74-009-2891

URBAN CORRIDOR DEMONSTRATION PROGRAM
MANHATTAN CBD - NORTH JERSEY

ROUTE 3 URBAN CORRIDOR - SUMMARY

VOLUME I

NEW JERSEY DEPARTMENT OF TRANSPORTATION
DIVISION OF RESEARCH AND DEVELOPMENT

SEPTEMBER 1973

PREPARED FOR
TRI-STATE REGIONAL PLANNING COMMISSION

TECHNICAL REPORT STANDARD TITLE PAGE

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
TS-7920		

4. Title and Subtitle	
Urban Corridor Demonstration Program Manhattan CBD - North Jersey Corridor Route 3 Urban Corridor - Summary	5. Report Date 6. Performing Organization Code
7. Author(s)	8. Performing Organization Report No.
9. Performing Organization Name and Address New Jersey Department of Transportation Division of Research & Development 1035 Parkway Ave. Trenton, NJ 08625	10. Work Unit No. 11. Contract or Grant No. DOT-FH-11-7778
12. Sponsoring Agency Name and Address Federal Highway Administration Urban Mass Transportation Administration U.S. Department of Transportation	13. Type of Report and Period Covered Final 14. Sponsoring Agency Code

15. Supplementary Notes

16. Abstract

A summary of the findings for the implementation of improvements to traffic operations and the design of surveillance and control system in New Jersey Route 3 is presented in this volume. This project was one of five conducted in the Manhattan CBD - North Jersey Corridor under the Urban Corridor Demonstration Program.

This volume is the first in a five volume set covering the traffic demonstration studies and surveillance and control design for the New Jersey Route 3 Urban Corridor Demonstration Program:

Volume I - Route 3 Urban Corridor - Summary

Volume II - Route 3 Traffic Demonstrations

Volume III - Route 3 Traffic Surveillance & Control - Design

Volume IV - Route 3 Traffic Surveillance & Control - Hardware Specifications

Volume V - Route 3 Traffic Surveillance & Control - Software Specifications

17. Key Words	18. Distribution Statement
Traffic Surveillance, Traffic Control, Traffic Diversion, Equipment, Ramp metering, Changeable Message Signing Alternate routing, Software	

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price

Form DOT F 1700.7 (8-69)

ACKNOWLEDGEMENTS

The staff of the Bureau of Operations Research conducted the studies required to complete the work associated with this program. The traffic demonstrations were performed solely by this Bureau. The surveillance and control design was accomplished by the Sperry Systems Management Division of the Sperry Rand Corporation under review by the Bureaus of Operations Research, Traffic Operation, Electrical Operations, Special Engineering, Surface Design and Plant Engineering and Operations.

Particular credit for the completion of these projects is given to Gene Reilly, Fan Melton and Dick Hollinger.

D. W. Gwynn
Director of Research

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1.1 Urban Corridor Demonstration Program

The Route 3 Surveillance and Control study is one of five projects in the Manhattan CBD-North Jersey Corridor financed under the Federally sponsored Urban Corridor Demonstration Program. The objectives of this transportation management project are to plan, program, design, and when possible, implement improvements along Route 3 to provide improved travel service. Improved travel service applies to all types of vehicles, but special emphasis is placed on bus transportation in this project, as it is in the other four projects. The very successful Exclusive Bus Lane project was the first of the Urban Corridor Demonstration Projects in this corridor and it has been a key element in generating interest in the Manhattan CBD - North Jersey Corridor.

Five volumes have been used to report the findings of work under the Route 3 Surveillance and Control project.

