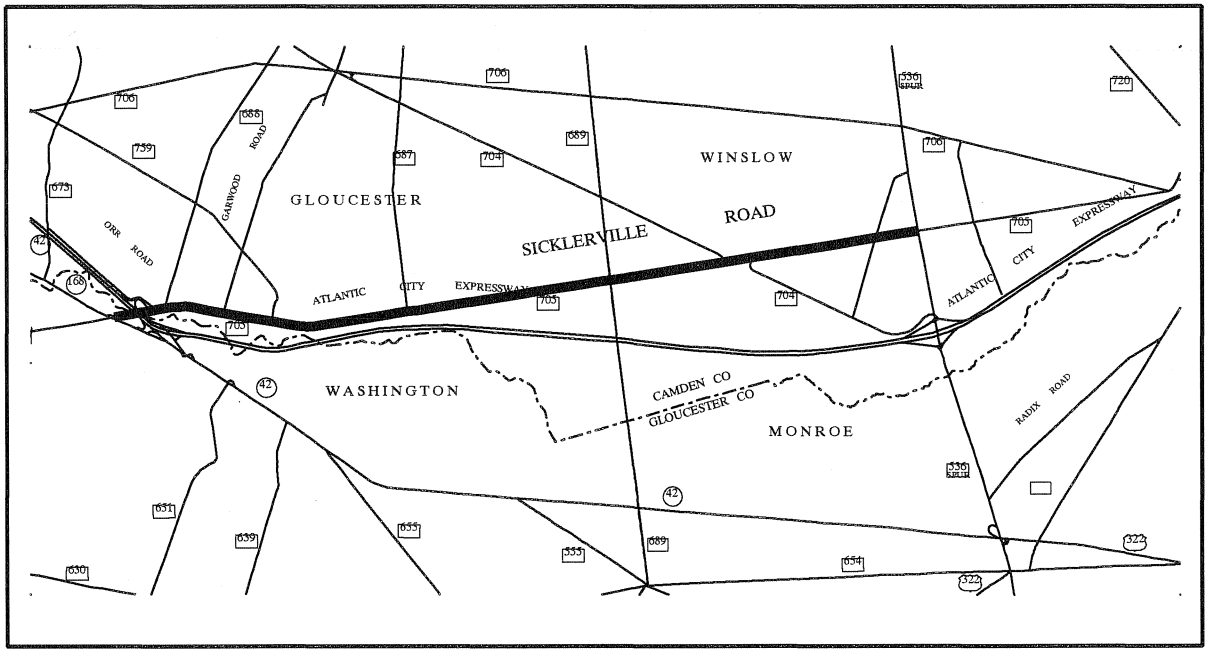
SICKLERVILLE ROAD (CR 705)

TRAFFIC STUDY



DELAWARE VALLEY
REGIONAL PLANNING COMMISION

FEBRUARY 1996

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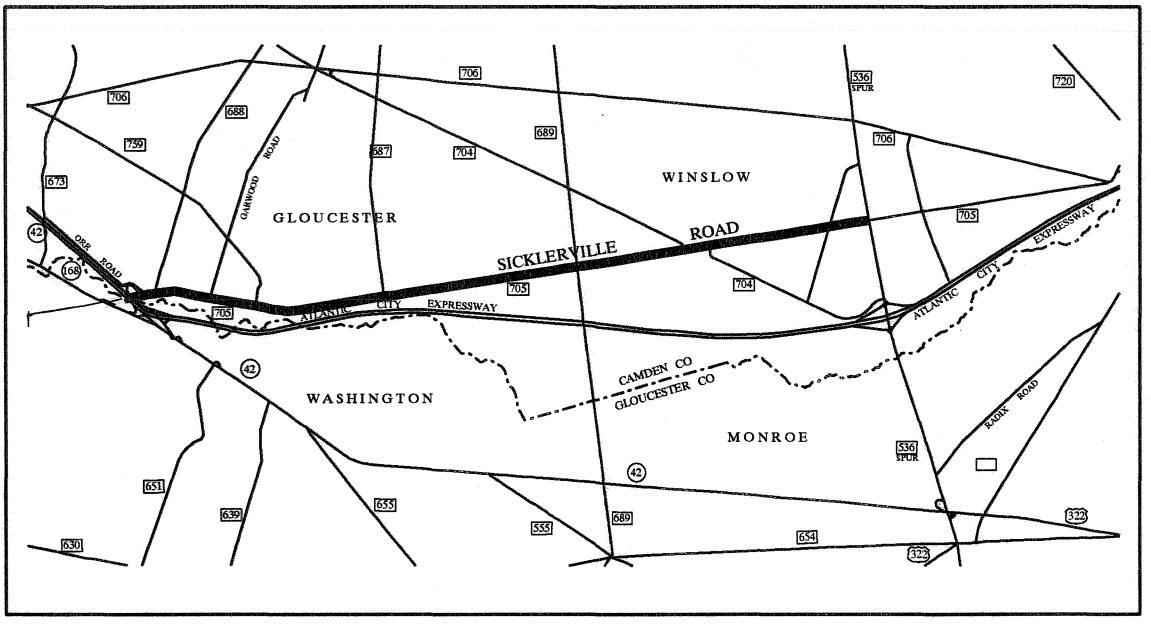
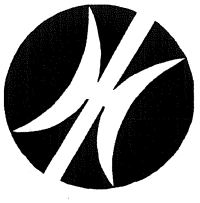


DELAWARE VALLEY
REGIONAL PLANNING COMMISION
The Bourse Building
111 S. Independence Mall East
Philadelphia, PA 19106-2515

FEBRUARY 1996

This report, prepared by the Transportation Planning Division of the Delaware Valley Regional Planning Commission, was financed in part by the Federal Highway Administration, the New Jersey Department of Transportation and the Camden County Planning Department. The authors, however, are solely responsible for its findings and conclusions, which may not represent the official views or policies of the funding agencies.

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



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	Date Published: February 1996
SICKLERVILLE ROAD (CR 705) TRAFFIC STUDY	Publication No.: 96002

Geographic Area Covered:

Camden County, New Jersey (Winslow Township and Gloucester Township), and;
Gloucester County, New Jersey (Washington Township)

Key Words:

traffic congestion, traffic counts, population and employment growth, land development, traffic growth, level of service analysis, traffic improvements

ABSTRACT

This report summarizes an examination of existing and projected future traffic volumes along Sicklerville (CR 705). Undertaken at the request of Camden County, the study was conducted to determine: the ability of Sicklerville Road to accommodate continued area-wide traffic growth, and; the traffic consequences within the corridor of constructing a partial interchange between the Atlantic City Expressway and Cross Keys Road (CR 689).

Two total future traffic volume scenarios were developed and subjected to traffic engineering analyses to determine traffic improvements within the corridor. Right of way needs of the recommended traffic improvements were sketched on aerial photographs (scale: 1" = 200') of the corridor and are provided in a separate companion document.

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF FIGURES (continued)

LIST OF TABLES

APPENDIX

1 EXECUTIVE SUMMARY

This report summarizes the undertakings and findings of a traffic evaluation of Sicklerville Road (CR 705) performed in cooperation with the Camden County Planning and Engineering Departments. The six mile long study corridor extends from CR 536 Spur (on the south) in Winslow Township, through Gloucester Township, Camden County to NJ 168 (on the north), just across the county line in Washington Township, Gloucester County.

The highway's alignment traverses two of the fastest growing municipalities within the nine county region as witnessed by population growth between 1980 and 1990. Similar trends are expected to continue in Winslow and Gloucester Townships to the year 2020 according to population forecasts prepared by the Delaware Valley Regional Planning Commission (DVRPC). Indeed, the main reason for conducting the study emanated from the county's concern for the ability of CR 705 to accommodate the associated future traffic growth.

Additional impetus for performing the study regarded investigating the traffic consequences within the corridor if an interchange linking the Atlantic City Expressway with Cross Keys Road is constructed. Which, by coincidence and subsequent to beginning this study, was determined to be undergoing feasibility study by the South Jersey Transportation Authority (SJTA is the operator of the Atlantic City Expressway).

Multiple activities were performed as part of the work program. First, taffic engineering services were rendered to provide the technical foundation for the undertaking. As such, DVRPC formulated and analyzed present and future travel characteristics and traffic demands within the corridor for two future traffic volume scenarios. As a result of the analysis, DVRPC identified roadway and intersection improvements that were necessary to accommodate the future flows. The County then determined the preferred scenario and recommended improvement set.

Next, right of way needs analysis reflecting the final recommendations was undertaken and mapped on a set of the aerial photographs (scale: 1" = 200') of the CR 705 corridor.

This report details the activities performed in the first stage of the work program and describes the set of final recommendations. The right of way needs analysis, illustrated on aerial photos of the corridor, are provided in a separate companion document.

The detailed study corridor consists of Sicklerville Road, which typically provides one travel lane by direction. Eight major intersections with county and state highways, within the study limits, were also examined. Based upon the analysis of existing traffic volumes, peak hour

traffic operations are unacceptable at Sicklerville Road's intersections with Cross Keys Road (CR 689), Hickstown Road (CR 688), the North-South Freeway (NJ 42) Ramps and the Black Horse Pike (NJ 168). Traffic improvement recommendations addressing these existing deficiencies are included in Table 3 in the main body of this report.

DVRPC estimated future peak hour traffic volumes for the year 2020 accounting for the traffic oriented to and from 30 proposed/potential developments within the corridor, in addition to ongoing region-wide growth. Total future corridor-wide traffic growth on the order of 40 to 70 percent is estimated to occur in the corridor. The projected growth in traffic indicated that improvements would be required to maintain mobility within the corridor.

Two scenarios of total future traffic volumes were formulated for analyses. They are summarized below.

I. WITHOUT CROSS KEYS ROAD INTERCHANGE - Estimates travel conditions within the corridor if "present" traffic circulation patterns are maintained throughout the study area. Assessment finds that, in addition to specific intersection recommendations, widening the entire length of CR 705 for an additional through travel lane in each direction will be necessary to accommodate future traffic.

II. WITH CROSS KEYS ROAD INTERCHANGE - Estimates mobility enhancements afforded if a partial interchange is constructed between Cross Keys Road and the Atlantic City Expressway and that the interchange serves on and off traffic movements oriented to and from the north (i.e., to and from Camden and Philadelphia). Assessment finds that, by taking advantage of corridor capacity afforded by the parallel Atlantic City Expressway, required roadway widening within the central section of the CR 705 corridor can be reduced by approximately 2.5 miles versus scenario I.

After a series of communication/coordination meetings with representatives of Camden County's Planning and Engineering Departments, the SJTA, NJ DOT and the Gloucester County Engineer's Office, Camden County staff indicated to DVRPC that the circulation conditions and traffic improvements portrayed within the "With Cross Keys Road Interchange" scenario were generally preferred -- yielding the set of recommended traffic improvements for the study. The final recommendations are summarized in Table 9 in the main body of this report.

The recommended improvements may be staged within the corridor based upon available finances, incremental need and/or changes in planned conditions or circumstances. As a result, the set of final recommendations allows flexibility for the County in upgrading Sicklerville Road.

2 INTRODUCTION

This report addresses existing traffic conditions occurring along Sicklerville Road (CR 705) in Camden County and the conditions projected to occur as a result of recent and proposed development within the corridor. The section of Sicklerville Road under study extends from CR 536 Spur (Williamstown-New Freedom Road) in Winslow Township, through Gloucester Township, Camden County, to NJ 168 (Black Horse Pike) just across the county line in Washington Township, Gloucester County -- a distance of about six miles (Figure 1).

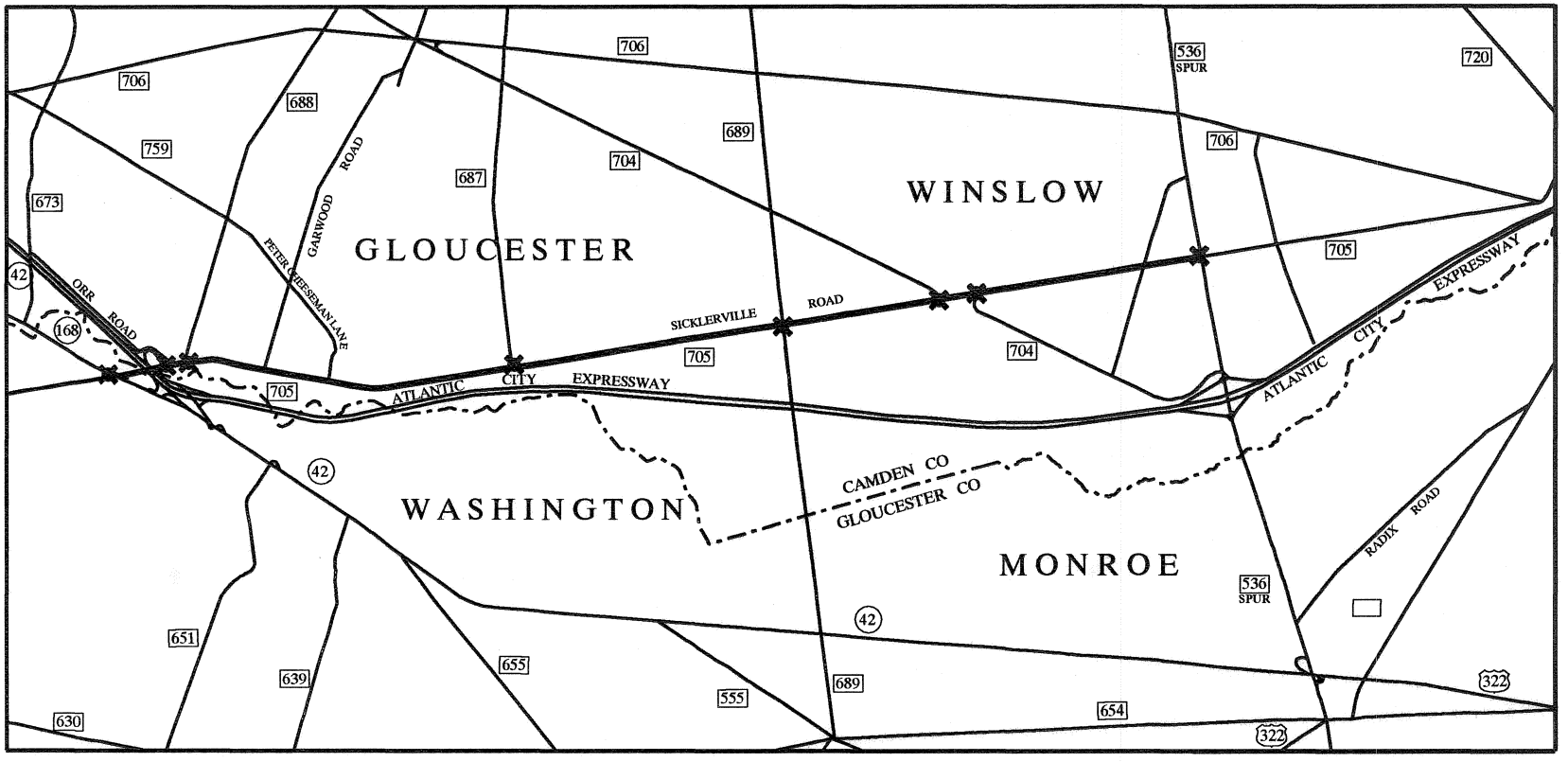
The development boom of the 1980's had a tremendous impact in Gloucester and Winslow Townships, located in the lower portion of Camden County. Between 1980 and 1990 the population of Gloucester Township increased from 45,156 to 53,797 (+19%) and Winslow Township's population increased 50% from 20,034 to 30,087. Much of this growth resulted from new residential development adjacent to or in the vicinity of Sicklerville Road. The corridor has not seen the end of this development; in fact, Winslow Township and Gloucester Township are projected by DVRPC to be the fastest growing municipalities in the nine-county DVRPC area between 1990 and 2020. Winslow is projected to gain almost 21,000 new residents, a 70% increase and Gloucester is projected to gain almost 20,000, a 37% increase.

With the expectation of continued significant development in this corridor, the county is concerned about the amount of traffic to be accommodated on the county road system. To address this concern, DVRPC was commissioned to conduct an in-depth analysis of existing and projected future traffic conditions within the Sicklerville Road corridor. This report summarizes that effort. Components of the work effort are outlined below.

- Determine the existing physical characteristics of the county roads in this corridor.
- Obtain existing peak hour traffic volumes at eight study intersections along the corridor.
- Conduct level of service analysis, and traffic signal warrant and accident analyses of existing traffic volume as was necessary to identify improvements to rectify existing deficiencies at the eight study intersections.
- Identify, with the county's participation, proposed developments within the corridor.
- Estimate additional future peak traffic demands resulting from the new development, as well as, traffic resulting from ongoing regional growth for two traffic scenarios. One assumed no changes to the circulation patterns provided by the existing roadway network. The second scenario assumed a partial interchange on the Atlantic City Expressway at Cross Keys Road.
- Conduct level of service analysis of future (2020) traffic volumes to identify improvements necessary to accommodate each scenario.

- Coordinate with the county, and communicate with neighboring jurisdictions and affected operators, to determine a final set of recommended improvements within the corridor.
- Prepare aerial photographs showing right of way requirements associated with the recommended improvements (scale: 1" = 200').

FIGURE 1
STUDY AREA
LOCATION MAP



Delaware Valley Regional Planning Commission

SCHEMATIC NOT TO SCALE

LEGEND:

- Studied Intersection
- Studied Highway Alignment

3 EXISTING TRANSPORTATION CONDITIONS

In examining existing transportation conditions, the variety of and demand for transportation services within the corridor are presented. The ability of the network to adequately satisfy the demand is also assessed.

HIGHWAY NETWORK DESCRIPTION

Sicklerville Road runs in a north-south direction along the western edge of Camden County. The section under study is closely parallelled on the west by the Atlantic City Expressway.

Sicklerville Road generally carries one travel lane in each direction except the segment between the Erial-Williamstown Road (CR 704) offset intersections, where two lanes in each direction are provided. Approaches to signalized intersections intermittently provide left turning lanes and less frequently right turning lanes. There are no posted speed limits in the northern section of the corridor which by statute sets limits to 50 miles per hour. In the southern portions, however, the speed limit is posted at 50 miles per hour.

The typical land use abutting Sicklerville Road is residential or undeveloped tracts. Commercial activity occurs in the vicinity of intersections. Roadside interferences are light due to the low intensity of land development abutting the highway and infrequent driveway and side street intersections along the route. Major new subdivisions are served by driveways/roadways which are complemented with acceleration and deceleration lanes.

Physical and operating conditions at the eight study intersections along Sicklerville Road are enumerated below.

Williamstown-New Freedom Road (CR 536 Spur) - This four-way intersection is controlled by a two-phase traffic signal. The signal timing does not include an all-red interval between phases. The northbound CR 705 approach consists of an exclusive left turn lane, a through lane and an exclusive right turn lane. The through lane is not lined up properly with the departure lane and through traffic must shift to the left as it passes through the intersection. The southbound approach is striped for one lane but, is sufficiently wide so that vehicles frequently line up two abreast. The eastbound approach lane is also sufficiently wide so that through and right turning traffic can easily bypass vehicles queued up to turn left. The westbound approach also provides sufficient width for two travel lanes to form abreast. Dependent upon traffic volume on the approach -- a left turn lane plus a shared through and right turn lane can form reducing the through carrying capability to one lane. Alternately, two westbound through lanes can form on the approach which becomes problematic as through traffic must merge back into one lane as it departs the intersection. All other intersection departure legs also function as one lane. The adjacent land use consists of two gas stations, a convenience store and a vacant building.

