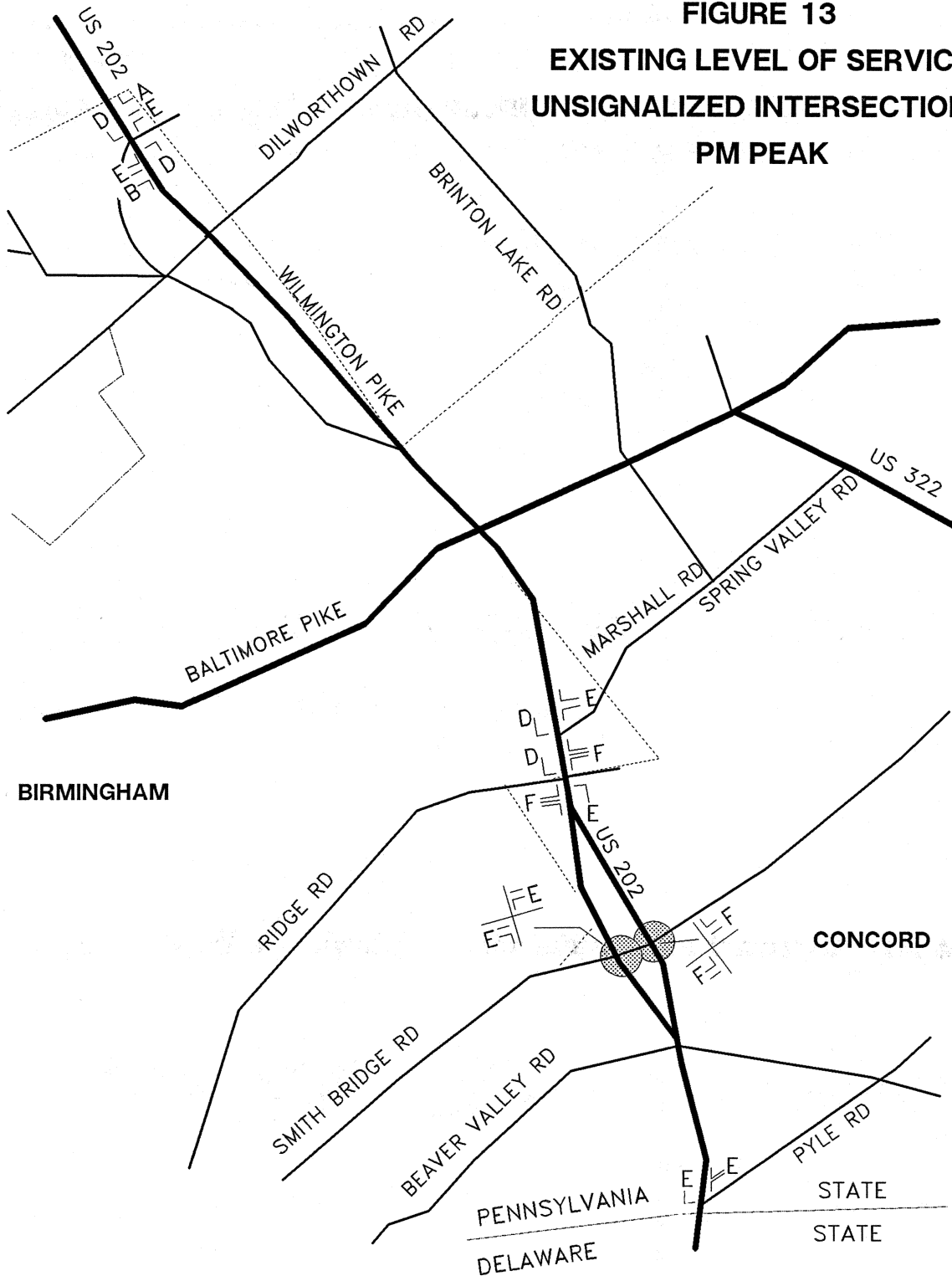
*When demand volume exceeds the capacity of the lane, extreme delays will be encountered with queuing which may cause severe congestion affecting other traffic movements in the intersection.

FIGURE 12
EXISTING LEVEL OF SERVICE
UNSIGNALIZED INTERSECTIONS
AM PEAK



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FIGURE 13
EXISTING LEVEL OF SERVICE
UNSIGNALIZED INTERSECTIONS
PM PEAK



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- . US 202-Pyle Road: The Pyle Road approach operates at level of service E during both peak periods. The left turn from southbound US 202 onto Pyle Road operates at level of service A during the AM peak when only 8 vehicles make the movement and level of service E during the PM peak period when 52 vehicles make the left turn movement.
- . US 202-Smith Bridge Road: Both approaches of Smith Bridge Road operate at level of service F at its intersection with US 202 northbound during the AM and PM peak periods and level of service E at its intersection with southbound US 202 during both peak periods.
- . US 202-Ridge Road/Spring Hill Road: Both Ridge Road and Spring Hill Road operate at level of service E during the AM peak and level of service F during the PM peak period. During the study this intersection was signalized.
- . US 202-Marshall Road: Marshall Road operates at level of service F and E during the AM and PM peak periods, respectively. The left turn movement from US 202 southbound onto Marshall Road operates at level of service C during the AM peak and level of service D during the PM peak.
- . US 202-Old Wilmington Pike: The through and left turn movements on Old Wilmington Pike and Penn Oaks Country Club operate at level of service E during both peak periods.

Safety Analysis

The DVRPC staff conducted a safety analysis for the US 202 study corridor. The PennDOT provided accident records for the years 1984, 1985 and 1986. These accidents were reviewed and plotted to determine the location and type of deficiencies which may exist. The results of the accident analysis are summarized in Table 5.

There were a total of 473 accidents within the study corridor during the three year period analyzed. These 473 accidents resulted in 470 injuries and 4 fatalities. There were approximately 150 accidents in 1984 and 1985 and a slight increase to 177 accidents in 1986. It is premature to judge whether this portends a trend.

Two accident types were prevalent throughout the corridor. Rear end accidents accounted for 177 accidents or 37 percent of the total while off road accidents accounted for 147 accidents or 31 percent of the total accidents. The next most common accident type was right angle accidents, accounting for only 14% of the accidents.

Table 5

US 202 ACCIDENT STATISTICS

Total Reportable Accidents by Year

1984	-	153
1985	-	143
1986	-	177

Three-year total: 473

Summary of Reportable Accidents by Type

Head On	11 or	2%
Rear End	177 or	37%
Left Turn	44 or	9%
Side Swipe	30 or	6%
Right Angle	64 or	14%
Off Road/Fixed Object	<u>147</u> or	<u>31%</u>
	473	100%

Accident Rates of Total Reportable Accidents
(In Accidents per Million Vehicle Miles)

US 202 Accident Rate	1.38
Pennsylvania Accident Rate	1.89

Of the total number of accidents, 286 or 60.5 percent occurred under dry road conditions. Similarly, 269 accidents or 57 percent occurred during the daylight hours. The percentages are consistent with statewide statistics.

To place traffic accidents on US 202 in perspective an accident rate analysis was conducted. Accident rates (accidents per million vehicle miles travelled) minimize the affect traffic volumes and length of roadway have on the number of traffic accidents. There were approximately 343 million vehicle miles travelled in the corridor during 1985. This yields an accident rate of 1.38 accidents per million vehicle miles, an injury rate of 1.37 injuries per million vehicle miles and a fatality rate of 1.17 fatalities per hundred million vehicle miles. The Center For Highway Safety of PennDOT has published a report entitled 1985 TRAFFIC ACCIDENT FACTS AND STATISTICS. This publication is a statistical review of motor vehicle traffic accidents in the Commonwealth of Pennsylvania. The US 202 corridor rates compare favorably to the statewide rates which show an accident rate of 1.89 accidents per million vehicle miles, an injury rate of 1.85 injuries per million vehicle miles and a fatality rate of 2.39 fatalities per hundred million vehicle miles.

The six highest accident locations along US 202 are listed below. The number of accidents at Painters Crossroads (US 202-US 1) is significantly higher than the second ranked intersection. Similarly, the number of accidents at the next grouping of intersections is significantly lower than the locations listed below. All intersections are signalized except Old Wilmington Pike.

1. US 1
2. Naamans Creek Road/Beaver Valley Road
3. Street Road
4. Oakland Road
5. Smithbridge Road
6. Old Wilmington Pike

FUTURE TRAFFIC CONDITIONS

TRAVEL DEMAND FORECAST

In this section, the year 2008 traffic projections for the US 202 corridor will be presented. This section will also present the methodology and assumptions used to make the projections and the two alternatives modeled. The travel projections will lay the groundwork for the next two sections- the US 202 alternatives analysis and the Painters Crossroads alternatives analysis.

Focused Traffic Simulation Model

Traffic demand projections for the year 2008 were estimated using a focused traffic simulation model. The model, an extension of the DVRPC regional traffic simulation model, was specifically calibrated to evaluate impacts in the study area. Trip generation and traffic flow patterns were driven by demographic data while the assignment of traffic to particular roads was a function of the highway network; thus changes to land development patterns or the highway network were reflected in the model's output.

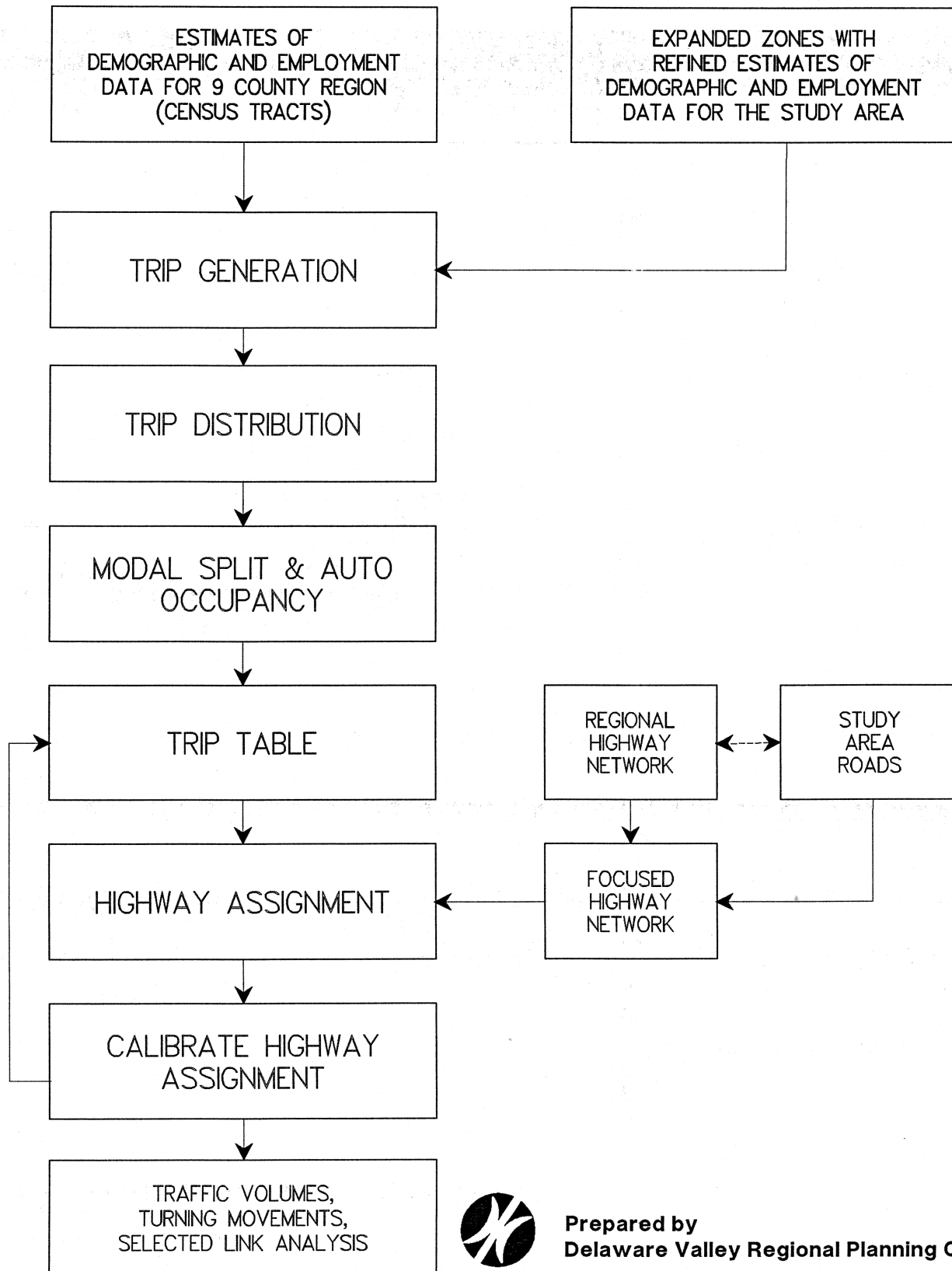
The DVRPC traffic simulation model is essentially the Federal Highway Administration's Urban Transportation Planning System (UTPS) package customized for the Delaware Valley. The model is periodically updated and recalibrated to reflect changing conditions. PennDOT uses the model for alternatives testing and 20 year traffic projections.

The model (see Figure 14) is based on the standard four step transportation planning process described below:

1. Trip Generation - The DVRPC region is divided into 1335 zones, generally corresponding to census tracts. The number of trips generated by each zone is estimated using the following demographic data: population, households, employed residents, households stratified by auto ownership, total automobiles, and employment stratified by the 11 standard industrial classification (SIC) groups. Estimates of external and through travel to the region are developed independently.
2. Trip Distribution - Trips are distributed among the zones within the region by means of a gravity model. This model assumes that the propensity to travel to a zone of destination increases with the attractiveness of the destination (as measured by employment) and decreases as the difficulty of travelling between zones increases.

FIGURE 14

FOCUSED TRAFFIC SIMULATION PROCESS



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3. Modal Split - Modal split divides the trips between zones into highway trips and transit trips.
4. Traffic Assignment - Through an iterative process the trips are assigned to the highway network, based upon minimal path travel times, forming link volumes. The minimum path between zones is calculated on the basis of link length, highway type (limited access expressway, arterial or collector) and link volumes.

The DVRPC highway network contains virtually every street of significance in the region. All expressways, arterials and a majority of the collector roads are included in the network. Statistically, the network includes over 1,000 miles of expressways, 8,500 miles of arterials, and 3,000 miles of collectors. Each highway segment, or link, is defined by the following parameters: length in miles, functional classification, type of surrounding area (e.g., urban, suburban, or rural), geographic location, hourly capacity, toll class and number of lanes.

The focused simulation traffic zones are shown in Figure 15. The original simulation zones have been subdivided into smaller zones in order to provide more accurate estimates of trip generation and highway assignment.

The focused simulation highway network is shown in Figure 16. Several roads have been added to the regional highway network as part of the focused simulation process.

Future Development

To estimate future trips, the trip matrix for the study area required updating. The number of households and square footage of office and retail development for the year 2008 had to be estimated with square footage of office and retail development serving as a surrogate for employment. Development levels were obtained at the meetings between the technical steering committee representatives and the municipal representatives. Estimating development on a 20 year time frame was a tenuous task; however the municipal representatives were able to rely on their knowledge of: 1) the area, 2) the property owners, 3) the pressures on local development and 4) the existing zoning regulations to provide a best estimate of future development. The assistance of these municipal representatives was essential in this process.

