Final Report

Newark Area Transportation Study

Division of Highways
Department of Transportation
State of Delaware

March 1989

Vanasse Hangen Brustlin, Inc.

NEWARK AREA TRANSPORTATION STUDY

FINAL REPORT

Prepared for

THE DIVISION OF HIGHWAYS
DEPARTMENT OF TRANSPORTATION
STATE OF DELAWARE
KERMIT H. JUSTICE, SECRETARY

March, 1989

Prepared by

Vanasse Hangen Brustlin, Inc.
Consulting Engineers and Planners
60 Birmingham Parkway
Boston, Massachusetts 02135
617/783-7000

CONTENTS

CONTENTS (Continued)

FIGURES

FIGURES (Continued)

TABLES

PREFACE/ACKNOWLEDGEMENTS

This report was prepared in cooperation with the Systems Planning section, Division of Highways, State of Delaware Department of Transportation, which provided the traffic volumes used throughout the study process.

It is a compilation of the highlights of a series of technical memoranda issued during the course of the Newark Area Transportation Study (NATS). It also focuses on the detailed evaluation of Phase 2 improvement strategies and presents a program of prioritized Phase 2 recommendations. The material previously presented has been updated and revised as required.

The technical memoranda previously submitted include:

- No. 1 - Review of Previous Work
- No. 2 - Refined Work Program
- No. 3 - Proposed Deficiency Criteria
- No. 4 - Short-Term Improvement Analysis (Phase 1)
- No. 5 - Future Year 2010 Deficiencies (Phase 2)

Input from various State and City officials, as well as the Citizens Advisory Committee, was received throughout the course of the study. This information is incorporated in this final report. Vanasse Hangen Brustlin, Inc. wishes to acknowledge the valuable assistance and cooperation of the various groups and organizations which took part in this effort at the State and local levels, particularly the following:

- Citizens' Advisory Committee
- City of Newark Planning Department
- City of Newark Police Department
- Delaware State Police
- WILMAPCO

I. OVERVIEW

Newark, the second largest city in New Castle County, is growing at a rate several times faster than Wilmington. The Greater Newark Area, once known for its farms and as the location of the University of Delaware, has more recently become home for many who are connected with the rapidly expanding banking industry in the County. Prior to this recent development surge, firms such as Chrysler and DuPont were the main contributors to the growth of the area. Current growth patterns in the Newark area steadily threaten to increase congestion and delay on the existing roadway network, which until recently was considered mostly rural in character. The Delaware Department of Transportation, in recognition of these changing trends, commissioned Vanasse Hangen Brustlin, Inc. to conduct a systems analysis study of both short-term and long-term travel needs in the Newark area through the year 2010. The primary intent of a system analysis is to take a broad-brush look at travel conditions in the study area and to develop a wide-ranging program of improvements which address the likely conditions resulting from forecasts of area-wide growth in population and employment. This report documents the results of that study.

A two-phase approach was used to identify, first, required short-term improvements and, second, improvements to be completed by the year 2010. A significant data collection effort included the conduct of turning movement and automatic traffic recorder counts, an origin-destination study, travel time runs, and other field observations. The Delaware Department of Transportation provided the year 2010 traffic volume projections which were the basis for the long-term analysis. Evaluation criteria were established early in the process to set the stage for the analysis of both short and long-term improvements.

While the study focused on identifying roadway improvements, travel demand reduction strategies and transit issues were also addressed as part of the recommendations for both Phase 1 and Phase 2. We are convinced that capacity increases without a strong commitment to reduce or limit growth in vehicle demand is a short-sighted approach and serves only to reduce the cost effectiveness of providing the new capacity.

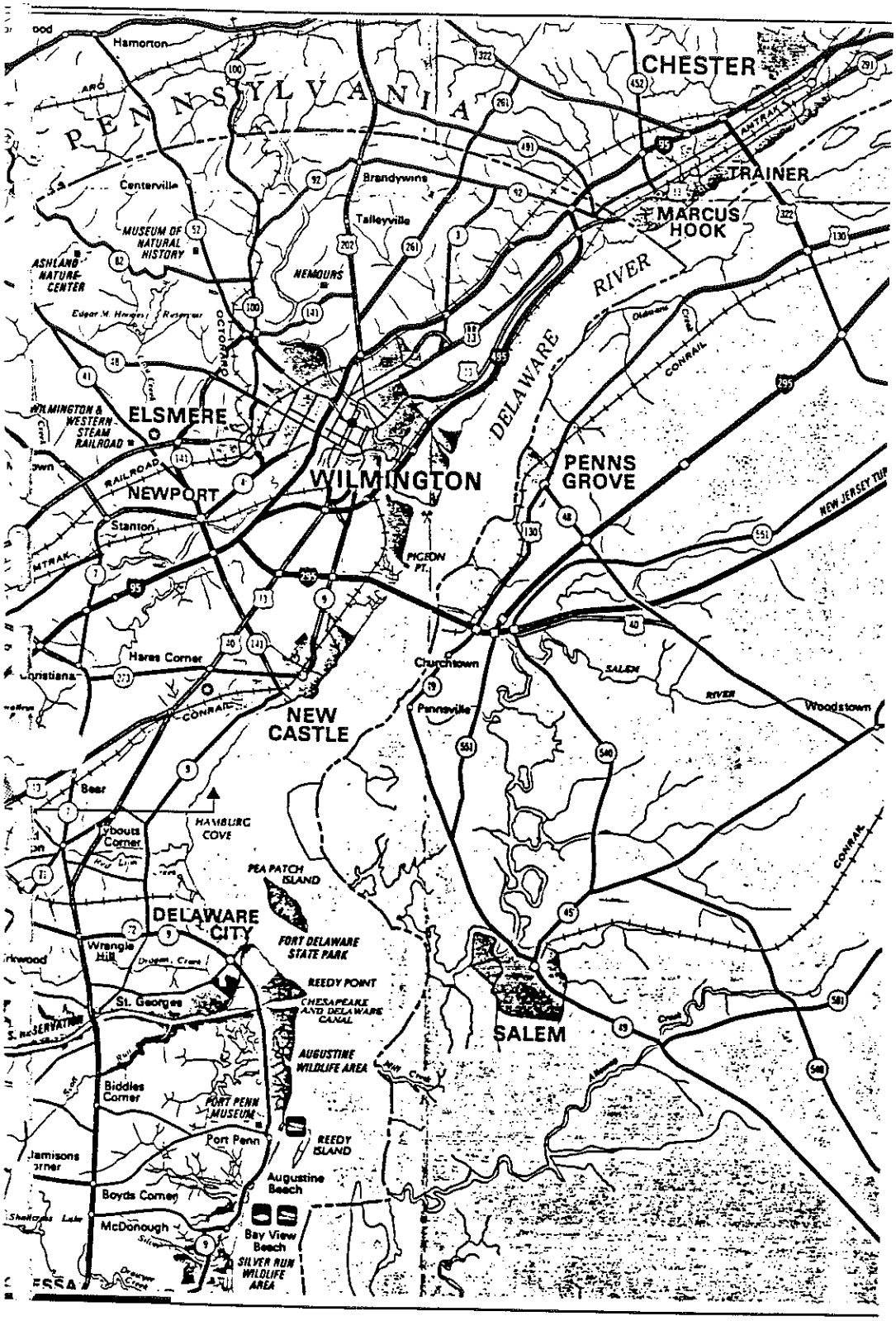
The chapters which follow document the analysis procedures and study tasks conducted in preparation of the recommended improvement plan for the Newark area.

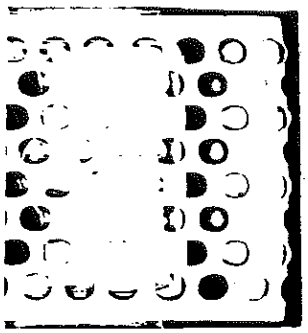
A. PROJECT SETTING

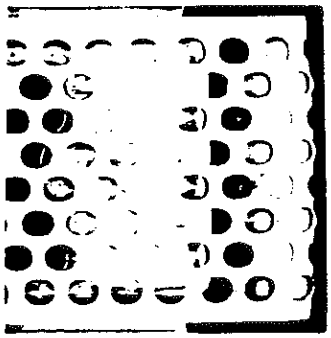
The project study area is located in the western part of New Castle County. The City of Newark is at the center of the study area, which is bounded by the Commonwealth of Pennsylvania and Chambers Rock Road on the North; Station Road, Possum Park Road, Ruthby Road and Salem Church Road on the east; the Pulaski Highway (U.S. Route 40) on the south, and the State of Maryland on the west (see Figure I-1). All state maintenance routes within the area are included as study corridors. Major roadways serving the study area include:

- I-95 (east/west)
- U.S. Route 40 (east/west)
- Route 4 (east/west)
- Route 896 (north/south)
- Route 72 (north/south)
- Route 2 (east/west)
- Route 273 (east/west)

The study area ranges from level ground in the southern section to steadily increasing elevations in the northern area. The White Clay Creek serves as a natural boundary for the north-







Vanasse Hangen Brustlin, Inc.
Consulting Engineers & Planners
60 Birmingham Parkway, Boston, MA 02135

0 3.5
SCALE IN MILES

LEGEND:

Study Area

ap

Fig. I-1

east quadrant in the study area, running north/south adjacent to North College Avenue and east/west to the north of Cleveland Avenue and Route 2.

This area of the county, which as of 1985 maintained close to 25 percent of its population and housing and nearly 20 percent of its employment, has experienced considerable growth in population in comparison to the rest of the county (20.5 percent to 4.2 percent, respectively, between 1970 and 1985).[1] Population in the City of Wilmington actually decreased 11.5 percent during the same time period. It is anticipated that the growth trends previously experienced will continue. This is evidenced by the recent residential subdivision proposals within the study area. Proposals for major office and retail centers have also been made recently.

Major employers in the study area include the University of Delaware, Chrysler Corporation, and the DuPont Companies. With the exception of the University, these employers and others are located outside of the Newark Central Business District (CBD).

Traffic generation and travel patterns generally follow the expected time distribution for an area with predominantly business or commuter traffic. The daytime peak hours coincide with the commuter peak hours and traffic volumes during the summer are slightly lower. The study area generally has traffic characteristics which more closely resemble urban rather than rural conditions.

1/ Population and employment data - 1986 Annual Profile - New Castle County, NCC Department of Planning (1985 data are estimated).

B. ISSUES

As population and employment throughout the study area increase, so do traffic volumes. Average daily traffic on some of the study area corridors is expected to increase to two or three times their current level by 2010. Growth management will continue to be an important issue relative to population, employment, and traffic. As of 1985, undeveloped property accounted for approximately 62 percent of the land in the greater Newark area. As these parcels develop, traffic will likely increase even with growth management. The majority of the undeveloped parcels are located outside of the CBD. Development of this land creates new "mini-suburbs" requiring travel from one to the other contrary to the traditional suburb-to-CBD travel pattern.

In general, the existing roadway network is a radial pattern around the greater Newark area. There are, however, corridors such as I-95, U.S. Route 40, and others which skirt the City. There are no complete "ring-roads" around the City or north/south routes which do not pass through the City. The lack of a bypass system has created additional congestion in the CBD. In addition, Route 273 connects with Main Street in downtown Newark, thereby providing a direct route through the CBD for east/west through traffic. In future years, Cleveland Avenue, Main Street, and Delaware Avenue are likely to suffer from increasing congestion and safety problems resulting from these roadway network deficiencies.

Contributing to these problems are the following:

- Existing zoning regulations encourage high density but services such as local public transportation have not been fully developed to support the growth,

- The public transportation system currently focuses on regional routes (such as Newark to Wilmington) reducing potential ridership,

- Automobile use is particularly high because of low vehicle occupancy rates (about 1.3 persons per vehicle), and,

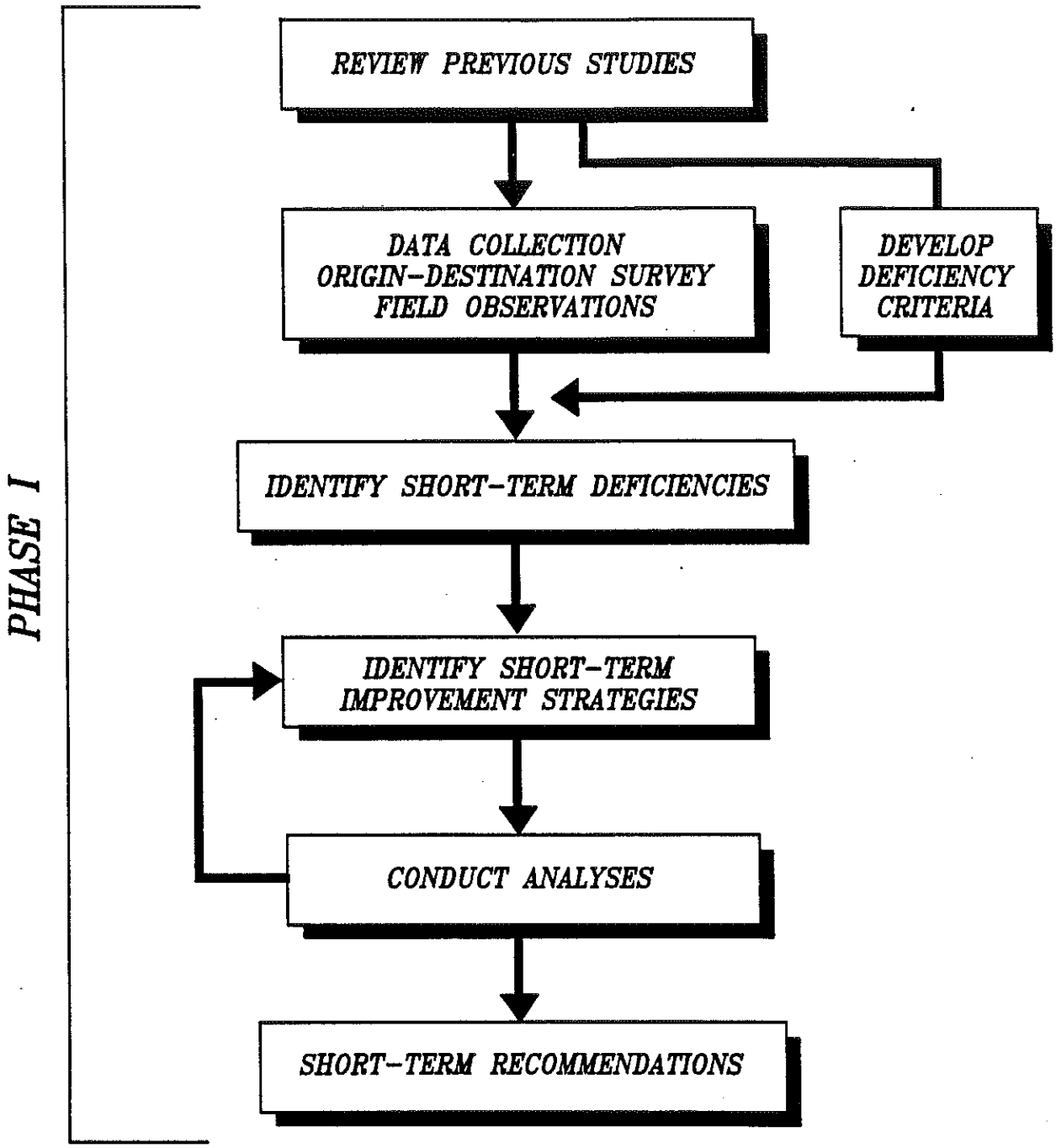
- Developers and major employers have not been officially required to mitigate traffic impacts through traditional or creative travel demand reduction techniques.