Erial-Williamstown Road (CR 704) South - This three-legged intersection is controlled by a two-phase actuated traffic signal. Traffic signal operation is coordinated with the Erial-Williamstown Road (CR 704) North/Wilby Road intersection located approximately 1,000 feet to the north along Sicklerville Road. Both the northbound and southbound approaches on Sicklerville Road carry two lanes into the intersection. This section of Sicklerville Road is four lanes wide so there are two departure lanes in each direction to accept the through traffic. The CR 704 eastbound approach consists of an exclusive left turn lane and an exclusive right turn lane. The adjacent land use consists of residential properties and a vacant field.

Erial-Williamstown Road (CR 704) North/Wilby Road - A multi-phase actuated traffic signal, with provisions for exclusive left turn movements on all four approaches, controls the operation of this intersection. Traffic signal operation is coordinated with the Erial-Williamstown Road (CR 704) South intersection located about 1,000 feet to the south along Sicklerville Road. Both the eastbound (Wilby Road) and westbound (CR 704) approaches consist of an exclusive left turn lane, and a shared through and right turn lane. The CR 705 approaches consist of an exclusive left turn lane and two continuous through lanes in each direction. Right turn channelization islands are present on both the northbound and southbound approaches, however only the northbound leg is afforded a separate right turn lane. Land use adjacent to the intersection consists of residential developments on two quadrants, a vacant parcel, and a small shopping center with a convenience store anchor.

Cross Keys Road (CR 689) - A two-phase traffic signal controls traffic movement at this four-way intersection. Each leg of the intersection is striped for a single lane entering and departing, however additional pavement width is provided on the northbound CR 705 and eastbound CR 689 approaches. Under peak traffic conditions the added space on the northbound approach is typically used by left turning traffic. On the eastbound approach left turns and right turns are afforded sufficient space, due to frontage widening along a restaurant's property, so that these movements operate separately from the through traffic. On the corners of the intersection are two restaurants, a house and a gas station.

Jarvis Road (CR 687) - This is a three-legged intersection with traffic control provided by a stop sign on the westbound Jarvis Road approach. Each leg entering and departing the intersection is striped for a single lane of traffic. The intersection has been redesigned to provide for traffic signalization such that southbound CR 705 will have a separate left turn lane, northbound CR 705 will have additional width for an added northbound approach lane (quickly tapering back to a single lane upon departure of the intersection) and separate left and right turn lanes will be provided on the westbound Jarvis approach. The new traffic signal will be actuated with an advance southbound left turn/through phase in addition to a phase for northbound traffic and a green phase for movements on the westbound approach. Land use on two sides of the intersection is devoted to single family homes while the west side is undeveloped.

Hickstown Road (CR 688) - This is a three-legged skewed intersection with traffic control provided by a stop sign on the westbound Hickstown Road approach. Each leg entering and departing the intersection is striped for a single lane of traffic. Additional pavement width on the southeast corner, resulting from widening along a convenience store's frontage, allows sufficient roadway space to act as a separate northbound right turn lane. The remaining sides

of the intersection are devoted to a dwelling and an undeveloped tract.

North-South Freeway (NJ 42) Ramps - This three-legged intersection is formed by the ramps from and to northbound NJ 42 (access to/from southbound NJ 42/the Atlantic City Expressway and CR 705 is provided at NJ 168). Stop and yield signs control left turn and right turn exiting movements from the ramp, respectively, and each movement is separated by a channelization island. A very wide median island is also present separating the on-ramp lane from the off-ramp lane. The effect of the median's width contributes to physical blockages of left turns from the exit ramp by stopped/stored southbound left turning vehicles. While striped for just two travel lanes, Sicklerville Road is sufficiently wide to allow separate space for southbound left turns and northbound right turns. As a consequence, during periods of peak demand, through traffic in each direction is not impeded. Physical constraints nearby the intersection are posed by: an auto body shop opposite the ramps; the Orr Road intersection (a Gloucester Township owned and maintained highway) immediately south of the interchange, and; the NJ 42 overpass/bridge structure immediately north of the interchange.

Black Horse Pike (NJ 168) - The intersection of the Black Horse Pike with Sicklerville Road forms a skewed four-way intersection. A multi-phase actuated traffic signal, providing advance left turn green arrows for the southbound NJ 168 and the northbound CR 705 approaches, controls the intersection. NJ 168 provides two continuous travel lanes in each direction separated by a grass median through the intersection. Its cross section is enhanced by the presence of paved shoulders (adjacent to the outer travel lanes), a separate left turn lane provided on the southbound approach, and a right turn channelization island present on the northbound approach. CR 705 provides one continuous undivided travel lane through the intersection in each direction. The northbound approach is supplemented by a separate left turn lane. The great width of NJ 168's cross section (80 feet) facilitates the storage of left turning vehicles from both Sicklerville Road approaches within the center of the intersection. This is a particular benefit for the southbound approach which is somewhat narrow and not fitted with a separate left turn lane. Commercial development encroaches quite closely to all corners of the intersection with the exception of the southwest quadrant (the corner with the right turn channelization island). Another physical constraint in the vicinity of the intersection includes the two lane wide bridge carrying Sicklerville Road over a stream just to the south of the NJ 168 junction.

As mentioned earlier, highway travel in the corridor is supplemented by the Atlantic City Expressway. Located due west of Sicklerville Road, access to this four lane freeway is accomplished by interchanges. Within the study area, two interchanges are available -- 1) at the Williamstown Interchange, interchange #38, at Williamstown-New Freedom Road (CR 536 Spur), and; 2) at the convergence of the Black Horse Pike (NJ 168), the North-South Freeway (NJ 42) and CR 705. At present the Williamstown Interchange requires a $0.10 toll for autos and a $0.25 toll for trucks entering to or exiting from the north.

EXISTING PUBLIC TRANSPORTATION SERVICES

In addition to the above referenced highway facilities, traditional automobile travel

within the corridor is supplemented by the Avandale Park and Ride lot and New Jersey Transit (NJT) bus services. The Avandale Park and Ride lot is located on a parcel adjacent to the northeast quadrant of the Williamstown-New Freedom Road (CR 536 Spur) and Erial-Williamstown Road (CR 704) intersection, just east of interchange #38 of the Atlantic City Expressway. According to a Friday, September 23, 1994 field survey, it was determined that the lot has 368 free parking spaces, including seven handicapped spaces. On that date the lot contained 136 parked cars. The Avandale Park and Ride lot is available to NJT users only.

The corridor is also served by six regularly scheduled NJT bus routes affording both local and express type services. Descriptions of the routes as they operate on typical weekdays within the environs of the study area (according to NJT schedules effective as of September 2, 1995) are shown below.

- 400 - Operating between Sicklerville, Camden and Philadelphia -- primarily via CR 536 Spur and the Black Horse Pike. Service to the Avandale Park and Ride lot is provided about every 20 minutes during the peak hours and hourly during the midday and evening periods. Only midday trips are extended from the park and ride lot to the "village" of Sicklerville.
- 403 - Operating between Turnersville, the Lindenwold PATCO station, Camden and Philadelphia -- via Sicklerville Road, Jarvis Road, Erial-Gibbsboro Road and the White Horse Pike. Inbound service (i.e., to Camden and Philadelphia) is offered at 15 minute intervals, but is limited to the peak hours. Outbound service is offered at about the same frequency as inbound service during the rush hours, but is also provided on an hourly basis during the midday and at two hour intervals during the evening.
- 459 - Operating between Echelon Mall, Camden County College and the Avandale Park and Ride lot -- primarily via Laurel Road, Peter Cheeseman Lane, Garwood Road, Sicklerville Road and Erial-Williamstown Road. Thirty minute service is provided in the peaks while hourly service is delivered during the midday and evening service periods.
- 463 - Operating between Woodbury and the Avandale Park and Ride lot -- primarily via Delsea Drive, Egg Harbor Road, Main Street through Williamstown and CR 536 Spur. Hourly headways in each direction are maintained on a 24 hour basis.
- 551 - Operating between Atlantic City, the Avandale Park and Ride lot, Camden and Philadelphia -- via the Atlantic City Expressway and the North-South Freeway. Thirty minute headways are provided in both directions throughout the majority of the day. Owl service (i.e., during the late evening and the early morning) is hourly.
- 555 - Operating between Ocean City, the Avandale Park and Ride lot, Camden and Philadelphia -- via the Garden State Parkway, the Atlantic City Expressway and the North-South Freeway. Two morning rush hour trips inbound to Philadelphia and two evening rush hour trips outbound to Ocean City.

EXISTING TRAFFIC VOLUMES

Average daily traffic volumes (ADTs) were collected for selected segments of the study corridor. Those counts were expressly for this study or were obtained from recent traffic

counts performed in the areas as part of DVRPC's ongoing travel monitoring program. From those sources, it was determined that about 10,000 vehicles per day (1994) are served by the highway between CR 536 Spur and CR 704 in Winslow Township. Approximately 12,000 vehicles per day (1994) are travelling the study highway between CR 689 and CR 687 in Gloucester Township. Between Garwood Road and Hickstown Road, also in Gloucester Township, daily volume was recorded at 16,000 vehicles (1993).

Manual turning movement traffic counts were conducted by DVRPC in early Autumn 1994 for this study or were obtained from traffic studies recently performed along the corridor to determine peak hour traffic demands at the study intersections. Sources and dates of the traffic count data are listed below.

Sicklerville Road (CR 705) and:

1) Williamstown-New Freedom Road (CR 536 Spur) - DVRPC, October 1992.
2) Erial-Williamstown Road (CR 704) South - DVRPC, September 1994
3) Erial-Williamstown Road (CR 704) North/Wilby Road - DVRPC, September 1994.
4) Cross Keys Road (CR 689) - Horner-Canter & Associates, February 1992.
5) Jarvis Road (CR 687) - Key Engineers Inc., September 1990.
6) Hickstown Road (CR 688) - DVRPC, October 1992.
7) North-South Freeway (NJ 42) Ramps - DVRPC, November 1994.
8) Black Horse Pike (NJ 168) - DVRPC, November 1994.

It should be noted that, where necessary, peak hour volumes were adjusted to 1994 conditions to serve as the analytical data for this study.

Current peak travel hour traffic volumes are presented in Figure 2, for the a.m. peak hour and Figure 3 for the p.m. peak traffic hour. A brief overview of the peak hour traffic situation within the corridor indicates that during the a.m. peak hour the distribution of traffic is predominantly northbound, during the p.m. southbound volume predominates. Generally higher volumes are recorded during the p.m. peak hour. In both peaks, the highest traffic activity along the corridor occurs in the vicinity of the North-South Freeway interchange at the northern end of the corridor. Typically, volume diminishes as distance from the interchange increases.

EXISTING LEVEL OF SERVICE ANALYSIS

Level of service analysis is a procedure which relates traffic operations to motorist's perceptions in terms of -- speed, travel time, traffic operations, freedom to maneuver, comfort, and convenience. Level of service analyses were performed at the study intersections given existing roadway, geometry and traffic control conditions. These analyses were performed using the methodology and procedures of the Highway Capacity Manual (Special Report 209, Transportation Research Board, Washington, D.C., 1985.). It should be noted that since

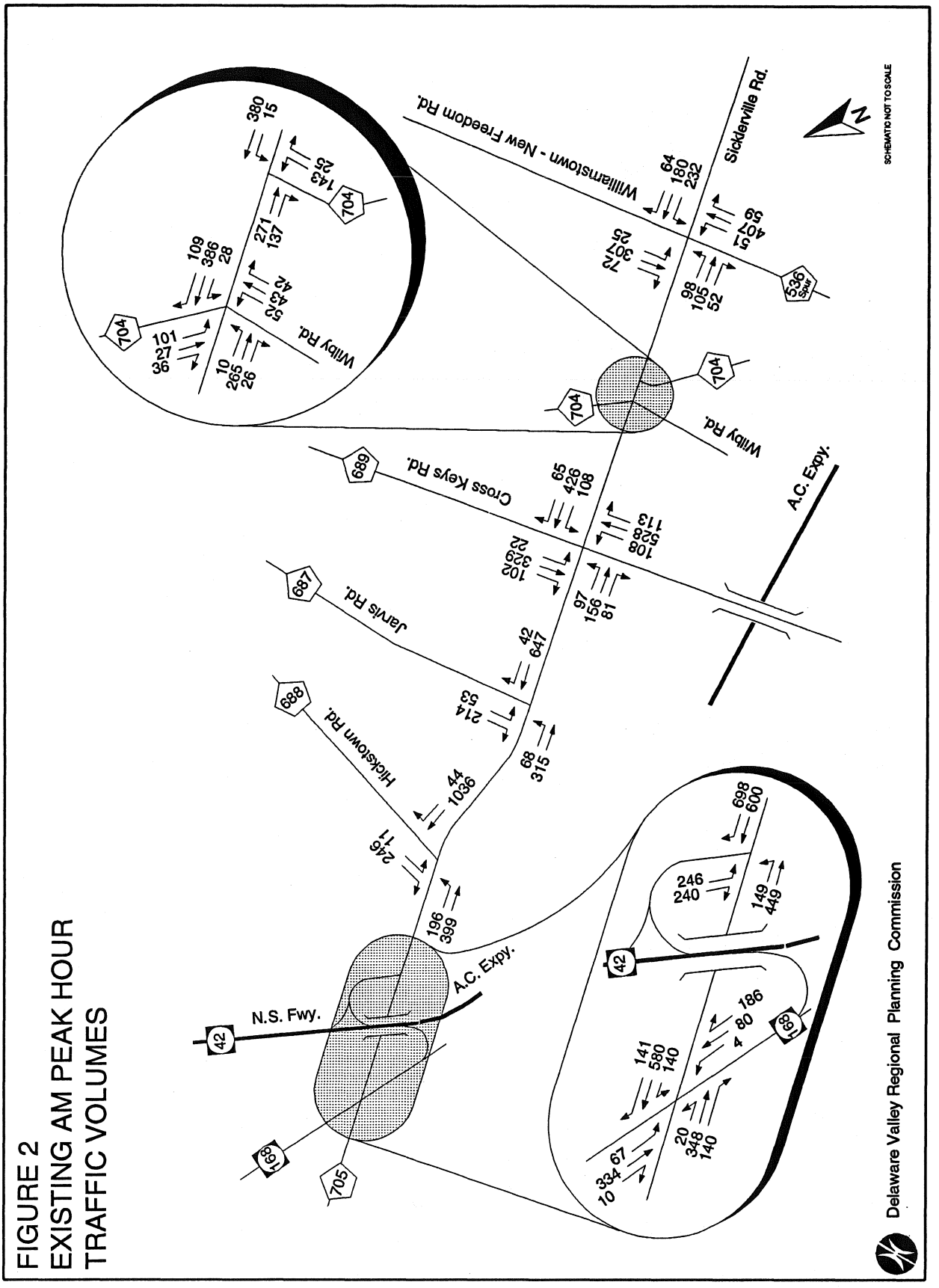


FIGURE 2
EXISTING AM PEAK HOUR
TRAFFIC VOLUMES
Delaware Valley Regional Planning Commission
SCHEMATIC NOT TO SCALE
N
Sicklerville Rd.
Williamstown - New Freedom Rd.
Willby Rd.
Cross Keys Rd.
Jarvis Rd.
Hicksiown Rd.
A.C. Expy.
N.S. Fwy.
536
704
689
687
688
42
168
705

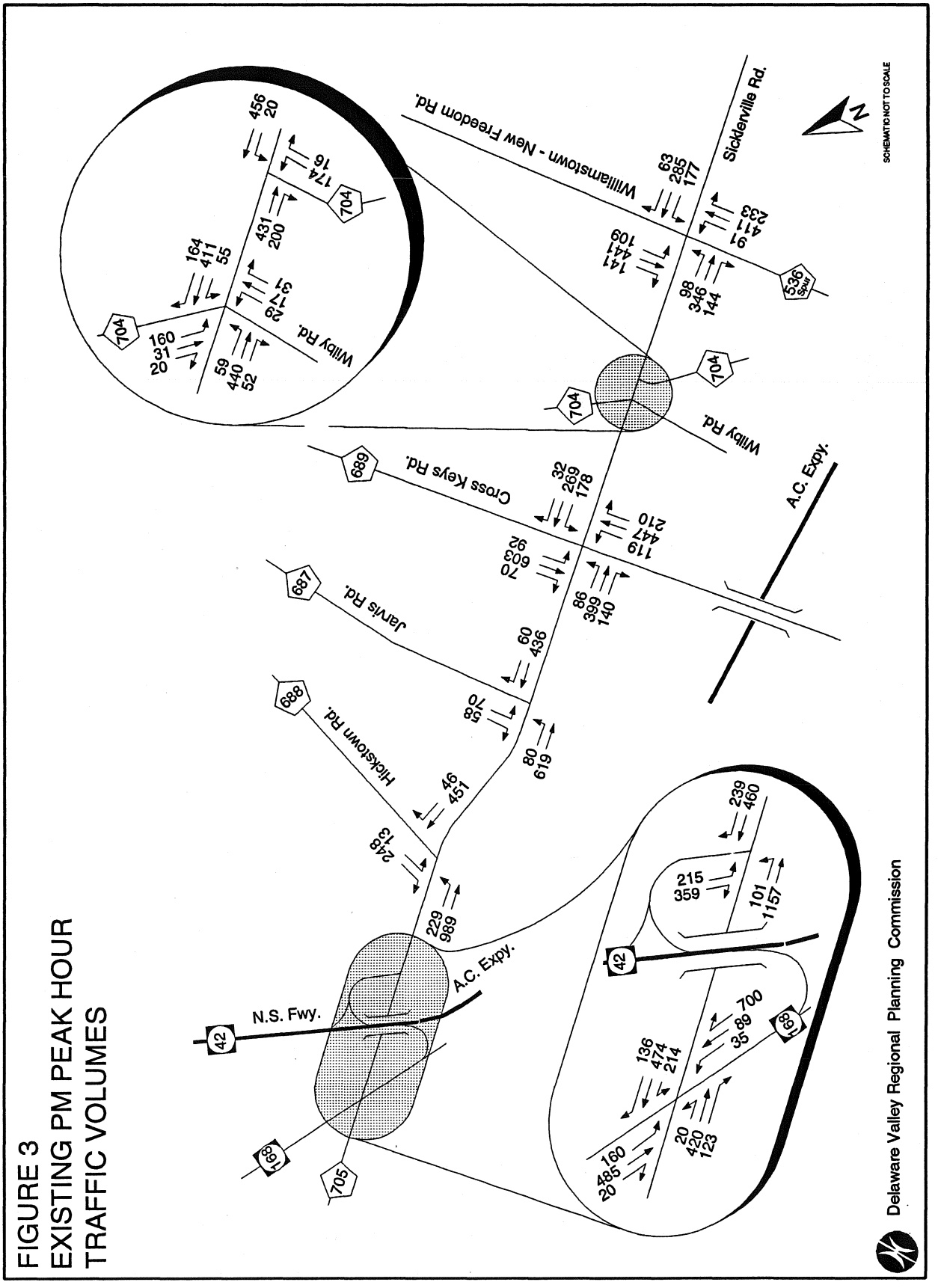


FIGURE 3
EXISTING PM PEAK HOUR
TRAFFIC VOLUMES
Delaware Valley Regional Planning Commission
SCHEMATIC NOT TO SCALE
N
Sicklerville Rd.
Williamstown - New Freedom Rd.
Willby Rd.
Cross Keys Rd.
Jarvis Rd.
Hicksetown Rd.
A.C. Expy.
N.S. Fwy.
42
536
704
689
687
688
705
63 285 177
91 233 241
141 441 109
98 346 144
32 269 178
119 447 210
70 603 92
86 399 140
60 436
70 58
80 619
46 451
248 13
229 989
456 20
174 16
431 200
164 411 55
29 17 31
160 31 20
59 440 52
239 460
215 359
101 1157
136 474 214
700 35 89
160 285 20
20 420 123

signalized and stop sign controlled intersections are measured differently, the letter designations for level of service are not directly comparable to one another.