The results of the meetings are presented in Table 6. It is estimated that for the period 1988 to 2008 anticipated development in the study area will include over 6,100 single family residential units and over 4,000 multi-family residential units. Chester County accounts for close to two-thirds of the anticipated residential development with over 4,700 single family residential units and 1,700 multi-family residential units. In Delaware County 1,400 single family residential units and

FIGURE 15

FOCUSED SIMULATION TRAFFIC ZONES

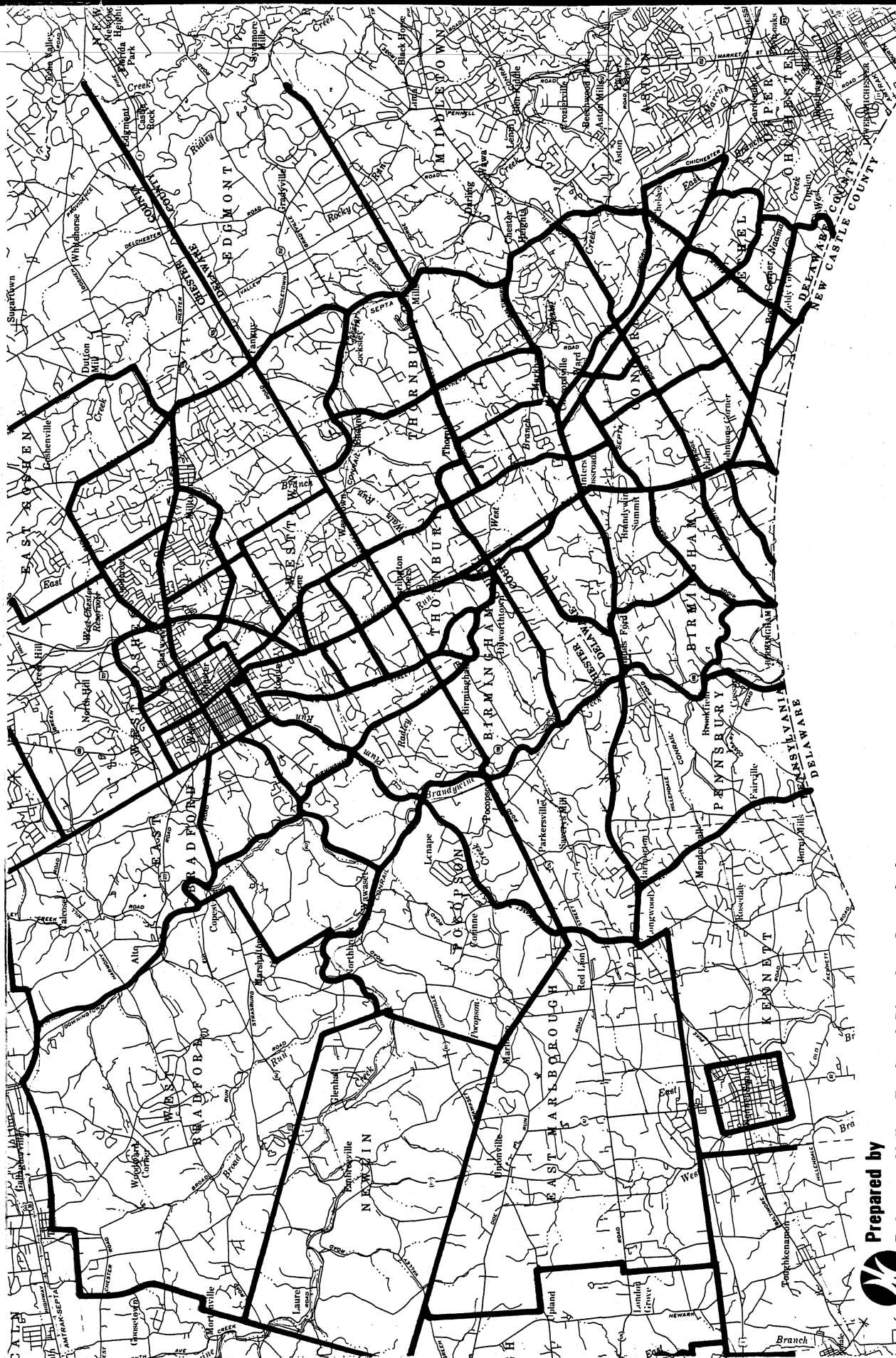
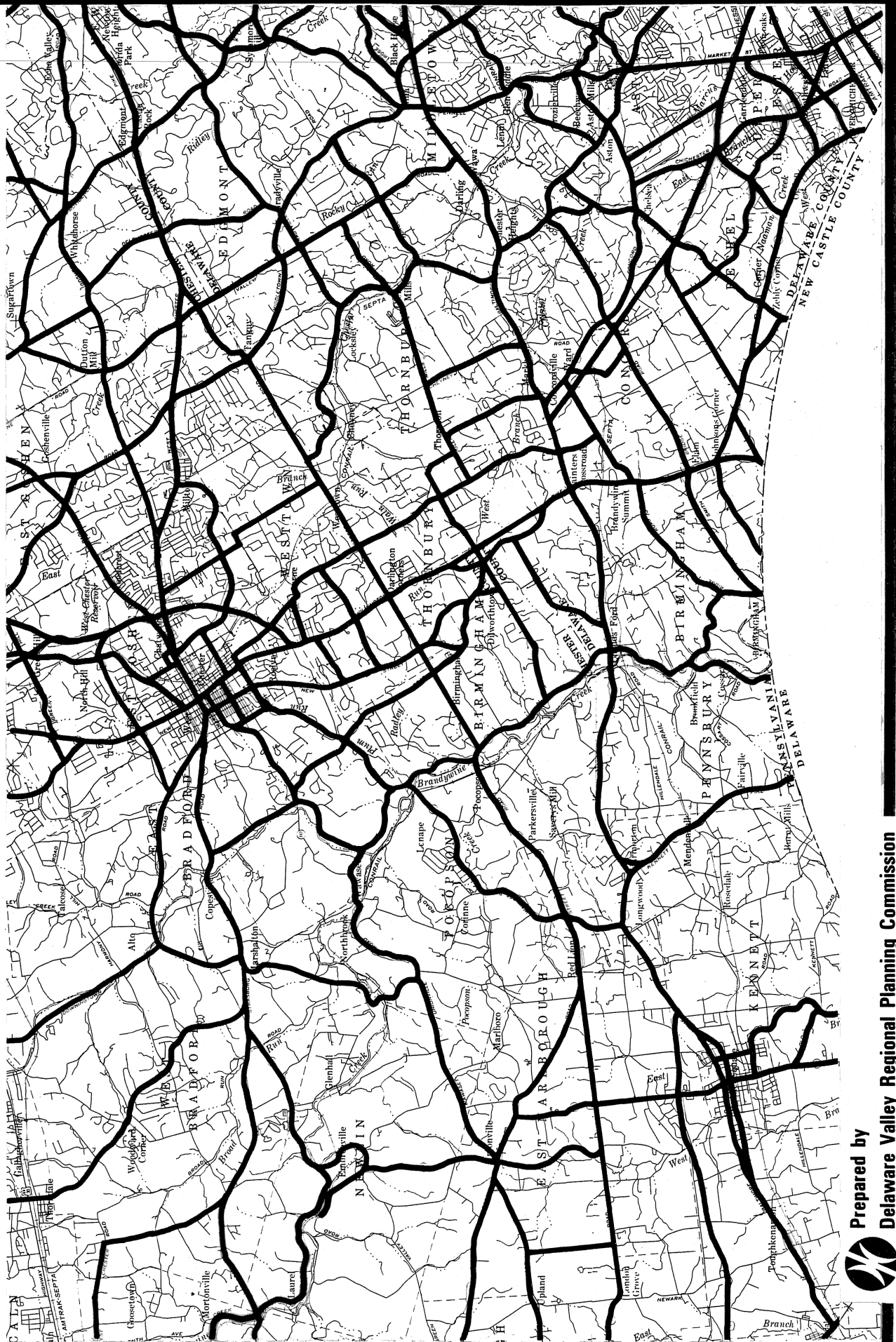


FIGURE 16

FOCUSED SIMULATION HIGHWAY NETWORK



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Table 6

ANTICIPATED DEVELOPMENT 1988-2008

	<u>Residential</u>	<u>(Units)</u>			
	<u>Single</u>	<u>Multi-</u>	<u>Commercial</u>	<u>Office</u>	
	<u>Family</u>	<u>Family</u>	<u>(Square ft.)</u>	<u>(Square ft.)</u>	<u>Other</u>
<u>CHESTER COUNTY</u>					
Birmingham	401	171	-	-	-
East Bradford	958	276	50,000	50,000	-
Kennett	605	-	50,000	100,000	-
Pennsbury	530	160	-	-	School/400 Students
Pocopson	205	-	-	120,000	-
Thornbury	507	600	50,000	50,000	-
West Goshen	1,060	350	200,000	250,000	-
Westtown	485	200	-	-	School/300 Students
Total	4,751	1,757	350,000	570,000	
<u>DELAWARE COUNTY</u>					
Bethel	N/A	N/A	N/A	N/A	N/A
Birmingham	470	350	700,000	200,000	300 Hotel Rooms
Concord	621	1,433	-	1,700,000	60 Hotel Rooms
Thornbury	300	520	500,000	500,000	-
Total	1,391	2,303	1,200,000	2,400,000	-
TOTAL Study Area	6,142	4,060	1,550,000	2,970,000	-

N/A Data not available

2,300 multi-family residential units are anticipated. These projections represent a continued growth rate at a pace slightly accelerated over the existing growth between 1980-1987.

Also projected for the study area are over 1.5 million square feet of commercial space, approximately 3 million square feet of office space, 360 hotel rooms and two new schools serving approximately 700 students. Non-residential development will be concentrated in Delaware County.

Traffic Projection Alternatives

Traffic projections for the year 2008 were made for two alternatives, a four lane highway and a six lane highway scenario. The four lane alternative assumed the existing four lane roadway with jug handles at major intersections in lieu of the left turn lanes. The six lane alternative assumed an additional through lane in each direction and jug handles at major intersections. The conceptual intersection improvements are detailed more fully in the alternatives analysis section. In addition, to simulate the future conditions as accurately as possible, the highway network was updated to reflect improvements which can reasonably be expected. Both alternatives were modeled with US 322 widened to four lanes, no major improvements to the Painters Crossroads intersection, and the Blue Route (I-476) open to traffic.

Consideration was given to the concept of frontage and backage roads. The former was rejected because of insufficient right-of-way. A properly designed frontage road requires a buffer between itself and the main line roadway and storage capacity for turning vehicles entering and exiting US 202. A review of aerial photographs of the corridor revealed that existing commercial properties provided inadequate set backs. Backage roads were rejected because the parcels fronting US 202 do not have uniform rear property lines. Backage roads were also rejected because of signage problems associated with them. Rejection of these concepts as corridor-wide improvements should not inhibit their application on a more limited parcel specific basis.

Another alternative consisting of a limited access highway on a new alignment was given a cursory review. The technical steering committee determined that this alternative was not feasible from an environmental and cost perspective. The National Environmental Protection Act (NEPA) requires an extensive analysis to identify mitigation measures to reduce the highway's impact on parks or public recreation sites, historic sites, wetlands, agricultural preserve lands and stream valleys/greenways. The technical steering committee identified and mapped a large number of sites in the corridor that fall under these categories. These sites, which included the following: Brandywine Battlefield National Historic Landmark, historic districts in both Birmingham Townships, and the Brandywine Creek, precluded a new alignment. A new limited access highway between the Delaware State Line and the West Chester Bypass could cost between \$120-200 million depending upon length of route and different assumptions on cost per mile. The current funding level of

PennDOT's Twelve Year Program for Delaware and Chester Counties is \$721.1 million. Even at this funding level, many high priority projects have no committed funding. Thus it is not feasible that PennDOT will fund a new US 202 alignment under the projected funding levels.

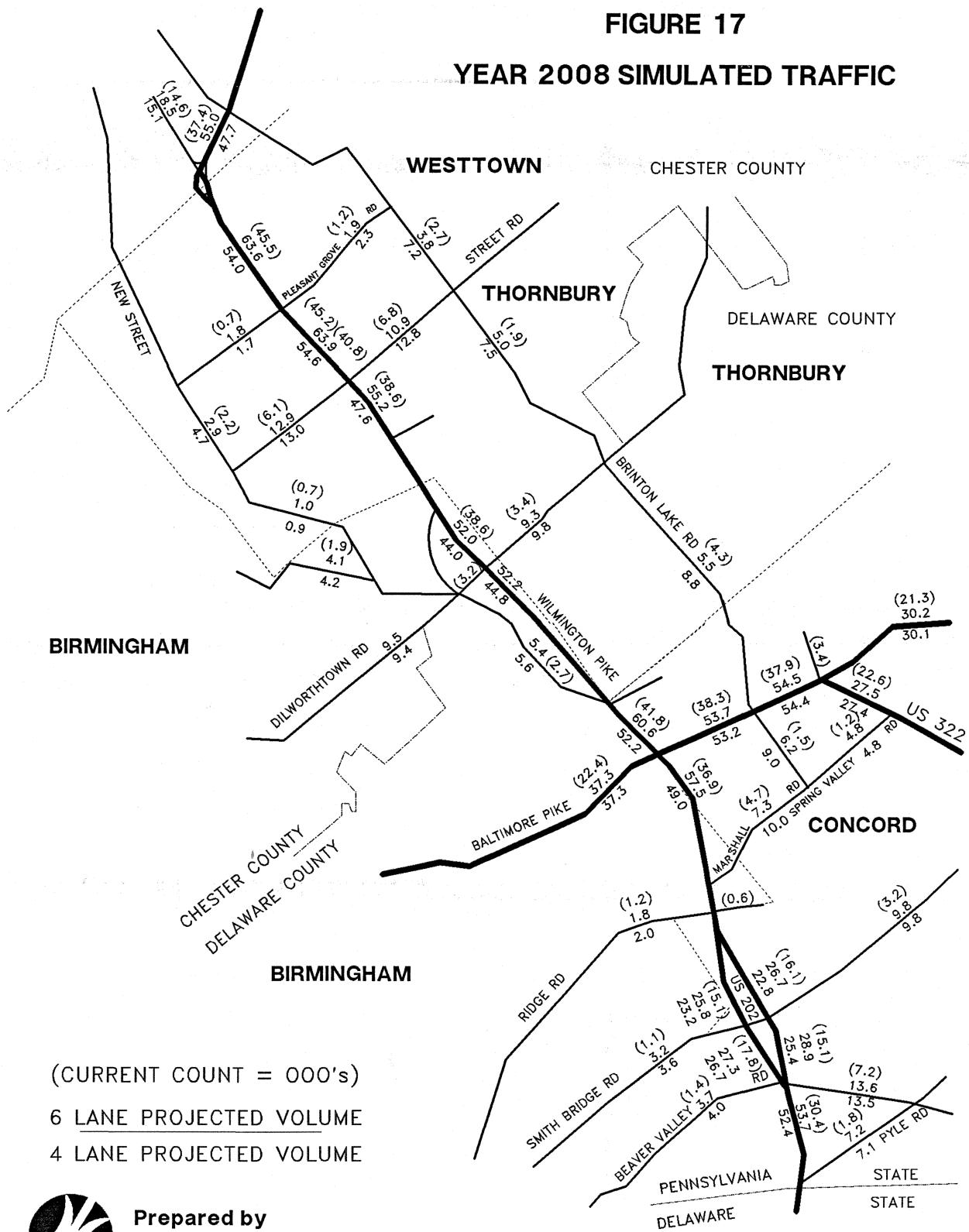
US 202 Year 2008 Traffic Projections

The projected year 2008 AADT traffic volumes for the four and six lane scenarios are presented in Figure 17. A comparison between the projected volumes and the existing AADT is presented in Table 7. The major findings are presented below.