C. STUDY PROCESS

The issues identified above were partially addressed in several technical memoranda previously issued. They are addressed again in full in this final report. As previously mentioned, this was a two-phase project identifying short-term (quick-action) solutions to existing problems in the first phase and longer-term solutions in the second phase. The study involved six major tasks as listed below:

1. Review of Previous Studies;
2. Preparation of Deficiency Criteria;
3. Data Collection/Short-Term (Phase 1) Improvement Analysis;
4. Phase 2 Deficiency Analysis
5. Phase 2 Improvement Evaluations; and,
6. Phase 2 Recommendations.

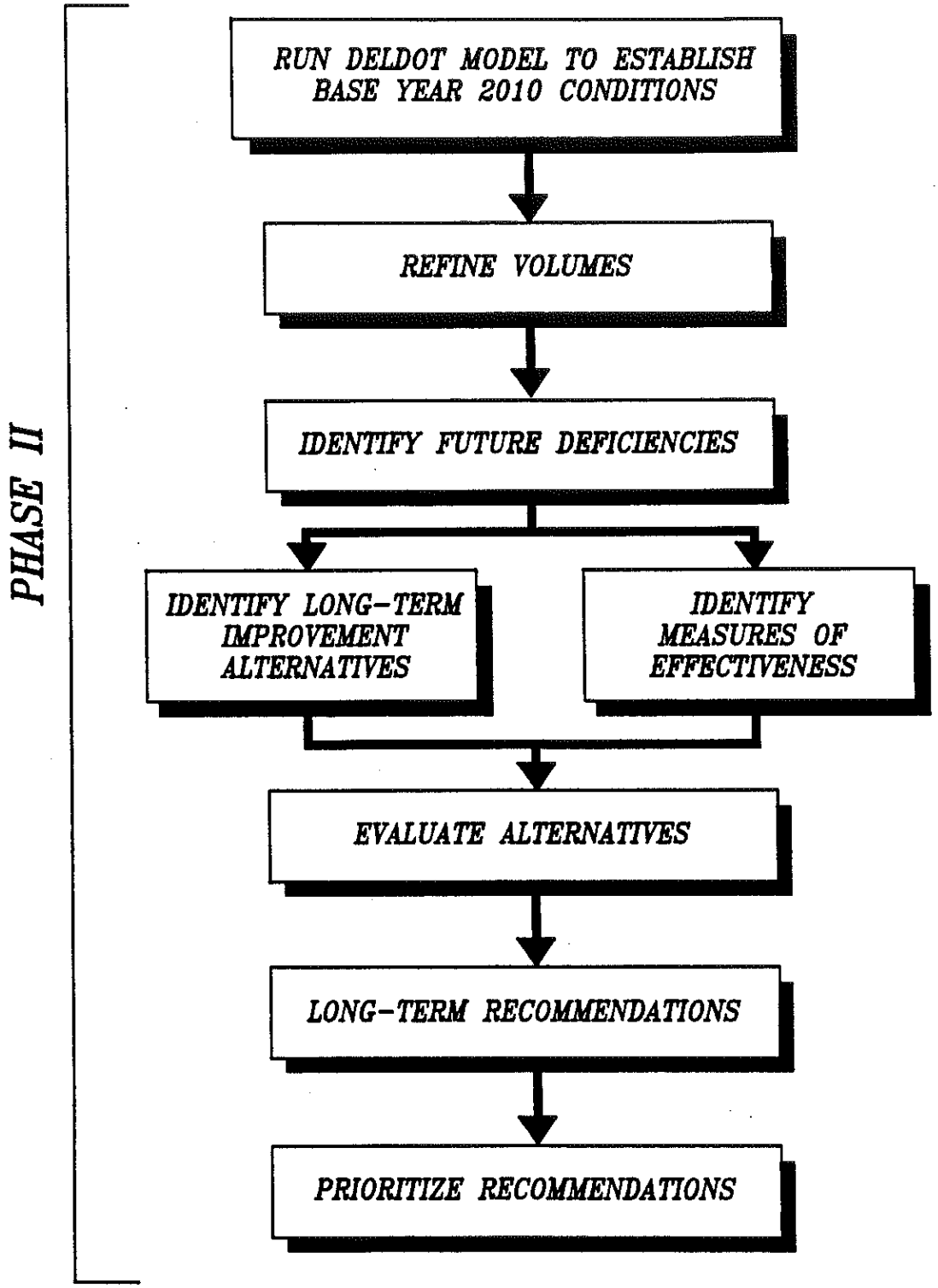
The Phase 1 study process is presented in Figure I-2. The Phase 2 study process is presented in Figure I-3.



Vanasse Hangen Brustlin, Inc.
Consulting Engineers & Planners
60 Birmingham Parkway, Boston, MA 02135

Phase 1 Study Process

Fig. I-2



Vanasse Hangen Brustlin, Inc.
Consulting Engineers & Planners
60 Birmingham Parkway, Boston, MA 02135

Phase 2 Study Process

Fig. I-3

With the exception of numbers 5 and 6 above, each of these topics was covered in a technical memorandum. The contents of the memoranda are summarized below.

- **Technical Memorandum Number 1 - Review of Previous Work**

This memorandum summarized the contents of reports published during the past 15 years which have relevance to the Newark Area Transportation Study. It also provided sources for available data likely to be used in conjunction with this study. This information is presented in Chapter I.

- **Technical Memorandum Number 2 - Refined Work Program**

Included in this memorandum was a detailed explanation of the work tasks and products to be provided as part of this project.

- **Technical Memorandum Number 3 - Proposed Deficiency Criteria**

The criteria which became the basis for both the short-term deficiency analysis and the subsequent long-term alternatives analysis were presented in this memorandum. The information is incorporated in Chapters IV, VI, and VII.

- **Technical Memorandum Number 4 - Short-Term Improvement Analysis**

Existing conditions in the study area were documented in this memorandum, including land use, demographics, travel patterns, roadway and traffic characteristics, and travel deficiencies. A program of short-term (Phase 1) improvements was also presented. This information is presented in Chapters III, IV, and V of this report.

- Technical Memorandum Number 5 - Future Year 2010 Deficiencies (Phase 2)

Using DelDOT-produced traffic volume forecasts as a base, a segment-level analysis was conducted to identify the roadway and intersection deficiencies for the year 2010. These deficiencies were documented in the memorandum and are presented in Chapter VI of this report.

Throughout the study process, input from the local citizenry was obtained through a series of meetings with a group formally known as the citizens Advisory Committee (CAC). Meetings were held at appropriate points during the study process as listed below:

1. Project Initiation - October 7, 1987
2. Existing Conditions - December 17, 1987
3. Phase 1 Improvement Program - April 13, 1988
4. Phase 2 Deficiencies - June 23, 1988
5. Phase 2 Improvement Program - November 15, 1988

Minutes from these meetings are presented in Appendix A of this report. The input obtained from the members of the CAC was found to be very useful in identifying both the deficiencies and potential improvements.

This final report is a stand-alone document which recapitulates and updates the subject matter presented in the draft technical memoranda. It also focuses on the detailed evaluation of Phase 2 improvement strategies and presents a program of prioritized Phase 2 recommendations.

II. REVIEW OF PREVIOUS STUDIES

The first stage of this project entailed the research of studies conducted previously and, based on this review, refinement of the work program identified in the initial scope of work prepared for the Department.

Several reports prepared by public agencies or private developers on subjects relevant to the Newark Area Transportation Study were reviewed to provide background information to the study team. The reports were published between the years 1974 and 1988 and are listed below:

1. I-95 Route 40 Corridor Transportation Study, New Castle County, Interim Report No. 1, Michael Baker, Jr., Inc., Consulting Engineers, Harrisburg, PA, June 1974.

2. Micro-Transportation Study for Newark, Delaware, Technical Memorandum No. 1 - Existing Conditions, Problems and Issues, Alan M. Voorhees & Associates, Inc., August, 1976.

3. Micro-Transportation Study for Newark, Delaware, Phase II - Long Range Transportation Plan, Alan M. Voorhees, Inc., October, 1977.

4. 1986 Annual Profile, New Castle County, Delaware, New Castle County Planning Department, June, 1986.

5. Delaware Turnpike Authority: Study of Truck Movements in the Newark Area, URS/Coverdale and Colpitts, November, 1986.

6. Capital Improvements Program, Fiscal Years 1989 - 1994, Delaware Department of Transportation, October, 1987.

7. Traffic Summary 1986, Delaware Department of Transportation, 1987.

8. Comprehensive Development Plan II, City of Newark, Delaware, 1987.

9. Final Traffic Impact Study - Stanley IV, George C. Govatos, Ph.D., P.E., August, 1987.

10. Preliminary Traffic Impact Study for Willow Associates IV, Old Baltimore Pike, White Clay Creek and Pencader Hundreds, New Castle County, Delaware, Vandemark and Lynch, Inc. 1987.

11. Draft Phase I Report - U.S. Route 40 Corridor (Elkton) Study, Wilmington Metropolitan Area Planning Coordinating Council, March, 1988.

12. Draft Working Paper Service Proposals - DART Strategic Development Plan, Abrams - Cherwany & Associates with Mundle & Associates, Inc., March, 1988.

13. Expanded Metroform Area Study - Final Report, Vanasse Hangen Brustlin, Inc., April 1988.

In addition to these reports, other data were reviewed, including:

- State Maintenance Roadway Inventory;
- Roadway Accident Reports;
- New Castle County Land Use Data by Traffic Zone;

- Travel Demand Modelling Data; and,
- Turning Movement Counts.

Abstracts and summaries of all reports and relevant data are presented in Technical Memorandum No. 1.

III. EXISTING CONDITIONS

An extensive data collection effort was conducted in conjunction with this study. It included the collection of traffic count data, field observations, and documentation of area demographics, land use data, travel patterns, and transit usage. Each of these topics is discussed below, including the results of a comprehensive origin-destination survey.

A. DEMOGRAPHICS AND LAND USE

The pattern of land use within and adjacent to the study area is an important determinant of traffic demand on the area roadways. The land use characteristics are described herein in terms of the demographics of the study area. This section of the report presents a profile of the key demographic factors which affect the level of daily trip making. The data are presented by traffic analysis zone (provided by DelDOT), which represents smaller areas within the study area forming the basis for transportation planning throughout New Castle County. The socioeconomic variables which are used to describe the study area are listed below:

- Population
- Dwelling Units
- Automobile Registrations
- Mean Income
- Manufacturing Employment
- Industrial/Service Employment
- Commercial Employment
- Community Service Employment
- Total Employment

Table III-1 compares these variables for the study area and for New Castle County.

The study area constitutes close to 25 percent of the population and housing in the county and 19 percent of the total employment. Key demographic factors which are related to the number of daily and peak hour trips produced in a zone (e.g., home-based trips) or attracted to a zone (e.g., work-based trips) within the study area are population, housing, employment, and auto ownership (registration). Another factor which contributes to the trip making characteristics in a zone is the location of major activity centers. These variables are described in more detail below.

TABLE III-1
1985 DEMOGRAPHIC PROFILE

Feature	Study Area	New Castle County	Study Area As Percent of County
Population	100,868	412,585	24
Dwelling Units	34,633	148,629	23
Autos	55,485	218,283	25
Employment			
Manufacturing	10,859	53,918	20
Industrial	6,112	27,607	22
Commercial	12,616	65,283	19
Community Service	7,682	50,061	15
Total Employment	37,269	196,869	19

1. Population/Housing/Auto Ownership

Population and housing are two components which are used to generate vehicle trips in the transportation model utilized by DelDOT. Figure III-1 presents 1985 population by traffic analysis zone. The most populated areas are generally in the eastern and southeastern sections adjacent to the study area. The most populated zone within the study area is Zone 157 with 6,570 persons. Its boundaries are I-95 to the south, Route 4 to the north, Salem Church Road to the east, and Route 72 to the west. In the western section of the study area, Zone 172 bordered by Nottingham Road, Elkton Road, and Casho Mill Road is also highly populated. There are also a few pockets of sparse population located in areas of higher employment.

The characteristics of housing distribution are presented in Figure III-2. Consistent with the population trends, the area of most intense housing development within the study area is in Traffic Analysis Zones 157 and 158, with 2,385 and 2,657 units, respectively. Again, traffic zones bordering the study area to the east and southeast include a high number of dwelling units.

Between 1970 and 1985, the population in the greater Newark area grew by 20.5 percent. This compares to growth in the entire county of 4.2 percent over the same period.[2] The number of dwelling units has also increased significantly compared to the total for the county (46.8 percent to 26.2 percent, respectively).