At intersections, level of service reflects the ability to clear a traffic signal and/or the freedom to maneuver through conflicting traffic volumes. Level of service at signalized intersections is measured in terms of average stopped delays encountered by vehicles traversing the intersection. Delays in these cases are influenced by the length of the signal cycle, the amount of green time apportioned to an approach, as well as, the vehicular demand on the approach. Table 1 gives a 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 direct manner. Thus, the designation of level of service F does not automatically imply the approach is overloaded. Long cycle length and/or poor progression through adjacent traffic signals can also result in excessive delays.

Level of service criteria for unsignalized intersections (e.g., stop sign controlled side streets approaching uninterrupted major highway segments) are measured in terms of reserve capacity. Reserve capacity is related to qualitative delay ranges (see Table 2).

The analysis for unsignalized operation focuses on minor street traffic approaching a stop or yield sign and left turns from the major street. The potential capacity of the critical traffic movement 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.

Level of service analyses were completed for the study corridor's five signalized and three unsignalized intersections. The results of existing level of service conditions are illustrated on Figure 4. A summary of the findings, on an intersection-by-intersection basis, follows.

Williamstown-New Freedom Road (CR 536 Spur) and Sicklerville Road -
All approaches to the intersection operate reasonably well during the morning peak, however during the evening rush hour the Sicklerville Road southbound through and right turn movement experiences a moderate degree of congestion while the northbound left turn lane experiences lengthy delays. Overall intersection operations are at level B in the morning and level D in the evening.

Erial-Williamstown Road (CR 704) South and Sicklerville Road -
Eastbound left turns on CR 704 operate with moderate delays during the a.m. and p.m. peak hours, on the other hand, the approach is actuated and receives enough green time to clear the approach. Side street delays in this case are a function of the cycle length and the minimum green time afforded to the major street approaches. Overall intersection operations are at level B during both peak hours.

TABLE 1: LEVEL OF SERVICE CRITERIA - SIGNALIZED INTERSECTIONS

LEVEL OF SERVICE A - Very low delay, good progression; most vehicles do not stop at intersection. Average stopped delays equal 5.0 seconds or less 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'. The average stopped delay range is between 5.1 to 15.0 seconds per vehicle.

LEVEL OF SERVICE C - Fair progression and/or longer cycle length; significant number of vehicles stop at intersection. The delay range averages 15.1 to 25.0 seconds per vehicle.

LEVEL OF SERVICE D - Congestion becomes noticeable, many vehicles stop at signal, individual cycle failures. Longer delays from unfavorable progression and longer cycle lengths. Delay range is between 25.1 to 40.0 seconds per vehicle.

LEVEL OF SERVICE E - Considered limit of acceptable delay, indicative of poor progression, long cycle lengths. Frequent individual cycle failures. Delay range equals 40.1 to 60.0 seconds per vehicle.

LEVEL OF SERVICE F - Unacceptable delay, indication of oversaturation (i.e., arrival flow exceeds capacity). Average delay exceeds 60.0 seconds per vehicle.

Source: Highway Capacity Manual, Transportation Research Board, Special Report 209, 1985

TABLE 2: LEVEL OF SERVICE CRITERIA - UNSIGNALIZED INTERSECTIONS

LEVEL OF SERVICE A - Little or no delay. Reserve capacities equal 400 or more passenger cars per hour.

LEVEL OF SERVICE B - Short traffic delays. Reserve capacities between 300 to 399 passenger cars per hour.

LEVEL OF SERVICE C - Average traffic delays. Reserve capacities between 200 to 299 passenger cars per hour.

LEVEL OF SERVICE D - Long traffic delays. Reserve capacities between 100 to 199 passenger cars per hour.

LEVEL OF SERVICE E - Very long traffic delays. Reserve capacities between 0 and 99 passenger cars per hour.

LEVEL OF SERVICE F - Extreme traffic delays. Reserve capacities less than 0. When demand volume exceeds the capacity of the lane queuing may result causing congestion and affecting other traffic movements in the intersection.

Source: Highway Capacity Manual, Transportation Research Board, Special Report 209, 1985

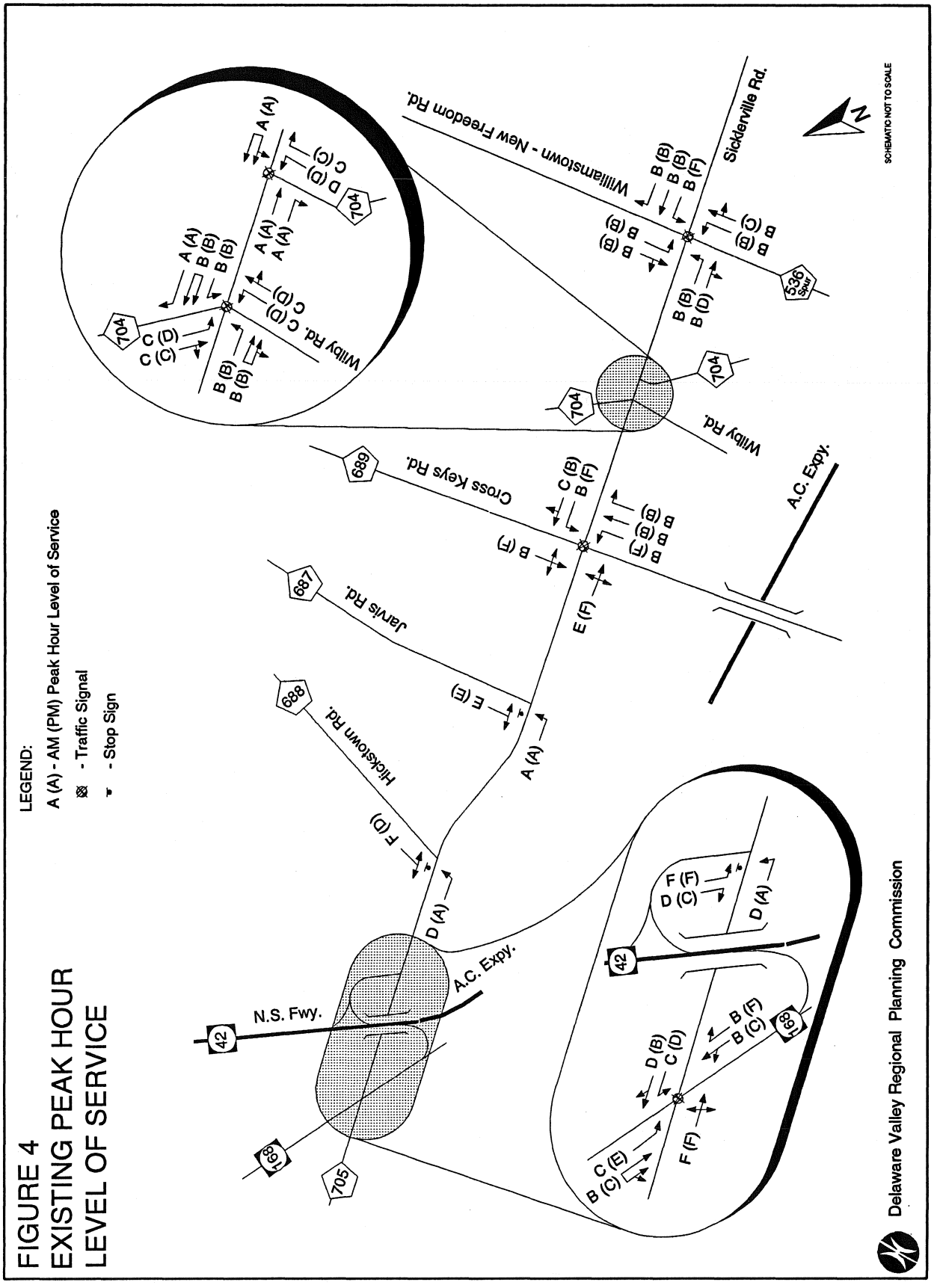


FIGURE 4
EXISTING PEAK HOUR
LEVEL OF SERVICE
LEGEND:
A (A) - AM (PM) Peak Hour Level of Service
- Traffic Signal
- Stop Sign
Williamstown - New Freedom Rd.
Sicklerville Rd.
Willby Rd.
Cross Keys Rd.
Jarvis Rd.
Hicksktown Rd.
A.C. Expy.
N.S. Fwy.
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Erial-Williamstown Road (CR 704) North/Wilby Road and Sicklerville Road -
Moderate signal timing delays are encountered on the minor street approaches during the p.m. peak hour in a fashion similar to that described above. Overall intersection performance is level B for the morning and evening peak travel hours.

Cross Keys Road (CR 689) and Sicklerville Road -
Severe traffic conditions are encountered on each approach of the intersection during the p.m. peak hour. The overall intersection operates at level C during the a.m. and level F and over-capacity conditions during the p.m. peak hour.

Jarvis Road (CR 687) and Sicklerville Road -
Side street stop controlled movements operate with lengthy delays encountered during both rush hours. Traffic movements along Sicklerville Road are uninterrupted and encounter little or no delays.

Hickstown Road (CR 688) and Sicklerville Road -
Side street stop controlled movements operate with severe delays and southbound left turns also experience difficulty during the a.m. peak hour as the volume of northbound traffic makes it difficult for minor movements to cross or merge with the major traffic stream.

North-South Freeway (NJ 42) Ramps and Sicklerville Road -
Ramp exiting traffic seeking to turn left to southbound CR 705 experiences extreme delays during the a.m. and p.m. peak hours. During the p.m. peak, queues frequently exceeded 20 vehicles stacked up on the off-ramp. As queues on the approach lengthen, the ability to freely turn right from the off-ramp is compromised. A sampling of delay measurements, taken at the intersection during the p.m. peak period, indicated delays of three to five minutes per vehicle to clear the ramp's approach to Sicklerville Road. Observations of the intersection during the course of the traffic count also indicated a fair amount of "near misses" -- suggesting that vehicular safety is being compromised as a consequence of the congested conditions.

Black Horse Pike (NJ 168) and Sicklerville Road -
Traffic operations on the southbound Sicklerville Road approach during both peaks are experiencing extreme delays. Similarly, extreme delay is encountered by right turns from the northbound Black Horse Pike approach in the p.m. peak hour as heavy volume heads outbound from the region's commercial core. As a consequence of these constrained intersection approaches the overall intersection operates at level F and over-capacity conditions during both peak travel hours.

In summary of the level of service analysis of existing traffic volume it is concluded that unacceptable conditions along Sicklerville Road are encountered at: Cross Keys Road (CR 689); Hickstown Road (CR 688); the North-South Freeway (NJ 42) Ramps, and; the Black Horse Pike (NJ 168).

Because of the unique observations made at the Sicklerville Road and North-South Freeway Ramps' intersection, two special analyses were conducted: 1) an accident analysis, and;

2) a traffic signal warrant analysis.

ACCIDENT ANALYSIS

Traffic accident reports were obtained from the Gloucester Township Police Department for the period 1992, 1993 and 1994. Reportable accidents[1] were tabulated (see APPENDIX), plotted in a collision diagram, analyzed for probable cause and evaluated for potential countermeasures. Figure 5 displays the collision diagram and a summarized accident analysis.

A review of the accident data indicates that most of the accidents occur during the daylight hours, with no adverse weather and dry pavement conditions. Many of the accidents are recorded to have occurred during or close to the peak travel periods and the major accident pattern is angle accidents (13 of 23 total). An acceptable countermeasure for an angle accident pattern is the installation of a traffic signal.

TRAFFIC SIGNAL WARRANT ANALYSIS

According to New Jersey statues, when evaluating locations for the installation of traffic signals, the Manual on Uniform Traffic Control Devices (MUTCD) must be used. This manual sets forth a series of eleven warrants based on traffic/pedestrian levels, accident histories or combinations thereof that must be met before an intersection is legally eligible for signal installation.

Within the conduct of this study only Warrant 11, the Peak Hour Volume Warrant, was evaluated at the unsignalized ramp intersection[2]. The peak hour volume warrant is intended for application when traffic conditions are such that for one hour of the day minor street traffic may suffer undo delay in entering or crossing the major street. This warrant is satisfied when, for any hour of an average day, the plotted points representing the vehicles per hour on both approaches of the major street and the corresponding vehicles per hour on the higher volume minor street approach all fall above the curve in Figure 6. The curve on the graph represents minimum vehicular volumes that must be met or exceeded for an intersection with one lane approaches. The volume displayed for the NJ 42 off-ramp is left turning traffic volume only.

As can be seen, the volumes in both the a.m. and p.m. peak hours currently exceed the requirements for this warrant, indicative that a traffic signal is justified for installation at the

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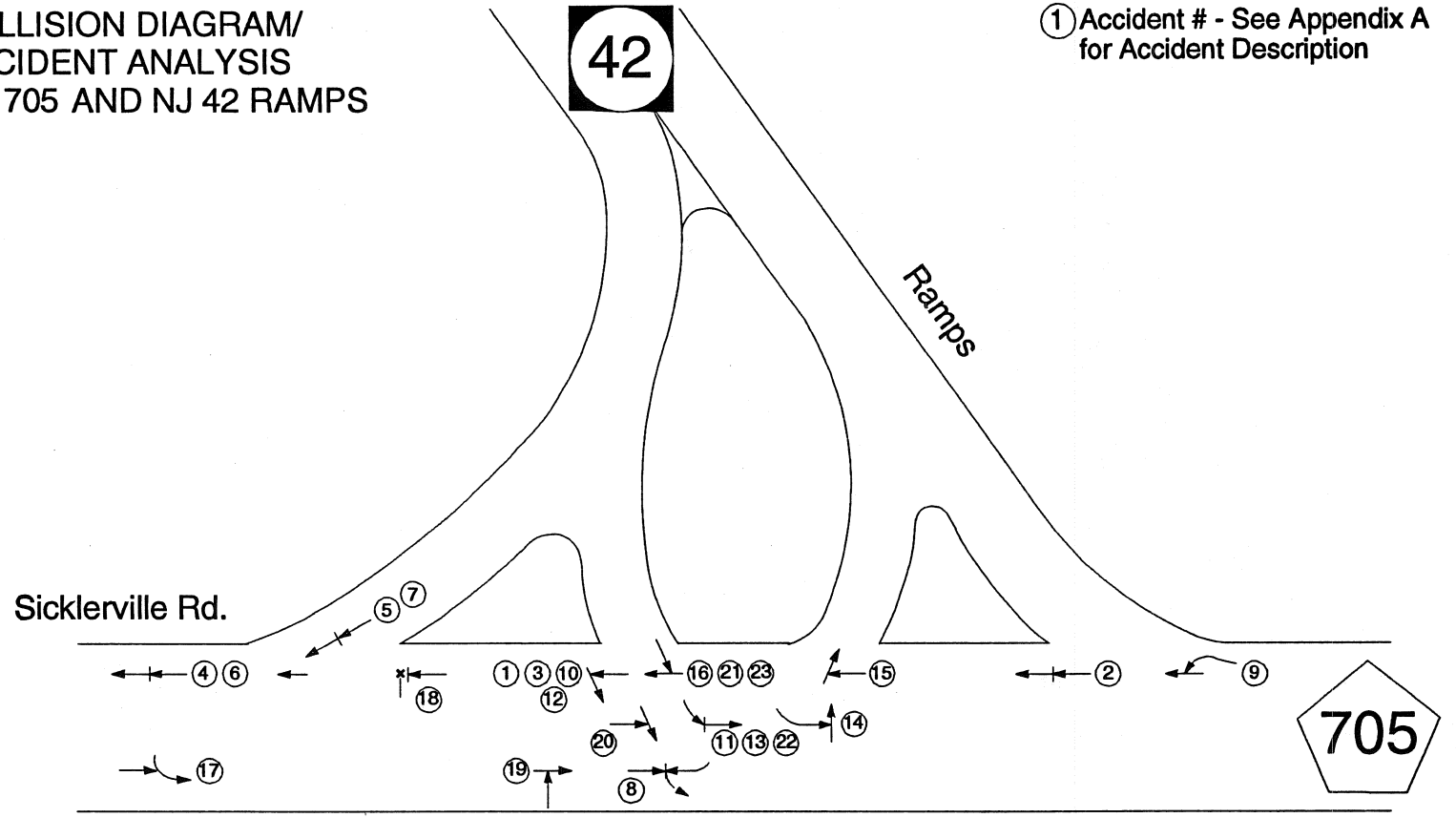
[1] A reportable accident in the State of New Jersey is defined as an accident in which personal or property damages total $500 or more, or in which an injury or a death occurs.

[2] It should be noted that the MUTCD also contains the Accident Experience Warrant (Warrant 6), which is met when certain volume and reportable accident thresholds are met or exceeded. No evaluation of this warrant was performed for this study.