- . The six lane scenario shows significantly higher traffic volumes on US 202 than the four lane scenario. Generally, the six lane alternative will carry 15-18% more traffic than the four lane roadway.
- . Traffic volumes at the southern terminus of the US 202 corridor display the largest increase in terms of both absolute volumes and percent increase above existing levels. Proceeding further north along US 202, the increase in traffic and percent increase above existing levels continually diminish.
- . US 202 traffic volumes at Pyle Road are expected to increase from the existing 30,400 vehicles per day to 52,400 vehicles per day under the four lane scenario and to 53,700 vehicles per day under the six lane scenario. This represents approximately a 75% increase over existing traffic levels.
- . North of US 1 daily traffic is projected to increase from 41,800 vehicles to 52,200 vehicles under the four lane scenario and to 60,600 vehicles under the six lane scenario. This represents a 25% and a 45% increase, respectively. South of US 1 the magnitude of increase and percent increase is slightly greater, from 36,900 vehicles to 49,000 under the four lane scenario and 57,500 under the six lane scenario. The net result is a diminution of the traffic level differential between north and south of US 1.
- . Between Pleasant Grove Road and US 322 Bus., US 202 traffic volumes are expected to increase from 45,500 vehicles per day to 54,000 per day under the four lane scenario and 63,600 vehicles per day under the six lane scenario. This translates into a 17% and 40% increase, respectively.

FIGURE 17

YEAR 2008 SIMULATED TRAFFIC



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Table 7

COMPARISON OF 1987 AADT to FOUR AND SIX LANE AADTs

<u>Road/Segment</u>	<u>1987</u> <u>AADT</u>	<u>FOUR LANE</u> <u>AADT</u>	<u>% INC</u>	<u>SIX LANE</u> <u>AADT</u>	<u>% INC</u>
<u>US 202</u>					
Pyle Rd-Naamans Creek Rd	30,400	52,400	72%	53,700	77%
Marshall Rd-US 1	36,900	49,000	33%	57,500	56%
US 1-Oakland Rd	41,800	52,200	25%	60,600	45%
Dilworthtown Rd- Old Wilmington Pike	38,600	44,000	14%	52,000	35%
Greentree Dr-Street Rd	38,600	47,600	23%	55,200	43%
Pleasant Grove Rd-US 322	45,500	54,000	19%	63,600	40%
US 322-Matlack St	37,400	47,700	28%	55,000	47%
<u>Brinton Lake Road</u>					
Spring Valley Rd-US 1	1,500	9,000	500%	6,200	313%
US 1-Dilworthtown RD	4,300	8,800	105%	5,500	28%
Dilworthtown Rd-Street Rd	1,900	7,500	295%	5,000	163%
Street Rd-Pleasant Grove Rd	2,700	7,200	167%	3,800	41%
<u>South New Street/Oakland Rd</u>					
Oakland Rd-Dilworthtown Rd	2,700	5,600	107%	5,400	100%
Birmingham Rd-Street Rd	700	900	29%	1,000	43%
Street Rd-Pleasant Grove Rd	2,200	4,700	114%	2,900	32%
<u>Pyle Road</u>	1,800	7,100	294%	7,200	300%
<u>Naamans Creek/Beaver Valley</u>					
East of US 202	7,200	13,500	88%	13,600	89%
West of US 202	1,400	4,000	186%	3,700	164%
<u>Smithbridge Road</u>					
East of US 202	3,200	9,800	206%	9,800	206%
West of US 202	1,100	3,600	227%	3,200	191%
<u>Ridge Road</u>	1,200	2,000	67%	1,800	50%
<u>Marshall Road</u>	4,700	10,000	113%	7,300	55%

(CONTINUED)

COMPARISON OF 1987 AADT to FOUR AND SIX LANE AADTs
(CONTINUED)

<u>Road/Segment</u>	1987	<u>FOUR LANE</u>		<u>SIX LANE</u>	
	<u>AADT</u>	<u>AADT</u>	<u>% INC</u>	<u>AADT</u>	<u>% INC</u>
<u>Dilworthtown Road</u>					
East of US 202	3,400	9,800	188%	9,300	174%
West of US 202	-	9,400	-	9,500	-
<u>Street Road</u>					
East of US 202	6,800	12,800	88%	10,900	60%
West of US 202	6,100	13,000	113%	12,900	111%
<u>Pleasant Grove Road</u>					
East of US 202	1,200	2,300	92%	1,900	58%
West of US 202	700	1,700	143%	1,800	157%
<u>US 1</u>					
East of US 322	21,300	30,100	41%	30,200	42%
US 322-Brinton Lake Rd	37,900	54,400	44%	54,500	44%
Brinton Lake Rd-US 202	38,300	53,200	38%	53,700	40%
West of US 202	22,400	37,300	67%	37,300	67%
<u>US 322</u>					
South of US 1	22,600	27,400	21%	27,500	22%
<u>US 322 BUS.</u>	14,600	15,100	4%	18,500	28%

- . Traffic on roads parallel to US 202 is expected, in many locations, to double or triple above existing levels. The increase can be attributed, in part, to the roads functioning as collectors to the new development and, in part, to through traffic using the parallel roads as a bypass to US 202. Even though the six lane scenario is successful in diminishing the latter affect, traffic increases arising from new development will still be substantial.
- . Brinton Lake Road is expected to experience the largest absolute increase in traffic between Spring Valley Road and US 1, from 1,500 vehicles per day in 1987 to 9,000 under the four lane scenario and 6,200 under the six lane scenario. Between US 1 and Street Road, Brinton Lake Road is expected to average 8,100 vehicles a day under the four lane scenario and 5,200 vehicles daily under the six lane scenario.
- . Among the crossroads in Delaware County, Pyle Road is expected to have the largest percent increase in traffic above existing levels, approximately 300% from 1,800 to over 7,000 vehicles daily. Traffic levels are expected to double on Naamans Creek Road and Smithbridge Road.
- . In Chester County, on Street Road east of US 202, traffic is expected to increase from approximately 6,800 vehicles to 12,800 vehicles under the four lane scenario and 10,900 vehicles per day under the six lane scenario. West of US 202, daily traffic is projected to increase from 6,100 to 13,000 vehicles.
- . The two scenarios to improve US 202 have a uniform impact on US 1. Under either scenario US 1 volumes are expected to increase approximately 41% east of US 202 and 67% west of US 202. Traffic on the segment between US 322 to US 202 is expected to increase from 38,000 vehicles a day to 54,000 vehicles daily.
- . Under both scenarios, daily traffic on US 322 south of US 1 is projected to increase from 22,600 vehicles to approximately 27,400 vehicles, a 21% increase. However, on US 322 Bus., daily traffic will increase from 14,600 vehicles to 15,100 under the four lane scenario, a 4% increase, and to 18,500 under the six lane scenario, a 28% increase.

Painters Crossroads Year 2008 Traffic Projections

To assist in evaluating alternative improvements to Painters Crossroads, year 2008 AADT turning movements for the intersection are presented in Figure 18. The volumes were derived from the output of the six lane traffic simulation. A review of the turning movements indicates the following patterns:

- . The largest traffic flow at Painters Crossroads will be the north-south through movement consisting of 39,500 vehicles per day.
- . The east-west through movement will consist of 26,500 vehicles per day.
- . The movement that follows US 322 through the intersection will account for 16,200 vehicles per day. There will be 9,000 right turns from westbound US 1 onto northbound US 202, and 7,200 corresponding left turns from southbound US 202 onto eastbound US 1. The unequal AADT travel flow pattern is a very common phenomenon.
- . The remaining Painters Crossroads turning movements will range between 1,300 and 5,700 vehicles per day.
- . In all, 105,600 vehicles will transverse the intersection on an average daily basis.

US 202 ALTERNATIVES ANALYSIS

The two alternatives, a four lane scenario and a six lane scenario, were evaluated with respect to their impact on traffic flow patterns, level of service, impact on existing land uses, and other measures of effectiveness.

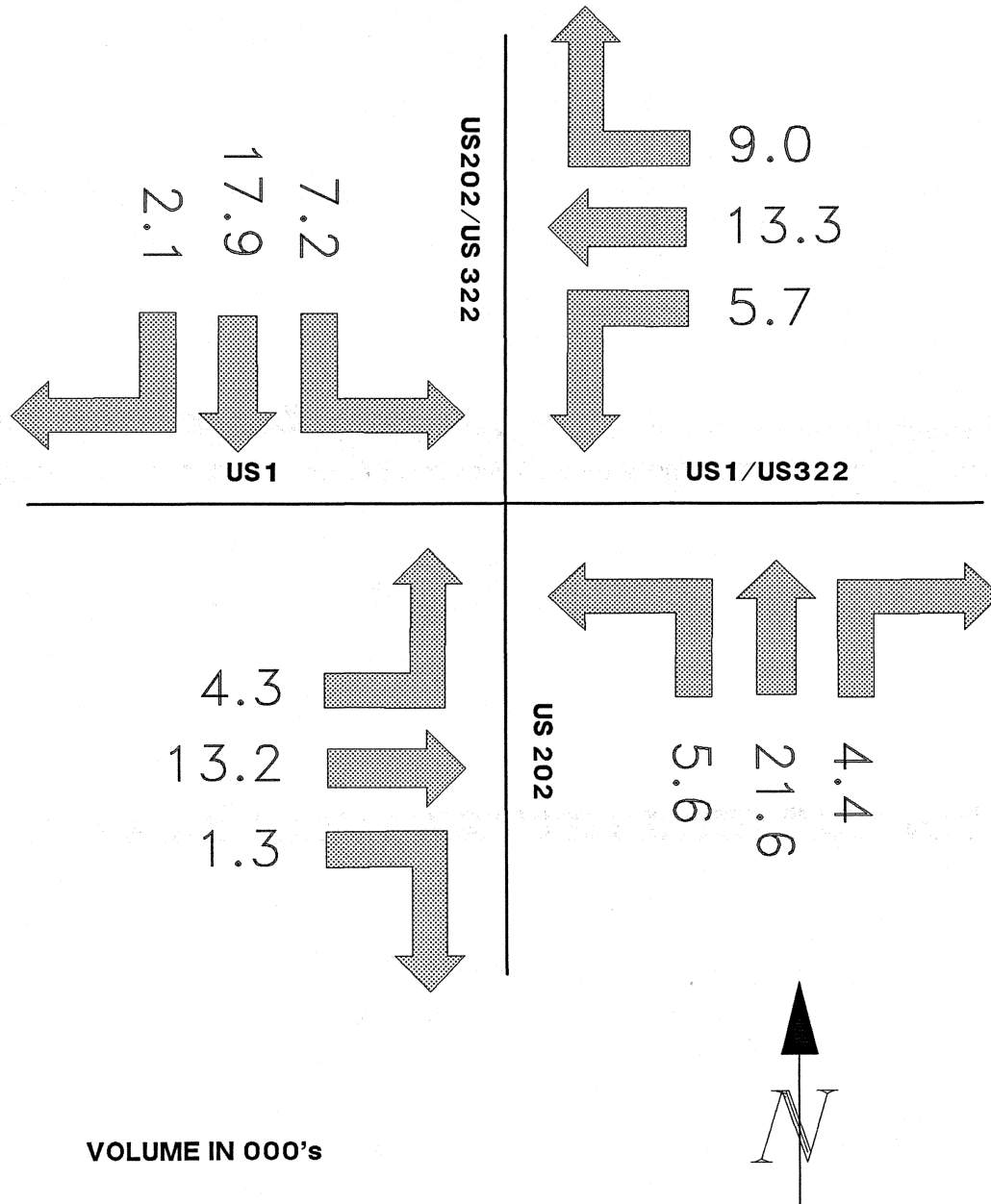
Travel Volumes and Patterns

As part of the travel simulation process, traffic volumes were developed and assigned to the road network for both the four and six lane scenarios. Increasing the number of lanes on US 202 would affect not only traffic demand on US 202 but also the traffic demand on other roads in the corridor. This section will address the magnitude of traffic on the four and six lane US 202. It will also look at the traffic volumes on the parallel roads in the corridor under both scenarios.

The six lane scenario traffic volumes have a higher growth rate than those for the four lane scenario relative to existing traffic levels. The four lane scenario shows growth in the range of 14%-33% (see Table 7) while the six lane scenario is in the range of 35%-56% over existing

FIGURE 18

YEAR 2008 AADT TURNING MOVEMENTS
PAINTERS CROSSROADS INTERSECTION



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levels. The six lane scenario is projected to carry a higher volume caused, in part, by through trips taking advantage of the increased capacity and, in part, by the diversion of traffic off of the parallel roads. A capacity analysis will address the issue of whether the increase in volume offsets the increase in capacity.

A comparison of the two alternatives is presented in Table 8. The six lane scenario is projected to carry up to 9,600 more vehicles a day than the four lane scenario. This translates into an increase of approximately 17%. Approximately 3,000 of these vehicles are diverted from Brinton Lake Road onto US 202. Another 1,800 vehicles are diverted from New Street. Therefore, the number of new trips induced onto US 202 from outside the corridor is expected to be less than 5,500 vehicles per day.

Roads parallel to US 202, namely Brinton Lake Road and New Street, will experience enormous increases in traffic under both the four and six lane scenarios; however, the impacts from the six lane scenario will not be as severe as those from the four lane scenario. This increase is attributable to local land development with the roads functioning as collectors instead of the local roads. A secondary factor is the use of these roads as a bypass around overcongested US 202. Under the six lane scenario, Brinton Lake Road will carry approximately 3,000 fewer daily vehicles than under the four lane scenario, roughly a 35% reduction. Similarly, New Street will carry 1,800 fewer vehicles, a 38% reduction when compared to the four lane scenario. Constructing the six lane scenario will significantly diminish the magnitude of traffic growth on the parallel roads in the corridor.

Intersection Improvement Scenarios

The evaluation of the four and six lane scenarios required that intersection improvements be conceptualized for each intersection. These improvements are summarized in Table 9. The intersection configurations were then used to conduct level of service analyses for each scenario. Slight modifications were made to these conceptualized configurations to reflect the development that has occurred subsequent to this analysis, comments raised by the counties, and design considerations.