Important to the trip-making characteristics of a particular area is auto ownership. Figure III-3 presents auto ownership by traffic analysis zone. Perhaps more interesting is the relation-

2/ 1986 Annual Profile - New Castle County Delaware, NCC Department of Planning

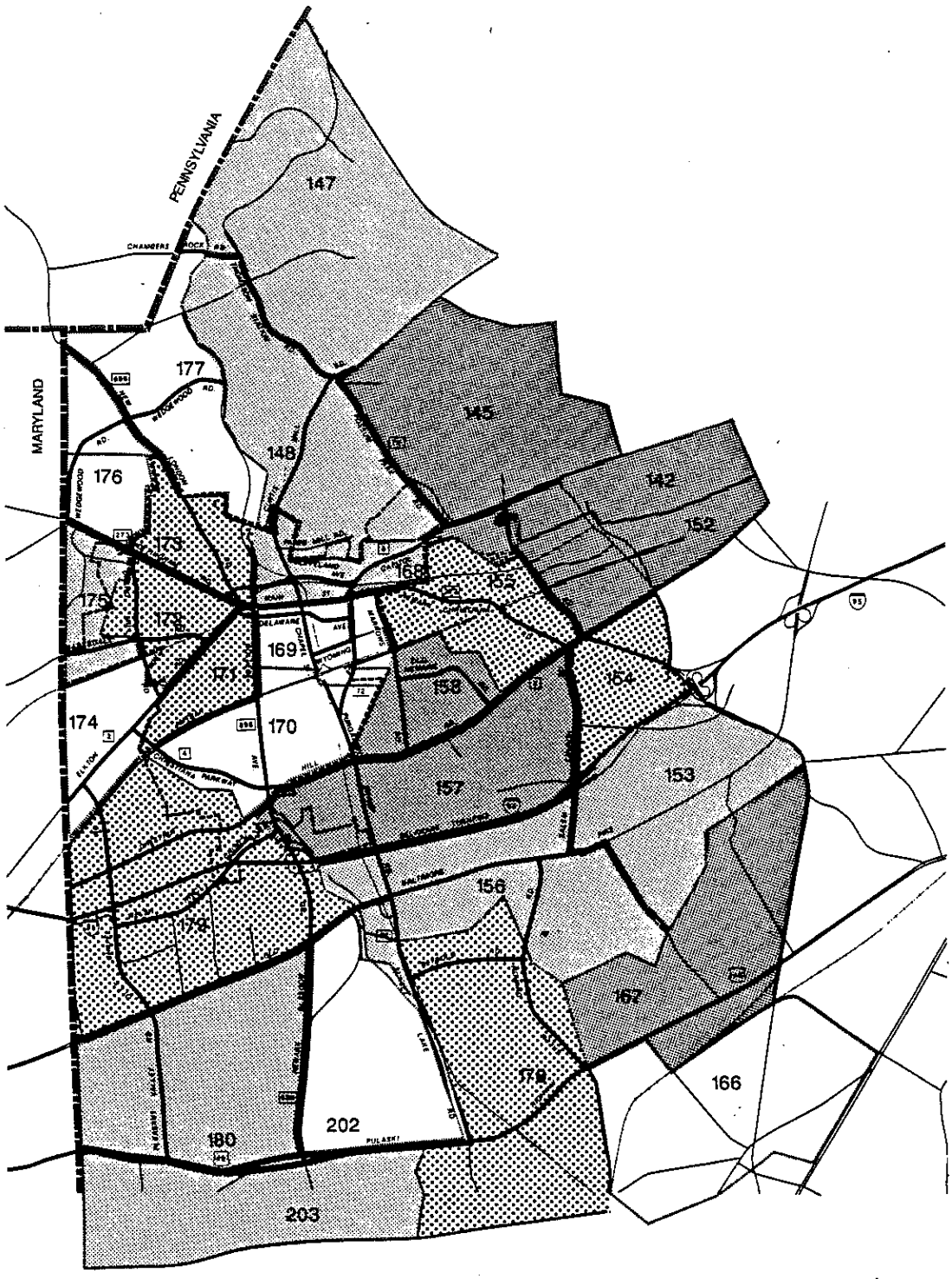
1985 Population by Traffic Analysis Zone

LEGEND:

- Traffic Analysis Zone
- 1-2000 Persons
- 2001-3300 Persons
- 3301-5100 Persons
- >5100 Persons
- Zone Boundaries

Vanasse Hangen Brustlin, Inc.
Consulting Engineers & Planners
60 Birmingham Parkway, Boston, MA 02135

Fig. III-1



LEGEND:

- Traffic Analysis Zone
- 1–600 Units
- 601–1100 Units
- 1101–1900 Units
- >1901 Units
- Zone Boundaries

1985 Dwelling Units by Traffic Analysis Zone

Vanasse Hangen Brustlin, Inc.
Consulting Engineers & Planners
60 Birmingham Parkway, Boston, MA 02135

Not to Scale

Fig. III–2

1985 Auto Registration by Traffic Analysis Zone

LEGEND:

- Traffic Analysis Zone
- 1-900 Autos
- 901-1800 Autos
- 1801-2900 Autos
- >2901 Autos
- Zone Boundaries

Vanasse Hangen Brustlin, Inc.
Consulting Engineers & Planners
60 Birmingham Parkway, Boston, MA 02135

Fig. III-3

ship between auto ownership and number of households (dwelling units). This relationship is presented in Table III-2. Traffic Analysis Zone 155 has the highest auto ownership rate per dwelling unit at 2.10. This zone straddles Route 273 at the eastern border of the study area. Zone 169 in the heart of the study area, consisting primarily of University of Delaware housing and classrooms, has the lowest ratio at 1.08 vehicles per dwelling unit.

TABLE III-2
RATIO OF AUTO OWNERSHIP TO DWELLING UNITS
BY TRAFFIC ANALYSIS ZONE

Traffic Analysis Zone	Auto Ownership	Dwelling Units	Autos/D.U.
142	4,659	3,369	1.38
145	3,266	1,918	1.70
147	2,049	1,049	1.95
148	901	801	1.12
152	2,974	1,924	1.54
153	1,577	1,052	1.50
154	3,417	1,897	1.80
155	2,407	1,146	2.10
156	739	605	1.22
157	4,003	2,385	1.68
158	3,848	2,657	1.45
166	730	429	1.70
167	4,903	2,832	1.73
168	2,019	1,059	1.91
169	553	514	1.08
170	811	502	1.62
171	1,900	1,331	1.43
172	2,628	1,646	1.60
173	1,602	1,251	1.28
174	394	257	1.53
175	1,397	750	1.86
176	916	489	1.87
177	164	108	1.52
178	1,851	1,423	1.30
179	2,201	1,322	1.66
180	1,464	894	1.64
202	501	257	1.95
203	1,580	766	2.06

2. Employment Distribution

Zones of high employment are located in and adjacent to the City of Newark central business district (CBD), as shown in Figure III-4. Zone 168, which is bounded by Main Street on the south and extends just north of Cleveland Avenue with east and west boundaries within the CBD, has the highest employment with 7,478 workers. Generally, it would be expected that the zones further from the CBD would have lower employment; however, some of the larger employers are located outside the CBD. In addition to the geographic distribution of employment, there exists a subset of employment categories. Table III-3 presents the distribution of total employment in the study area among the various subsets.

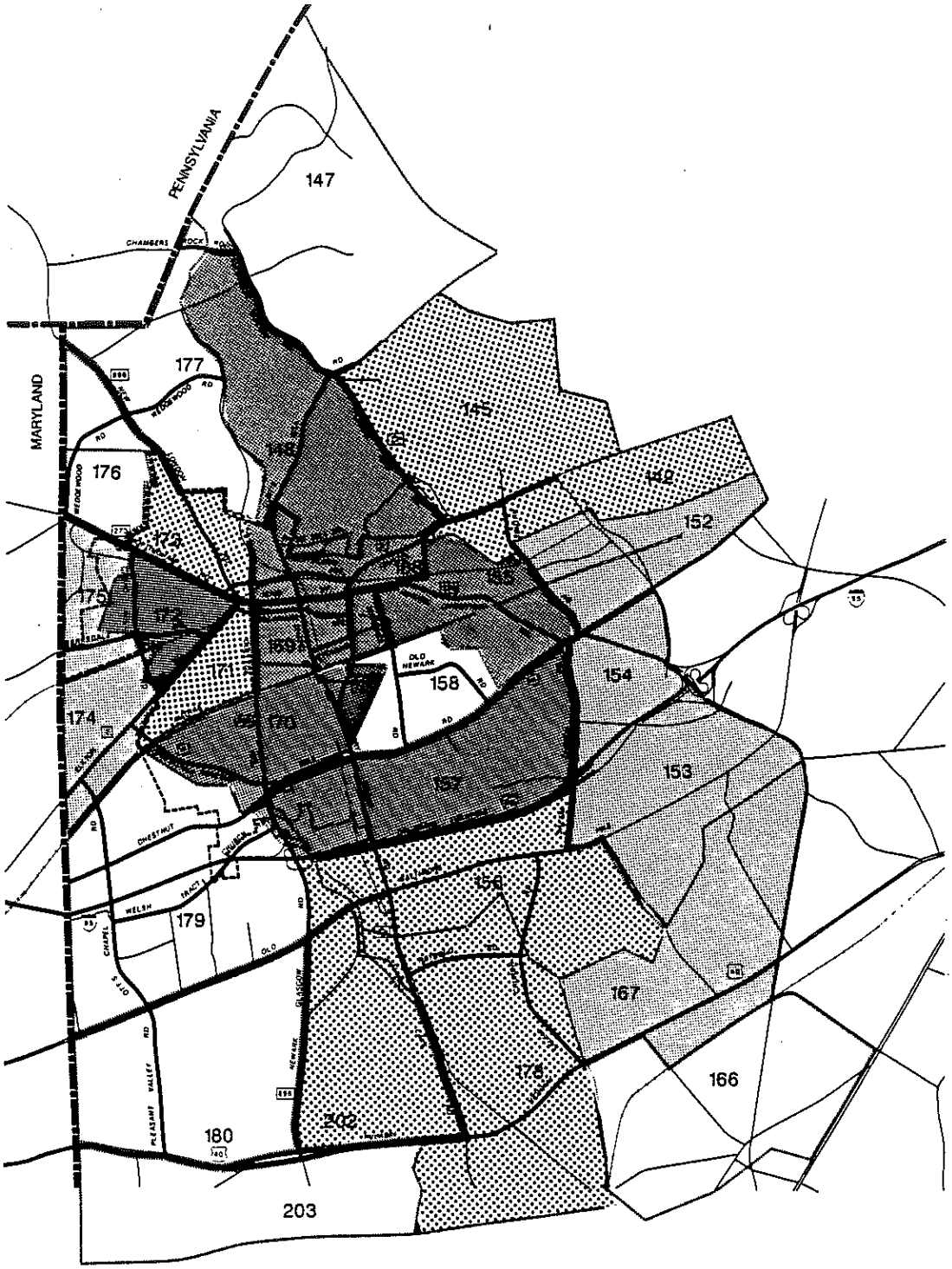
TABLE III-3
STUDY AREA EMPLOYMENT DISTRIBUTION BY CATEGORY

Category	Number of Employees	% of Total
Manufacturing	10,859	29
Industry/Service	6,112	16
Commercial	12,616	34
Community Service	7,682	21
Total	37,269	100

As shown, commercial-related employment accounts for approximately one-third of the total while manufacturing services are just below one-third. These numbers become significant in the modelling process when determining trip generation tables and trip densities.

3. Major Activity Centers

In and around the study area there are a number of major trip generators. Figure III-5 presents some of these activity centers which include the University of Delaware, Chrysler, DuPont,



1985 Total Employment by Traffic Analysis Zone

LEGEND:

- Traffic Analysis Zone
- 1-200 Employees
- 201-500 Employees
- 501-2000 Employees
- >2000 Employees
- Zone Boundaries

Vanasse Hangen Brustlin, Inc.
Consulting Engineers & Planners
60 Birmingham Parkway, Boston, MA 02135

Fig. III-4

LEGEND:

- General Commercial
- University of Delaware
- Chrysler
- Du Pont
- Shopping Centers

Major Activity Centers

Vanasse Hangen Brustlin, Inc.
Consulting Engineers & Planners
60 Birmingham Parkway, Boston, MA 02135

Not to Scale

Fig. III-5

various shopping malls, and general commercial centers. These major generators are located throughout the study area and represent some of the primary land use types described in the previous sections, as presented in Table III-4.

The locations of these centers and the magnitude of their trip-generating characteristics are exemplified through the results of the origin-destination study described in the next section of this report.

TABLE III-4
LAND USE OF MAJOR ACTIVITY CENTERS

Activity Center	Land Use
University of Delaware	Institutional
Chrysler	Manufacturing
DuPont	Office/Research
Shopping Malls	Retail/Commercial

B. AREA TRAVEL PATTERNS

Travel patterns are determined by the relative location and interaction of complementary land uses (e.g. residential, office) and the roadways which provide travel links between them. These patterns are determined through a number of methods, including traffic simulation models. Input data for these models are sometimes obtained from origin-destination surveys (see Section 2 below).

Since travel demands for this study were obtained from the DelDOT traffic simulation model, a brief overview of the model follows.

1. 1985 Travel Demand Modeling Profile

The Delaware DOT model simulates traffic patterns on roadways through the entire State. The year 1985 is used as the base condition. The model is also used, perhaps more importantly, to project traffic volumes for future years, and served to forecast trips for the long-range evaluation conducted in Phase 2 of this study.

The model (for New Castle County) presents a summary of the trip characteristics of the 204 traffic zones in the County, as well as 24 external stations. Patterns such as number of through trips and internal trips can be detected through this method. Figure III-6 provides an indication of the daily travel patterns into and out of the study area on a gross level. In addition to the number of trips, the percentage of these trips which are through trips (not having origin or destination within the study area) is also presented. As shown in the figure, the greatest orientation of traffic is to/from the east with approximately 201,00 daily trips, of which approximately 76,000 (38 percent) are through trips. This is in contrast to traffic oriented to the west of the study area (about 104,000 vehicles), of which about 75,000 (72 percent) are through trips. Most through traffic in the study area is oriented to the west (Maryland).

To identify trip origins and destinations more completely, an origin-destination study was conducted. Study methodology and results are presented in the next section.

2. Origin-Destination Survey

The origin-destination survey was conducted to determine trip patterns and paths into and through the study area. Specifically, the survey involved the distribution of mailback postcards at nine cordon points located along major roads within the study

SOURCE: Deldot 1985 Base Model Trip Table Data

Legend:

X — Daily Volume into/ Out of Study Area

X% — % Through Trips

Vanasse Hangen Brustlin, Inc.
Consulting Engineers & Planners
60 Birmingham Parkway, Boston, MA 02135

Regional Traffic Patterns

Fig. III–6

Delaware Department of Transportation

Please take one minute to fill out this card, even if you have already participated in this survey. Information should be provided only for the trip you were making when you received this card. The information will be used to plan improvements and increase the safety and comfort of your trip.