FIGURE 5
COLLISION DIAGRAM/
ACCIDENT ANALYSIS
CR 705 AND NJ 42 RAMPS

LEGEND:
(1) Accident # - See Appendix A for Accident Description



SUMMARY (Reportable Accidents Only)

Year	Accident #	Head-on	Side	Rear-end	Pedestrian	Total
1992	#1 - #10	1	4	5	0	10
1993	#11 - #17	0	5	2	0	7
1994	#18 - #23	0	4	1	1	6
Total		1	13	8	1	23

N

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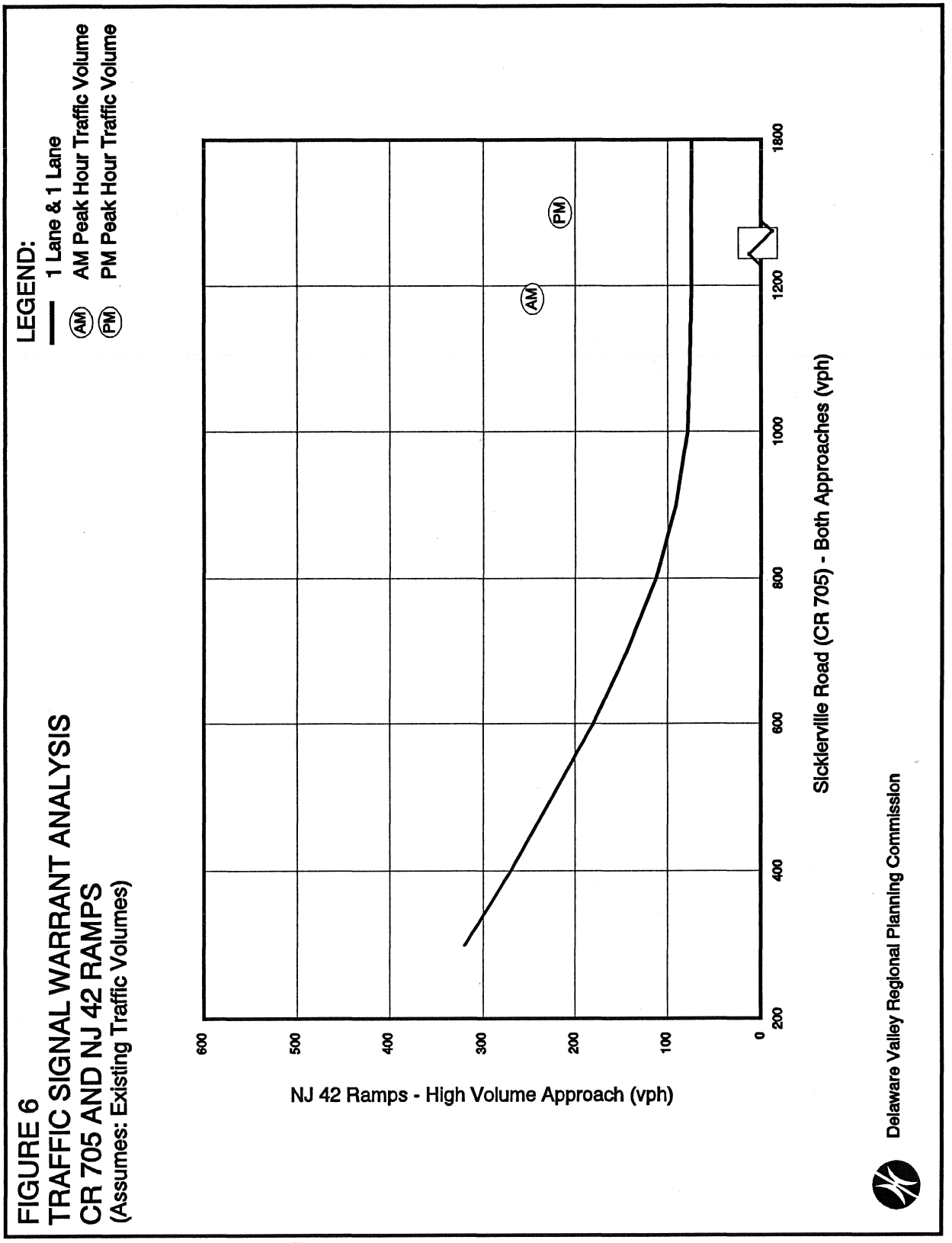


FIGURE 6
TRAFFIC SIGNAL WARRANT ANALYSIS
CR 705 AND NJ 42 RAMPS
(Assumes: Existing Traffic Volumes)
LEGEND:
1 Lane & 1 Lane
AM Peak Hour Traffic Volume
PM Peak Hour Traffic Volume
AM
PM
600
500
400
300
200
100
0
200
400
600
800
1000
1200
1800
NJ 42 Ramps - High Volume Approach (vph)
Sicklerville Road (CR 705) - Both Approaches (vph)
Delaware Valley Regional Planning Commission

location.[3]

IMPROVEMENTS TO EXISTING TRAFFIC OPERATIONS

At the direction of the county, level of traffic service thresholds were identified for the purposes of achieving preferred standards for traffic operations at the eight study intersections. Consequently, the level of service analyses of existing traffic volumes were re-performed to identify a practical set of improvements which would yield the highest operating threshold achievable from the following set:

- desirable - level of service C;
- acceptable - level of service D;
- poor, but operable - level of service E.

The resultant traffic improvements suggested to achieve minimum preferred operating conditions are described on Table 3. "Before and after" conditions for overall intersection level of service are shown on Table 4. As can be seen from a review of Table 4, each of the deficient intersections can be improved to provide, at the very least, stable and predictable traffic operations.

[3] It was determined after these analyses were complete that Gloucester Township has already received permission from the NJ DOT to install a traffic signal at the NJ 42 Ramp and CR 705 intersection.

TABLE 3: ASSUMED TRAFFIC IMPROVEMENTS - EXISTING TRAFFIC VOLUMES

INTERSECTION WITH
SICKLERVILLE ROAD (CR 705):

1) Williamstown-New Freedom Road (CR 536 Spur) -
   {a) Realign northbound and southbound approaches.}
   b) Provide full width separate southbound left turn and through/right lanes.
   c) Retime signal.

2) Erial-Williamstown Road (CR 704) South -
   a) None.

3) Erial-Williamstown Road (CR 704) North/Wilby Road -
   a) None.

4) Cross Keys Road (CR 689) -
   a) Provide full width northbound left turn and through/right lanes.
   b) Add separate southbound left turn lane.
   c) Provide full width eastbound left turn and through/right lanes.
   d) Add separate westbound left turn lane.
   e) Retime signal.

5) Jarvis Road (CR 687) - As proposed and shown on Key Engineer's LTS diagram --
   a) Install traffic signal with multi-phase operation.
   b) Add separate southbound left turn lane.
   c) Add separate northbound right turn lane.
   d) Provide separate left and right turn lanes on the westbound approach.

6) Hickstown Road (CR 688) -
   {a) Realign westbound approach to more closely intersect CR 705 at a right angle.}
   b) Provide separate left and right turn lanes on the westbound approach.
   {c) Add separate southbound left turn lane.}

7) North-South Freeway (NJ 42) Ramps -
   {a) Realign and narrow ramp median between left turn-out and left turn-in movements.}
   b) Install traffic signal with multi-phase operation and interconnect with Black Horse Pike intersection.
   c) Add separate southbound left turn lane.
   d) Add separate northbound right turn lane.

8) Black Horse Pike (NJ 168) -
   a) Fit separate southbound left turn lane (note: probably not critical as left turning traffic stores in the median area of NJ 168).
   b) Retime signal and interconnect with North-South Freeway ramp intersection.

{Note: Items in the braces {} above are improvements which cannot be justified through level of service analysis procedures. On the other hand, they would benefit traffic flow and can be justified using published warrants and/or were judged to be logical extensions when constructing the identified improvements. As such, they are identified herein.}

TABLE 4: SUMMARY OF STUDY INTERSECTION LEVEL OF SERVICE ANALYSIS - EXISTING TRAFFIC VOLUMES (WITH AND WITHOUT IMPROVEMENTS)

INTERSECTION WITH SICKLERVILLE ROAD (CR 705):	LEVEL OF SERVICE			
	CURRENT CONDITIONS		POTENTIAL CONDITIONS	
	AM	PM	AM	PM
1) Williamstown-New Freedom Road (CR 536 Spur)	B	D	B	C
2) Erial-Williamstown Road (CR 704) South	B	B	no changes suggested	
3) Erial-Williamstown Road (CR 704) North/Wilby Road	B	B	no changes suggested	
4) Cross Keys Road (CR 689)	C	**F**	B	C
5) Jarvis Road (CR 687)	E (side street stop conditions)	E	B	B
6) Hickstown Road (CR 688)	**F** (side street stop conditions)	D	E&E (side street stop conditions)	E&B
7) North-South Freeway (NJ 42) Ramps	**F**&D (side street stop conditions)	**F**&C	B	C
8) Black Horse Pike (NJ 168)	**F**	**F**	B	E

4 FUTURE TRAFFIC CONDITIONS

Future traffic conditions for the design year (2020) are predicated upon formulating future peak hour traffic demands and determining the highway network necessary to serve them through level of service analysis. The development of future traffic demands includes estimating volume associated with identifiable developments within the study area and background traffic growth resulting from ongoing regional development from outside the study limits.

FUTURE LAND DEVELOPMENT

Projected land development expected to occupy the general area surrounding the study highway network was provided by Camden County planning staff and supplemented with in-house information at DVRPC . Thirty (30) developments were identified as a result of those efforts. Figure 7 displays the general location of each identified development. Thirteen proposed developments are located in Camden County and seventeen are located within Gloucester County. The variety and magnitude of the future development includes: one elementary school; 5,533 residential units; 458,000 square feet of office and corporate space, and; 243,000 square feet of retail/shopping center space.

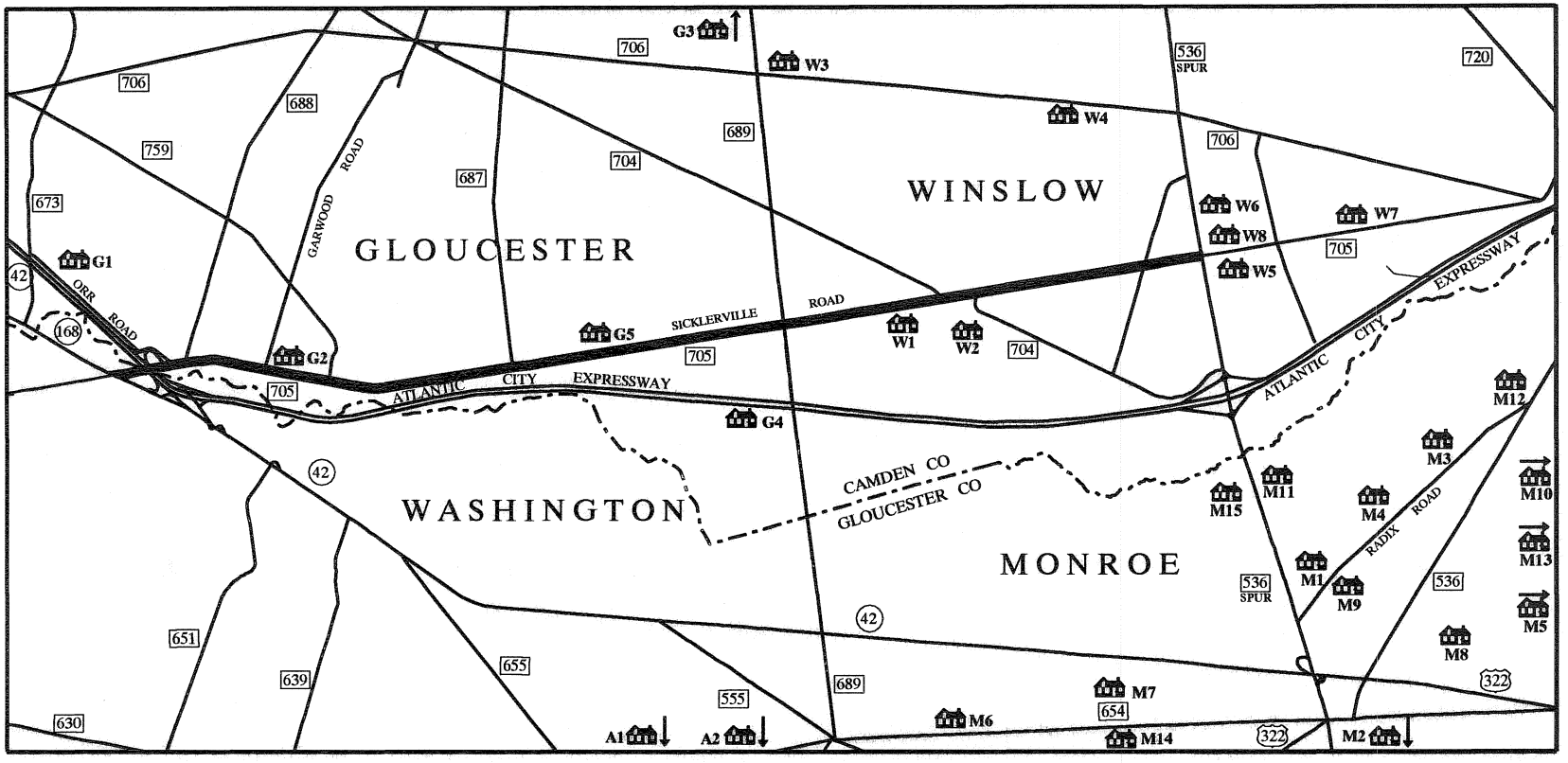
FUTURE TRAFFIC VOLUMES

Estimates of future peak hour traffic volume were prepared to assess traffic conditions within the corridor for the study horizon year of 2020. Two components of new future traffic volume were estimated: background growth applied to through traffic, and study area development oriented traffic.

Background traffic growth occurs as a consequence of ongoing regional development. Based upon projected changes in population and employment between 1990 and the year 2020, for this portion of the region, it is estimated that through travel within the immediate study area will increase at 1.25 percent per year. Therefore, existing through peak hour traffic volumes were factored upward by 38 percent to account for the area-wide traffic growth anticipated to occur between 1994 and 2020.

Development expected to take place within the corridor will also generate new travel demand upon the study area highways. Associated vehicular trip activity for that development were formulated by applying trip generation rates and/or formulas (obtained from: Trip Generation, 5th edition, Institute of Transportation Engineers, January 1991) to the future development scenario described above. Table 5 summarizes the trip generation. It should be

FIGURE 7
FUTURE DEVELOPMENT WITHIN SICKLERVILLE ROAD STUDY AREA



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LEGEND:

G1 Approximate Location of Proposed/Potential Development Site (See Table 5)

Sicklerville Road

TABLE 5: NEW TRIPS GENERATED BY FUTURE DEVELOPMENT WITHIN THE SICKLERVILLE ROAD STUDY CORRIDOR

MAP CODE	DEVELOPMENT DESCRIPTION (ITE CODE)	AVERAGE WEEKDAY TOTAL	AM PEAK HOUR IN	AM PEAK HOUR OUT	AM PEAK HOUR TOTAL	PM PEAK HOUR IN	PM PEAK HOUR OUT	PM PEAK HOUR TOTAL
CAMDEN COUNTY								
GLOUCESTER TOWNSHIP								
G1	FREEWAY CORPORATE CENTER: 200,000 square feet (770)	2,870	275	49	324	68	242	310
G2	DUNLEIGH: 73 Single Family (210)	770	16	45	61	53	28	81
G3	SPRING VALLEY: 84 Single Family (210)	880	18	51	69	60	32	92
G4	WOOD HILL: 64 Single Family (210)	680	14	41	55	49	27	76
G5	ANN MULLIN SCHOOL 140,000 sq ft (520)	1,500	230	154	384	22	17	39
Sbttl	**Gloucester Township**	6,700	553	340	893	252	346	598
WINSLOW TOWNSHIP								
W1	OLD ORCHARD: 168 Single Family (210)	1,660	33	93	126	112	60	172
W2	PARK SIDE TOWNHOUSES: 40 Townhouses (230)	300	4	21	25	19	10	29
W3	WILTON'S CORNER:							
	771 Single Family (210)	7,360	150	428	578	506	273	779
	564 Townhouses (230)	3,310	42	206	248	205	105	310
	580 Apartments (221)	3,820	55	218	273	222	114	336
	158,000 sq ft Office[1] (710)	1,980	231	30	261	44	206	250
	[1] Office trips reduced to account for interaction with retail							
	103,000 sq ft Retail (820) {40% passby traffic}	4,320	62	37	99	200	201	401
W4	MORELAND FARMS: 281 Townhouses (230)	1,650	21	103	124	102	52	154

TABLE 5: NEW TRIPS GENERATED BY FUTURE DEVELOPMENT WITHIN THE SICKLERVILLE ROAD STUDY CORRIDOR

MAP CODE	DEVELOPMENT DESCRIPTION (ITE CODE)	AVERAGE WEEKDAY TOTAL	AM PEAK HOUR IN	AM PEAK HOUR OUT	AM PEAK HOUR TOTAL	PM PEAK HOUR IN	PM PEAK HOUR OUT	PM PEAK HOUR TOTAL
W5	COUNTY HOUSE SHOPPING CENTER: 140,000 sq ft (820) {40% passby traffic}	5,230	75	44	119	244	244	488
W6	WOODLANDS: 448 Townhouses (230)	2,630	33	164	197	162	84	246
W7	RACQUET CLUB TOWNHOUSES: 184 Townhouses (230)	1,090	14	69	83	68	35	103
W8	PROFESSIONAL OFFICE CONDO 100,000 sq ft (710)	1,400	170	21	191	32	154	186
Sbttl	**Winslow Township**	34,750	890	1,434	2,324	1,916	1,538	3,454
GLOUCESTER COUNTY								
MONROE TOWNSHIP								
M1	SABLE ESTATES: 46 Twins (210)	500	11	30	41	35	19	54
M2	RUGBY PLACE: 48 Townhouses (230)	350	5	24	29	23	11	34
M3	TWEED FARM ESTATES: 107 Single Family (210)	1,100	22	64	86	75	40	115
M4	SCHOOLHOUSE GATE: 148 Single Family (210)	1480	29	84	113	100	54	154
M5	WOODS AT MALAGA: 116 Single Family (210)	1,180	24	68	92	80	43	123
M6	THE CLOISTERS: 90 Townhouses (230)	600	8	39	47	38	19	57
M7	MONROE TWP. INVESTMENT GROUP: 107 Townhouses (230)	690	9	45	54	44	22	66

TABLE 5: NEW TRIPS GENERATED BY FUTURE DEVELOPMENT WITHIN THE SICKLERVILLE ROAD STUDY CORRIDOR

MAP CODE	DEVELOPMENT DESCRIPTION (ITE CODE)	AVERAGE WEEKDAY TOTAL	AM PEAK HOUR IN	AM PEAK HOUR OUT	AM PEAK HOUR TOTAL	PM PEAK HOUR IN	PM PEAK HOUR OUT	PM PEAK HOUR TOTAL
M8	KIMBERLY EAST: 97 Single Family (210)	1,000	20	59	79	68	37	105
M9	MINK LANE PARTNERS: 58 Twins (210)	630	14	39	53	43	23	66
M10	DUCK LAKE PARTNERS: 271 Single Family (210)	2,590	50	142	192	172	93	265
M11	TANBARK ASSOC: 118 Townhouses (230)	750	10	48	58	47	24	71
M12	NEW BROOKLYN RD PARTNERS: 55 Single Family (210)	600	12	36	48	41	22	63
M13	OAKLAND RIDGE: 163 Single Family (210)	1,620	32	91	123	109	59	168
	218 Townhouses (230)	1,280	16	80	96	79	41	120
M14	IRV CYZNER: 19 Single Family (210)	220	5	14	19	16	8	24
M15	HOLIDAY CITY: 420 Elderly Housing (230)	2,460	31	154	185	152	79	231
Sbttl	**Monroe Township**	17,050	298	1,017	1,315	1,122	594	1,716
WASHINGTON TOWNSHIP								
A1	ACKERMAN TRACT: 178 Single Family (210)	1,760	35	98	133	118	64	182
A2	WHISPERING OAKS: 17 Single Family (210)	200	5	12	17	14	8	22
Sbttl	**Washington Township**	1,960	40	110	150	132	72	204
GRANDTOTAL								
	SICKLERVILLE ROAD CORRIDOR	60,460	1,781	2,901	4,682	3,422	2,550	5,972

noted that the trips shown in Table 5 are the volume of new trips[4] expected to be added to the surrounding roadways between 1994 and the year 2020.

As a summary of Table 5, it is estimated that almost 60,500 total new vehicular trips will be added throughout the study area over the course of a typical weekday. During the a.m. peak hour about 4,700 total trips are anticipated to be drawn to/from the study area. In the p.m. peak hour, when the strongest effects of retail shopping traffic are felt, approximately 6,000 new vehicular trips will be generated within the study area. Over half of the expected trips will be generated from developments within Winslow Township, Camden County.

The directional distribution of development traffic was estimated giving due consideration to: the patterns of existing peak hour traffic volume; the dispersion of employment and population anticipated in twenty years, and; traffic data obtained from other traffic studies performed within the general study area. Immediately following is a summary of the directional distribution of development traffic volume used in the analysis.

	to/from the:			
Use	North	East	South	West
Residential	45%	15%	25%	15%
Retail (new)	50%	15%	25%	10%
Office	40%	20%	20%	20%

The routes that development traffic will use depends upon: the location of the development site; the network of roadways serving the site and the quantity and quality of the transportation network serving the study area. It has been assumed for the purposes of this study that vehicular access would take place via the highway(s) immediately surrounding each development site.