The intersection improvements under the two alternatives are very similar: left turns are not permitted on US 202, near side or far side jug handles are used to accommodate left turns, the jug handles are generally located in the same spot and the lane configurations on the cross roads are the same. The primary difference between the two scenarios is that under the four lane scenario when a third lane is added to a US 202 approach it is restricted to right turn vehicles and vehicles using a far side jug handle. Under the six lane scenario, the third lane can also be used by through traffic in addition to the two movements previously noted.

Table 8

COMPARISON OF FOUR VS. SIX LANE AADT's
US 202 AND PARALLEL ROADS

<u>Road/Segment</u>	<u>1987 Volumes</u>	<u>4 Lane Volumes</u>	<u>6 Lane Volumes</u>	<u>Difference 6 Lane vs. 4 Lane</u>	<u>Percent Difference 6 vs. 4 La.</u>
<u>US 202</u>					
Pyle Rd-Naamans Creek Rd	30,400	52,400	53,700	1,300	2.5
Marshall Rd-US 1	36,900	49,000	57,500	8,500	17.3
US 1-Oakland Rd	41,800	52,200	60,600	8,400	16.1
Dilworthtown Rd- Old Wilmington Pike	38,600	44,000	52,000	8,000	18.2
Greentree Dr-Street Rd	38,600	47,600	55,200	7,600	16.0
Pleasant Grove Rd-US 322	45,500	54,000	63,600	9,600	17.8
US 322-Matlack St	37,400	47,700	55,000	7,300	15.3
<u>Brinton Lake Road</u>					
Marshall Rd-US 1	1,500	9,000	6,200	-2,800	-31.1
US 1-Dilworthtown Rd	4,300	8,800	5,500	-3,300	-37.5
Dilworthtown Rd-Street Rd	1,900	7,500	5,000	-2,500	-33.3
Street Rd-Pleasant Grove Rd	2,700	7,200	3,800	-3,400	-47.2
<u>New Street/Oakland Rd</u>					
Oakland Road-Dilworthtown Rd	2,700	5,600	5,400	- 200	-3.6
Birmingham Rd-Street Rd	700	900	1,000	100	11.1
Street Rd-Pleasant Grove Rd	2,200	4,700	2,900	-1,800	-38.3

Table 9

CONCEPTUALIZED IMPROVEMENTS FOR LEVEL OF SERVICE ANALYSIS

	<u>EXISTING</u>		<u>FOUR LANE</u>		<u>SIX LANE</u>	
1. PYLE ROAD	UNSIGNALIZED		SIGNALIZED		SIGNALIZED	
	1L1TR	W.B.	1L & 1R	W.B.	1L & 1R	W.B.
	1T & 1TR	N.B.	1L1TR	E.B.	1L1TR	E.B.
	1LT & 1T	S.B.	2T & 1R	N.B.	2T & 1TR	N.B.
			2T	S.B.	3T	S.B.
			NEAR SIDE JUG	S.B.	NEAR SIDE JUG	S.B.
2. BEAVER VALLEY - NAAMANS CREEK ROAD	SIGNALIZED		SIGNALIZED		SIGNALIZED	
	1LT & 1R	W.B.	1L & 1T & 1R	W.B.	1L & 1T & 1R	W.B.
	1L1TR	E.B.	1L & 1T & 1TR	E.B.	1L & 1T & 1TR	E.B.
	1L & 1T & 1TR	N.B.	2T & 1R	N.B.	2T & 1TR	N.B.
	1L & 1T & 1TR	S.B.	2T	S.B.	3T	S.B.
			FAR SIDE JUG	N.B.	FAR SIDE JUG	N.B.
			NEAR SIDE JUG	S.B.	NEAR SIDE JUG	S.B.
3. SMITHBRIDGE ROAD NORTHBOUND	UNSIGNALIZED		SIGNALIZED		SIGNALIZED	
	1TR	W.B.	1T & 1R	W.B.	1T & 1R	W.B.
	1LT	E.B.	1L & 1T	E.B.	1L & 1T	E.B.
	1LT & 1TR	N.B.	1LT & 1T & 1R	N.B.	1LT & 1T & 1TR	N.B.
4. SMITHBRIDGE ROAD SOUTHBOUND	UNSIGNALIZED		SIGNALIZED		SIGNALIZED	
	1LT	W.B.	1L & 1T	W.B.	1L & 1T	W.B.
	1TR	E.B.	1T & 1R	E.B.	1T & 1R	E.B.
	1LT & 1TR	S.B.	1LT & 1T & 1R	S.B.	1LT & 1T & 1R	S.B.

L-left movement T-through movement R-right movement

(CONTINUED)

CONCEPTUALIZED IMPROVEMENTS FOR LEVEL OF SERVICE ANALYSIS
(CONTINUED)

<u>EXISTING</u>			<u>FOUR LANE</u>			<u>SIX LANE</u>		
5. RIDGE ROAD								
UNSIGNALIZED			UNSIGNALIZED			UNSIGNALIZED		
1L1TR	W.B.		1R	W.B.		1R	W.B.	
1L1TR	E.B.		1R	E.B.		1R	E.B.	
1LT & 1TR	N.B.		1LT & 1TR	N.B.		1LT & 1T & 1TR	N.B.	
1LT & 1TR	S.B.		1LT & 1TR	S.B.		1LT & 1T & 1TR	S.B.	

6. MARSHALL ROAD								
UNSIGNALIZED			SIGNALIZED			SIGNALIZED		
1L1TR	W.B.		1L & 1R	W.B.		1L & 1R	W.B.	
1T & 1TR	N.B.		1T	E.B.		1T	E.B.	
2T	S.B.		2T	N.B.		3T	N.B.	
			2T	S.B.		3T	S.B.	
			NEAR SIDE JUG	N.B.		NEAR SIDE JUG	N.B.	
			NEAR SIDE JUG	S.B.		NEAR SIDE JUG	S.B.	

7. BALTIMORE PIKE								
SIGNALIZED			GRADE SEPARATION			GRADE SEPARATION		
1L & 2T & 1R	W.B.							
1L & 2T & 1R	E.B.							
1L & 2T & 1R	N.B.							
2L & 2T & 1R	S.B.							

8. OAKLAND ROAD								
SIGNALIZED			SIGNALIZED			SIGNALIZED		
1L1TR	W.B.		1L1TR	W.B.		1L1TR	W.B.	
1L1TR	E.B.		1L & 1TR	E.B.		1L & 1TR	E.B.	
1L & 1T & 1TR	N.B.		2T & 1R	N.B.		2T & 1TR	N.B.	
2T	S.B.		2T	S.B.		3T	S.B.	
NEAR SIDE JUG	S.B.		NEAR SIDE JUG	S.B.		NEAR SIDE JUG	S.B.	
			FAR SIDE JUG	N.B.		FAR SIDE JUG	N.B.	

L-left movement T-through movement R-right movement

(CONTINUED)

CONCEPTUALIZED IMPROVEMENTS FOR LEVEL OF SERVICE ANALYSIS
(CONTINUED)

<u>EXISTING</u>			<u>FOUR LANE</u>			<u>SIX LANE</u>		
9. DILLWORTH TOWN ROAD								
SIGNALIZED			SIGNALIZED			SIGNALIZED		
1L1TR		W.B.	1L & 1TR		W.B.	1L & 1TR		W.B.
1L1TR		E.B.	1L & 1TR		E.B.	1L & 1TR		E.B.
1L & 2T & 1R		N.B.	2T		N.B.	3T		N.B.
1L & 1T & 1TR		S.B.	2T & 1R		S.B.	2T & 1TR		S.B.
			NEAR SIDE JUG		N.B.	NEAR SIDE JUG		N.B.
			FAR SIDE JUG		S.B.	FAR SIDE JUG		S.B.

10. GREENTREE DRIVE

SIGNALIZED			SIGNALIZED			SIGNALIZED		
1L1TR		W.B.	1L1TR		W.B.	1L1TR		W.B.
1L & 1T & 1TR		N.B.	1L1TR		E.B.	1L1TR		E.B.
1L & 2T		S.B.	2T		N.B.	3T		N.B.
			2T		S.B.	3T		S.B.
			NEAR SIDE JUG		N.B.	NEAR SIDE JUG		N.B.
			NEAR SIDE JUG		S.B.	NEAR SIDE JUG		S.B.

11. STREET ROAD

SIGNALIZED			SIGNALIZED			SIGNALIZED		
1L1T & 1TR		W.B.	1L & 1TR		W.B.	1L & 1TR		W.B.
1L1T & 1TR		E.B.	1L & 1TR		E.B.	1L & 1TR		E.B.
1L & 2T & 1R		N.B.	2T & 1R		N.B.	2T & 1TR		N.B.
1L & 1T & 1TR		S.B.	2T & 1R		S.B.	2T & 1TR		S.B.
			FAR SIDE JUG		N.B.	FAR SIDE JUG		N.B.
			FAR SIDE JUG		S.B.	FAR SIDE JUG		S.B.

12. MATLACK STREET

SIGNALIZED			SIGNALIZED			SIGNALIZED		
1L1T & 1R		W.B.	1L & 1T & 1R		W.B.	1L & 1T & 1R		W.B.
1L1T & 1R		E.B.	1L & 1T & 1R		E.B.	1L & 1T & 1R		E.B.
*1L & 2T & 1R		N.B.	1L & 2T & 1R		N.B.	1L & 2T & 1TR		N.B.
1L & 2T & 1R		S.B.	1L & 2T & 1R		S.B.	1L & 2T & 1TR		S.B.

L-left movement T-through movement R-right movement

In order to understand how to interpret Table 9, a discussion focusing on the Pyle Road intersection follows. Pyle Road, under the existing conditions, is unsignalized and has one lane westbound to accommodate left, through, and right turn movements. Northbound on US 202 there are one through lane and one through/right turn lane. Southbound on US 202 there are one left/through lane and one through lane. Pyle Road under the four lane scenario becomes signalized with one left turn lane and one right turn lane westbound, and one lane for left/through/ right turn movements eastbound. Northbound on US 202 there are two through lanes and one right turn lane. Southbound, US 202 has two through lanes and a near side jug handle. Pyle Road under the six lane scenario is signalized with one left turn lane and one right turn lane westbound, and one lane for left/through/right turn movements eastbound. Northbound on US 202 there are two through lanes and one through/right turn lane, and three through lanes southbound with a near side jug handle.

Level of Service Analysis

Utilizing the four and six lane traffic projections and the conceptual intersection improvements, levels of service for US 202 and the surrounding local road system have been developed.

In the existing conditions chapter, an extensive description of level of service criteria for signalized intersections is given. Level of service is defined in terms of delay, seconds per vehicle, with the threshold for each service level given in Table 3. For example, if the average delay on an intersection approach falls between 25 and 40 seconds per vehicle the approach is classified as operating under level of service D. If the average delay exceeds 60 seconds per vehicle, the approach is operating under level of service F. Level of service F does not differentiate between simple oversaturated conditions and queues of a quarter mile; whether the average delay is 61 seconds or 300 seconds both conditions are considered level of service F. A secondary measure of congestion is the volume to capacity (v/c) ratio. Generally, as the ratio approaches 1.0 the intersection approaches capacity and delays start increasing. Between 1.0 and 1.2, the intersection starts to deteriorate. Ratios higher than 1.2 are so excessive that estimates of delay become meaningless. Again, a v/c ratio of 1.2 and 2.5 both mean failure of the intersection with excessive delays; the difference between the two, while not quantifiable, would be noticeable.

In evaluating the signalized intersections under the four and six lane scenarios, this paradox was repeatedly encountered. Many intersections are expected to operate at level of service F under both scenarios, yet one scenario will experience vastly greater delays than the other scenario. An example of this phenomenon at the Street Road intersection is presented in Figures 19 and 20. In the AM peak (see Figure 19) the eastbound approach of Street Road (approach C) will experience over 300 seconds of delay per vehicle for both the left turn