1. Where did you start this trip?

   Local Place Name/Address: _____

   State: _____ Zip Code: _____

2. Where are you going?

   Local Place Name/Address: _____

   State: _____ Zip Code: _____

3. What is the main reason for making this trip?(circle one):

   Work Business Shopping

   Social Recreation Other: _____

4. How many times do you make this trip each week? _____

5. Are you (driver) a resident of (circle one):

   Newark City New Castle County New Jersey

   Pennsylvania Maryland Other: _____

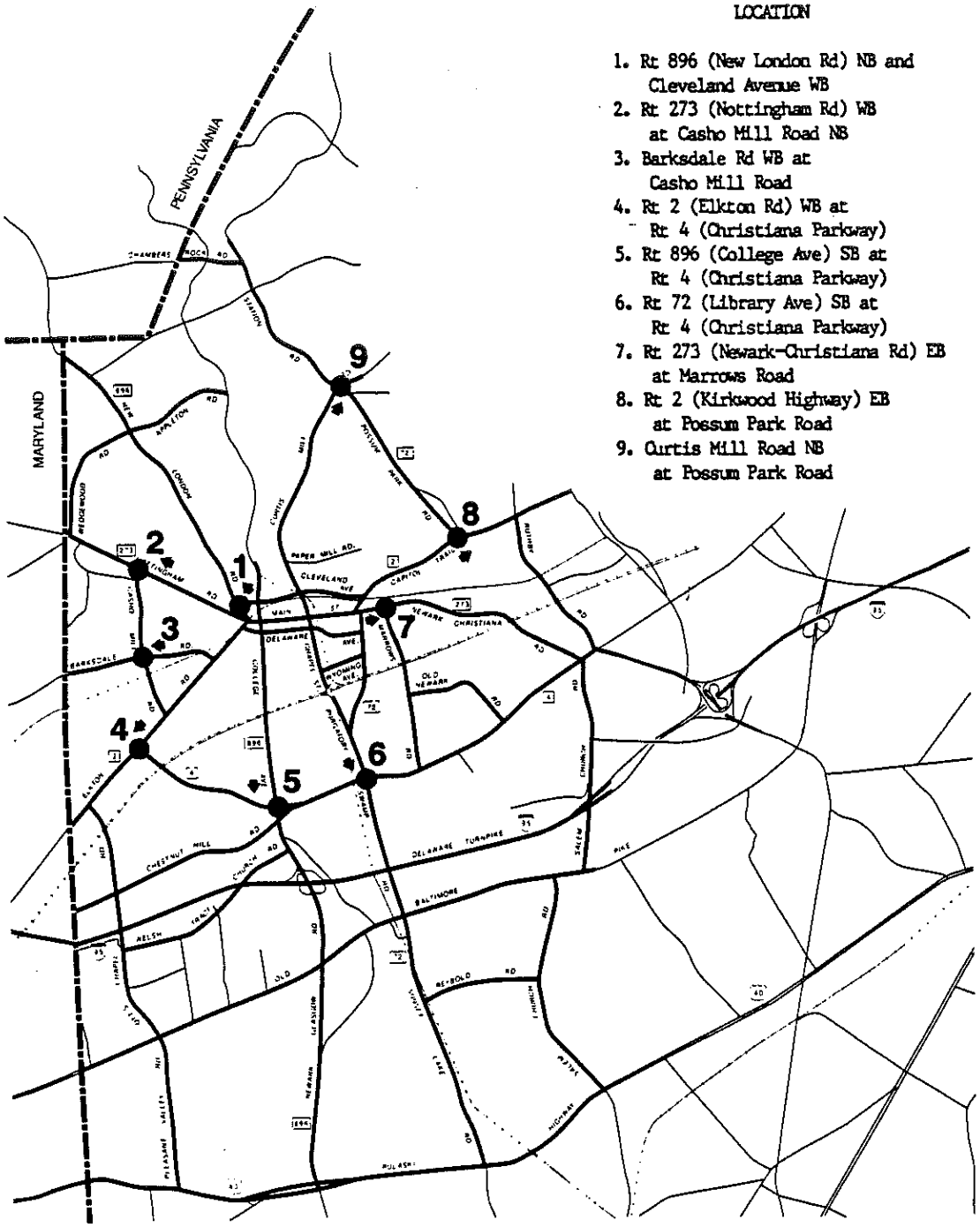
6. How many individuals are in your vehicle (including driver)? _____

Please drop this card off in the nearest mail box. (No postage necessary.) Thank you very much for your cooperation.

Vanasse Hangen Brustlin, Inc.
Consulting Engineers & Planners
60 Birmingham Parkway, Boston, MA 02135

Sample Origin–Destination Survey Card

Fig. III–7



LOCATION

1. Rt 896 (New London Rd) NB and Cleveland Avenue WB
2. Rt 273 (Nottingham Rd) WB at Casho Mill Road NB
3. Barksdale Rd WB at Casho Mill Road
4. Rt 2 (Elkton Rd) WB at Rt 4 (Christiana Parkway)
5. Rt 896 (College Ave) SB at Rt 4 (Christiana Parkway)
6. Rt 72 (Library Ave) SB at Rt 4 (Christiana Parkway)
7. Rt 273 (Newark-Christiana Rd) EB at Marrows Road
8. Rt 2 (Kirkwood Highway) EB at Possum Park Road
9. Curtis Mill Road NB at Possum Park Road

Vanasse Hangen Brustlin, Inc.
Consulting Engineers & Planners
60 Birmingham Parkway, Boston, MA 02135

Not to Scale

Origin–Destination Survey Locations

Fig. III-8

TABLE III-5
ORIGIN-DESTINATION SURVEY LOCATIONS

Map Reference*	Roadway Surveyed	Direc-tion	Police Control	Survey Date
1**	Route 896 (New London Road) at Cleveland Avenue	NB	City	11/16/87
2	Route 273 (Nottingham Road) at Casho Mill Road	WB	City	11/16/87
3***	Barksdale Road at Casho Mill Rd.	WB	City	11/16/87
4+	Route 2 (Elkton Road) at Route 4 (Christiana Parkway)	SB	State	11/16/87
5	Route 896 (College Avenue) at Route 4 (Christiana Parkway)	SB	City	11/17/87
6	Route 72 (Library Avenue) at Route 4 (Christiana Parkway)	SB	State	11/17/87
7+	Route 273 (Newark Christiana Rd.) at Marrows Road	EB	City	11/17/87
8	Route 2 (Kirkwood Highway) at Possum Park Road	EB	State	11/17/87
9	Curtis Mill Road at Possum Park Road	NB	State	11/17/87

* See Figure III-8.
** Westbound Cleveland Avenue right turn also surveyed.
*** Casho Mill Road northbound approach surveyed from 3:00 PM-4:15 PM when the road was closed due to a truck accident.
\+ Traffic signal timings were adjusted by Delaware DOT staff to ensure stops in traffic when cards could be distributed.

• Survey Results

Overall, 2,931 valid survey forms were returned out of 7,587 cards distributed, resulting in a return rate of 39 percent. The expected rate of return for mailback surveys is 25 to 35 percent. The high return rate in this survey may be representative of the level of interest in transportation issues in the Newark area. A summary of the survey returns by station is presented in Table III-6. As shown, even the lowest rate of return (28 percent at Station 2 - Route 273) is well within the acceptable rate for mailback surveys. The highest rates of return were experienced at Station 3 - Barksdale Road (42 percent) and Station 1B - Cleveland Avenue (43 percent).

TABLE III-6
SUMMARY OF ORIGIN-DESTINATION SURVEY RETURNS

Station	3 Hr. PM Peak Period Traffic Count	Survey Cards Distributed	Valid Survey Cards Returned	Percent Cards Returned
Monday 11/16/87				
1A Rt. 896 (New London Rd.)	1,096*	1,031	372	36%
1B Cleveland Ave. to Rt. 896	734*	687	295	43%
2 Rt. 273 (Nottingham Rd.)	**	713	198	28%
3 Barksdale Rd.	1,683***	1,392	581	42%
4 Rt. 2 (Elkton Rd.)	1,912***	1,311	495	33%
Tuesday 11/17/88				
5 Rt. 896 (College Ave.)	2,481***	764	234	31%
6 Rt. 72 (Library Ave.)	3,011***	575	207	36%
7 Rt. 273 (Newark-Christiana Rd.)	2,284*	566	164	29%
8 Rt. 2 (Kirkwood Hwy.)	4,585***	793	268	34%
9 Curtis Mill Rd.	1,842***	321	117	36%
		7,587	2,931	39%

* From manual turning movement counts conducted by VHB on the survey days.
** Not Available
*** From automatic traffic recorder counts conducted by Delaware DOT on the survey days.

Three other summaries were tabulated by station regarding residence, trip purpose, and vehicle occupancy. Table III-7 presents the residence distribution by station. With four exceptions, 80 percent or more of the respondents indicated their place of residence as either Newark or other areas in New Castle County. The exceptions presented below involve a significant out-of-state percentage ranging from about one-quarter to more than one-half of total station activity:

- Station 1 (Route 896 - New London Road) - 24 percent in Pennsylvania
- Station 2 (Route 273 - Nottingham Road) - 54 percent in Maryland
- Station 3 (Barksdale Road) - 22 percent in Maryland
- Station 4 (Route 2 - Elkton Road) - 38 percent in Maryland

It should be noted that Station 2 - Route 273 (Nottingham Road) also had 16 percent of the respondents residing in Pennsylvania.

Table III-8 presents the station summary by trip purpose. More than two-thirds of the trips at all stations were either commuter or business-oriented trips. Station 6 - Route 72 (Library Avenue) had 13 percent shopping trips, probably due to the close proximity of the Castle Shopping Mall. Station 5 - Route 896 (College Avenue) had nine percent school-related trips. This would be expected due to the proximity of University of Delaware classrooms to this survey location.

Vehicle occupancy by origin-destination survey station is presented in Table III-9. As would be expected, the percentage of vehicles with one or two persons is 90 percent or greater at all stations. The interesting factor, however, is the percentage of vehicles with two persons. This ranges from 14 percent to 20 percent, indicating that some ridesharing is occurring. Station 9 - Curtis Mill Road had the highest percentage of one occupant vehicles at 84 percent. Station 2 - Route 273 (Nottingham Road) had the highest percentage of three- and four-person vehicles, at five percent each.

Actual vehicle occupancy rates range from 1.17 to 1.43, with an overall average of 1.33 persons per vehicle. This is relatively low compared to some urban areas and indicates room for improvement in ridesharing such as carpooling or vanpooling as the area continues to urbanize.

The survey results reported herein serve to quantify and document the traffic patterns and travel trends within the Newark area. The impression that certain roads carry high volumes of Maryland and Pennsylvania traffic are also validated by the survey results. Overall, the sampling was unbiased and statistically sound.

TABLE III-7
SURVEY STATION SUMMARY
BY PLACE OF RESIDENCE

Station	Location	Survey Returns	Place of Residence Percent					
			City of Newark	Remainder New Castle County	New Jersey	Penn.	Maryland	Other
1	Rt. 896 (New London Rd.)	667	38	25	2	24	9	2
2	Rt. 273 (Nottingham Rd.)	198	17	12	0	16	54	1
3	Barksdale Road	581	56	16	0	5	22	1
4	Rt. 2 (Elkton Rd.)	495	22	29	2	7	38	2
5	Rt. 896 (College Ave.)	234	25	59	0	3	8	5
6	Rt. 72 (Library Ave.)	207	23	60	1	0	11	5
7	Rt. 273 (Newark - Christiana Rd.)	164	27	63	2	0	4	4
8	Rt. 2 (Kirkwood Hwy.)	268	10	76	0	3	3	1
9	Curtis Mill Rd.	117	9	71	0	13	3	4
	All Stations	2,931	32	37	1	10	18	2

TABLE III-8
SURVEY STATION SUMMARY
BY TRIP PURPOSE

Station	Location	Survey Returns	Trip Purpose (Percent)						
			Work	Business	Shop	Social	Recreational	School	Other
1	Rt. 896 (New London Rd.)	667	56	10	12	5	4	7	6
2	Rt. 273 (Nottingham Rd.)	198	64	7	11	3	2	4	9
3	Barksdale Road	581	65	10	8	5	4	2	5
4	Rt. 2 (Elkton Rd.)	495	59	8	10	8	4	4	7
5	Rt. 896 (College Ave.)	234	65	10	4	4	3	9	5
6	Rt. 72 (Library Ave.)	207	66	10	13	2	0	3	6
7	Rt. 273 (Newark - Christiana Rd.)	164	53	15	9	7	4	2	10
8	Rt. 2 (Kirkwood Hwy.)	268	55	10	10	6	7	5	7
9	Curtis Mill Rd.	117	63	15	3	4	2	7	6
	All Stations	2931	60	10	10	5	4	5	6

TABLE III-9
SURVEY STATION SUMMARY
BY VEHICLE OCCUPANCY

Station	Location	Survey Returns	Vehicle Occupancy (Percent) 1	2	3	4+	Persons Per Car
1	Route 896 (New London Road)	667	77	16	4	3	1.33
2	Route 273 (Nottingham Road)	198	72	18	5	5	1.43
3	Barksdale Road	581	78	15	5	2	1.31
4	Route 2 (Elkton Road)	495	75	17	5	3	1.36
5	Route 896 (College Avenue)	234	81	14	2	3	1.27
6	Route 72 (Library Avenue)	207	73	20	5	2	1.36
7	Route 273 (Newark - Christiana Road)	164	76	19	2	3	1.32
8	Route 2 (Kirkwood Highway)	268	78	16	1	1	1.17
9	Curtis Mill Road	117	84	14	1	1	1.19
	All Stations	2,931	77	16	4	3	1.33

3. Other Transportation Services

In the study area, there exists a somewhat limited public transportation system utilizing buses as the means of transport. Three such systems exist:

- University of Delaware Shuttle
- UNICITY Bus System
- DART (Delaware Administration for Regional Transit)

The University of Delaware shuttle is operated by the University and makes regular stops on campus and at University park-and-ride lots located on the periphery of the campus area. The purpose of the shuttle is to reduce trips into the CBD area of Newark.

The UNICITY bus system is free and includes three routes in various areas of the City, including a Newark loop operating Monday through Friday.

The DART system provides regional bus service to other locations within the County. Information provided in the 1986 Annual Profile for New Castle County indicates that two bus routes pass through some portion of the study area. The DART Strategic Development Plan (dated March, 1988) was prepared by Abrams-Cherwony and Associates in conjunction with Mundle and Associates, Inc. for the Delaware Transportation Authority. Recommendations made as part of the strategic plan will be discussed later in this report, as will other transit recommendations.