The traffic assignment process follows the trip generation and trip distribution steps. As part of that process, peak hour development traffic is "loaded" onto the study highway network guided by the distribution percentages (trip assignment = trip generation * trip distribution). Total future peak hour traffic volumes were then calculated by summing existing peak hour traffic volumes plus peak hour background traffic growth volumes plus development oriented peak hour traffic assignments.

[4] Only new trips generated to/from retail developments which would impact surrounding public roadway systems are included (passby trips -- which will have their highest impact at proposed driveway locations are assumed to come from the volume of traffic which will be on surrounding roadways by 2020). Trips emanating to/from developments which contain complementary uses have been discounted for the trip internalization effects of multi-use sites.

Two future peak hour traffic volume scenarios were prepared and analyzed within this study. The scenarios were identified at the outset of the study, and were chosen to investigate the potential traffic benefit of an interchange connecting the Atlantic City Expressway and Cross Keys Road. The first scenario assumes that "present" traffic circulation patterns are maintained throughout the study area. This serves as a baseline for comparison between existing conditions and the second future -- a "build scenario". The second scenario assumes that a partial interchange is constructed between Cross Keys Road and the Atlantic City Expressway and that the interchange serves on and off traffic movements oriented to and from the north (i.e., to and from Camden and Philadelphia)[5]. A brief description of each future traffic volume scenario is presented below.

Future Traffic Volumes Without Cross Keys Road Interchange:

Traffic volumes developed under the premises of this scenario, assume the present roadway system's circulation pattern and, are shown on Figure 8 and Figure 9. The following summaries are offered of the illustrated volumes.

- South corridor (south of Cross Keys Road) - future volumes are approximately 70% higher than existing peak hour demands, representing annual traffic growth rates of 2.75%.[6]

- Central corridor (between Cross Keys Road and the NJ 42 Ramp) - future volumes are approximately 60% higher than existing, representing annual growth rates of 2.25% per year.

- North corridor (north of the NJ 42 ramp) - future volumes are approximately 40% higher than existing, representing annual traffic growth rates of 1.50% per year.

Future Traffic Volumes With Cross Keys Road Interchange:

The traffic volumes which result from the assumption that the potential interchange between Cross Keys Road and the Atlantic City Expressway is constructed, are shown on

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[5] While much discussion has taken place over the years regarding a potential interchange between CR 689 and the Atlantic City Expressway, to our knowledge no study has examined the effects that an interchange might have upon Sicklerville Road. At the outset of the study, DVRPC staff sought to determine which alternate interchange configuration if any was the most feasible to include in our study. It was determined in conversation with the SJTA that, while no active consideration was being given to an interchange at the time, the most likely interchange would be a partial design with orientation to/from the north.

[6] By comparison, according to data obtained from the South Jersey Transportation Authority (SJTA), annual toll traffic at the Williamstown toll area of the Atlantic City Expressway increased approximately 15% between 1989 and 1994, representing annual traffic growth rates of 3% per year in the recent past.

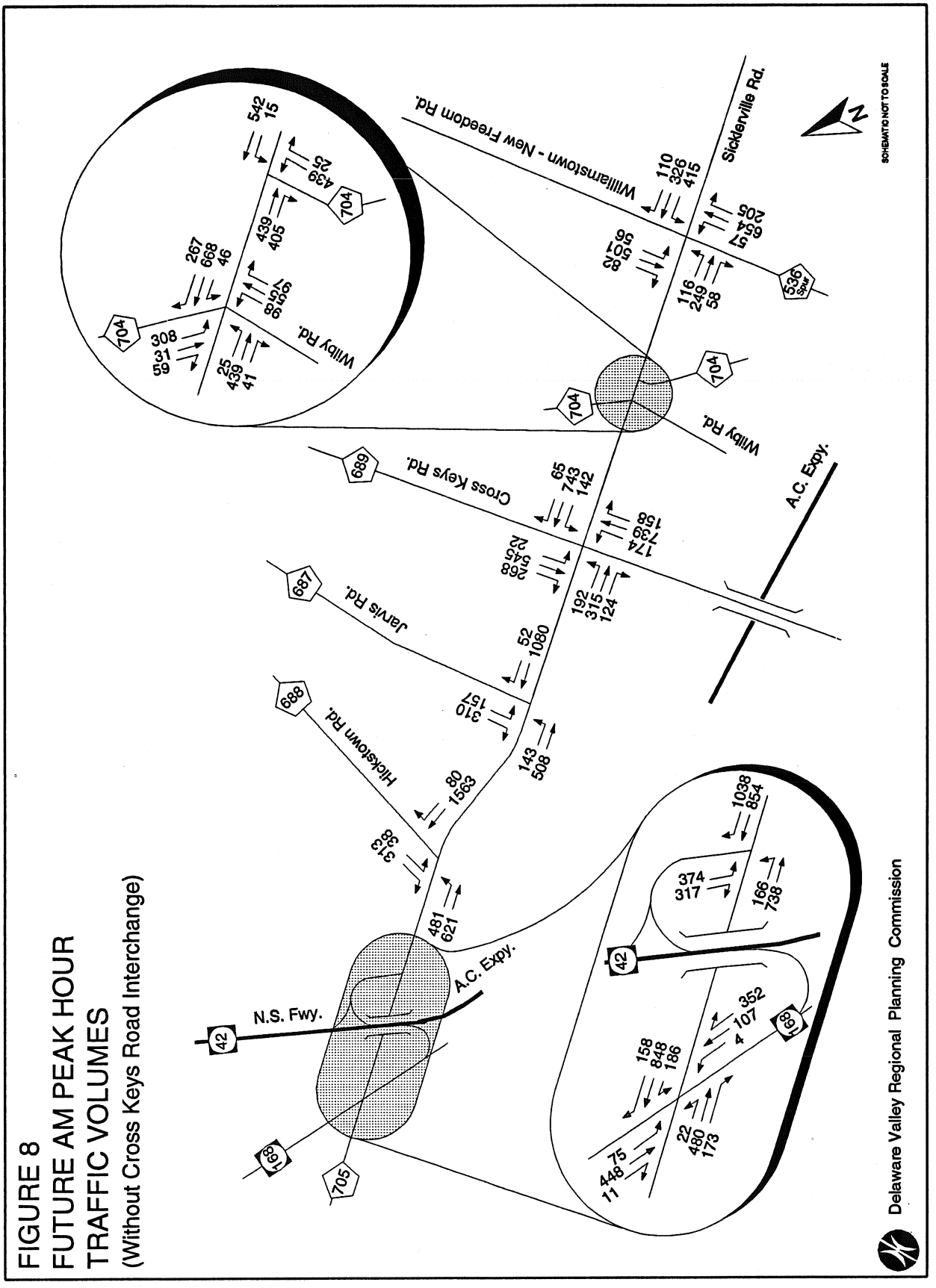


FIGURE 8
FUTURE AM PEAK HOUR
TRAFFIC VOLUMES
(Without Cross Keys Road Interchange)
SCHEMATIC NOT TO SCALE
Williamstown - New Freedom Rd.
Sicklerville Rd.
Willby Rd.
Cross Keys Rd.
Jarvis Rd.
Hicksiown Rd.
N.S. Fwy.
A.C. Expy.
Delaware Valley Regional Planning Commission

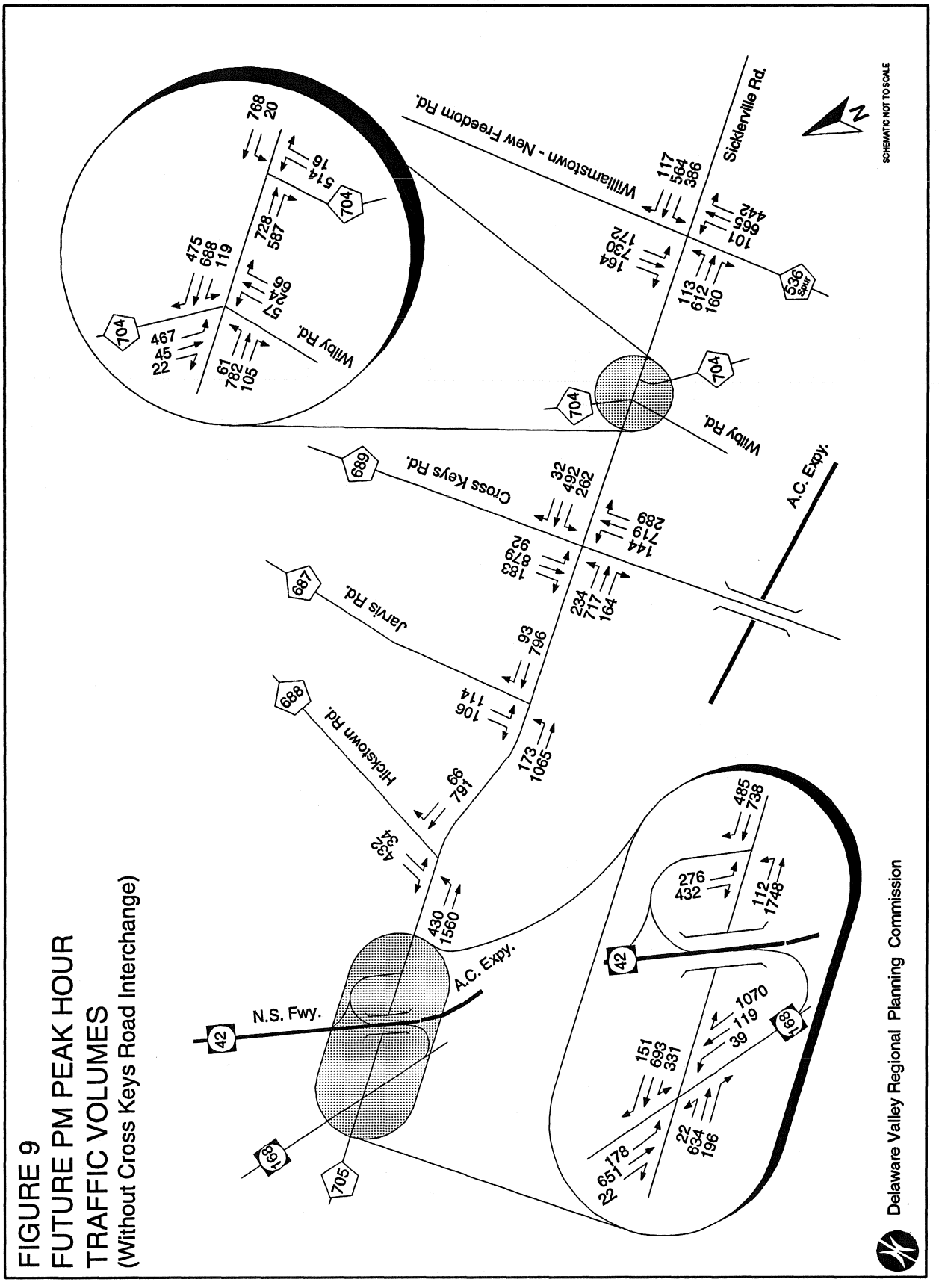


FIGURE 9
FUTURE PM PEAK HOUR
TRAFFIC VOLUMES
(Without Cross Keys Road Interchange)
Delaware Valley Regional Planning Commission
SCHEMATIC NOT TO SCALE
N
Sicklerville Rd.
Williamstown - New Freedom Rd.
Willby Rd.
Cross Keys Rd.
Jarvis Rd.
Hicks town Rd.
A.C. Expy.
N.S. Fwy.
536
704
689
687
688
42
168
705

Figures 10 and 11. Estimated diversions to the interchange assume travel time savings for the southern limits of the study area resulting from direct access to the Atlantic City Expressway (to and from the north) and capacity restraint due to maintaining a two lane cross section along CR 705 immediately to the north of Cross Keys Road. The following summaries are offered of the illustrated volumes.

- South corridor (south of Cross Keys Road) - gains between 172 to 226 total two-way vehicles in the a.m. peak and between 213 to 285 total two-way vehicles in the p.m. peak versus future volumes without the interchange.

- Central corridor (between Cross Keys Road and the NJ 42 Ramp) - loses between 237 to 330 total two-way vehicles in the a.m. peak and between 268 to 390 total two-way vehicles in the p.m. peak versus future volumes without the interchange.

- North corridor (north of the NJ 42 ramp) - loses 82 southbound vehicles in the a.m. peak and 244 southbound vehicles in the p.m. peak hour versus future volume without the interchange.

- Approximately 550 a.m. peak hour (390 on and 160 off) and 650 p.m. peak hour (250 on and 400 off) trips are projected to use the interchange to and from the Camden County side of the Expressway.

FUTURE LEVEL OF SERVICE ANALYSIS

Level of service analyses were performed for the study intersections for each future traffic volume scenario. This analysis, was iterative in certain cases and resulted in the identification of traffic improvements required to accommodate future peak hour traffic demands. Before presenting those items, in their entirety, it is advantageous to explain two sets of meaningful improvements common to both scenarios.

1. Traffic signalization at Sicklerville Road and Hickstown Road (CR 688).
2. Left turn lane treatments for southbound Sicklerville Road at NJ 42.

As part of the analysis of future traffic volume -- a traffic signal warrant investigation for the Hickstown Road intersection was prepared. The traffic signal warrant investigation is shown on Figure 12. The curve on the graph represents minimum vehicular volumes that must be met or exceeded for an intersection with two lane approaches on each leg. The volume displayed for Hickstown Road is total peak hour volume on the approach. As can be seen, the volumes in both the a.m. and p.m. peak hours exceed the requirements for this warrant, indicative that a traffic signal will be justified for installation at the location. The level of service analysis of future peak hour traffic volumes, therefore, assumes a traffic signal is

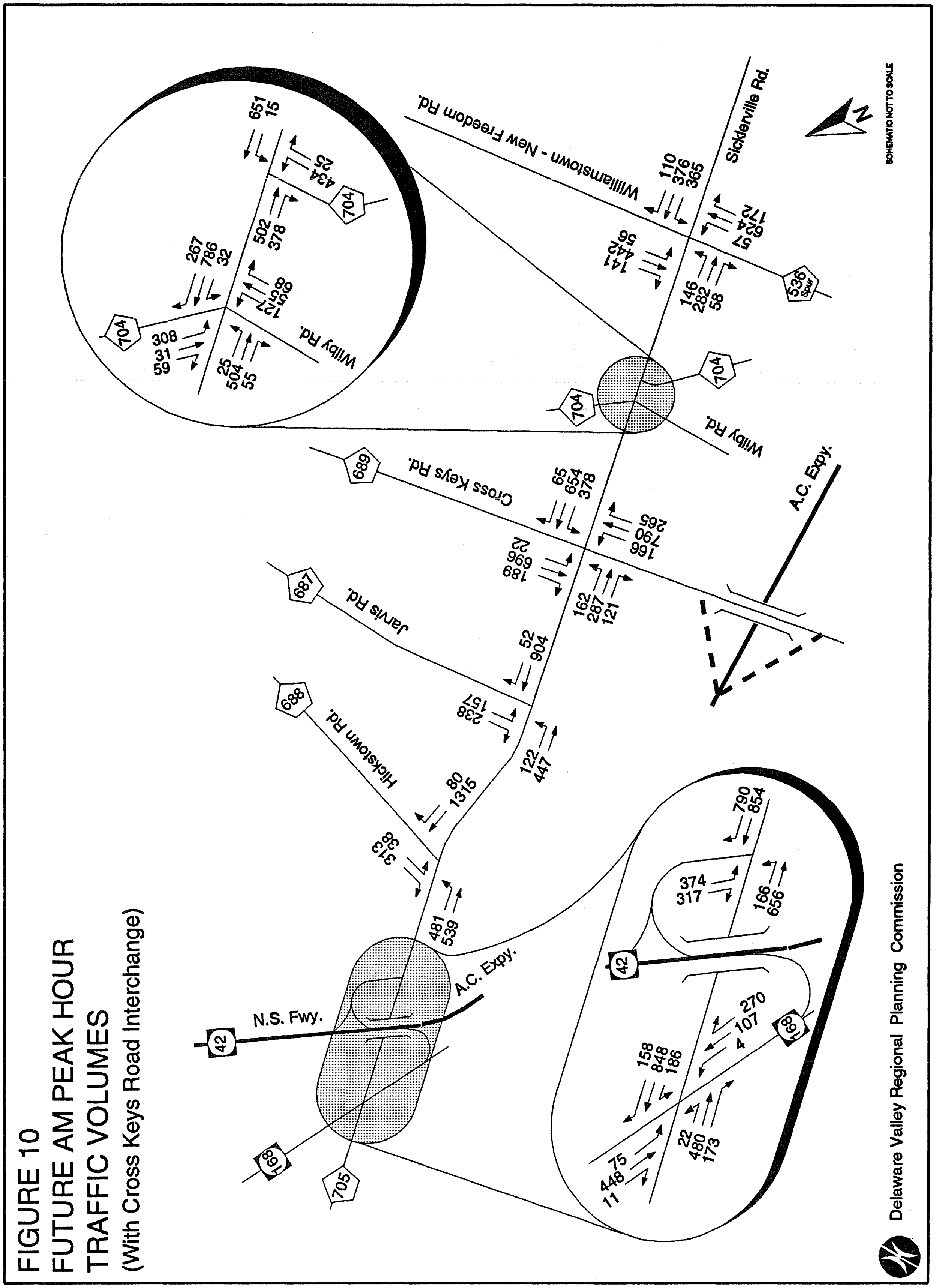


FIGURE 10
FUTURE AM PEAK HOUR
TRAFFIC VOLUMES
(With Cross Keys Road Interchange)

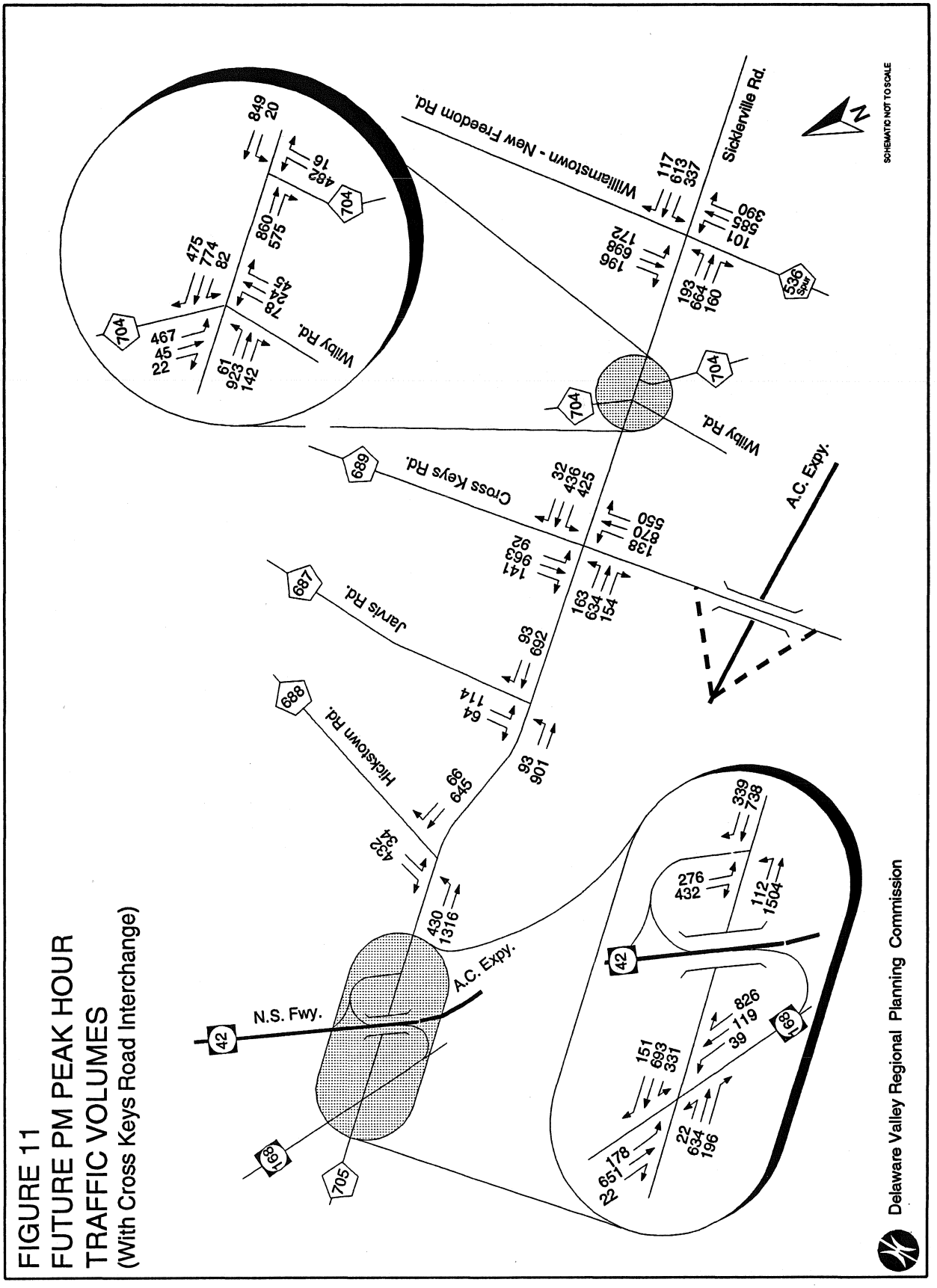


FIGURE 11
FUTURE PM PEAK HOUR
TRAFFIC VOLUMES
(With Cross Keys Road Interchange)