FIGURE 19
DELAY COMPARISON
FOUR vs. SIX LANE SCENARIOS AM PEAK

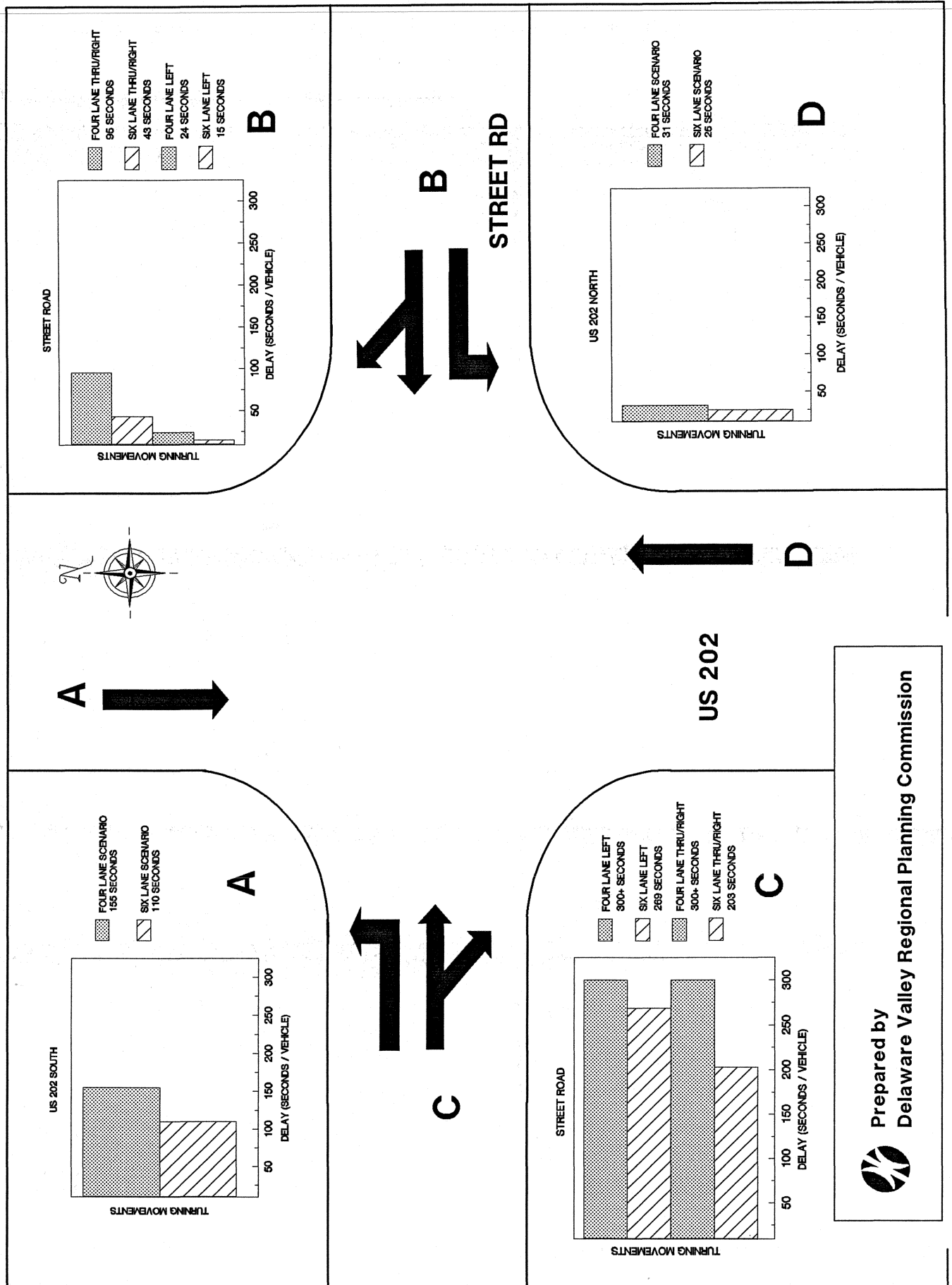
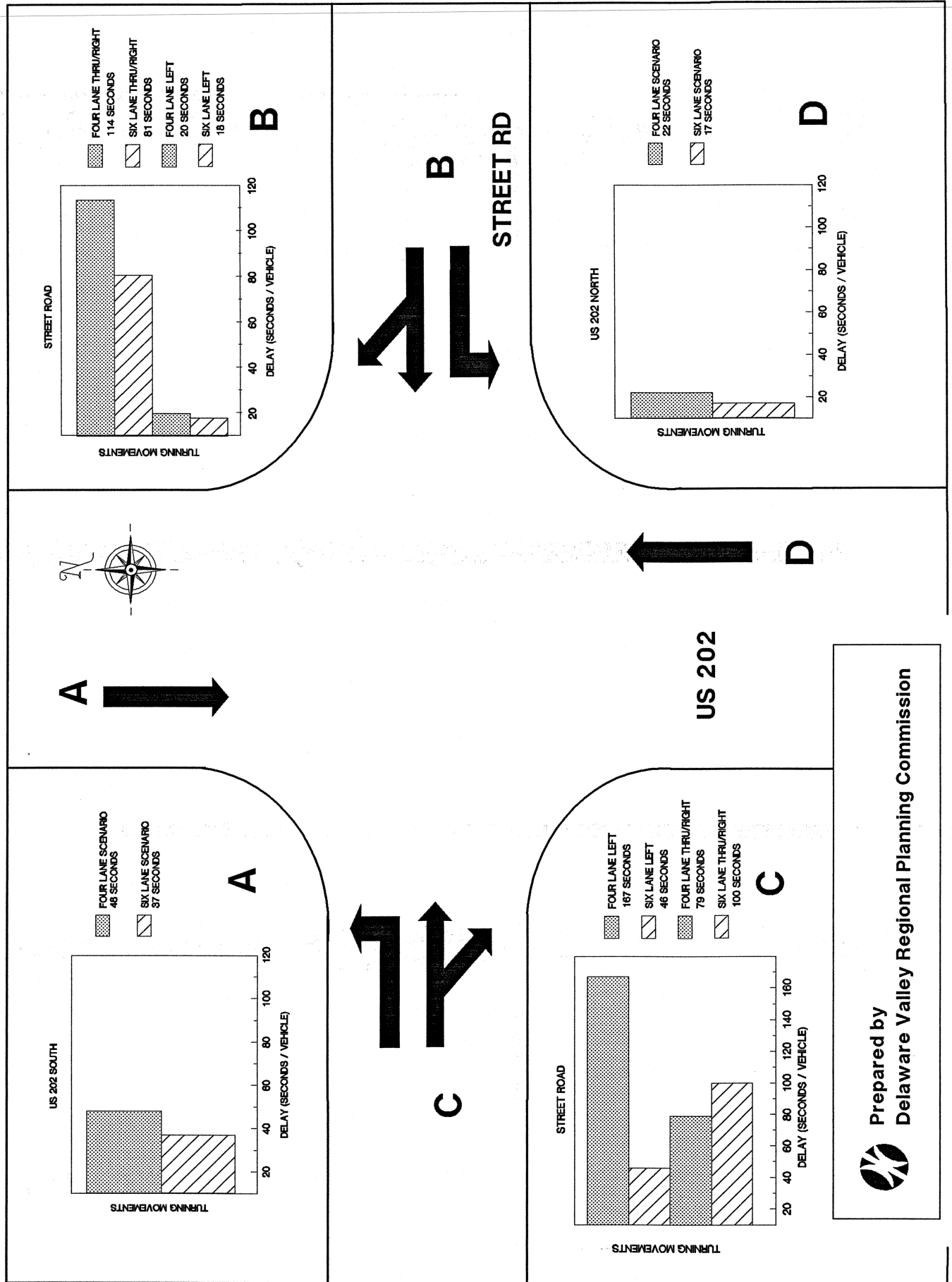


FIGURE 20
DELAY COMPARISON
FOUR VS. SIX LANE SCENARIOS PM PEAK

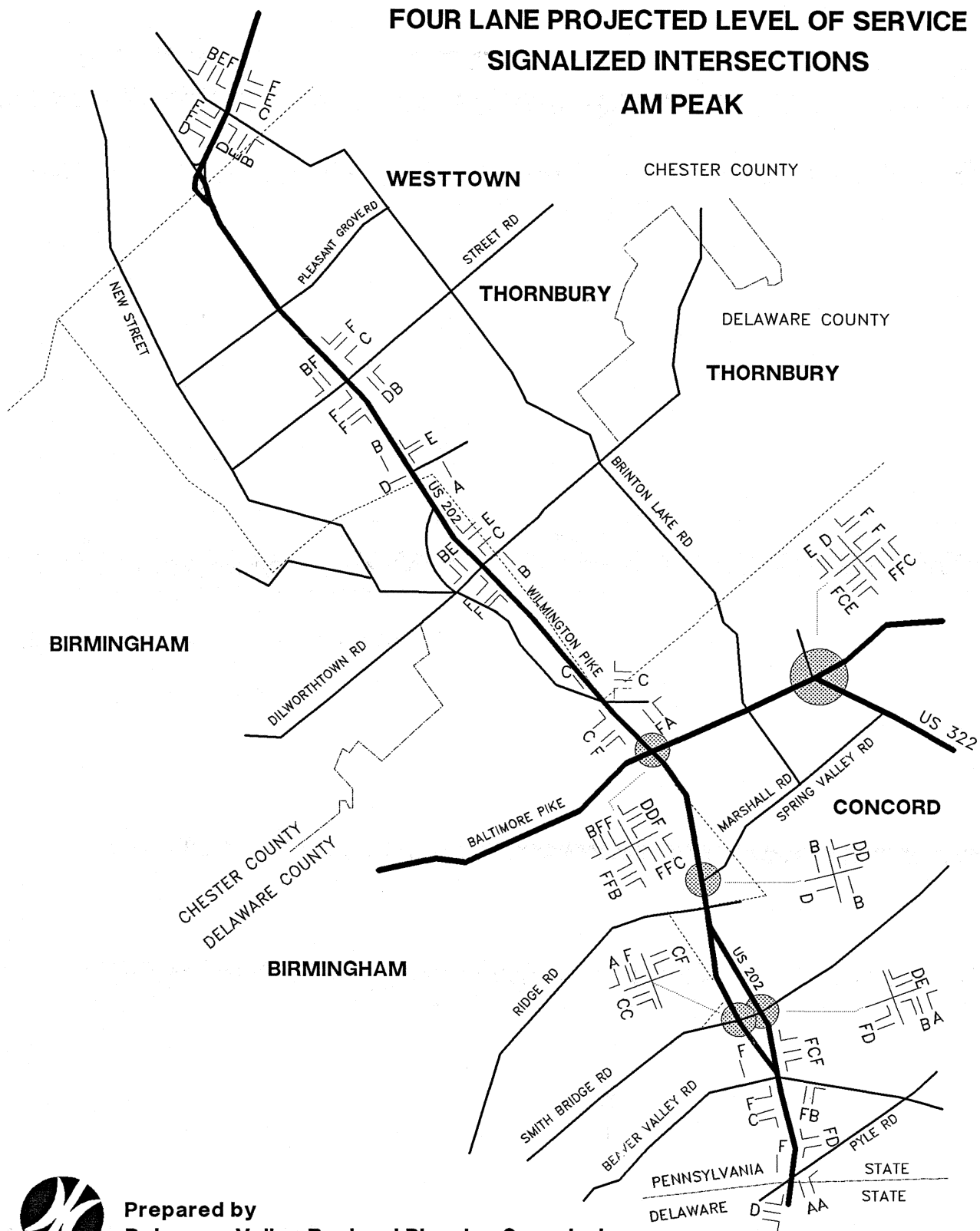


lane and the through/right lane under the four lane scenario. Under the six lane scenario the delays are 269 seconds and 203 seconds respectively. Under both alternatives, the delays are in the level of service F range; however delays under the six lane scenario are noticeably shorter than under the four lane scenario. An examination of the v/c ratios concurs with this analysis.

Projected levels of service for the four lane scenario are presented in Figures 21 and 22 and for the six lane scenario in Figures 23 and 24. The foregoing analysis compares the two scenarios; the scenarios are not compared to existing conditions because the projected increase in traffic volumes makes the comparison invalid.

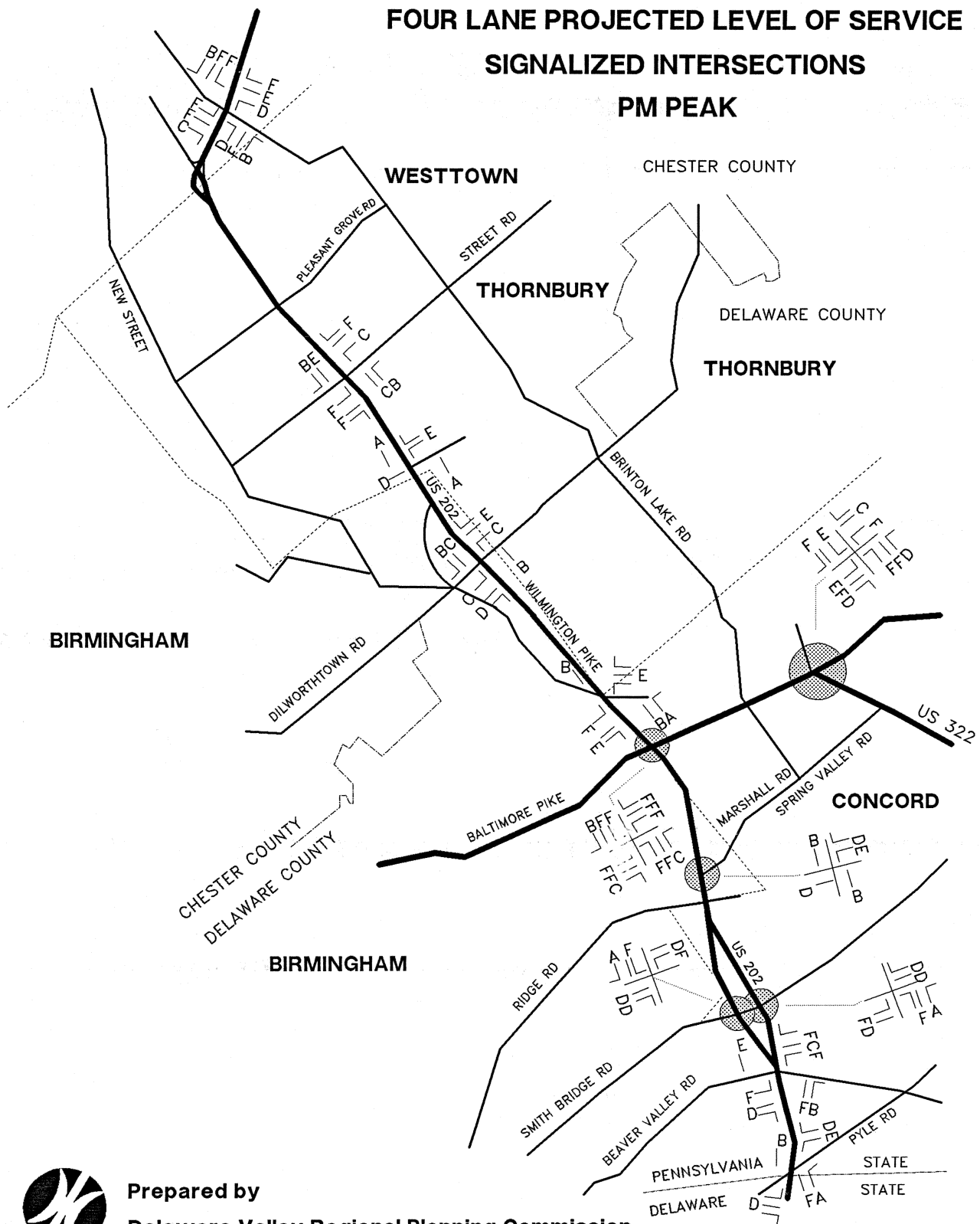
- . US 202-Pyle Road: Under the four lane scenario US 202 will experience level of service F southbound in the AM and northbound in the PM. Under the six lane scenario US 202 will operate in a satisfactory manner. There is no appreciable difference on Pyle Road between the two scenarios.
- . US 202-Beaver Valley/Naamans Creek Road: US 202 will experience level of service F with the four lane scenario and generally level of service C under the six lane scenario. There is no appreciable difference on Beaver Valley Road or Naamans Creek Road between the scenarios.
- . US 202-Smithbridge Road: Northbound US 202 in the PM peak and southbound US 202 in both peaks will operate with level of service F under the four lane scenario. US 202 will operate at service level B or C under the six lane scenario. Under both scenarios, the left turn movement on Smithbridge Road will experience delay. Overall, the six lane scenario will result in a better level of service on Smithbridge Road.
- . US 202-Ridge Road/Spring Hill Road: When the analysis was conducted, this intersection was not yet signalized; it is assumed that a signal will ultimately be installed at Marshall Road.
- . US 202-Marshall Road: Under both scenarios this intersection will operate in a satisfactory manner. The six lane scenario will provide a higher level of service.
- . US 202-US 1: To be discussed in the next section.
- . US 1-Oakland Road: The six lane scenario provides considerable relief to the intersection.