C. EXISTING STATE MAINTENANCE ROADWAY SYSTEM

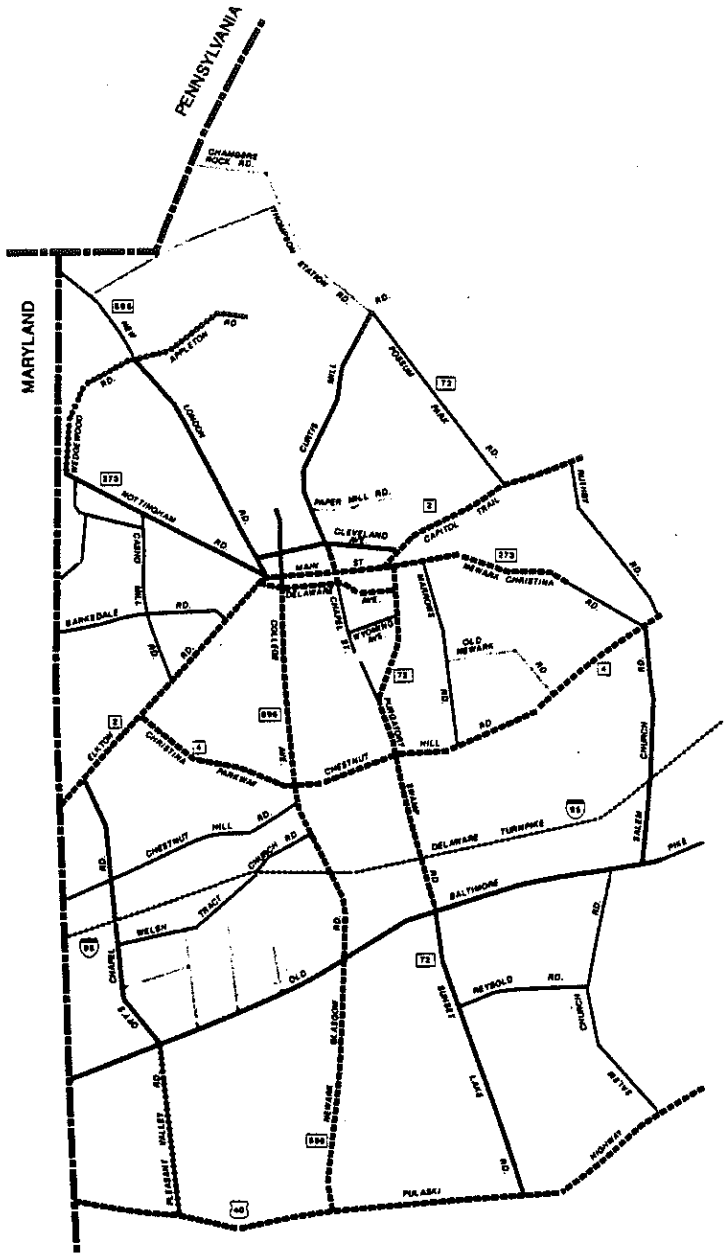
This section presents the geometric and traffic volume characteristics of the State maintenance routes within the Newark study area. Items which are discussed in detail include:

- Functional classification
- Peak hour traffic volume
- Daily traffic volume
- Time distribution of traffic volumes
- Travel speeds
- Safety

The purpose of gathering such data was to enable the identification of possible roadway deficiencies related to traffic volume capacity, safety, and other external conditions which could affect traffic flow throughout the corridor. Data were collected for intersections and roadway segments, including traffic volumes, accidents, travel speeds, roadway geometrics, and traffic signal phasing and timing. Seasonal, daily, and hourly distributions of traffic volumes were also collected. Sources included state and city agencies, along with extensive field data on traffic volumes and travel times.

1. Roadway Characteristics

Six of the seven state-designated functional roadway classifications are represented within the Newark study area. The character of these roadways ranges from local two-lane gravel roads along the northern periphery of the area to a major interstate highway through its center. The functional roadway classifications are presented graphically in Figure III-9. There are about 78 miles of state-maintenance roadways within the corridor. The relative percentages based upon the functional classifications are presented in Table III-10.



Functional Roadway Classifications

* Note: Not within the study area.

LEGEND:

- Interstate
- Freeway/Expressway
- Principal Arterial
- Minor Arterial
- Rural Major/Urban Collector
- Rural Minor Collector
- Local

Vanasse Hangen Brustlin, Inc.
Consulting Engineers & Planners
60 Birmingham Parkway, Boston, MA 02135

Not to Scale

Fig. III-9

TABLE III-10
FUNCTIONAL CLASSIFICATION DISTRIBUTION
FOR STATE-MAINTENANCE ROADWAYS

Functional Classification	Percent of Total Mileage
Interstate	10
Freeway/Expressway	0
Principal Arterial	36
Minor Arterial	24
Rural Major/Urban Collector	16
Rural Minor Collector	5
Local	9
	100

The most prevalent roadway categories within the study area are the principal arterial classification at 36 percent and minor arterials at 24 percent. Delaware Avenue, Main Street (both principal arterials), and Cleveland Avenue (minor arterial) traverse the central business district in Newark. Certain north-south roadways (e.g., Route 896 and Route 72) change functional classification along their length. Roadways furthest from this area take on a more rural character (e.g., Route 40). As development continues to occur, these roadways will become more suburban in nature.

2. Traffic Characteristics

The character of the Newark area has changed in recent years, as has the traffic which travels the roadway system. The previous distinction of urban and rural roadways within the study area may no longer be valid as urbanization has expanded to create not only suburban-type land use but also suburban travel patterns. These changes are reflected in traffic volumes as well

as the hourly distribution of these volumes. On some roadways in the study area, traffic volumes are high during several hours of the day in addition to the typical morning and evening commuter peak hours.

To identify and evaluate travel characteristics and roadway deficiencies within the study area, an extensive data collection program was carried out. The results of this effort are presented in the following sections.

- Hourly Traffic Volumes

Intersection turning movement volumes were counted during the morning and evening peak periods (7:00 AM to 9:00 AM and 4:00 PM to 6:00 PM) at several locations within the study area during November, 1987. In addition, recent (1986) counts were provided by the Delaware DOT. These counts were updated as required. The intersections at which turning movement count data are available are presented in Figure III-10.

The peak hour traffic volume entering the intersection for the locations counted is presented in Figure III-11. The intersection with the highest peak hour volume is Main Street/Route 273/Kirkwood Highway, with close to 4,500 vehicles during the evening peak hour. The highest morning peak hour volume is at the same location, with 3,150 vehicles. The intersection of Cleveland Avenue/Woodlawn Avenue/Kirkwood Highway experiences the second highest peak hour traffic volume, with 2,660 vehicles during the morning peak hour. The intersection with the lowest peak hour volume is Ott's Chapel Road/Chestnut Hill Road, with 860 vehicles during both the morning and evening peak hours.

Figure III-12 presents the total two-way peak hour traffic volume on a sample of roadway segments. These volumes provide a more focused representation of the traffic volumes within the

Vanasse Hangen Brustlin, Inc.
Consulting Engineers & Planners
60 Birmingham Parkway, Boston, MA 02135

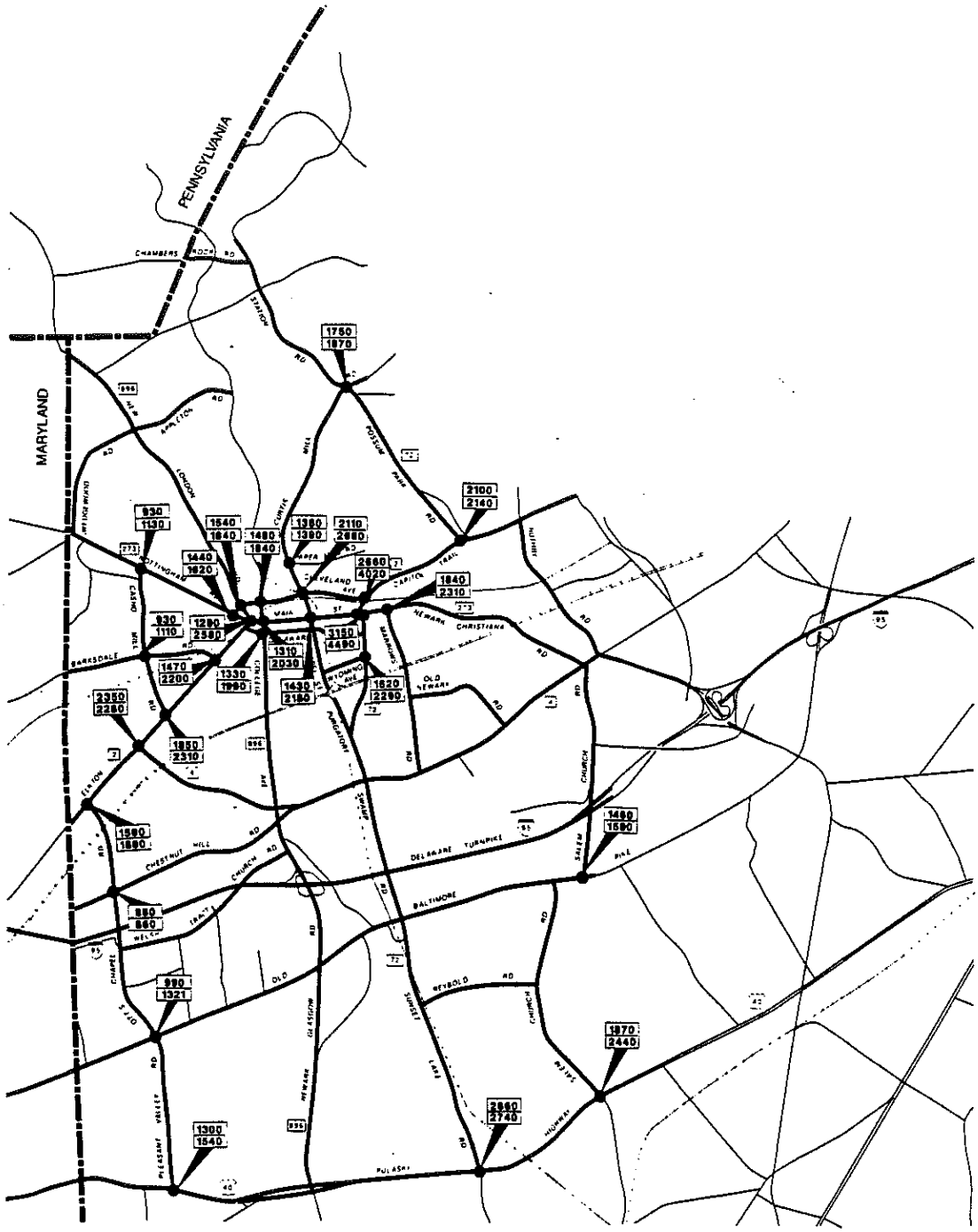
Not to Scale

LEGEND:

- ■ DelDot Counts
- ● VHB Counts

Turning Movement Count Locations

Fig. III-10



Peak Hour Total Intersection Volumes

LEGEND:

XXXX — AM Volume
XXXX — PM Volume

Vanasse Hangen Brustlin, Inc.
Consulting Engineers & Planners
60 Birmingham Parkway, Boston, MA 02135

Not to Scale

Fig. III-11

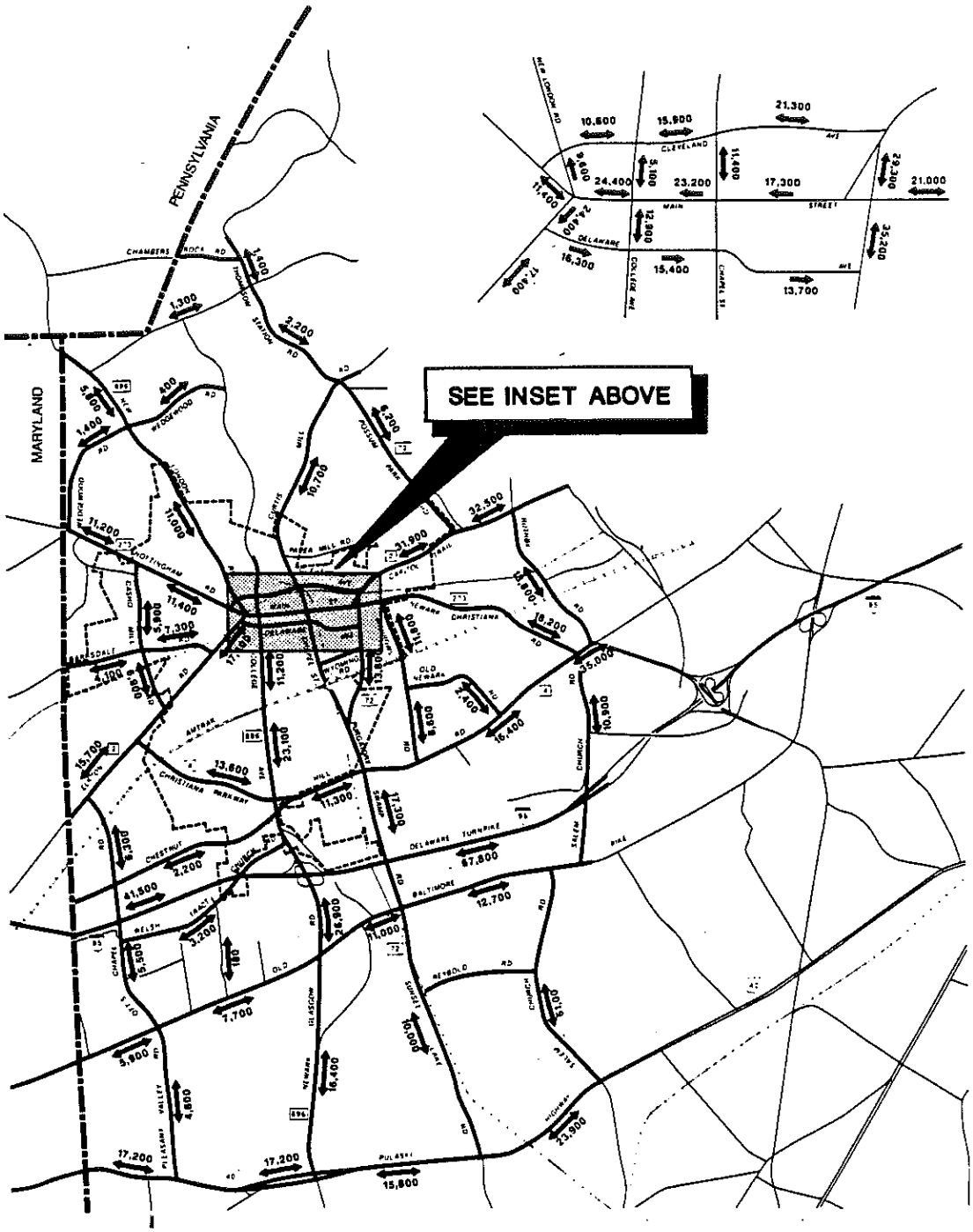
Vanasse Hangen Brustlin, Inc.
Consulting Engineers & Planners
60 Birmingham Parkway, Boston, MA 02135

Not to Scale

Peak Hour Roadway Volumes

LEGEND:
Morning(Evening)

Fig. III-12



Base Year Daily Traffic Volumes

Vanasse Hangen Brustlin, Inc.
Consulting Engineers & Planners
60 Birmingham Parkway, Boston, MA 02135

Not to Scale

Fig. III–13

study area compared with the total intersection volumes as specific directions and approaches are identified. Similarities do exist and basic trends established indicate that the highest volumes are experienced on Route 2 (Kirkwood Highway) during the evening peak hour. Volumes along Ott's Chapel Road, Casho Mill Road, and Salem Church Road are among the lowest in the study area, ranging from approximately 500 to 800 vehicles. Other roadways, including Route 40, Elkton Road, and Curtis Mill Road, carry volumes ranging from 1,000 to 1,600 vehicles during a particular peak hour.