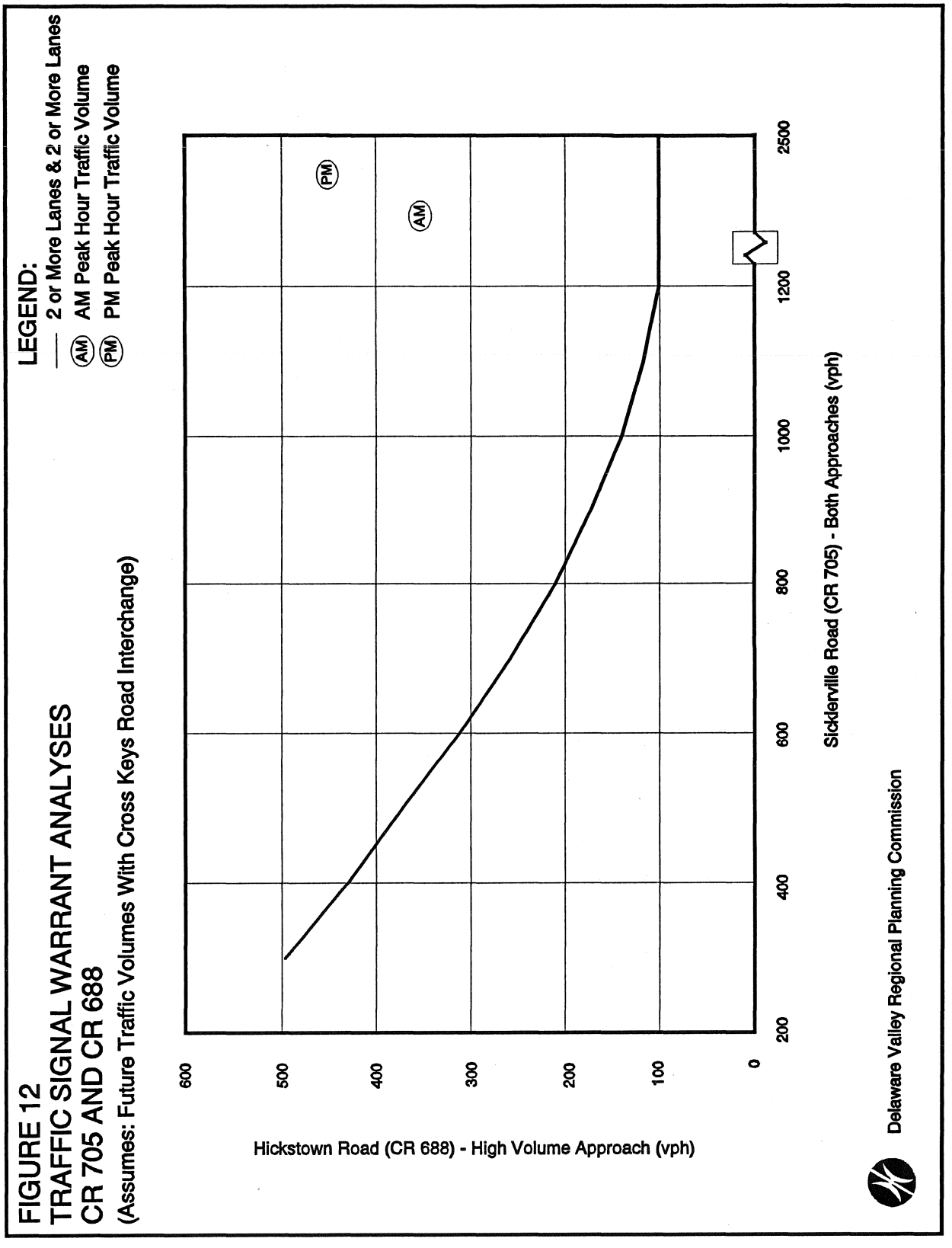


FIGURE 12
TRAFFIC SIGNAL WARRANT ANALYSES
CR 705 AND CR 688
(Assumes: Future Traffic Volumes With Cross Keys Road Interchange)
LEGEND:
2 or More Lanes & 2 or More Lanes
AM Peak Hour Traffic Volume
PM Peak Hour Traffic Volume
600
500
400
300
200
100
0
200
400
600
800
1000
1200
2500
PM
AM
Hickstown Road (CR 688) - High Volume Approach (vph)
Sicklerville Road (CR 705) - Both Approaches (vph)
Delaware Valley Regional Planning Commission

provided at the CR 705 and CR 688 intersection.

At the NJ 42 Ramp intersection, the Atlantic City Expressway/North-South Freeway overpass limits the ability to widen CR 705's cross section to more than four lanes[7]. The proximity of the overpass also constrains the storage length available for a center left turn lane serving southbound traffic turning to the North-South Freeway Ramp. Therefore, a "conventional" intersection design using a center left turn lane may not be feasible for the location. Consequently, three alternatives have been examined utilizing jughandle designs to accommodate southbound left turns. Because of the proximity between the ramp intersection and the CR 688 intersection, consistent treatment at the adjacent intersections is recommended.

The first alternative (A) bans left turns from southbound CR 705 at the Ramp and directs them to a far-side jughandle at Hickstown Road (CR 688) about 600 feet to the south. The jughandle at CR 688 consolidates left turns to CR 688 and U turns to the NJ 42 Ramp (and Orr Road). The second alternative (B) maintains consolidated turns as described in alternative A, but replaces the far-side jughandle with a near-side design. The third alternative (C) provides separate far-side jughandles at both the NJ 42 Ramp intersection and the CR 688 intersection. Thus serving southbound left turns directly at each location. A preliminary listing of the impacts associated with each alternative jughandle scheme is presented below.

Preliminary Assessment of Alternative Left Turn Treatments

A. "Consolidated Far-Side Jughandle":
- \+ Reduces cross section under the bridge
- \- Jughandle is an unusual condition along CR 705
- \- Consolidates all turns
- \+ Requires one investment
- \- Indirect access for N.S. Freeway
- \- Potential wetlands impacts

B. "Consolidated Near-Side Jughandle":
- \+ Reduces cross section under the bridge
- \- Jughandle is an unusual condition along CR 705
- \- Consolidates all turns
- \+ Requires one investment
- \- Indirect access for N.S. Freeway

[7] Determination that a four lane cross section is required along Sicklerville Road emanated from preliminary rounds of the level of service analysis.

C. "Separate Far-side Jughandles":
   + Reduces cross section under the bridge
   - Jughandle is an unusual condition along CR 705
   + Separate treatments for each intersection
   - Double the expenditure
   - Business acquisition -- body shop
   - Potential wetlands impacts

Absent the findings of traffic operational analyses of the alternatives and any unforeseen impediments, it appears that alternative B is the most favorable option.

Future Level of Service Analysis Without Cross Keys Road Interchange:

The complete set of traffic improvements necessary to accommodate future traffic demands along Sicklerville Road without an interchange between the Atlantic City Expressway and Cross Keys road are summarized in Table 6. For comparative purposes, conventional intersection designs and the three alternative treatments for southbound CR 705 left turns to the NJ 42 Ramps and to Hickstown Road, as described above, were evaluated. The results of the level of service analysis for this future traffic volume scenario are illustrated on Figure 13 and Figure 13a.

Summarized findings associated with this scenario, specifically addressing conditions and improvements along Sicklerville Road, are listed below:

- South corridor (south of Cross Keys Road): Improvements which deliver increased capacity at the CR 536 Spur intersection, notably traffic movements between CR 705 and Interchange #38 of the Atlantic City Expressway, will be required.

  Signalized intersection operations along CR 705 between CR 536 Spur and CR 704 indicate that the present two-lane cross section is sufficient to serve future volumes at desirable level of service thresholds.

  Widening the segment between the CR 704/Wilby Road intersection and CR 689 (Cross Keys Road) intersection to four lanes would appear warranted based upon each boundary intersection's future need, and to prevent a potential "hour-glass condition".

- Central corridor (between Cross Keys Road and the NJ 42 Ramp): Conditions at signalized intersections along CR 705, from Cross Keys Road to the NJ 42

TABLE 6: ASSUMED TRAFFIC IMPROVEMENTS - FUTURE TRAFFIC VOLUMES (WITHOUT CROSS KEYS ROAD INTERCHANGE)

INTERSECTION WITH
SICKLERVILLE ROAD (CR 705):

1) Williamstown-New Freedom Road (CR 536 Spur) -
   a) Provide double left turn lanes, a single through lane and a separate right turn lane on the northbound CR 705 approach.
   b) Provide a separate left turn lane, a single through lane and a separate right turn lane on the southbound CR 705 approach.
   c) Construct a continuous five lane cross section on CR 536 Spur (center left turn lane and two through lanes in the eastbound and westbound direction), and provide a separate right turn lane on the eastbound approach to the CR 705 intersection.
   d) Install a new traffic signal with multi-phase operation.

2) Erial-Williamstown Road (CR 704) South -
   a) Retime signal and interconnect with CR 704 North/Wilby Road intersection.

3) Erial-Williamstown Road (CR 704) North/Wilby Road -
   a) Retime signal and interconnect with CR 704 South intersection..

4) Cross Keys Road (CR 689) -
   a) Construct a continuous four lane cross section on CR 705 (two through lanes in the northbound and southbound direction) from north of the CR 705 North/Wilby Road intersection.
   b) Provide a separate left turn lane, and two through lanes with shared right turns on both the northbound and southbound CR 705 intersection approaches.
   c) Construct a continuous five lane cross section along CR 689 (center left turn lane and two through lanes in the eastbound and westbound direction), and provide separate right turn lanes on the eastbound and westbound approaches to the CR 705 intersection.
   d) Install a new traffic signal with multi-phase operation.

5) Jarvis Road (CR 687) -
   a) Construct a continuous four lane cross section on CR 705 (two through lanes in the northbound and southbound direction) from north of the CR 689 intersection through the Jarvis Road intersection.
   b) Provide separate left and right turn lanes on the westbound Jarvis Road approach.
   c) Install traffic signal with multi-phase operation.

6) Hickstown Road (CR 688) -
   a) Realign westbound Hickstown Road approach to more closely intersect CR 705 at a right angle.
   b) Provide separate left and right turn lanes on the westbound Hickstown Road approach.
   c) Construct a continuous four lane cross section on CR 705 (two through lanes in the northbound and southbound direction) from north of the CR 687 intersection through the Hickstown Road intersection, and provide a separate northbound right turn lane on CR 705 approaching CR 688.
   d) Three alternatives for treating southbound left turns -- 1) a separate southbound left turn lane, or; 2) a far-side jughandle on CR 705 served by a separate southbound right turning lane, or; 3) a near-side jughandle on CR 705.
   e) Install traffic signal with multi-phase operation and interconnect with NJ 42 Ramp intersection.

TABLE 6: ASSUMED TRAFFIC IMPROVEMENTS - FUTURE TRAFFIC VOLUMES (CONT.) (WITHOUT CROSS KEYS ROAD INTERCHANGE)

INTERSECTION WITH
SICKLERVILLE ROAD (CR 705):

7) Orr Road (Gloucester Township owned/maintained road) -
   a) Restrict turns at CR 705 to right turns only, left turn access to CR 705 -- relocated to Hickstown Road via Freeway Corporate Center internal site roadway.

8) North-South Freeway (NJ 42) Ramps -
   a) Construct a continuous four lane cross section on CR 705 (two through lanes in the northbound and southbound direction) from north of the CR 688 intersection through the North-South Freeway Ramps intersection, and provide a separate northbound right turn lane on CR 705.
   b) Three alternatives for treating southbound left turns -- 1) a separate southbound left turn lane, or; 2) no southbound left turns -- U-turns to the ramp accommodated and consolidated with left turns at the CR 688 intersection via a far-side jughandle or a near-side jughandle (see #6.d.2. and #6.d.3. above), or; 3) a far-side jughandle directly serving the ramp intersection supported by a separate southbound right turn lane.
   c) Install traffic signal and interconnect with the Black Horse Pike intersection and the Hickstown Road intersection. Multi-phase signal operation required for southbound left turn lane and jughandle alternates, two phase operation required for the "no southbound left turns" option.
   d) Realign and narrow ramp median between left turn-out and left turn-in movements if left turns continue to be accommodated at the intersection.

9) Widen CR 705 under the NJ 42/A.C. Expressway overpass.
   a) Provide a continuous four lane cross section on CR 705 (two through lanes in the northbound and southbound direction) from north of the North-South Freeway Ramps intersection through the overpass.

10) Widen CR 705 bridge over stream.
   a) Provide a continuous four lane cross section on CR 705 (two through lanes in the northbound and southbound direction) from north of the NJ 42/A.C. Expressway overpass through the bridge.

11) Black Horse Pike (NJ 168) -
   a) Provide a continuous four lane cross section on CR 705 (two through lanes in the northbound and southbound direction) along the intersection's south leg between NJ 168 and the CR 705 bridge over stream just to south.
   b) Provide double left turn lanes on the northbound CR 705 approach.
   c) Provide double right turn lanes on the northbound NJ 168 approach.
   d) Fit separate southbound left turn lane for the CR 705 approach (note: this improvement is optional -- left turning traffic on the approach can continue to store in the median area of NJ 168).
   e) Update traffic signal. Provide multi-phase operation and interconnect with North-South Freeway ramp intersection.

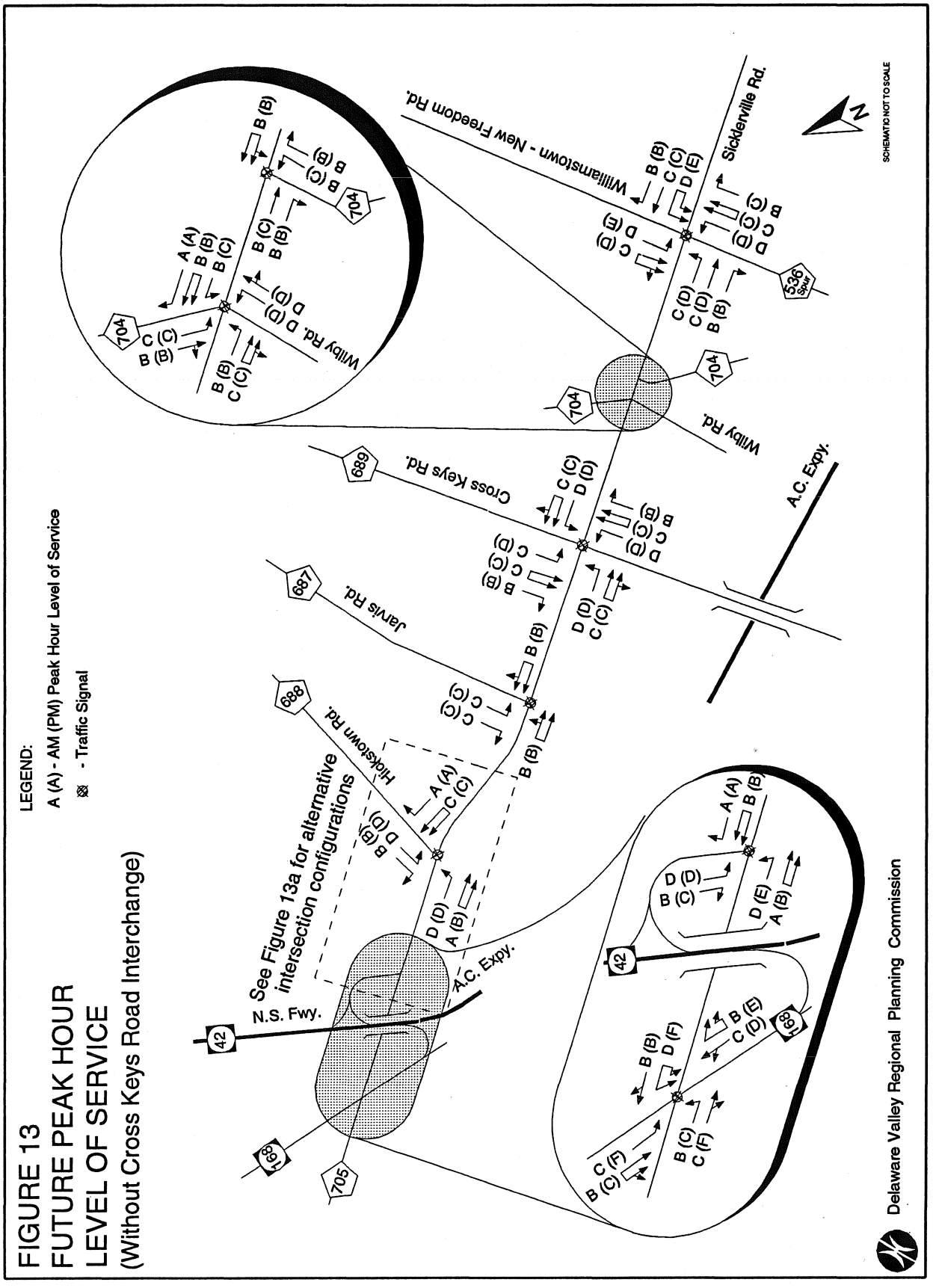
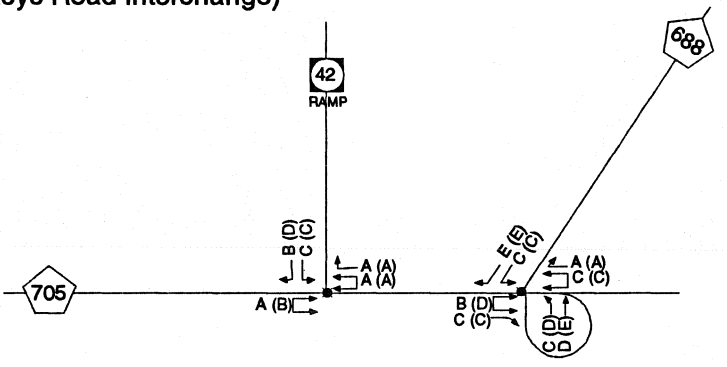