FIGURE 21
FOUR LANE PROJECTED LEVEL OF SERVICE
SIGNALIZED INTERSECTIONS
AM PEAK



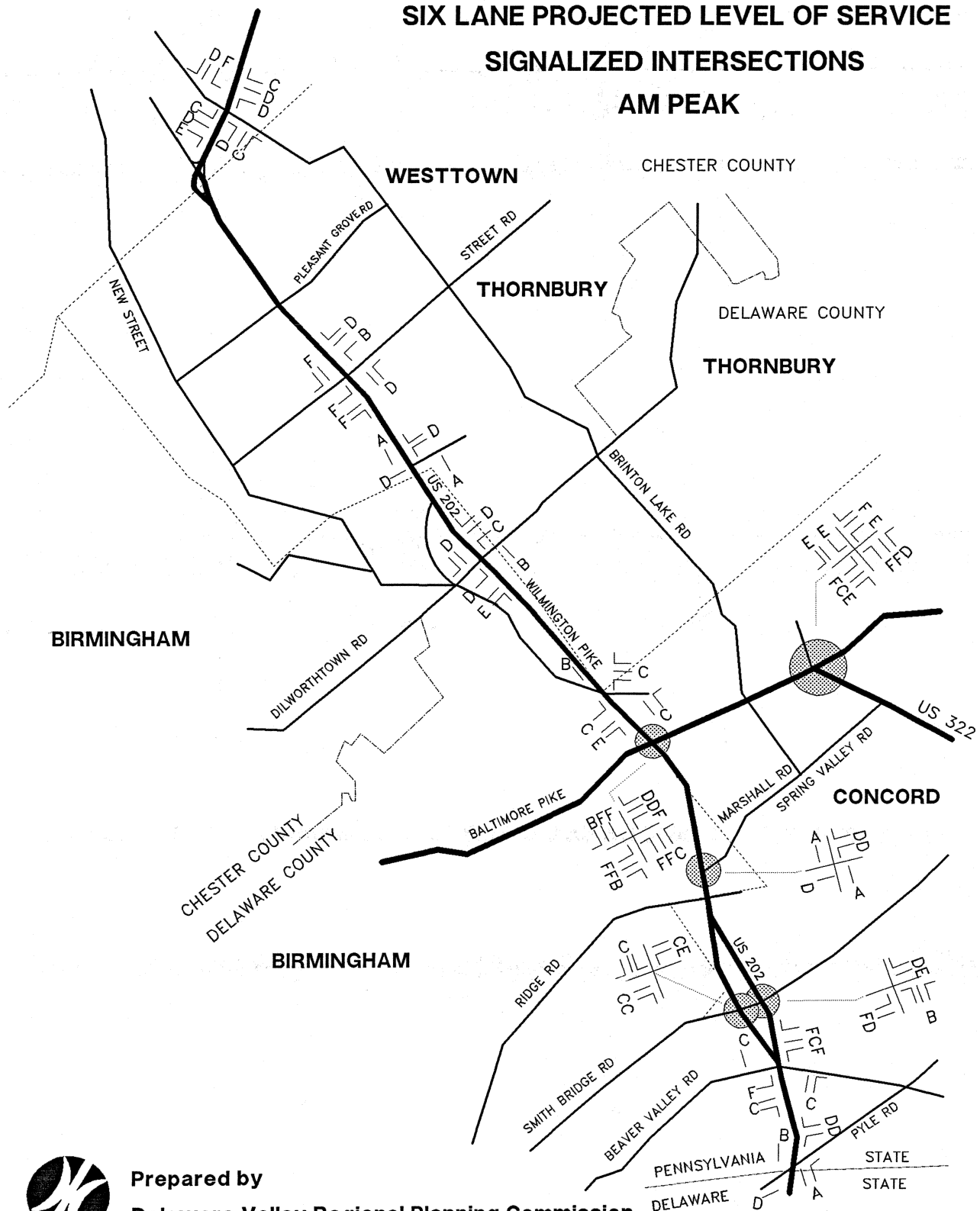
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FIGURE 22
FOUR LANE PROJECTED LEVEL OF SERVICE
SIGNALIZED INTERSECTIONS
PM PEAK



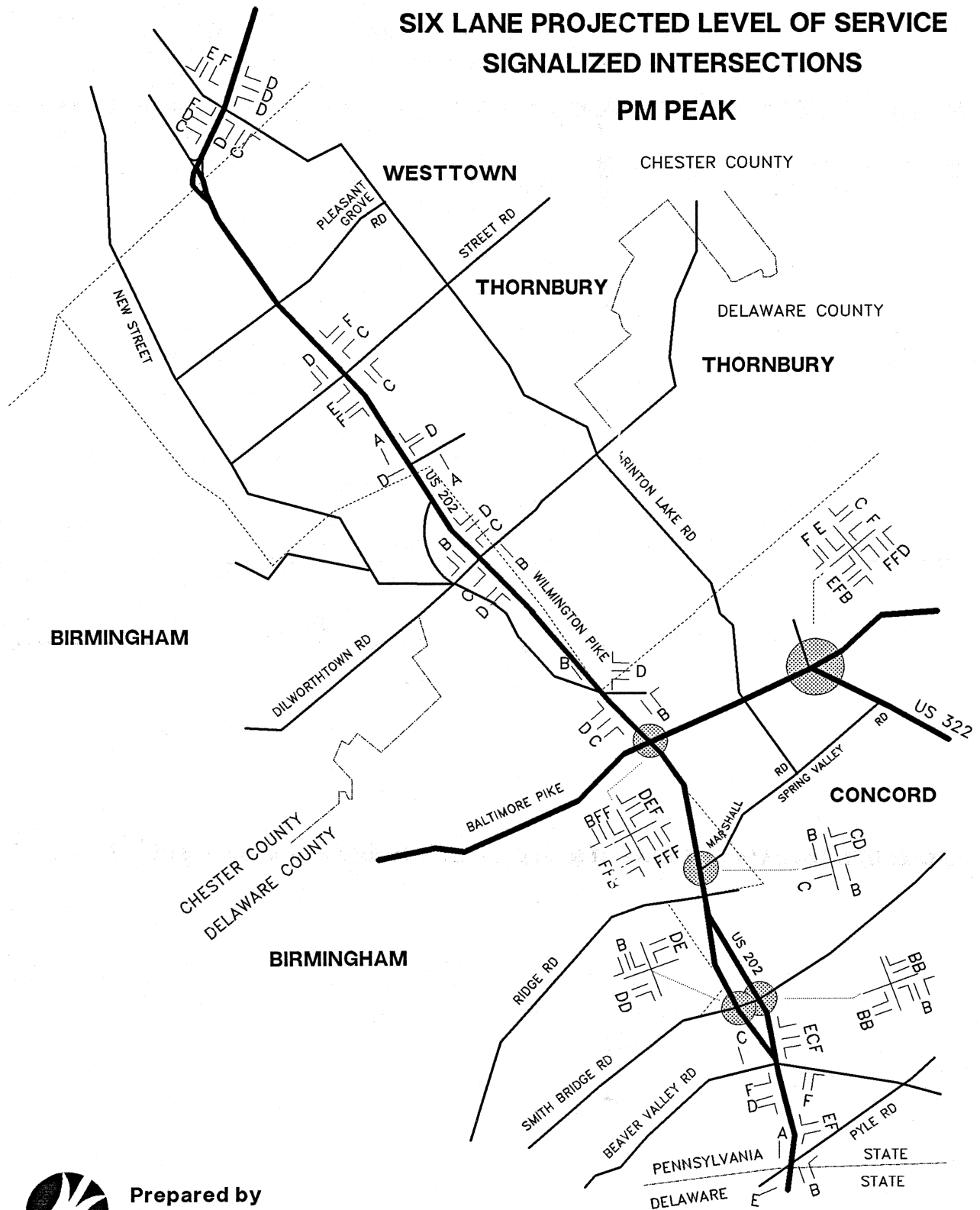
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FIGURE 23
SIX LANE PROJECTED LEVEL OF SERVICE
SIGNALIZED INTERSECTIONS
AM PEAK



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FIGURE 24
SIX LANE PROJECTED LEVEL OF SERVICE
SIGNALIZED INTERSECTIONS
PM PEAK



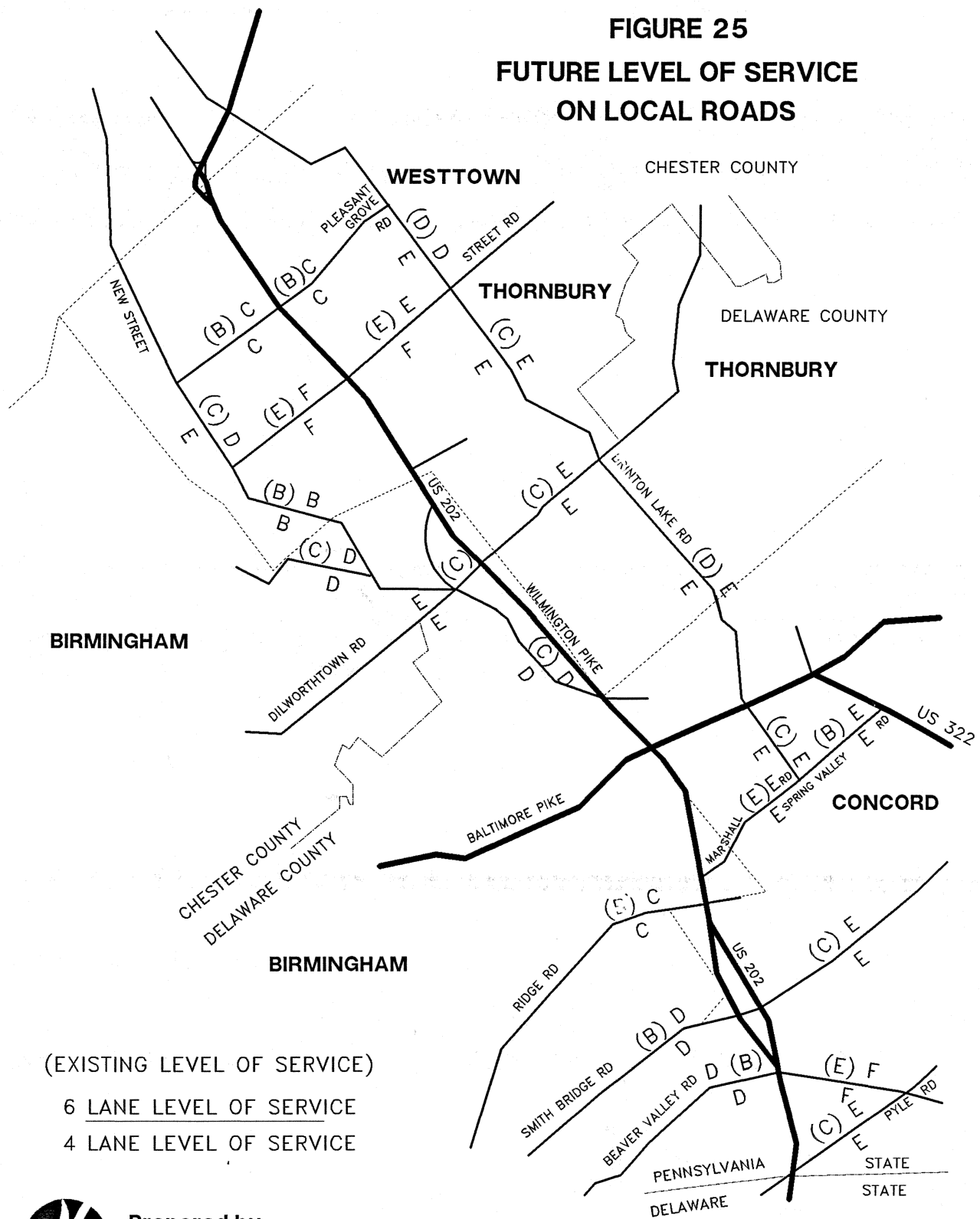
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- . US 202-Dilworthtown Road: Under the six lane scenario, US 202 will operate in a satisfactory manner. Under the four lane scenario, southbound US 202 will operate at level of service E in the AM peak. Congestion levels on Dilworthtown Road will generally diminish under the six lane scenario; the eastbound approach in the AM will operate at level of service E instead of F. The westbound approach operates at service level E under the four lane scenario and level D under the six lane scenario.
- . US 202-Greentree Drive: There is no appreciable difference in service levels between the two alternatives. US 202 will operate at level of service A or B. Greentree Drive appears to show some delay; however this is a function of waiting for green time instead of congestion.
- . US 202-Street Road: This intersection will experience acute congestion, particularly on Street Road, even with widening to six lanes. Southbound US 202 will operate at level of service F in the AM under both scenarios. Eastbound Street Road will operate at level of service F at all times under both scenarios. Westbound Street Road will operate at level of service F at all times under the four lane scenario and at level F in the PM under the six lane scenario. Detailed examination of the capacity analysis indicates that the six lane scenario will provide demonstrable relief to the intersection. However, even with six lanes, the level of congestion is so extraordinarily substantial that improvements beyond the scope outlined are warranted.

Projected levels of service on roads parallel and perpendicular to US 202 are presented in Figure 25 for the four and six lane scenarios. All roads will experience a deterioration of service levels from existing conditions. Brinton Lake Road will go from level of service C/D to E. In Chester County, Street Road will go from level of service E to F; Dilworthtown Road will drop from C to E. In Delaware County, on the west side of US 202 the service levels on Ridge Road, Smith Bridge Road, and Beaver Valley Road will go from B to C/D. On the east side of US 202, the same roads will be operating at level of service E.

In general, there is no difference in service levels between the two scenarios examined. While the six lane scenario does not appear to offer relief to the parallel roads, a closer examination of the capacity analysis rebuts this theory. As previously discussed, the volumes on the parallel roads under the six lane scenario are at least 30% lower than the four lane scenario. While the level of service will diminish under the six lane scenario, its reduction will not be as drastic as under the four lane scenario. The substandard quality of the local roads and the broad range of service levels make the six lane scenario more desirable than the four lane scenario.

FIGURE 25
FUTURE LEVEL OF SERVICE
ON LOCAL ROADS



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Travel Time Analysis

On an arterial corridor, a comparison of overall travel times is usually a better predictor of the relative merit of each alternative. The preceding capacity analysis focused exclusively on intersection delays. On a long corridor, intersection delay may be only a small component of the overall travel time with the time between signalized intersections representing the largest component. Also, the benefits of widening a road between intersections are not directly accounted for in a signalized intersection capacity analysis.

One product of the focused traffic simulation model is the average speed on each link in the highway network. The projected speeds along US 202 between the Delaware state line and Matlack Street were converted into travel times for both alternatives.

The construction of the six lane scenario will result in a 22.7% time savings as compared to the four lane scenario. The biggest time savings will occur between the Delaware state line and the northern end of the one-way section, between the State Farm driveway and just south of Street Road, and around Stentson Middle School.

A similar analysis was conducted for Brinton Lake Road/Matlack Street between Marshall Road and West Chester Bypass. Overall, the six lane scenario will result in a 26.1% time savings as compared to the four lane scenario. This is basically a product of lower traffic volumes resulting from the widening of US 202 to six lanes.

Land Use Analysis

Construction of physical improvements to US 202 and its intersections will have an impact on the existing residential and non-residential uses that abut the roadway. The degree of impact will be not only a function of how much land is physically acquired, but also to what extent the existing land use will be able to continue to function. The latter will be valid especially for non-residential uses. It was assumed that retaining US 202 as a four lane roadway will entail minimal right-of-way acquisition. The question this section addresses will be how the widening to six lanes and the extensive intersection improvements associated with it will affect the existing land uses.

The recommended improvements were laid out in a conceptual manner on aerial photos (see the Appendix). The proposed right-of-way was superimposed on the centerline of the existing right-of-way. The criteria used to select a right-of-way and other improvement specifics are discussed later in this report under long-term recommendations. An effort was made then to quantify the impact of the proposed right-of-way on existing land uses. The analysis was very subjective because subsequent preliminary engineering studies will shift the highway alignment to minimize the disruption of existing land uses.

The land uses were divided into two categories, residential and non-residential. No differentiation was made to the value of the property from either a monetary or community perspective. Each land use was graded on the basis of a minimal impact, moderate impact or severe impact. Each rating is defined below.