The intersection and roadway volumes provide a relative measure of travel on the roadway system. To be truly meaningful they must be compared with the capacity of the particular intersection and/or roadway segment. This issue will be addressed in a later section on deficiencies.

- **Daily Traffic Volumes**

Daily traffic volumes for the base year 1985 were compiled from the DelDOT model data and calibrated using actual counts and the DelDOT Annual Traffic count book to reflect the year 1985 traffic volumes. Daily volumes for selected links are presented in Figure III-13. Volumes are generally highest within the core area of the City of Newark and on the routes to the south. The major east-west routes south of the City (Route 4, Delaware Turnpike, Old Baltimore Pike, and Route 40) carry a total of 120,800 vehicles per day. The routes which feed radially into and through the City also carry a significant amount of traffic as presented in Table III-11 below.

TABLE III-11
SUMMARY OF DAILY TRAFFIC VOLUMES
ON RADIAL ROUTES

Roadway	Volume (veh/day)
New London Road	11,000
Nottingham Road	11,200
Elkton Road	15,700
South College Avenue	23,100
Purgatory Swamp Road	17,300
Newark-Christiana Road	18,200
Kirkwood Highway	31,900
Curtis Mill Road	10,700

In the heart of the city, daily volumes are also higher than what might be expected. Generally, peak volumes were once experienced during four hours of the day; now however, this peak is extended to include as many as eight hours in a day. This results in higher than expected daily traffic volumes. One reason is that the Main Street/Delaware Avenue couplet provides the only direct path from one side of the City to the other. The absence of a downtown bypass route for through traffic also contributes to the high volume on Main Street and Delaware Avenue. The one-way westbound volume on Main Street is 23,200 vehicles per day. Delaware Avenue carries 15,400 vehicles per day in the eastbound direction and Cleveland Avenue has a two-way volume of 15,900 vehicles per day.

- **Seasonal and Hourly Traffic Volume Distributions**

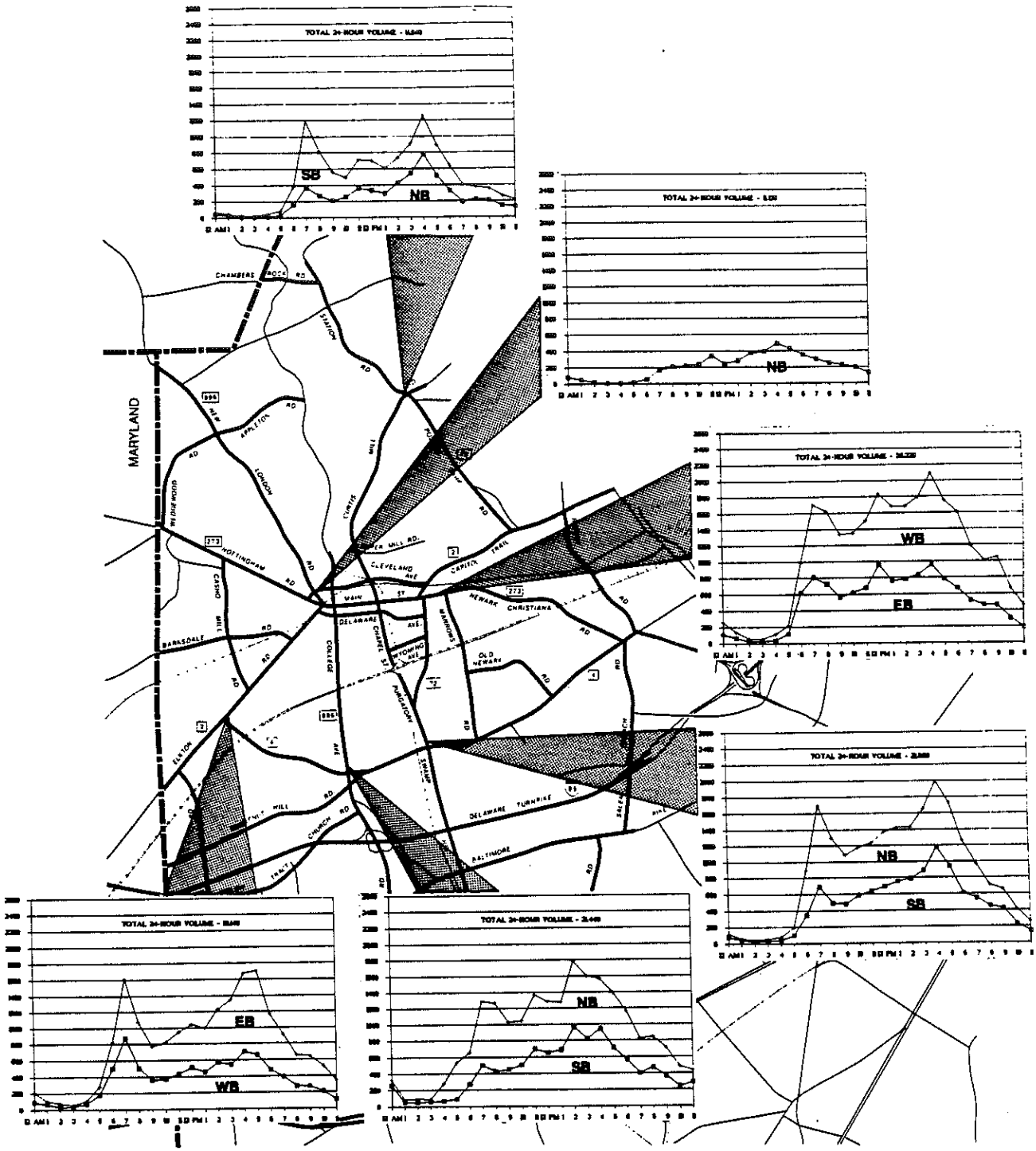
The roadways within the Newark study area are in the DelDOT designated "Group I" seasonal category, with the exception of Route 40, which is in Group II. This indicates that the roadways

in the study area are not significantly affected by seasonal variations in traffic patterns. As an example, the monthly variation factors in Group I range from 1.09 in February to 0.95 in December and May. These factors would be applied to traffic count data collected during these months to obtain a normalized volume. The 1987 seasonal factors indicate that September and April are considered average months. The Group II factors, which would relate specifically to Route 40, vary from 1.39 in January to 0.88 in August. December, October, and April volumes would most closely represent average volumes. Seasonal variations in traffic in urban areas are generally due to summer vacations. The lack of significant variation in the study area indicates a relatively stable year-round population and also indicates that the university's seasonal schedule does not significantly impact traffic volumes in the area.

The hourly distribution for a typical weekday was examined for six locations which coincided with origin-destination survey locations. These locations are:

- Elkton Road (Route 2) east of Route 4,
- College Avenue (Route 896) north of Route 4,
- Purgatory Swamp Road (Route 72) north of Route 4,
- Newark Christiana Road (Route 273) west of Marrows Road,
- New London Road (Route 896) south of Cleveland Avenue, and
- Curtis Mill Road south of Possum Park Road (Route 72).

Figure III-14 presents the hourly traffic volume distribution characteristics at each of these locations. Typically, one would expect distinct morning and evening peaking characteristics and perhaps less significant midday peaking. This is the case at all but two locations. The first diversion from this expectation occurs at New London Road (Route 896) south of Cleveland Avenue



Vanasse Hangen Brustlin, Inc.
Consulting Engineers & Planners
60 Birmingham Parkway, Boston, MA 02135

Hourly Traffic Volume Distribution

Not to Scale

Fig. III-14

(Station 1), where morning volumes are lower than both the midday and evening volumes. The primary reason for this trend is that this roadway section is one-way away from the city. The second exception is Route 273 (Newark Christiana Road), Station 7, where the midday peak hour volume is almost as high as the evening peak hour volume. This location is most likely influenced by its proximity to major traffic generators as well as area restaurants. Traffic patterns at the remaining four locations were similar to the expected trends. The higher midday volumes are indicative of urbanization of the area.

- Corridor Travel Speeds

Travel speeds and intersection delays were measured along several roadways within the study area, including:

- Elkton Road,
- Nottingham Road,
- Delaware Avenue,
- Main Street,
- Cleveland Avenue,
- New London Road,
- Curtis Mill Road/Purgatory Swamp Road (Route 72), and
- College Avenue/Newark-Glasgow Road (Route 896).

The limits of each corridor are presented in Figure III-15. As shown, the two primary north/south routes turn through the center of Newark. Three travel time runs were conducted in each direction on each roadway during the morning, midday, and evening peak hours. Average travel speeds for the network during the evening peak hour are presented in Figure III-16. As might be expected, speeds through the City center on Cleveland Avenue, Main Street, and Delaware Avenue are generally below 20 miles per hour. Speeds on the north/south roads are also low because of

Vanasse Hangen Brustlin, Inc.
Consulting Engineers & Planners
60 Birmingham Parkway, Boston, MA 02135

Not to Scale

Travel Speed and Delay Corridors

LEGEND:

Speed and Delay Study Corridor

Fig. III-15

Average Travel Speeds – Evening Peak Hour

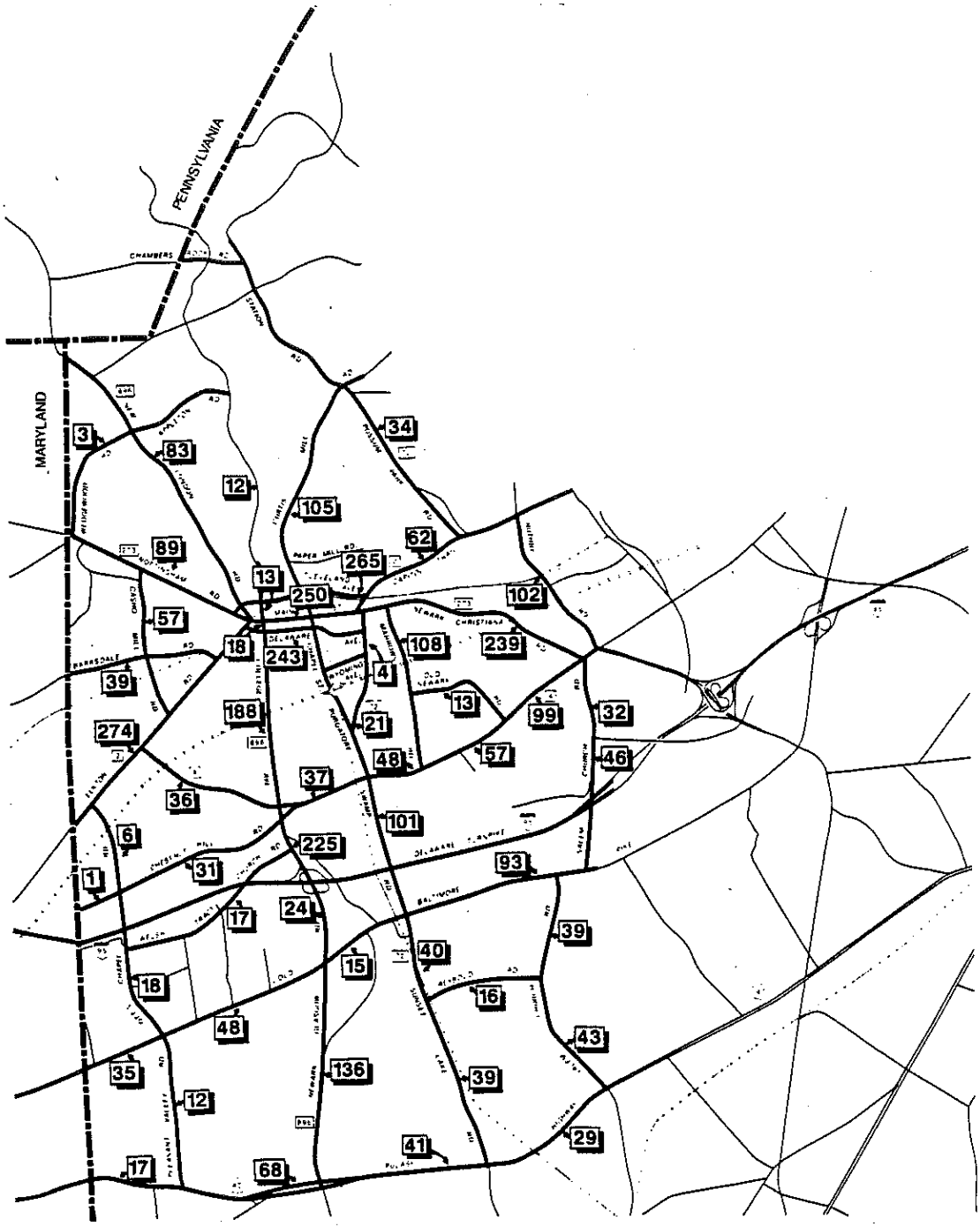
LEGEND:

XX Average Travel Speed (MPH)

Vanasse Hangen Brustlin, Inc.
Consulting Engineers & Planners
60 Birmingham Parkway, Boston, MA 02135

Not to Scale

Fig. III–16



Vanasse Hangen Brustlin, Inc.
Consulting Engineers & Planners
60 Birmingham Parkway, Boston, MA 02135

Not to Scale

Study Area Accident Summary

LEGEND:

XX Number of Accidents 3 Years 1984–1986

Fig. III–17

delay at intersections and the lack of signal coordination along the corridors. Speeds on each of the corridors generally increase with distance from the City to as high as 50 miles per hour on Elkton Road and 41 miles per hour on Nottingham Road. Elsewhere in the study area, speeds generally ranged between 25 and 30 miles per hour. Intersection delays determined from the data collected were used to identify potential problem locations in the study area.