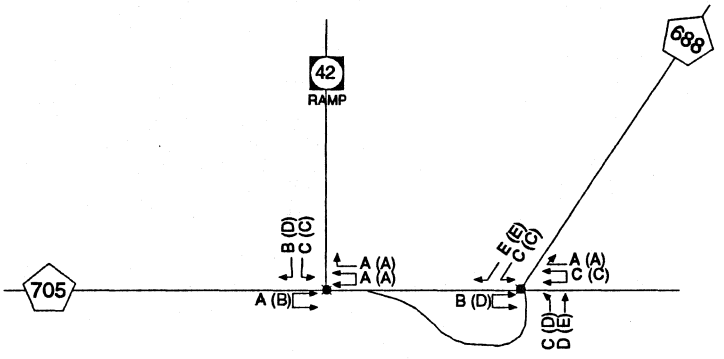
FIGURE 13
FUTURE PEAK HOUR
LEVEL OF SERVICE
(Without Cross Keys Road Interchange)
LEGEND:
A (A) - AM (PM) Peak Hour Level of Service
- Traffic Signal
SCHEMATIC NOT TO SCALE
N
Williamstown - New Freedom Rd.
Sicklerville Rd.
Willby Rd.
Cross Keys Rd.
Jarvis Rd.
Hilkstown Rd.
A.C. Expy.
N.S. Fwy.
See Figure 13a for alternative intersection configurations
536 Spur
704
689
687
688
42
168
705
Delaware Valley Regional Planning Commission

FIGURE 13a
FUTURE LEVEL OF SERVICE
ALTERNATIVE INTERSECTION CONFIGURATIONS
FOR CR 705 AND NJ 42 RAMP
AND CR 705 AND CR 688
(Without Cross Keys Road Interchange)

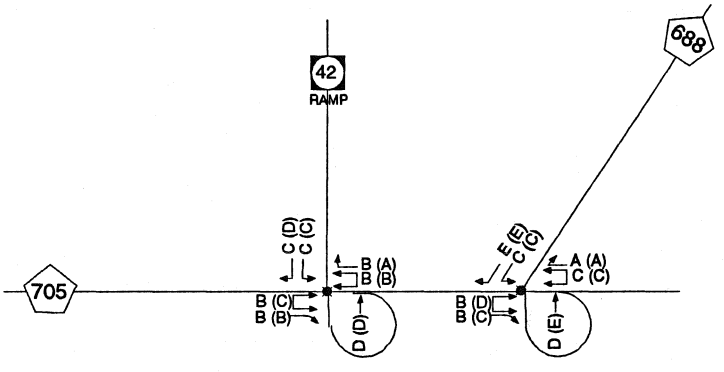
LEGEND:
A (A) - AM (PM) Peak Hour Level of Service
▣ - Traffic Signal



Alternative A: Consolidated Far-Side Jughandle



Alternative B: Consolidated Near-Side Jughandle



Alternative C: Separate Far-Side Jughandles

Delaware Valley Regional Planning Commission

SCHEMATIC NOT TO SCALE

Ramp intersection, indicate that a four-lane cross section will be necessary to provide desirable traffic operations.

- North corridor (north of the NJ 42 ramp): The improvements identified to serve the NJ 168 intersection and the northern limits of the corridor are extensive, and common to both future scenarios. In large part, increased intersection capacity will be needed by traffic movements turning between the southern leg (CR 705) and the western leg (NJ 168). Widening Sicklerville Road (to four lanes) south from the intersection will also be necessary as a complement to the NJ 168 intersection improvement. Coincidentally, these improvements relate closely with roadway recommendations made for the north end of the corridor's central section.

In summary of the level of service analysis of future traffic volume assuming "present" roadway circulation patterns (i.e., without a partial interchange) indicates that the identified traffic improvements will result in acceptable traffic operations with light to moderate traffic delays experienced during the peak hours at all study intersections except one. The sole exception is the NJ 168 and CR 705 intersection during the p.m. rush hour. At that hour the intersection will provide tolerable traffic operations with long delays encountered (level of service E).

Future Level of Service Analysis With Cross Keys Road Interchange:

Table 7 summarizes the full range of traffic improvements identified to serve future traffic assuming the partial interchange is constructed. Again, for comparative purposes, conventional and alternative treatments for southbound CR 705 left turns to the NJ 42 Ramps have been included in the analysis. The results of the level of service analysis for the future volume scenario, including the partial interchange, are illustrated on Figure 14 and Figure 14a.

Summarized findings with specific reference to Sicklerville Road are listed below:

- South corridor (south of Cross Keys Road): Capacity improvements at the CR 536 Spur intersection cited in the preceding section will also be true for this scenario.

Traffic volume surcharges will necessitate widening Sicklerville Road, between CR 536 Spur and CR 704, to provide two continuous travel lanes in each direction between and through the adjacent intersections.

TABLE 7: ASSUMED TRAFFIC IMPROVEMENTS - FUTURE TRAFFIC VOLUMES (WITH CROSS KEYS ROAD INTERCHANGE)

INTERSECTION WITH
SICKLERVILLE ROAD (CR 705):

1) Williamstown-New Freedom Road (CR 536 Spur) -
   a) Provide double left turn lanes, a single through lane and a shared through/right turn lane on the northbound CR 705 approach.
   b) Provide a separate left turn lane, two through lanes and a separate right turn lane on the southbound CR 705 approach.
   c) Construct a continuous five lane cross section on CR 536 Spur (center left turn lane and two through lanes in the eastbound and westbound direction), and provide a separate right turn lane on the eastbound approach to CR 705.
   d) Install a new traffic signal with multi-phase operation.

2) Erial-Williamstown Road (CR 704) South -
   a) Construct a continuous four lane cross section on CR 705 (two through lanes in the northbound and southbound direction) from north of the CR 536 Spur intersection.
   b) Retime signal and interconnect with CR 704 North/Wilby Road intersection.

3) Erial-Williamstown Road (CR 704) North/Wilby Road -
   a) Retime signal and interconnect with CR 704 South intersection..

4) Cross Keys Road (CR 689) -
   a) Construct a continuous four lane cross section on CR 705 (two lanes in the northbound and southbound direction) from north of CR 705 North/Wilby Road intersection.
   b) Provide double left turn lanes, a separate through lane and a separate right turn lane on the northbound CR 705 approach to CR 689.
   c) Provide a separate left turn lane, a separate through lane and a separate right turn lane on the southbound CR 705 approach to CR 689.
   d) Construct a continuous five lane cross section along CR 689 (center left turn lane and two through lanes in the eastbound and westbound direction), and provide separate right turn lanes on the eastbound and westbound approaches to the CR 705 intersection.
   e) Install new traffic signal with multi-phase operation.
   f) Maintain two lane cross section for through traffic along CR 705 north of the CR 689 intersection.

5) Jarvis Road (CR 687) -
   a) Maintain two lane cross section for through traffic along CR 705 from north of the CR 689 intersection.
   b) Construct separate southbound left turn lane on CR 705.
   c) Provide separate northbound right turn lane on CR 705.
   d) Provide separate left and right turn lanes on the westbound Jarvis Road approach.
   e) Install traffic signal with multi-phase operation.

6) Vicinity of Peter Cheeseman Lane (Gloucester Township owned/maintained road) -
   a) Maintain two lane cross section for through traffic along CR 705 from north of the CR 687 intersection.
   b) Transition cartway width of CR 705 from two lane cross section, on the south, to a continuous four lane cross section (affording two through lanes in the northbound and southbound direction) to the north of this area.

TABLE 7: ASSUMED TRAFFIC IMPROVEMENTS - FUTURE TRAFFIC VOLUMES (CONT.) (WITH CROSS KEYS ROAD INTERCHANGE)

INTERSECTION WITH
SICKLERVILLE ROAD (CR 705):

7) Hickstown Road (CR 688) -
   a) Realign westbound Hickstown Road approach to more closely intersect CR 705 at a right angle.
   b) Provide separate left and right turn lanes on the westbound Hickstown Road approach.
   c) Construct a continuous four lane cross section on CR 705 (two through lanes in the northbound and southbound direction) from north of the vicinity of Peter Cheeseman Lane through the Hickstown Road intersection and a separate northbound right turn lane on CR 705 approaching CR 688.
   d) Three alternatives for treating southbound left turns -- 1) a separate southbound left turn lane, or; 2) a far-side jughandle on CR 705 served by a separate southbound right turning lane, or; 3) a near-side jughandle on CR 705.
   e) Install traffic signal with multi-phase operation and interconnect with NJ 42 Ramp intersection.

8) Orr Road (Gloucester Township owned/maintained road) -
   a) Restrict turns at CR 705 to right turns only, left turn access to CR 705 relocated to Hickstown Road via Freeway Corporate Center internal site roadway.

9) North-South Freeway (NJ 42) Ramps -
   a) Provide continuous four lane cross section for through traffic along CR 705 (two through lanes in the northbound and southbound direction) from north of the CR 688 intersection through the North-South Freeway Ramps intersection, and provide a separate northbound right turn lane on CR 705.
   b) Three alternatives for treating southbound left turns -- 1) a separate southbound left turn lane, or; 2) no southbound left turns -- U-turns to the ramp accommodated and consolidated with left turns at the CR 688 intersection via a far-side jughandle or a near-side jughandle (see #7.d.2. and #7.d.3. above), or; 3) a far-side jughandle directly serving the location supported by a separate southbound right turn lane.
   c) Install traffic signal and interconnect with the Black Horse Pike intersection and the Hickstown Road intersection. Multi-phase signal operation required for southbound left turn lane and jughandle alternates, two phase operation required for the "no southbound left turns" option.
   d) Realign/narrow ramp median between left turn-out and left turn-in movements if left turns continue to be accommodated at the intersection.

10) Widen CR 705 under the NJ 42/A.C. Expressway overpass.
   a) Provide a continuous four lane cross section on CR 705 (two through lanes in the northbound and southbound direction) from north of the North-South Freeway Ramps intersection through the overpass.

11) Widen CR 705 bridge over stream.
   a) Provide a continuous four lane cross section on CR 705 (two through lanes in the northbound and southbound direction) from north of the NJ 42/A.C. Expressway overpass through the bridge.

12) Black Horse Pike (NJ 168) -
   a) Provide a continuous four lane cross section on CR 705 (two through lanes in the northbound and southbound direction) along the intersection's south leg between NJ 168 and the CR 705 bridge over stream just to south.
   b) Provide double left turn lanes on the northbound CR 705 approach.
   c) Provide double right turn lanes on the northbound NJ 168 approach.
   d) Fit separate southbound left turn lane for the CR 705 approach (note: this improvement is optional -- left turning traffic on the approach can continue to store in the median area of NJ 168).
   e) Update traffic signal. Provide multi-phase operation and interconnect with North-South Freeway ramp intersection.

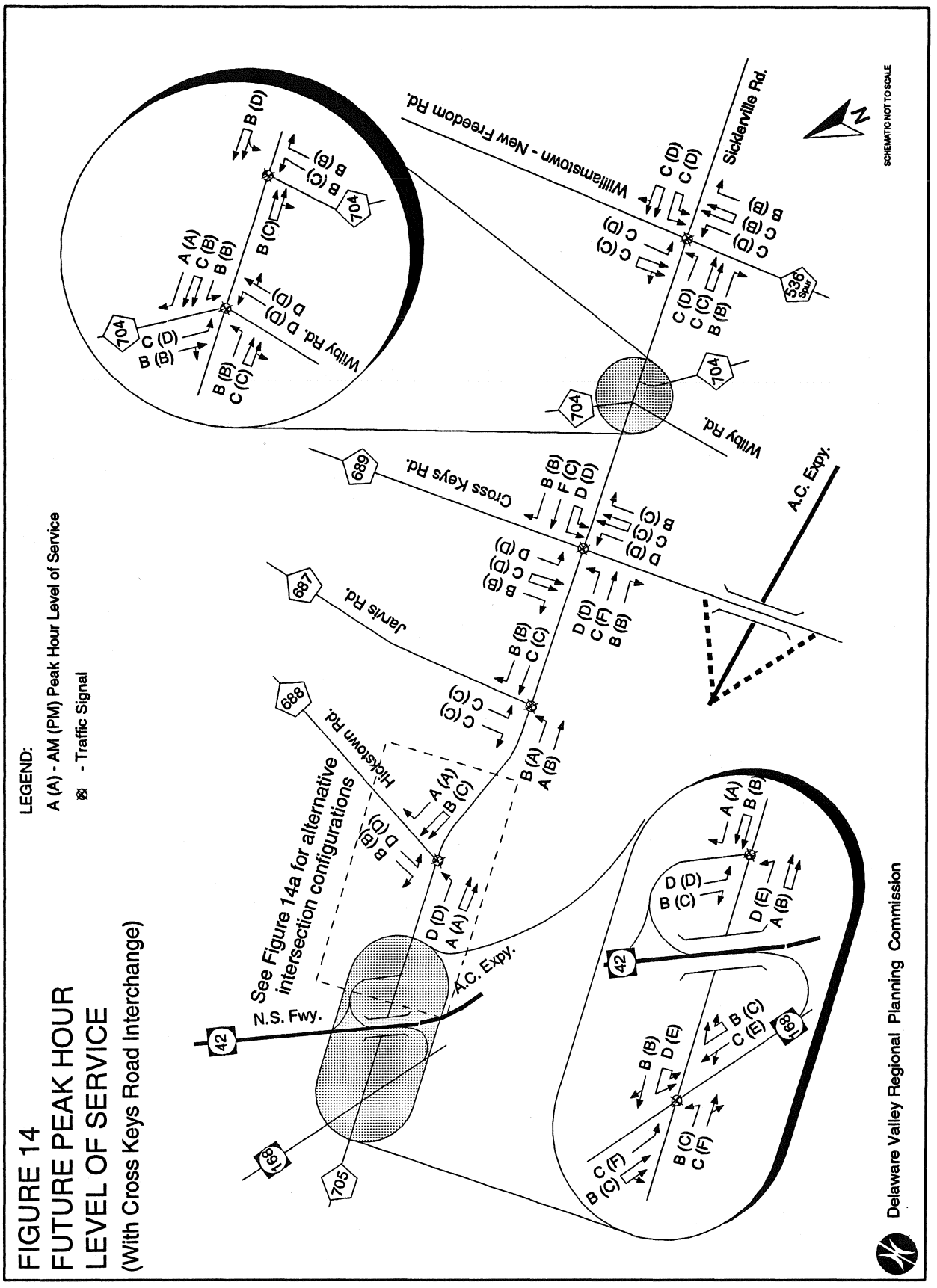
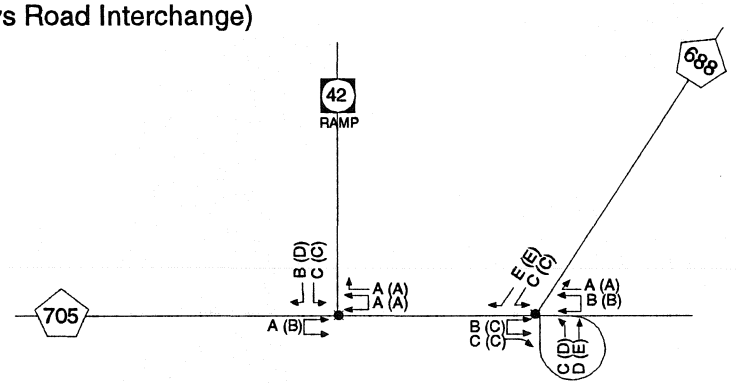


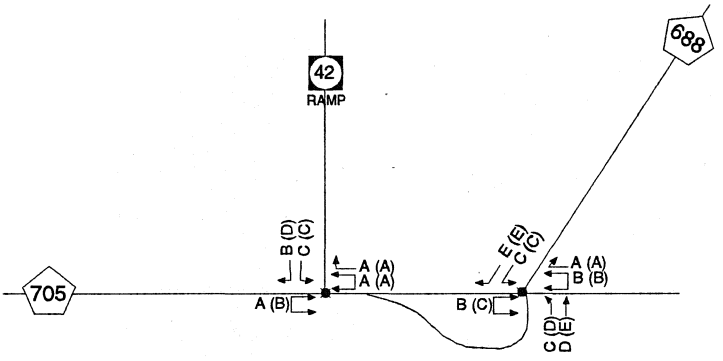
FIGURE 14
FUTURE PEAK HOUR
LEVEL OF SERVICE
(With Cross Keys Road Interchange)
LEGEND:
A (A) - AM (PM) Peak Hour Level of Service
⊗ - Traffic Signal
SCHEMATIC NOT TO SCALE
N
Williamstown - New Freedom Rd.
Sicklerville Rd.
Willby Rd.
Cross Keys Rd.
Jarvis Rd.
Hicksiown Rd.
A.C. Expy.
N.S. Fwy.
See Figure 14a for alternative intersection configurations
Delaware Valley Regional Planning Commission

FIGURE 14a
FUTURE LEVEL OF SERVICE
ALTERNATIVE INTERSECTION CONFIGURATIONS
FOR CR 705 AND NJ 42 RAMP
AND CR 705 AND CR 688
(With Cross Keys Road Interchange)

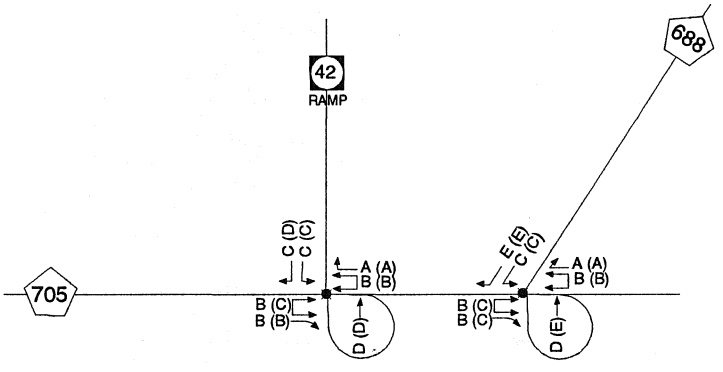
LEGEND:
A (A) - AM (PM) Peak Hour Level of Service
■ - Traffic Signal



Alternative A: Consolidated Far-Side Jughandle



Alternative B: Consolidated Near-Side Jughandle



Alternative C: Separate Far-Side Jughandles

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SCHEMATIC NOT TO SCALE

Widening the segment between the CR 704/Wilby Road intersection and the CR 689 (Cross Keys Road) intersection to four lanes would appear warranted based upon each intersection's projected future need and to prevent a potential "hour-glass condition". Additional capacity will be necessary to serve left turning traffic from northbound Sicklerville Road oriented to the partial interchange.

- Central corridor (between Cross Keys Road and the NJ 42 Ramp): With a partial interchange, a two lane cross section along Sicklerville Road from Cross Keys Road to the vicinity of Peter Cheeseman Lane will yield acceptable signalized traffic operations (and provide the capacity restraints necessary to "support" the interchange).

  North from the area of the Peter Cheeseman Lane intersection, through the NJ 42 Ramp intersection (to the south leg of the NJ 168 intersection) future conditions suggest that two lanes for through travel in each direction be provided for satisfactory traffic operations along Sicklerville Road.

- North corridor (north of the NJ 42 ramp): Same improvements set as cited in the preceding Scenario's discussion.