- . Minimal Impact- Existing land use will not be affected. Road widening will necessitate the construction of new driveway aprons, new curbing, sign relocation, and other minor improvements of this nature. Any property that abuts US 202 or a cross street being widened will receive, by definition, at least a minimal impact.
- . Moderate Impact- For residential properties, the partial loss of a lawn will result in the residences being situated in closer proximity to the roadway. For non-residential properties, right-of-way acquisition will entail relocation of driveways, replacement and/or relocation of parking spaces on remainder of the property, loss of storage space, and other impacts of this nature.
- . Severe Impact- Taking of the property will be necessary. This will occur when a structure needs to be demolished or when it is not possible to reconfigure the property to provide adequate parking or storage space.

From a review of the aerial photos, the results of the analysis are summarized below:

Residential Land Uses-

Minimal Impact- 32 properties
Moderate Impact- 26 properties
Severe Impact- 15 properties

Non-residential Land Uses-

Minimal Impact- 49 properties
Moderate Impact- 25 properties
Severe Impact- 18 properties

A substantial amount of land abutting US 202, particularly in the northern portion of the corridor, is undeveloped; therefore it will not be impacted. In aggregate, 165 existing uses will be impacted by the widening of US 202 to six lanes and the construction of intersection improvements. For the majority of the properties, the impact will be insignificant. However, PennDOT will need to take 33 existing properties. This will be a costly proposition both in terms of the expense and the opposition it will generate. Normally, a number of takings of this magnitude would cast doubt on the success of the project; however, many of the land uses are marginal or the existing structure is currently vacant. In a few cases, proposed land development would eliminate the existing land use by consolidating the parcel into a larger property. To minimize the impact on the contiguous properties, thus

enhancing the success of the undertaking, stringent zoning and land development standards must be applied to the vacant properties and to properties undergoing redevelopment.

PAINTERS CROSSROADS ALTERNATIVES ANALYSIS

Three alternatives were considered to alleviate the severe traffic congestion at the intersection of US 1 and US 202. The first alternative was a connector road linking existing US 322 (Conchester Highway) with US 202 north of the State Farm property. The second alternative was a grade separated intersection at Painters Crossroads. The final alternative was a completed ring road system. A description of each alternative and the results of the analysis are presented below.

Connector Road

The extension of US 322 (Conchester Highway) to US 202 has been proposed numerous times over the years. The connector road examined in this study is a two lane roadway, originating at the intersection of US 322 and US 1, going in a northerly direction towards the Concordville Industrial Park then westerly in the area of the Concord Country Club. It terminates at US 202 in the vicinity of Oakland Road.

The connector road is projected to have an AADT of 17,000 vehicles per day. These represent the westbound right turn and southbound left turn traffic diverted from Painters Crossroads (shown in Figure 18) and traffic induced from Brinton Lake Road and other parallel roads. An AADT of the magnitude of 17,000 vehicles sufficiently justifies the construction of a two lane roadway. The key question becomes then whether the connector road sufficiently relieves congestion at Painters Crossroads. Although it removes most of the southbound left turn traffic, the connector road does not allow the southbound portion of the signal timing to be redistributed to the other intersection movements because it is still necessary to provide green time for the opposing northbound left turn movement. With no modification to the signal timing and a growth in traffic, congestion experienced by the other movements will surpass the excessive delays presently encountered. A capacity analysis confirmed the above conclusion; the intersection will still be at level of service F.

A cursory investigation of the feasibility of the connector road was conducted. Use of the Conchester Highway right-of-way would minimize disruption to the Concordville Industrial Park. However, regardless of the alignment chosen, the connector must cross the Concord Country Club greatly impairing the country club's viability. The ring road around State Farm has already impinged upon it causing the relocation of part of the golf course. Unless the country club is redeveloped for another purpose, it would be very costly to acquire the right-of-way.

Grade Separated Intersection

The second alternative evaluated was a grade separated intersection. Like the connector road, this was proposed numerous times over the years.

Under the analysis of this alternative, it was assumed that US 202 would be elevated above US 1 at the intersection, thus permitting US 202 through traffic to move through the intersection without stopping. Turning movements between US 202 and US 1 would be permitted by means of ramps adjacent to the elevated roadway but at grade. It is envisioned that it would be similar to the grade separated intersection of US 1 and Sproul Road (PA 320) with the through road being elevated instead of depressed. The decision on which road to elevate would ultimately be evaluated in a preliminary engineering study. The decision would have to consider a number of factors including grades, traffic volumes, availability of right-of-way, utility and drainage concerns. Design standards suggest that the road with the heavier through volume should be the through roadway.

A free flow movement on US 202 would remove up to 39,500 vehicles from the signalized intersection (see Figure 18). This is the largest bi-directional movement, representing over 37% of the total intersection traffic. Removing this north-south through movement from the intersection would permit the elimination of its signal phase and the redistribution of a significant portion of the signal timing to other intersection movements. According to a capacity analysis of Painters Crossroads, the traffic signal servicing the northbound ramp would operate at an overall level of service E during both peak periods. The southbound ramp traffic signal would operate at an overall level of service C in the AM peak and D during the PM peak period. A grade separated intersection clearly would provide relief to the Painters Crossroads intersection. With over 40,000 vehicles projected to use the elevated roadway a volume of this magnitude justifies at, a minimum, a four lane flyover.

Grade separating the intersection addresses moving the major traffic movement through the intersection but does not address the problems arising from access to commercial establishments. Painters Crossroads is becoming the retail and business hub of the Brandywine Valley in Pennsylvania. Land uses of this type are intense trip generators. Many trips are characterized by multiple stops within the Painters Crossroads area. The benefits of the grade separated intersection dissipate as vehicles backup at turn lanes into the commercial properties or as vehicles travel among the various sites.

A brief investigation of the feasibility of a grade separated intersection was conducted. A right-of-way of approximately 150 feet would be needed for the elevated roadway and associated ramps; exact right-of-way requirements would require further study. The vast majority of businesses are more than adequately set back. A small number of businesses, mainly fast food restaurants, may fall in the right-of-way.

If a grade separated intersection is not constructed and the intersection is substantially widened, these properties probably still fall in the needed right-of-way.

Ring Road

The final alternative for Painters Crossroads is a ring road. The ring road would serve two purposes; first it would relieve congestion at Painters Crossroads by providing a bypass around it, secondly it would create an internal circulation system for the businesses situated around the intersection. Unlike the other alternatives, the ring road is a fairly new concept which State Farm and other developers have already begun to implement.

A qualitative analysis was not conducted for this alternative. Utilization of a ring road as a bypass is a function of motorist perception. If the ring road is perceived as part of a private property, for example as part of a shopping center or a driveway for State Farm, motorists will tend to shy away from using it. However, if the road is properly designed and signed as a bypass, its usage will be more substantial. The concept of a ring road is extremely difficult to model because of the above concerns and because it is a very fine adjustment to the highway network.

On a subjective level, a ring road has some advantages and disadvantages. The primary advantage of the ring road is that, with proper design, it can intercept turning movements prior to Painters Crossroads and channel them around the intersection. As a result, the vehicles entering the intersection are mostly through movements, thus allowing redistribution of signal timing to the through traffic. This can be accomplished with minimal cost and right-of-way acquisition. The second advantage of the ring road is the provision of access to the businesses situated around the intersection. Business properties would be permitted access off of the ring road. Access from US 202 or US 1 would be limited to only those properties that could not be served by the ring road. The ring road would have a limited number of signalized intersections with the state highways. The number of internal trips passing through the Painters Crossroads intersection would be minimized by the ring road.

The primary disadvantage of a ring road is that it would add additional traffic signals to a chaotic situation. Each traffic signal would mean extra delay to vehicles passing through the intersection. Due to the close spacing between traffic signals, each traffic signal would also increase the probability of spill back into the preceding intersection. With traffic volumes of the magnitude projected and the multi-phase signals required at each intersection, state of the art (third generation) traffic control systems would be the only technique available to coordinate the traffic signals in an efficient manner.

From a feasibility perspective, the concept of a ring road is fairly easy to implement. However, with the limited experience gained from the partial ring road that already exists, two problems have been identified. First, the road must meet proper design standards. This means the road must be properly signed, meet design standards for tractor trailers, have high design type intersections at each terminus, and not look like an adjunct to a business' parking lot. Secondly, the ring roads should be laid out in advance. In this manner, it can be guaranteed that the ring roads will align up opposite each other at a signalized intersection and there are no discontinuities in the ring road system.

Each of the three alternatives for Painters Crossroads have problems associated with them. In recommending a solution a combination of approaches may be necessary.

RECOMMENDATIONS

The findings of the study will be presented in this section of the report along with the short-term and long-term recommendations. The recommended improvements will address the findings identified as a result of the analysis of existing and future traffic conditions. The objective of the improvements will be to mitigate congestion and decrease travel times on US 202, thus providing relief throughout the corridor.

FINDINGS

The findings listed below represent the results of the analysis of existing and future conditions which have been presented in previous sections of this report.

- . Construction of an expressway on a new alignment is not feasible due to environmental and fiscal considerations.
- . The intersections along US 202 will experience congestion under both the four lane and the six lane scenarios, however the congestion will be much less severe with six lanes.
- . The six lane scenario provides faster travel times along US 202.
- . The six lane scenario reduces traffic on the parallel roads.
- . The six lane scenario experiences higher volumes than the four lane scenario; however, the higher volumes do not offset the increased capacity.
- . It is necessary to widen US 202 to three lanes in each direction.
- . Left turns should be eliminated from US 202.
- . Jug handles should be constructed at all signalized intersections to facilitate left turn movements.
- . Approaches of cross streets should be widened at signalized intersections.
- . Steps must be taken to prevent development from encroaching on the right-of-way needed to construct the improvements.
- . All median openings on US 202 should be closed except at signalized intersections.
- . At Painters Crossroads, a grade separated intersection would provide maximum benefits for the through traffic but only minimum benefits for local access traffic.

- . At Painters Crossroads, a ring road system would provide maximum benefits for local access traffic but only minimum benefits for through traffic.
- . A grade separated intersection is warranted at Painters Crossroads.
- . A ring road system should be constructed around Painters Crossroads.
- . A connection on new alignment between US 322 (Conchester Highway) and US 202 is warranted on the basis of traffic volumes but does not provide adequate relief at Painters Crossroads.

US 202 SHORT-TERM RECOMMENDATIONS

This section of the report identifies short-term actions which PennDOT and the municipalities can undertake immediately. These recommendations are considered short-term because they are relatively easy to implement and they provide relief for only a limited time. Eventually, the implementation of additional improvements (long-term recommendations) is required to provide additional relief. To a large extent, these short-term actions are formulated to pave the way for the long-term recommendations. They are the logical, necessary first steps for the eventual implementation of the long-term recommendations. There are two general categories of short-term recommendations: physical highway improvements and zoning and land development review policies.

Physical Improvements

These recommendations involve physical improvements to US 202. Generally, implementation of these projects is PennDOT's responsibility. However, this does not preclude municipalities, either directly or through developers, from assisting PennDOT by providing right-of-way, conducting engineering/design studies, or actually funding or constructing the improvements. These physical improvements are as follows.

Initiate efforts to place the US 202 improvement recommendations on PennDOT's Twelve Year Program. Although this recommendation in itself is not a physical improvement, PennDOT cannot initiate any activity to implement a project until it is placed on the Twelve Year Program. To accomplish this, the municipalities along the corridor must petition their county planning commissions to support these improvements. The planning commissions receive submittals from all the municipalities in the county and must prioritize those submittals. The county's prioritized list of project requests is submitted to PennDOT for prioritization and inclusion on the Twelve Year Program. The project

must be also incorporated into the Regional Transportation Improvement Program (TIP) prepared by DVRPC to be eligible for federal funding. Currently, there are three projects on the Twelve Year Program for US 202 in the study area. The improvements generally entail construction of turn lanes and signalization improvements.

- . The intersection of US 202 and US 1 - intersection improvements programmed for \$930,000
- . The intersection of US 202 and Street Road - intersection improvements programmed for \$125,000
- . The intersection of US 202 and Matlack Street - signal improvements programmed for \$81,000

In addition to the Twelve Year Program projects, there is one project programmed for implementation on PennDOT's 3R (restoration, rehabilitation and resurfacing) Maintenance Program. The section of US 202 between the Delaware County Line and Rosedale Avenue (West Chester) is scheduled for restoration, drainage and guiderail improvements programmed for \$1,650,000.

Initiate preliminary engineering and begin closing median openings at all unsignalized intersections. This action will eliminate cross traffic except at signalized intersections and it will eliminate conflicting left turns. It will permit only right-in and right-out movements at the cross streets. There are 12 median openings that will need to be closed. In addition, a concrete median barrier will need to be constructed in what is currently a five lane cross section that extends from just south of US 1 to just south of Ridge Road. This recommendation is contingent upon reconstructing the signalized intersections to efficiently handle the change in traffic patterns.

Reconstruct the signalized intersections. This includes the construction of jug handles, widening US 202 to six lanes at the intersections and widening the cross streets to two approach lanes. These improvements will eliminate left turns from US 202. All turns from US 202 will be made from the right lane with left turns using the jug handle and the cross street. Widening US 202 at the intersections will provide additional capacity and will serve as a first step towards widening the highway to six lanes. It will be necessary to widen the cross roads to two approach lanes to accommodate the increased traffic which will result from the US 202 left turn traffic using the jug handles. The three intersections that should receive priority treatment are Naamans Creek Road, Dilworthtown Road and Street Road.

Initiate an accident reduction program. According to PennDOT's accident records, along this section of US 202 the predominant type of accident is rear-end collisions at signalized intersections. Oversized signs should be installed indicating signal ahead. On US 202, at the intersection of US 1, high speeds coupled with frequent long queues perpetuate the incidence of rear-end accidents. This report recommends

lowering the speed limit on US 202 at the approaches to US 1 and installing flashing signal ahead signs. These measures should provide the drivers with the necessary time to react to an approaching traffic signal and regulate them through the intersection at a slower and safer speed.

Zoning and Land Development Review Policies

These recommendations involve the adoption of local ordinances to preserve right-of-way for widening US 202 and constructing intersection improvements. They also involve access management policies to mitigate future impacts. The development and implementation of these policies are the responsibility of the municipalities located along the corridor. However, Chester and Delaware Counties have a vital role in developing a uniform and coordinated approach between the municipalities. These actions include:

Ultimate Right-of-Way

The concept of ultimate right-of-way is used to ensure that proposed road widenings can be accomplished with minimal disruption to existing development. It can also be used to reserve rights-of-way on roads where widenings are not presently programmed but may be needed in the future and where new development may foreclose any improvements. Claiming ultimate right-of-way is a common procedure employed in Pennsylvania in lieu of the more cumbersome official map. Although there are no official standards, ultimate rights-of-way are usually based upon functional classification. US 202, being a principal arterial, is recommended to have an ultimate right-of-way of 150 feet. This extended right-of-way will facilitate the widening of US 202 when future traffic volumes warrant such actions. Each municipality should adopt an ultimate right-of-way ordinance and map which designates a desired right-of-way width for each road in the municipality based on its functional classification.