- **Safety**

A review of the three-year accident history on roadways within the study area was undertaken to identify potential high accident areas. A summary is presented in Figure III-17. As shown, the roadway with the greatest number of accidents is Route 2 (Elkton Road) with 274. Cleveland Avenue, Main Street, and Delaware Avenue follow with 265, 250, and 243, respectively. Other roadways which carry comparatively fewer vehicles also have fewer accidents. Throughout the study area, "angle" and "rear-end" type accidents predominate with few "head-on" collisions. The numbers as presented in the figure have been converted to accidents per million vehicle miles of travel (accident rate) and compared with the accident rate of other roadways in its class to identify a deficiency.

- **Summary**

The data collected and documented in this section provided the study team with insight into the roadway and traffic characteristics of the study area. A strong base of existing data was prepared so that an evaluation of deficiencies would be made. The general conclusion from this task was that the Newark area, specifically the study area, is in transition from somewhat rural in character to suburban. This is evident from the diversity in

traffic volumes from one section of the study area to another, and also from the hourly distribution of traffic volumes. Based on this information, the following section identifies the deficiencies along the corridors and intersections.

IV. ANALYSIS OF EXISTING DEFICIENCIES

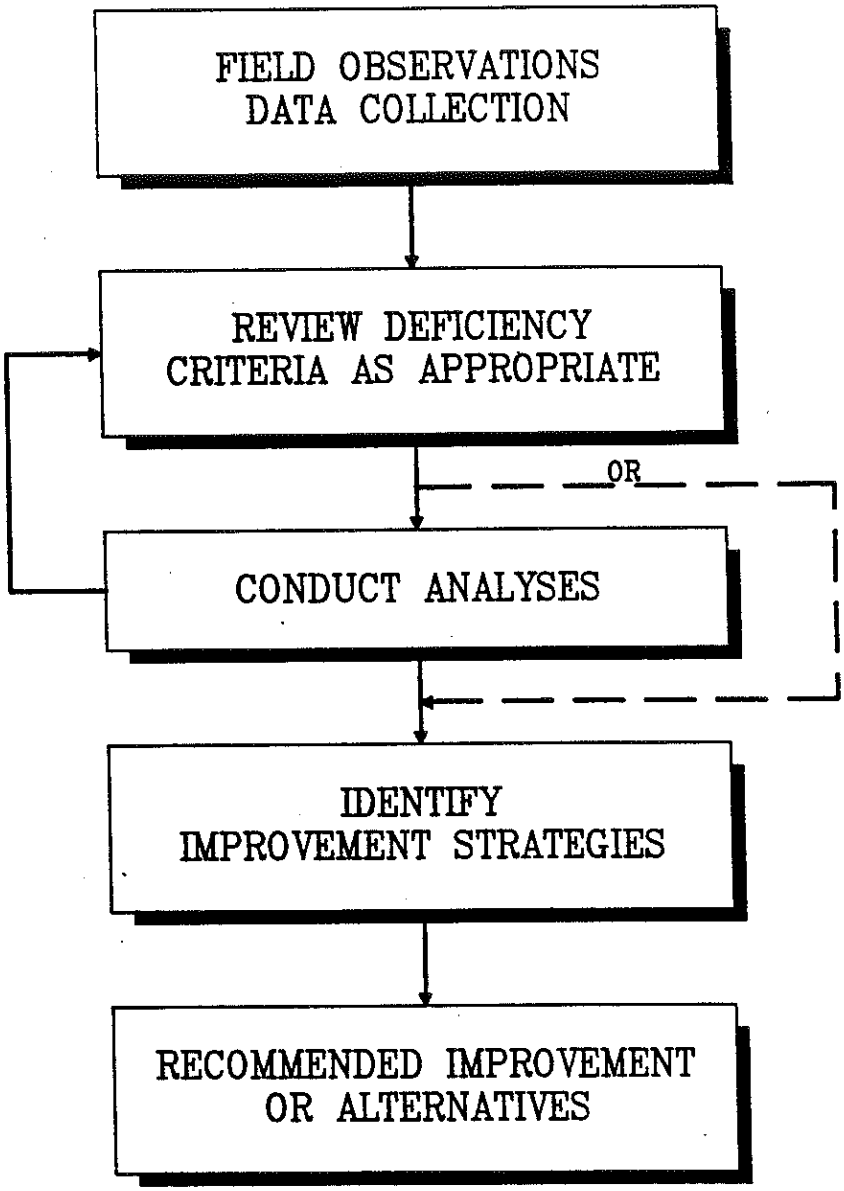
As noted previously, the Newark Area Transportation Study (NATS) used a two-phase approach to identify and address present and future transportation deficiencies in the study area. Phase 1 of the study involved an extensive data collection effort to identify existing conditions and to develop a program of short-term recommendations. The study process, presented graphically in Figure IV-1, started with an extensive data collection program, progressing through development of deficiency criteria, the conduct of various technical analyses to identify deficiencies, and identification and evaluation of various improvement strategies. It concluded with a recommended improvement program for both the short and long term.

To assist in the process of data summarization and application, all of the roadways included in the NATS were broken down into smaller segments for analysis purposes. Each segment was identified to include homogeneous characteristics. This made it easier to set up a computerized data base of information for all study area roadway segments, to identify deficiencies, and ultimately to propose improvement strategies. The NATS analysis segments are shown in Figure IV-2.

Evaluation criteria were developed and applied to identify deficiencies related to mobility, safety, and design. Tables IV-1 and IV-2 present primary and secondary level deficiency criteria. Technical Memorandum No. 3 discussed the deficiency criteria in detail.

Relative to the short-term analysis of existing deficiencies, two levels of analysis were conducted:

- Roadway segment analysis, and
- Specific corridor/intersection analysis.



Phase 1 Short-Term Analysis Procedure

Vanasse Hangen Brustlin, Inc.
Consulting Engineers & Planners
60 Birmingham Parkway, Boston, MA 02135

Fig. IV-1

Roadway Segments Studied

LEGEND:

Analysis Segment

Vanasse Hangen Brustlin, Inc.
Consulting Engineers & Planners
60 Birmingham Parkway, Boston, MA 02135

Not to Scale

Fig. IV-2

NOTE: Level of Service D,E,F based on DelDOT model v/c ratios

Vanasse Hangen Brustlin, Inc.
Consulting Engineers & Planners
60 Birmingham Parkway, Boston, MA 02135

Peak Hour Existing Roadway Segment Capacity Deficiencies

Not to Scale

Fig. IV-3

NOTE: Accident rate 25% greater than DelDOT standard for similar roadway and greater than 30 accidents over 3 year period

Vanasse Hangen Brustlin, Inc.
Consulting Engineers & Planners
60 Birmingham Parkway, Boston, MA 02135

Existing Safety Deficiencies by Road Segment

Not to Scale

Fig. IV-4

TABLE IV-1
PRIMARY DEFICIENCY CRITERIA

Evaluation Category	Type of Roadway or Intersection	Performance Measures	Criteria*
Mobility	Urban Arterial	Traffic Volume/ Average Travel Speed	LOS** "D"
	Suburban Segment	Traffic Volume/ Average Travel Speed	LOS "C"
	Rural Segment	Traffic Volume/ Average Travel Speed/Volume-to-Capacity	LOS "C"
	Signalized Intersection	Traffic Volume/ Delay	Urban LOS "D" Rural LOS "C"
	Unsignalized Intersection	Traffic Volume/ Available Reserve Capacity	Urban LOS "D" Rural LOS "C"
Safety	All Segments	Accident Rate	At least 10% greater than average for the functional roadway classification
Design	All Segments/ Intersections	Markings Signs Traffic Control Roadway Alignment	Non-conformance to MUTCD* and AASHTO*** standards

* Minimum acceptable
** LOS = Level of service defined by 1985 Highway Capacity Manual.
*** MUTCD = Manual on Uniform Traffic Control Devices.
AASHTO = American Association of State Highway and Transportation Officials

TABLE IV-2
SUPPLEMENTARY DEFICIENCY CRITERIA

Evaluation Category	Roadway or Intersection	Performance Measures	Criteria
Mobility	Origin-Destination Survey Locations or Contiguous Segments	% Through Traffic	Judgement/Pattern Analysis of Trip Distributions
	Various As Appropriate	% Truck Traffic	Judgement/Relative Comparisons
	All Segments	Vehicle Miles Traveled (VMT)	Percentage of Total System/Judgement
	Various Segments	Roadway Continuity	Judgement
Safety	Where Segment Rate is at Least 10% Above Average	-Accidents by Type -Accident Frequencies	Judgement/Relative Comparisons
	Highest Accident Occurrence Locations	Sight	Field Observation Distances
Design Standards	Various Segments	Number of Driveways	Judgement/ Recommended standards
	Various Segments	Availability of Shoulders or Curbs	Judgement/ Recommended Standards
	Various Segments	Lane/Roadway Widths	Judgement/ Recommended Standards
Misc.	Various Segments	-conformance to zoning -signage controls -aesthetics -other issues	Judgement/ Recommended Standards

A. ROADWAY SEGMENT ANALYSIS

Each of the state maintenance routes in the corridor was divided into segments representing homogeneous roadway characteristics. These segments are presented in Figure IV-2. A computer spreadsheet was developed which summarized specific geometric, traffic, and safety data for each segment. The computer spreadsheet used is presented in Appendix B.

Segment mobility (capacity) deficiencies are represented in Figure IV-3. These deficiencies represent segments which currently function at Level of Service "D", "E", or "F". The levels of service were determined by the volume-to-capacity ratio calculated using DelDOT capacities calibrated to actual conditions. According to the Table IV-1 criteria, almost 27 miles (35 percent) of the state maintenance route system in the study area are deficient. These roadways include sections of Route 896, Old Baltimore Pike, Route 273, and Salem Church Road.

Cleveland Avenue, Main Street, and Delaware Avenue are also deficient based upon the analysis. These deficiencies could be a result of:

- traffic volumes exceeding available roadway capacity,
- inefficient traffic signal timing, and/or
- poor traffic signal coordination.

Figure IV-4 presents the roadway segments which are deficient based on the safety criteria.

Application of the previously defined criteria has identified about 21 miles of roadway (28 percent) as safety-deficient. The deficient segments include sections of almost every roadway in the study area.

The purpose of the segment analysis was to identify corridor segments which may be subject to short-term improvements and to highlight potential problem locations. The following paragraphs identify specific deficiencies along corridors and/or at isolated intersections which were the subject of a more-detailed evaluation resulting from the segment analysis.

B. IDENTIFICATION OF SHORT-TERM DEFICIENCIES

Locations of possible intersection deficiencies were identified by locating intersections of two or more deficient roadway segments (previously identified) or by locating intersections along deficient corridors. These intersections were evaluated using the Critical Movement Analysis[3] method. Field observations were also used to identify deficient locations. Finally, other locations were identified by local public officials and City of Newark staff. Each location was evaluated. Those with short-term deficiencies are listed below. Other deficiencies identified as long-term are presented later in this report.

1. Elkton Road (Route 2) and Ott's Chapel Road

- This intersection is currently STOP sign controlled with a flashing beacon to accent the importance of safety at the location.

- Unsignalized intersection capacity analysis conducted for the morning and evening peak hours indicates that a Level of Service "F" exists on the minor street during both periods.

3/ Critical Movement Analysis - Transportation Research Circular 212, Transportation Research Board, January 1980.

- Approach traffic volumes available for four hours of the day indicate that a traffic signal may be warranted at this location.

- The high left-turn volumes during both peak hours indicate that an advance phase is also warranted.

2. Cleveland Avenue (Routes 2/273) and North Chapel Street/Curtis Mill Road

- Long queue lengths exist on the southbound approach (right-turn) and the eastbound approach (left-turn).

- Analysis of the intersection for the morning and evening peak hour indicates Level of Service "D" and "E", respectively.

- The signal is fully actuated and operating with at least three phases; therefore, it was concluded that the queues could not be reduced with adjustments to signal phasing or timing.

3. Curtis Mill Road (Route 72) and Station Road/Possum Park Road (Route 72)

- Long queues exist on all approaches during the morning and evening peak hours. The queues are 45 minutes to one-hour long and seem to be related to the release of DuPont Louviers employees (in the evening).

- Signalized intersection capacity analysis conducted for the morning and evening peak hours indicates Level of Service "E" and "D", respectively. The eastbound (Station Road) left-turn movement was found deficient after a left-turn check analysis.

- The signal is currently fully actuated with generally single-lane approaches to the intersection. Therefore, an increase in intersection capacity or demand reduction strategies combined with a modification of traffic signal timing and phasing may be required.

4. Main Street (Routes 2/273) and South Chapel Street

- Queues exist on the northbound South Chapel Street single-lane approach due to the inability of the left-turns to process through the opposing traffic.

- Curbside development restricts the widening of this approach to South Chapel Street.

5. Elkton Road and Apple Road/Barksdale Road

- Observations indicate that the westbound left-turn movement from Elkton Road is difficult at times. The left-turn volume during the evening peak hour is close to 100 vehicles. A reallocation of green time within the existing phasing would enable the lefts to move without conflict.

6. Cleveland Avenue and North College Avenue

- High volumes of pedestrians were observed and confirmed by traffic/pedestrian counts conducted as part of the data collection program.

- The volumes are high and exist on a regular basis as University of Delaware students travel between dormitories and classrooms.

- Similar patterns exist at the following two intersections and warrant the installation of pedestrian signals:

  -- Main Street and College Avenue, and
  -- Delaware Avenue and South College Avenue.

7. Route 40 and Pleasant Valley Road

- Unsignalized intersection capacity analysis conducted for the morning and evening peak hours indicates that the Pleasant Valley Road approach functions at Level of Service "F" under existing conditions.

- Evaluation of the approach traffic volumes available for the peak four hours indicates that traffic signal warrants may be satisfied.

- In addition, the Route 40 corridor has experienced a significant number of angle accidents which would indicate that a problem may exist at the intersection.

8. Old Baltimore Pike and Salem Church Road (North and South Approaches)

- This offset intersection experiences traffic which frequently backs up due to the nature of the traffic flow and the intersection configuration.

- Both approaches are signalized but uncoordinated.