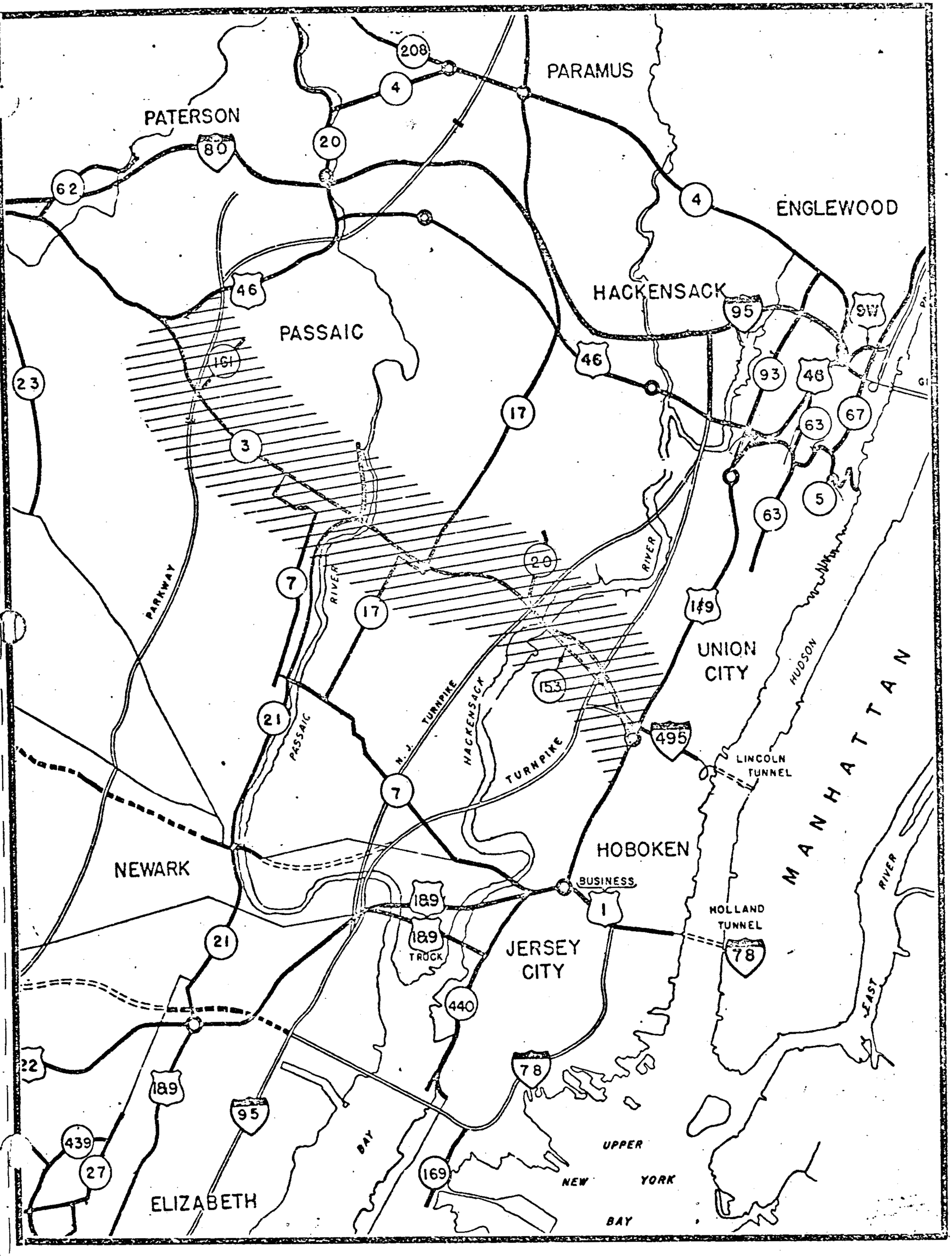
Volume I - Route 3 Urban Corridor - Summary
Volume II - Route 3 Traffic Demonstrations
Volume III - Route 3 Traffic Surveillance & Control - Design
Volume IV - Route 3 Traffic Surveillance & Control - Hardware Specifications
Volume V - Route 3 Traffic Surveillance & Control - Software Specifications

1.2 Project Location

The study design covers the eleven mile section of Route 3 extending from its western terminus at U.S. Route 46 to its merge with I-495, leading to the Lincoln Tunnel (Figure 1-1). This is the major east-west route in the North Jersey Corridor. Census figures for 1970 indicate over 5 million people live in Northeast New Jersey and Rockland County. The Tri-State REgional Planning Commission estimates this population will increase to 7 million by 1985. A TSRPC 1963 home interview study indicated that 85,000 of these corridor residents arrive at Midtown Manhattan via all modes between 7-10 a.m. Of these, 11,200 are auto drivers, 6,400 are auto passengers and 39,500 are bus passengers. Current estimates of the commuters using N.J. Route 3 during 7-10 a.m. are 12,000 bus passengers, 7,000 auto drivers and 4,000 auto passengers. It is further estimated that over two-thirds of the traffic using Route 3 in either the morning or evening peak is intrastate traffic.

Reconstruction programs to improve this route have included: the widening of Route 3 from Route 17 to the western spur of the New Jersey Turnpike (completed in November 1971); the current construction of the Route 3 and Route 17 interchange; and the current design for the widening of the four lane section known as the Rutherford cut to six lanes. The construction of the latter section is scheduled for completion by late 1974. No other major construction programs are scheduled within the next four years.

A sports complex of considerable size (25,000 parking spaces) is in the planning but has not been finalized and is not available as input into this project. The sports complex is to be located north of Route 3 between Berry's Creek and Route 20.