In summary of the level of service analysis of future traffic volume, assuming that the partial interchange is constructed to serve the study corridor, the identified traffic improvements will result in acceptable traffic operations with light to moderate peak hour traffic delays experienced at all study intersections.

Overall intersection performance for both scenarios are compared in Table 8. As can be seen in the table, most intersections will experience level of service D or better conditions for both scenarios. Without the Cross Keys Road interchange, p.m. peak traffic will operate at poor conditions (level of service E) at the NJ 168 intersection. With the partial interchange, traffic oriented to the southern study area will divert from the NJ 168 and CR 705 intersection. The diversion will result in a one step level of improvement in p.m. peak hour intersection operating conditions -- assuming the same set of intersection traffic improvements.

The traffic volume reductive effect of the partial interchange extends southward for the CR 705 corridor to the Cross Keys Road intersection. Further inferences in improved traffic operations at the intervening intersections are not possible between scenarios, since the improvements assumed for each scenario are not necessarily equal. Generally, however, less capital improvement is required for the central portion of the Sicklerville Road corridor when the partial interchange at Cross Keys Road and the Atlantic City Expressway is assumed.

TABLE 8: SUMMARY OF STUDY INTERSECTION LEVEL OF SERVICE ANALYSIS - FUTURE TRAFFIC VOLUMES (WITH AND WITHOUT INTERCHANGE)

INTERSECTION WITH SICKLERVILLE ROAD (CR 705):	LEVEL OF SERVICE			
	WITHOUT INTERCHANGE[8]		WITH INTERCHANGE[9]	
	AM	PM	AM	PM
1) Williamstown-New Freedom Road (CR 536 Spur)	C	C	C	C
2) Erial-Williamstown Road (CR 704) South	B	C	B	C
3) Erial-Williamstown Road (CR 704) North/Wilby Road	B	C	C	C
4) Cross Keys Road (CR 689)	C	C	D	D
5) Jarvis Road (CR 687)	B	B	C	B
6) Hickstown Road (CR 688)				
a) "conventional" design OR	C	B	B	B
b) consolidated far-side jughandle OR	C	D	C	D
c) consolidated near-side jughandle OR	C	D	C	D
d) separate far-side jughandle	C	D	C	C
7) North-South Freeway (NJ 42) Ramps				
a) "conventional" design OR	B	B	B	B
b & c) no southbound left turns OR	B	B	B	B
d) separate far-side jughandle	B	C	B	B
8) Black Horse Pike (NJ 168)	C	E	C	D

[8] Assumes traffic improvements noted in Table 6.

[9] Assumes traffic improvements noted in Table 7.

One final note on the alternatives studied for CR 705 southbound left turns at the NJ 42 Ramp and Hickstown Road intersections (again, please refer to Table 8). Conventional intersection designs (i.e., those with a center left turn lane) are more efficient in serving the traffic volume than a jughandle design[10]. On the other hand, each jughandle alternative yields approximately equal and acceptable traffic operations. Therefore in reflection of the earlier discussion regarding minimizing environmental, social and economic impacts in the vicinity of the improvement -- it appears that the near-side jughandle consolidating ramp and intersection turns would be the most logical alternative.

[10] Traffic signal phasing is most efficiently provided at these intersections via advance left turn phasing from a centered southbound left turn lane. This arrangement of signal green indications and traffic lanes allows multiple non-conflicting traffic movements at the intersection to move simultaneously (i.e., overlap). On the other hand, when jughandle designs are considered, separate split signal phasing for the side-street approaches are assumed in the analysis. As a result, reduced traffic signal efficiency is encountered with jughandles. Lastly, and perhaps the most obvious shortcoming relative to efficiently signalizing far-side jughandles is that left turning and U turning traffic volume using the jughandle actually traverses the intersection twice (first as a southbound through vehicle on CR 705 and second as a vehicle on the eastbound jughandle approach).

5 RECOMMENDATIONS

The preceding chapters of this report address the methodology used in determining roadway and intersection needs along Sicklerville Road assuming existing conditions and two future traffic circulation and traffic volume scenarios.

After that assessment was completed, the identified traffic improvements for each future circulation scenario, were discussed with representatives of Camden County's Planning and Engineering departments. The purposes of those discussions were to obtain agreement with the study's approach and findings, and to seek a decision as to which CR 705 improvement scenario will serve as the recommended plan.

The results of those discussions indicated that the County representatives support the undertakings and findings of the traffic analysis. Further, the County's preferred set of corridor traffic improvements are in line with the "With Interchange" traffic volume scenario.

The final recommendations are summarized on Table 9.

The recommendations were then "sized" to identify general right of way requirements within the corridor, assuming the following general criteria:

- Existing roadway dimensions are 36' (2 x 18'), adjacent to shoulders, within a 49.5' right of way;
- Provide curbing where physical improvements are constructed.
- The proposed right of way line is to be placed 7 feet beyond the proposed curb line on each side of the highway.
- Proposed travel lane widths are 12 feet each, therefore:
  3 lane cross section = 36' (3 x 12');
  4 lane cross section = 48' (4 x 12');
  5 lane cross section = 60' (5 x 12'), etc..
- Proposed cross sectional conditions (lanes plus right of way) are centered upon existing roadway's centerline. Auxiliary turning lanes at intersections are added to the appropriate side of the highway.

The proposed right of way needs along CR 705 were then drawn on copies of the aerial photographs of the corridor to provide a graphical sense of the magnitude of the recommended improvements (scale: 1" = 200'). Those drawings are incorporated into a separate document which serves as a supplement to this report.

TABLE 9: RECOMMENDED TRAFFIC IMPROVEMENTS

INTERSECTION WITH
SICKLERVILLE ROAD (CR 705):

1) Williamstown-New Freedom Road (CR 536 Spur) -
   a) Provide double left turn lanes, a single through lane and a shared through/right turn lane on the northbound CR 705 approach.
   b) Provide a separate left turn lane, two through lanes and a separate right turn lane on the southbound CR 705 approach.
   c) Construct a continuous five lane cross section on CR 536 Spur (center left turn lane and two through lanes in the eastbound and westbound direction), and provide a separate right turn lane on the eastbound approach to CR 705.
   d) Install a new traffic signal with multi-phase operation.

2) Erial-Williamstown Road (CR 704) South -
   a) Construct a continuous four lane cross section on CR 705 (two through lanes in the northbound and southbound direction) from north of the CR 536 Spur intersection.
   b) Retime signal and interconnect with CR 704 North/Wilby Road intersection.

3) Erial-Williamstown Road (CR 704) North/Wilby Road -
   a) Retime signal and interconnect with CR 704 South intersection..

4) Cross Keys Road (CR 689) -
   a) Construct a continuous four lane cross section on CR 705 (two lanes in the northbound and southbound direction) from north of CR 705 North/Wilby Road intersection.
   b) Provide double left turn lanes, a separate through lane and a separate right turn lane on the northbound CR 705 approach to CR 689.
   c) Provide a separate left turn lane, a separate through lane and a separate right turn lane on the southbound CR 705 approach to CR 689.
   d) Construct a continuous five lane cross section along CR 689 (center left turn lane and two through lanes in the eastbound and westbound direction), and provide separate right turn lanes on the eastbound and westbound approaches to the CR 705 intersection.
   e) Install new traffic signal with multi-phase operation.
   f) Maintain two lane cross section for through traffic along CR 705 north of the CR 689 intersection.

5) Jarvis Road (CR 687)** -
   a) Maintain two lane cross section for through traffic along CR 705 from north of the CR 689 intersection.
   b) Construct separate southbound left turn lane on CR 705.
   c) Provide separate northbound right turn lane on CR 705.
   d) Provide separate left and right turn lanes on the westbound Jarvis Road approach.
   e) Install traffic signal with multi-phase operation.

6) Vicinity of Peter Cheeseman Lane and Garwood Road (Gloucester Township owned/maintained roads) -
   a) Conduct detailed traffic analysis for this area of CR 705.
   b) Interim recommendations (for corridor sketches):
      1. Maintain two lane cross section for through traffic along CR 705 from north of the CR 687 intersection to south of the Peter Cheeseman Lane intersection.
      2. Transition cartway width of CR 705 from two lane cross section, on the south of Peter Cheeseman Lane, to a continuous four lane cross section (affording two through lanes in the northbound and southbound direction) through the intersection and to the north of this area.
      3. Replace northbound right turn lane.

TABLE 9 (CONT.): RECOMMENDED TRAFFIC IMPROVEMENTS

INTERSECTION WITH
SICKLERVILLE ROAD (CR 705):

7) Hickstown Road (CR 688) -
   a) Realign westbound Hickstown Road approach to more closely intersect CR 705 at a right angle.
   b) Provide separate left and right turn lanes on the westbound Hickstown Road approach.
   c) Construct a continuous four lane cross section on CR 705 (two through lanes in the northbound and southbound direction) from north of the vicinity of Peter Cheeseman Lane through the Hickstown Road intersection and a separate northbound right turn lane on CR 705 approaching CR 688.
   d) Provide a near-side jughandle for southbound CR 705 left turns and U-turns.
   e) Install traffic signal with multi-phase operation and interconnect with NJ 42 Ramp intersection.

8) Orr Road (Gloucester Township owned/maintained road) -
   a) Restrict turns at CR 705 to right turns only. (Left turn access to CR 705 relocated to Hickstown Road via Freeway Corporate Center proposed internal site roadway. Left turn access from southbound CR 705 directed by signage to the CR 688 intersection. U-turns to Orr Road accommodated and consolidated with left turns at the CR 688 intersection via the near-side jughandle.).

9) North-South Freeway (NJ 42) Ramps -
   a) Provide continuous, divided four lane cross section for through traffic along CR 705 (two through lanes in the northbound and southbound direction) from north of the CR 688 intersection through the North-South Freeway Ramps intersection, and provide a separate northbound right turn lane on CR 705.
   b) Prohibit southbound left turns from CR 705. (Direct southbound left turns, by signage, to the CR 688 intersection. U-turns to the NJ 42 ramp accommodated and consolidated with left turns at the CR 688 intersection via the near-side jughandle.)
   c) Install two phase traffic signal and interconnect with the Black Horse Pike intersection and the Hickstown Road intersection.

10) Widen CR 705 under the NJ 42/A.C. Expressway overpass.
   a) Provide a continuous, divided four lane cross section on CR 705 (two through lanes in the northbound and southbound direction) from north of the North-South Freeway Ramps intersection through the overpass.

11) Widen CR 705 bridge over stream.
   a) Provide a continuous, divided four lane cross section on CR 705 (two through lanes in the northbound and southbound direction) from north of the NJ 42/A.C. Expressway overpass through the bridge.

12) Black Horse Pike (NJ 168) -
   a) Provide a continuous, divided four lane cross section on CR 705 (two through lanes in the northbound and southbound direction) along the intersection's south leg between NJ 168 and the CR 705 bridge over stream just to south.
   b) Provide double left turn lanes on the northbound CR 705 approach.
   c) Provide double right turn lanes on the northbound NJ 168 approach.
   d) Update traffic signal. Provide multi-phase operation and interconnect with North-South Freeway ramp intersection.

** note: Improvements corresponding to the recommendations cited at CR 705 and Jarvis Road were constructed during 1995.

6 CONCLUSIONS

The foregoing analyses and recommendations have been coordinated with the Camden County Planning and Engineering departments. Additionally, meetings with The South Jersey Transportation Authority (SJTA), the New Jersey Department of Transportation (NJ DOT) and Gloucester County Engineer's Office were held to communicate the findings of the plan and to determine the soundness of its recommendations. As a result of those meetings it has been determined that the set of recommendations are supported in principle by the neighboring and potentially impacted "jurisdictions". On the other hand, continued and expanded coordination will be necessary between Camden County and Gloucester County, NJ DOT, SJTA, NJ Transit, and the affected municipalities as the improvements are advanced to design and construction.

The set of recommended improvements are flexible and may be staged within the corridor based upon available finances, incremental need and/or changes in planned conditions or circumstances. For example, the improvements identified to serve existing conditions will benefit the corridor's future requirements if the full complement of recommended improvements are unattainable. The improvements cited for the corridor between Peter Cheeseman Lane and the NJ 168 intersection will be required whether or not the partial interchange is constructed. Widening southward between Peter Cheeseman Lane and Cross Keys Road can be undertaken at a later time if the decision not to construct a partial interchange is reached or potentially in the event that a decision is rendered which recommends that a full interchange between the Atlantic City Expressway and Cross Keys Road be constructed.

Transportation benefits in the corridor can be extended if the following strategies are pursued as enhancements to the identified improvement recommendations.

1) Promote the existing Avandale Park and Ride lot facility. Explore the potential for the lot to be used by the general public.
2) Establish access management policies and guidelines within the county's set of ordinances and set them into practice (as the corridor develops and/or as the recommended improvements are designed) through an access management plan. Elements such as sharing access, proper driveway placement, and intersection and traffic signal spacing can be beneficial to both traffic movement and traffic safety along the corridor.
3) Provide transit friendly design elements within the set of recommendations to enhance the corridor's people movement capability. For example: provide transit stop "cut-outs" with sidewalks and shelters, and provide adequate turning radii at intersections or major driveways.
4) Seek trip and/or commute reduction options through participation with the Cross County Connection Transportation Management Association (CCC TMA).
5) Require that a public access park and ride lot accompany any interchange construction between the Atlantic City Expressway and Cross Keys Road.

APPENDIX

Summary of Reportable Accidents

at

CR 705 and NJ 42 Ramps

1992 to 1994

SUMMARY OF REPORTABLE ACCIDENTS AT CR 705 AND NJ 42 RAMPS, 1992 to 1994

No.	Station	Date	Time	Light Condition	Weather	Roadway Surface	Collision Type	No. Killed	No. Injured	Reported Causation Factors and/or Comments
1.	CR 705 & NJ 42	1/12/92	2:23 PM	Day	No Adv.	Dry	Angle	0	0	#1 WB made left turn from off-ramp, striking #2 NB on CR 705.
2.	CR 705 & NJ 42	5/9/92	6:43 PM	Day	No Adv.	Dry	Rear-end	0	0	#1 NB on CR 705 was distracted by another vehicle; didn't notice #2 NB stopped in traffic, which it struck in rear.
3.	CR 705 & NJ 42	6/18/92	7:38 AM	Day	No Adv.	Dry	Side-swipe	0	1	#1 NB on CR 705 struck #2 WB making left turn from off-ramp.
4.	CR 705 50' N of NJ 42	9/4/92	3:32 PM	Day	No Adv.	Dry	Rear-end	0	0	#1 NB on CR 705 accidentally pushed accelerator instead of brake, hitting #2 NB, which hit #3 NB.
5.	CR 705 & NJ 42	9/8/92	6:42 PM	Day	No Adv.	Dry	Rear-end	0	2	#1 WB was exiting the ramp when another vehicle cut them off; #2 WB hit #1 from behind when #1 came to a stop.
6.	CR 705 N of NJ 42	9/9/92	5:17 PM	Day	No Adv.	Dry	Rear-end	0	1	#1 NB was stopped in traffic on CR 705 when it was struck from behind by #2 NB.
7.	CR 705 & NJ 42	9/16/92	9:23 AM	Day	No Adv.	Dry	Rear-end	0	1	#1 WB was exiting the ramp when they had to stop because of traffic on CR 705; #2 WB struck #1 from behind when #1 came to a stop.
8.	CR 705 & NJ 42	11/2/92	11:16 AM	Day	No Adv.	Dry	Head-on	0	1	#1 NB on CR 705 swerved to avoid another vehicle exiting the NJ 42 ramp when it hit #2 SB head-on.
9.	CR 705 & NJ 42	12/21/92	2:01 PM	Day	No Adv.	Dry	Angle	0	2	#2 NB started to enter EB on-ramp, then decided to return to CR 705, where it struck #1 NB, originally behind #2.
10.	CR 705 & NJ 42	12/28/92	2:49 PM	Day	No Adv.	Dry	Angle	0	1	#1 NB on CR 705 struck #2 WB making left turn from off-ramp. #2 did not see #1.
11.	CR 705 & NJ 42	1/2/93	2:04 PM	Day	No Adv.	Dry	Rear-end	0	0	#2 SB was stopped in traffic on CR 705 waiting to enter NJ 42 on-ramp when #1 exited the off-ramp and struck #2 in the rear.
12.	CR 705 & NJ 42	1/25/93	5:29 PM	Dark	No Adv.	Dry	Side-swipe	0	2	#1 NB on CR 705 struck #2 WB making left turn from off-ramp. #2 did not see #1.
13.	CR 705 & NJ 42	3/8/93	4:43 PM	Dusk	No Adv.	Dry	Rear-end	0	0	#1 SB was stopped in traffic on CR 705 waiting to enter NJ 42 on-ramp when #2 exited the off-ramp and struck #2 in the rear.

SUMMARY OF REPORTABLE ACCIDENTS AT CR 705 AND NJ 42 RAMPS, 1992 to 1994

No.	Station	Date	Time	Light Condition	Weather	Roadway Surface	Collision Type	No. Killed	No. Injured	Reported Causation Factors and/or Comments
14.	CR 705 & NJ 42	4/7/93	11:20 AM	Day	No Adv.	Dry	Side-swipe	0	1	#1 was leaving a parking lot to enter NJ 42 EB on-ramp when it collided with #2, which was making a left turn from NJ 42 off-ramp to CR 705 SB.
15.	CR 705 & NJ 42	7/2/93	4:06 PM	Day	Rain	Wet	Side-swipe	0	0	#1 NB on CR 705 struck #2 making a left onto NJ 42 EB on-ramp. #1 had difficulty stopping due to rain.
16.	CR 705 & NJ 42	10/17/93	2:35 PM	Day	Rain	Wet	Side-swipe	0	0	#1 was making a left from NJ 42 WB off-ramp to CR 705 SB when it lost control and struck #2 NB on CR 705.
17.	CR 705 N of NJ 42	12/10/93	1:46 PM	Day	No Adv.	Dry	Side-swipe	0	1	#1 NB on CR 705 was making a U-turn when it was struck by #2 travelling SB.
18.	CR 705 & NJ 42	3/17/94	6:00 PM	Dusk	No Adv.	Dry	Ped.	0	1	Pedestrian was crossing CR 705 when they were struck by #2 NB. The pedestrian didn't see #2.
19.	CR 705 & NJ 42	4/2/94	3:30 PM	Day	No Adv.	Dry	Angle	0	1	#1 was parked when it rolled into CR 705, where it struck #2 SB, which struck #3 NB stopped in traffic. #1 continued and struck #3. There was no driver in #1.
20.	CR 705 & NJ 42	4/17/94	1:31 PM	Day	No Adv.	Dry	Angle	0	0	#1 WB made a left turn from off-ramp, passing through a space in traffic, when it was struck by #2 SB on CR 705.
21.	CR 705 & NJ 42	5/2/94	4:06 PM	Day	No Adv.	Dry	Side-swipe	0	0	#2 NB on CR 705 was struck by #1 WB making a left turn from off-ramp. #1 stalled while turning.
22.	CR 705 & NJ 42	8/9/94	11:22 AM	Day	No Adv.	Dry	Rear-end	0	1	#1 SB was stopped in traffic on CR 705 waiting to enter NJ 42 on-ramp when #2 made a left from off-ramp and struck #2 in the rear.
23.	CR 705 & NJ 42	8/20/94	12:19 PM	Day	No Adv.	Dry	Angle	0	0	#2 NB on CR 705 was struck by #1 WB making a left turn from off-ramp.