9. Old Baltimore Pike Corridor - Salem Church Road to Maryland State Line

- Review of the accident history along the corridor indicates a high percentage of angle, rear-end, and head-on collisions.

- These problems can be rectified to a certain degree by improvement of pavement markings which were found to be deficient along sections of the corridor.

10. Delaware Avenue/Main Street/Cleveland Avenue - Route 72 to Elkton Road

- The segment analysis indicates mobility and accident deficiencies along each of these corridors.

- Upon review of mobility throughout this system of roadways, it was discovered that the existing coordination system for Main Street and Delaware Avenue is no longer functioning.

- Frequent stopping along these corridors is prevalent. Coordination for the signals may minimize the number of intersections at which a vehicle must stop.

- The Elkton Road corridor is also subject to the problem of frequent stops at intersections.

11. I-95 Traffic Diversion

- It is difficult to classify traffic diversion as a deficiency; however, the additional traffic, including trucks, on local roads is one of the causes to a number of the deficiencies previously listed.

- Removal of this traffic from the local roadway system would restore, to a certain degree, the quality of the traffic flow in some areas.

It is apparent from observations made of traffic flow throughout the study area that roadway capacity problems exist primarily during the peak hours of the day and specifically

during the evening peak hour. Therefore, it is appropriate to suggest that demand reduction strategies aimed at local businesses and institutions would also be a viable alternative to alleviate some of the mobility problems identified above.

V. RECOMMENDED SHORT-TERM IMPROVEMENTS (PHASE 1)

The previous sections of this report have described the study area, both in terms of travel patterns and roadway configurations, as well as areas where certain deficiencies exist. This section defines a short-term improvement program and identifies several locations in the study area where deficiencies can be eliminated or reduced through improvements which meet certain selection criteria.

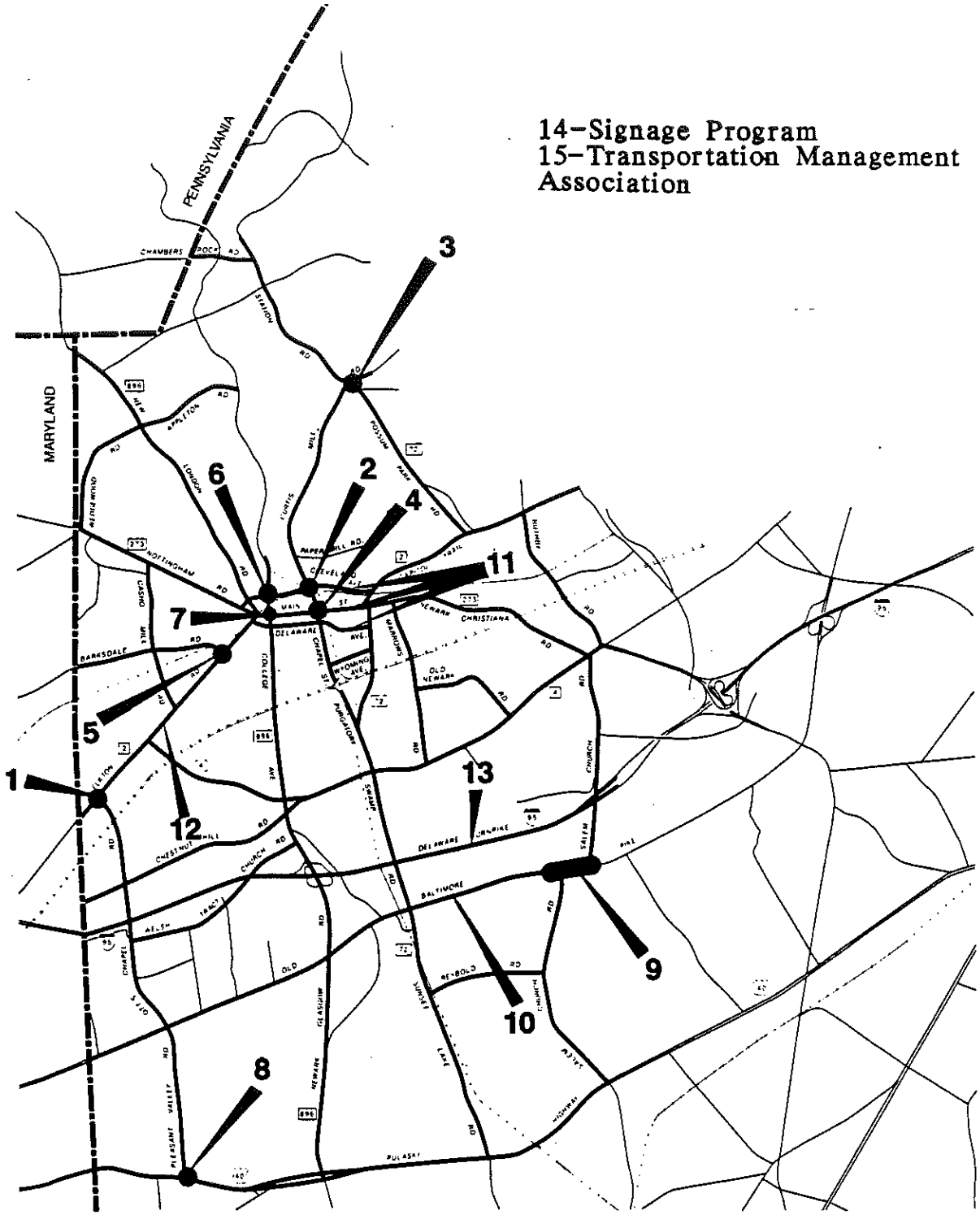
For the purpose of this study, a short-term improvement is one which satisfies the following criteria:

- Can be identified based upon existing traffic/roadway conditions;
- Can be determined within a short time period (not requiring complicated analyses of alternatives);
- Can be implemented in a reasonably short time frame; and,
- Will not preclude future improvements (long-term).

Based on these criteria, such measures as new roadways, traffic circulation changes, significant widenings, major right-of-way takings, and the like are considered to be beyond the realm of the short-term and, therefore, were deferred to the next phase of the study.

The mitigation measures described in the following section were identified to relieve either mobility, capacity, or safety deficiencies. Recommendations at certain locations relieve more than one deficiency. Each improvement location is numbered and corresponds to the reference numbers in Figure V-1. Included in

14-Signage Program
15-Transportation Management Association



Short Term Improvement Locations

LEGEND:

1 - Location Corresponding to Short Term Improvement Recommendations

Vanasse Hangen Brustlin, Inc.
Consulting Engineers & Planners
60 Birmingham Parkway, Boston, MA 02135

Not to Scale

Fig. V-1

each proposal, where appropriate, is an order-of-magnitude cost estimate for construction-related items, along with an estimate of the potential benefit likely to be achieved after implementation.

A. SHORT-TERM IMPROVEMENT PROGRAM

The short-term improvements recommended below and their respective order-of-magnitude cost estimates are presented based on existing levels of service and operational characteristics observed in the field during the peak hours. The order of presentation does not indicate the priority of the recommendation. The priorities were determined by the Department based upon the availability of funding, ease of implementation, and other projects scheduled which would be completed in conjunction with the recommendation. Since the study began, three of the short-term recommendations have been implemented by the Department.

1. Elkton Road (Route 2) and Ott's Chapel Road

- Install a three phase, actuated traffic signal at the intersection.

- Provide an advance phase for the westbound (outbound) Elkton Road approach.

This measure which would serve to provide safe access to Elkton Road for vehicles entering via Ott's Chapel Road has been implemented by the Department.

2. Cleveland Avenue (Routes 2/273) and North Chapel Street/Curtis Mill Road $50,000

- Lengthen the left-turn lane on eastbound Cleveland Avenue.

- Lengthen the right-turn lane on southbound Curtis Mill Road.

- Increase the turning radius of the northwest corner.

- Consider beginning the process to acquire right-of-way in the southeast quadrant of the intersection (under the railroad bridge) to ultimately create an additional right-turn lane on northbound Chapel Street.

A detailed analysis must be conducted to determine the appropriate lengths for the turn lanes. Additionally, the existing intersection geometrics must be reviewed to determine if right-of-way acquisitions will be required. Implications of these improvements could include loss of parking (or parking restrictions during peak hours) as well as utility relocation. The benefits of this improvement include reduced queues and congestion and therefore reduced delays.

3. Curtis Mill Road (Route 72) and Station Road/ Possum Park Road (Route 72) — **$300,000**

- Traffic improvements to this intersection can be achieved through a combination of demand-reduction strategies and signal improvements. Demand-reduction strategies would be effective at this location due to the proximity of the DuPont Louviers complex, and it is suggested that these recommendations be applied to that site. The following measures are proposed:

  -- Staggered work hours for Louviers, perhaps in 15-minute increments,

  -- Carpooling/vanpooling,

-- Add left-turn lanes on the Station Road and Possum Park Road approaches,

-- Add right-turn lanes on the Curtis Mill Road approaches (the northbound approach may only require restriping),

-- Multi-phase demand-responsive traffic signal which would provide for advance left-turns as appropriate, and

-- Coordinate this traffic signal with the signal south on Curtis Mill Road at the Louviers access point.

Implementation of these improvements would reduce peak hour delays at the intersection.

4. Main Street (Routes 2/273) and South Chapel Street $25,000

- Modify the traffic signal operation to provide an advance movement for the northbound South Chapel Street approach. This may require the installation of a new traffic signal controller to provide the third phase. This improvement would provide northbound left-turns with a greater opportunity to cross the intersection without conflict.

5. Elkton Road and Apple Street/Barksdale Road

- Replace traffic signal controller to provide for half-quad operation on the Elkton Road approaches. This improvement would provide the westbound left turns with an opportunity to move unopposed.

This has been implemented by the department.

6. Cleveland Avenue and North College Avenue $10,000

- Install Walk/Don't Walk indications to permit pedestrians to cross Cleveland Avenue concurrently with non-conflicting traffic movements.

7. Main Street and College Avenue $10,000

- Relocate Walk/Don't Walk indications to permit pedestrians to cross Main Street, west of South College Avenue, concurrently with non-conflicting traffic movements. This action may require the installation of new traffic signal equipment at the intersection of Main Street and North College Avenue (coordinated with South College Avenue) to permit safe crossings (the cost does not include signals for the southbound North College Avenue approach).

The North College/South College Avenue corridor provides a link between the University of Delaware dormitories north of Cleveland Avenue and classrooms located south of Delaware Avenue. Students have adapted to a rather consistent crossing pattern which occurs predominantly on the west side of the street, with the exception of Cleveland Avenue during the morning peak period, when east side crossings of North College Avenue occur. The pedestrian indications may serve to encourage the students to cross with the walk phase, thus improving pedestrian flow and safety along the corridor.

8. Route 40 and Pleasant Valley Road

- Confirm that traffic signal warrants are met.

- Install a three-phase traffic signal with an eastbound Route 40 advance phase to improve the level of service for traffic on the Pleasant Valley Road approach. This measure would also relieve safety problems.

  This has been implemented by the department.

9. Old Baltimore Pike and Salem Church Road (north and south approaches)

- Coordinate traffic signals to provide for the heavy north/south flow.

This action would reduce congestion and improve the flow of traffic. The department is currently working on improvements in this area.

10. Old Baltimore Pike Corridor - Salem Church Road to Maryland State Line $150,000

- Improve pavement markings (perhaps reflective centerline and edge markings).

- Investigate the creation of safe-passing zones at appropriate locations along the corridor.

- Improve overhead street lighting at spot locations.

These measures are intended to reduce accidents along the corridor.

11. Delaware Avenue/Main Street/Cleveland Avenue - Route 72 to Elkton Road $20,000

- Evaluate the network of intersections along the corridors from Route 72 west to New London Road/Elkton Road to determine the most appropriate coordination scheme (i.e., independent corridors or full network). Application of a signal optimization program should be considered for this evaluation. Following evaluation, the traffic signal system may need to be upgraded to provide coordination as appropriate (only the cost of study is included above).

Implementation of signal coordination on these corridors would improve traffic flow and reduce delays along the corridors.

12. Elkton Road Corridor - Main Street to Ott's Chapel Road $7,000

- Investigate the feasibility of coordinating the traffic signals. This could involve conversion from fully-actuated to semi-actuated or fixed-time signals along the corridor.

Implementation of signal coordination on this corridor would reduce Elkton Road delays.

TOTAL $572,000

13. I-95 Traffic Diversion

Excess traffic on Newark area roadways has been an issue ever since toll collections were eliminated on the Delaware Turnpike (Interstate Route 95) ramps some years ago. Although this involves general Maryland-based traffic, there is particular concern about truck traffic bypassing Delaware Turnpike mainline tolls by using local Newark-area roadways such as Chestnut Hill Road, Welsh Tract Road, and Old Baltimore Pike. Although truck

bans have been or are being put in place on these roads, the problem remains. Traffic counts conducted in conjunction with this study have confirmed the truck volumes and patterns previously identified by URS in their report prepared for the Delaware Transportation Authority in November, 1986. The issue was recently studied in detail by URS which examined alternatives to reinstate tolls on the Delaware Turnpike and institute truck bans on local roads.

To date, various truck restrictions have been implemented; however, it is recommended that the ramp toll alternatives presented in the URS report be re-examined as this type of improvement is most likely to have a positive impact.

14. Signage Program

A coordinated plan for signage through the Newark area for both automobiles and trucks should be prepared. This plan would serve to divert through traffic from the downtown Newark area and also route trucks to roadways suitable and appropriate. This plan should also incorporate truck restrictions as appropriate, in addition to signing alternate routes.

Some interim steps have already been taken, such as rerouting Route 2 around the CBD.

15. Transportation Management Association

The final recommendation, consistent with the definition of "short-term improvement", is the initiation of a Transportation Management Association (TMA) composed of the major private employers and public agencies in the Newark area.

The purpose of the TMA would be to provide an organizational framework for private sector activities involving developers, office park managers, and employers to identify and carry out traffic mitigation measures.

The objectives could include some or all of the following:

- Provide policy leadership and represent the private sector in the local and regional transportation planning process. The group would work closely with local government agencies and transportation providers.

- Work to provide supplementary funding by development within the Newark area.

- Encourage and facilitate ridesharing and transit programs and coordinate alternative work hours programs.

- Provide transportation services, including shuttle systems, which operate during off-peak periods to allow greater mobility without personal cars.

The TMA offers the opportunity for individual employers to reduce traffic demand without incurring the costs of instituting individual programs. Further, it provides an organized conduit through which demand-reduction programs can not only be implemented but also monitored for their effectiveness.