Legally a municipality cannot require the dedication of right-of-way. At a minimum, the municipalities along the corridor should require the reservation of land as part of application for land development. The property between the legal right-of-way line and the ultimate right-of-way line would remain deeded to the owner with a prohibition on construction. Prior to widening US 202, the land would have to be purchased from the owner. As a standard procedure, the municipalities should request dedication of land as part of the application for land development. In this case, the land between the legal right-of-way line and the ultimate right-of-way line is deeded to PennDOT to be used for the widening of the highway. The requesting of dedication of right-of-way is a customary procedure in suburban Philadelphia, therefore the preferred approach.

Zoning Overlay District

In suburban growth areas where increasing traffic volumes necessitate highway widening, zoning overlay districts provide a mechanism to reserve right-of-way along a highway corridor and to provide a buffer area between the highway and adjacent uses in order to preserve a spacious and scenic environment along the corridor. In addition, it provides a municipality with the opportunity to implement specific land use controls and land development standards.

Provided for by Pennsylvania's Municipalities Planning Code (Article VI section 605), "an overlay district includes but is not limited to, regulating, restricting or prohibiting uses and structures at or near major thoroughfares, their intersections, interchanges and transportation arteries". The highway overlay district would be deemed to be an overlay on any existing zoning district and would supercede the requirements of the underlying zoning district, unless those requirements are more stringent than the requirements set forth in the overlay district ordinance. The development of a highway overlay district ordinance includes such elements as declaration of intent, definition of district boundary, delineation of the district on the official zoning map, uses permitted in the district, uses prohibited in the district and uses permitted by special exemption.

The highway overlay district serves as a means to keep the adjacent land uses compatible with US 202. Another purpose of the overlay district is to provide sufficient setback of both principal and accessory uses to facilitate the widening of either US 202 or the approaches of its intersecting streets while minimizing disruption of said uses. A minimum setback should be specified. This setback is necessary to provide a buffer area which will separate the highway from the activities and uses of each particular site. In order to minimize the effects of visual encroachment on the highway, no temporary or permanent structures, parking or storage areas, or billboards or advertising devices should be located in the buffer area. Access management, landscape and signage plans should be developed and incorporated into the overlay district.

The technical steering committee, consisting of Chester County, Delaware County, The Brandywine Conservancy and DVRPC, as a part of their larger planning effort in the Brandywine Valley, has prepared a model overlay zoning ordinance specifically for US 202. For additional information concerning this zoning overlay district, the model ordinance may be referenced.

Access Management Program

Access problems exist in corridors which experience conflicts between mobility and land access. This leads to congestion and safety problems. Access problems typically occur on high volume roads with adjacent land uses which generate large numbers of daily trips. To implement a successful access management program, it is necessary to incorporate the following two important concepts: prohibit left turns

wherever possible and minimize the number of curb cuts along the highway. Implementation of these concepts can noticeably reduce the conflicts along the highway.

The municipalities along the corridor should develop an access management program and incorporate it into the subdivision and land development ordinances and into the zoning overlay district ordinance. The technical steering committee has prepared an access management program specifically for US 202. Further information concerning specific recommendations may be found in the access management plan. The program seeks to preserve and improve highway capacity, expedite traffic flow and reduce accidents. It also tries to achieve the best possible balance of benefits among the roadside landowner, the highway user and the community while improving the appearance of the highway and the roadside buffer area.

The municipalities should address the following improvement options when developing an access management program.

- . Install a continuous median barrier and construct jug handles to accommodate left turn traffic.
- . Minimize the number of new traffic signals on US 202.
- . Require a minimum distance between traffic signals.
- . Optimize timing and interconnect all traffic signals.
- . Require a minimum distance between curb cuts.
- . Construct or reconstruct two one-way driveways in lieu of one or two two-way driveways to a given site.
- . Require a minimum and maximum driveway width.
- . Consolidate driveways of adjacent properties (shared driveways).
- . Interconnect adjacent properties with side access driveways for internal circulation.
- . Construct deceleration lanes and acceleration lanes for all moderate and high volume turning movements.
- . Increase turning radii and require driveway paving to increase turning speeds.
- . Construct all driveways and intersecting streets at right angles to the primary road.
- . Construct access points onto the perpendicular roads in lieu of additional access points onto the primary road.

- . Install physical barriers (curbs, rails, fences, berms, buffer areas) along property frontage when no access controls exist.
- . Construct frontage and reverse frontage access roads to serve multiple adjacent properties where feasible.

It may not be possible to implement all of these options in every case but the more options that can be implemented the more successful the access management program will be. It is possible to implement these options in phases as properties are developed or redeveloped.

Transportation Development District

The Transportation Partnership Act (Act 1985-47), as amended, provides an alternative means of securing necessary funds for transportation projects. With federal aid on the decline, the available state and local funding capabilities cannot always keep up with the needs of an area. This shortfall necessitates the creation of new means of financing transportation improvements. The purpose of this act is to enable municipalities to cooperate with one another and with the private sector to provide funding for transportation projects in areas where economic growth and development have made the transportation facilities inadequate. It also permits a municipality or municipal authority to establish a transportation development district for the purpose of planning, financing, acquiring, developing, constructing and operating transportation facilities or services within the district. Transportation facilities are defined to include local streets, roads, sidewalks, alleys, passageways, traffic control systems, structures, roadbeds and rights-of-way. Transportation services pertain to the costs associated with public transportation. The facility improvements can be financed by any of the five methods listed below.

- . The imposition of a fair and reasonable assessment upon business property located within the district subject to the limitations and procedures of the Business Improvement Act of 1967,
- . The imposition of a fair and reasonable assessment on each benefitted property within the district using a formula based upon actual or projected usage by each property within the district of the transportation facilities being improved,
- . The imposition of any tax otherwise permitted by law but restricting the tax and its receipts to the district, the district must be coterminous with the municipal boundary,
- . The issuance of notes and bonds pursuant to the provisions of the Local Government Debt Act and
- . The acceptance of grants, gifts and donations.

Prior to the establishment of a transportation development district, a planning study must be undertaken to identify the projects to be financed. For a multi-year program, priorities and schedules must be established. A financial plan is also required.

Due to what the state legislature perceived as abuse of the intent of the original act, a number of limitations have been adopted. The act can be used only to expand or improve existing transportation facilities. Maintenance and repair of existing facilities are expressly prohibited. All properties having a substantial relationship to the improvement shall be included in the transportation development district, thus assessed. The planning study must identify all beneficiaries of projects and include an analysis of cost allocation among the beneficiaries. Notice must be given to property owners in the district and public hearings held. If, within 45 days of the adoption of the enabling ordinance, property owners representing more than 50% of the assessed property value of the district file a written protest, the district is voided.

Because of the limitations of the Transportation Partnership Act, very few municipalities have exercised its provisions. The main drawback appears to be that all benefitted properties must be included in the district paying their fair share assessment. In most cases, this is politically untenable or there is a strong possibility that property owners will invalidate the district.

Because of the current fiscal constraints at PennDOT, it is important for the municipalities to show their support for the implementation of the physical recommendations specified in this report. One way to show their support is to take action to make the necessary changes to the existing zoning ordinances and land development review procedures to reflect the aforementioned recommendations. However, the best way to get PennDOT to commit funds for the project is for the municipalities to provide matching funds. The money escrowed from the impact fees should be dedicated towards the implementation of the short term improvements. By providing a method to acquire right-of-way or completing planning/design studies the municipalities will show PennDOT that they have a commitment to the improvements and that they are willing to work together towards implementation.

US 202 LONG-TERM RECOMMENDATIONS

These recommendations involve physical improvements and require major capital investments. The implementation of these long term actions depends largely on the success of the implementation of the short term recommendations. The long term recommendations are presented graphically on a series of aerial photos contained in this report. These aerial photos were taken in March of 1985. Some minor development has taken place since then. The proposed improvements are laid out in a conceptual manner showing their general locations. The aerials were used to locate possible alignments with minimal disruption to existing uses. Historic

properties also played a significant role in situating the improvements. Properties perceived as historic by the steering committee are identified on the aerials. Subsequent preliminary engineering studies will locate exact alignments for the widening of US 202 and the jug handles. A description of the long term recommendations is presented below.

- . Widen US 202 from two lanes in each direction to three lanes in each direction. A 100 ft right-of-way for US 202 is shown on the aerial photos. This is a bare minimum right-of-way consisting of six 12 ft lanes (13 ft curb lanes), a concrete median barrier, left lane shoulders, curbs, and an 8 ft clear area on each side of the road. Additional right-of-way for clear area may be needed for cut or fill to match existing grades and for utilities and traffic control devices. A 150 ft right-of-way is preferred and recommended to provide an adequate buffer between the highway and adjacent land uses. The proposed right-of-way shown on the aerial photos is superimposed on the centerline of the existing right-of-way. During preliminary engineering and final design studies, where feasible, the alignment may be shifted to minimize the impact on existing land uses. For example, where right-of-way is vacant or has been reserved by a township on one side of US 202, the design engineers will try to avoid taking right-of-way from the other side where the land is developed. In a situation where both sides of US 202 are developed and acquiring right-of-way will severely disrupt all of the properties, the design engineers may shift the alignment of the highway to one side and leave the other side intact.
- . Reconstruct all signalized intersections to provide jug handles and widen the approaches of the cross streets. Jug handles increase the efficiency of an intersection because they eliminate left turn movements on US 202 and the need for a left turn signal phase. Again, the locations of the jug handles are conceptual in nature, exact alignments must await preliminary engineering. Acquisition of needed right-of-way could be accomplished through the land development review process. At two intersections, Ridge Road and Street Road, the intersection design must be integrated with proposed developments. Unless otherwise indicated, the proposed intersection lane configurations consist of three northbound lanes and three southbound lanes on US 202 and on the cross street approaches, an exclusive left turn lane and a combination through/right lane.

The steering committee has identified a need for collector roads to provide access from new development to the recommended signalized intersections on US 202. These collectors, running roughly parallel to US 202, will alleviate the need for new signalized intersections which

would subsequently deteriorate the level of service on US 202. It is envisioned that these collectors will be constructed by the developers in accordance with the concepts outlined below and as shown on the aerial photos. In some instances, only a stub road is shown in the approximate location. Developers should coordinate with the municipalities and the county in developing the exact alignment and construction of each facility.

Below is a brief description of the proposed improvements. The sheet number indicates on which aerial photo the improvement can be found. The recommendations for improvements at the Painters Crossroads intersection are discussed in a later section.

Matlack Street (sheet 1)

- Widen the eastbound and westbound approaches of Matlack Street.

Matlack Street to US 322 Bus. (sheet 1)

- Widen the ramps between US 202 and US 202/US 322 Bypass to two lanes in each direction.

Stanton Road to Pleasant Grove Rd. (sheets 1-2)

- Construct a frontage road along east side of US 202 from Stanton Road to Stetson Middle School Driveway.
- Construct a northbound near side jug handle at Stetson Middle School.
- Construct a collector road between the frontage road and Pleasant Grove Road on the east side of US 202.
- Construct a connector road between Westview Drive and Stetson Middle School Driveway.
- Construct a southbound far side jug handle at Stetson Middle School.
- Widen Westview Drive.

Street Road (sheet 3)

- Convert Street Road to a pair of one way streets.
- Change existing Street Road alignment to operate eastbound only.
- Construct a new alignment for westbound traffic north of existing Street Road.
- Reconstruct both the eastbound and westbound approaches to consist of an left turn lane, a through lane, and a combination through/right turn lane.
- Signalize and interconnect both the eastbound and the westbound intersections.
- Design the westbound alignment to allow access to potential adjacent development.

Greentree Drive (sheet 4)

- Construct a northbound near side jug handle.
- Construct a southbound far side jug handle.
- Widen the westbound approach.

Old Wilmington Pike (sheet 4)

- Construct a northbound near side jug handle.
- Reconstruct Country Club Drive approach.
- Construct a southbound far side jug handle.
- Realign Old Wilmington Pike into a new access road to be constructed by developers.
- Construct a cul-de-sac on Old Wilmington Pike east of Faucett Drive.

Dilworthtown Road (sheet 5)

- Construct a northbound near side jug handle.
- Construct a southbound far side jug handle.
- Widen the eastbound and westbound approaches.

Oakland Road (sheet 6)

- Construct a northbound far side jug handle.
- Reconstruct the southbound near side jug handle.
- Widen the eastbound approach.

Spring Valley Road to Ridge Road (sheet 8)

- Signalize the Spring Valley Road intersection.
- Construct a northbound far side jug handle at Spring Valley Road.
- Construct a connector road from Spring Valley Road to Spring Hill Road.
- Extend Spring Valley Road to Ridge Road.
- Construct a southbound far side jug handle at the Spring Valley Road extension.
- Remove the signal and close the median opening at Ridge Road.

Ridge Road to Naamans Creek Road (sheets 8-10)

- Widen the existing northbound roadway to three lanes in each direction to accommodate both northbound and southbound traffic. The existing southbound roadway would become a two-way road for local traffic only.
- Cul-de-sac the proposed local traffic road approximately 800 feet south of Ridge Road.
- Construct an access road from the proposed local traffic road for right in/right out access to US 202 southbound.
- Cul-de-sac the proposed local traffic road approximately 400 feet north of Naamans Creek Road.

Smithbridge Road (sheet 9)

- Install a traffic signal at the intersection with the six lane highway.
- Construct a northbound near side jug handle.
- Widen the eastbound and westbound approaches.

Naamans Creek Road (sheet 10)

- Construct a northbound near side jug handle.
- Construct a southbound near side jug handle.
- Widen the eastbound approach to one exclusive left turn lane, one through lane and a combination through/right lane.
- Widen the westbound approach to one exclusive left turn lane, one through lane and one exclusive right turn lane.

Pyle Road (sheet 10)

- Construct a southbound near side jug handle.
- Install a traffic signal.
- Widen the westbound approach.

PAINTERS CROSSROADS RECOMMENDATIONS

The long term recommendations for the Painters Crossroad intersection encompass two of the improvements previously discussed in the alternatives analysis section, namely, completion of the existing partial ring road system and a grade separated interchange.

The ring road system will provide internal circulation for existing and future development on the four quadrants surrounding the intersection. The ring roads will intersect US 202 and US 1 at signalized intersections. It is crucial that the details of this access management plan are agreed upon prior to any new development. Officials from Birmingham Township, Concord Township, Delaware County Planning Department, and PennDOT need to agree upon such issues as access points to US 202 and US 1, roadway alignments, circulation patterns, design criteria and responsibility for construction and maintenance.

In addition to the ring road system, a grade separated interchange is required to accommodate future traffic demands. A minimum 150 foot right-of-way is required to accommodate the grade separated interchange. Existing development precludes an interchange with huge cloverleaf ramps; however a tight diamond interchange configuration will adequately handle the projected volumes through the intersection and provide less disruption to existing development. Since US 202 experiences the higher volumes it should have the free flow movement through the interchange. Ramps between US 202 and US 1 will be signalized at US 1 and will be interconnected with the signals at the ring roads. Preliminary engineering is necessary to confirm right-of-way requirements and the ramp configurations.

APPENDIX