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1.3 Project Tasks

This study was separated into two major tasks. The first task, accomplished by the New Jersey Department of Transportation, was to design, implement and evaluate small scale improvements along Route 3 to reduce travel time and conflicts and improve bus movements and the overall flow of traffic. These improvements are in the form of ramp closures, recommended ramp realignments and improved merging conditions through striping and/or coning. After evaluating these improvements by the analyses of "before" or "after" traffic data, recommendations have been made to be incorporated in design or maintenance procedures performed by the State.

The second task was covered by contact with the Sperry Systems Management Division of Great Neck, New York. This task is the design of a traffic surveillance and control system for Route 3 between Routes 46 and I-495.

The primary objectives of the surveillance and control system are to:

- provide prompt detection of congestion-causing incidents thus facilitating their rapid removal
- to control access, by ramp control, thus improving flow on Route 3
- to investigate priority schemes for buses when and where feasible
- to investigate alternate routing where feasible
- to provide surveillance data for future planning

The design of the surveillance and control system includes preparation of hardware and software specifications, recommended site for the control center and details of cost estimates and cost benefits. Data for both elements of the study were supplied by the New Jersey Department of Transportation.

1.4 Data Collection

An aerial reconaissance of Route 3 was conducted in October 1971, and extensive photographs were taken. Base maps were prepared from as-built drawings.

A report published by Edwards and Kelcey for the Tri-State Regional Planning Commission in August 1971 entitled, "Manhattan CBD and North Jersey Corridor", was reviewed as input to this study. It recommended a surveillance and control system for Route 3, bus priority at ramps having substantial bus traffic, and ramp closings to Route 3 eastbound within the Rutherford cut. The Edwards and Kelcey report studied the morning eastbound peak hours of Route 3. Since the widening of Route 3, from 17 to the western leg of the New Jersey Turnpike, was in progress at the time of data collection, this information had to be updated.

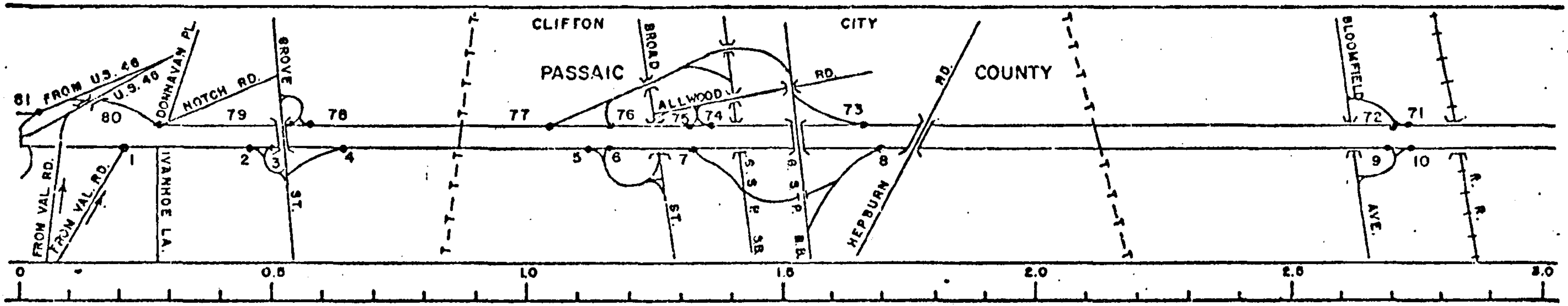
Volume data were collected for the westbound direction in October 1971, and eastbound during January 1972. The volume data were collected mechanically and manually on all ramps and at two locations on the mainline. These locations were at the bifurcation of Route 3 and 46 and the ramp area to I-495. Volumes during the peak periods of 7-10 a.m. and 4-7 p.m. are shown for each direction in Table 1-1.

Speed contours were plotted from data collected by a mechanical traffic data compiler in January and February 1972. Travel time runs in the eastbound direction were started 1/2 mile west of the Route 3 and 46 interchange and they were terminated about 1/2 mile east of the Route 3 and I-495 merge. The eastbound runs were only made for the morning peak period. Travel time runs for the westbound direction covered the same length of roadway. Data collection went beyond the study limits to record the effects of the major bifurcation at either end of Route 3. By marking off checkpoints such as gores of ramps and overpasses and averaging runs at each checkpoint, it is possible to show a pictorial representation of speed, as in Figure 1-2, and thus areas of congestion.

TABLE II-1. 19[illegible]-2 ROUTE 3 VOLUMES

WESTBOUND

HOUR	81	80	79	78	77	76	75	74	73	72	71	70
7- 8 AM	5010	2580	2530	2490	2800	2270	2760	2330	2580	3210	2920	3340
8- 9 AM	4100	2140	2090	2030	2350	1880	2330	2020	2310	2850	2490	2980
9-10 AM	3220	1600	1580	1550	1730	1430	1740	1470	1620	1960	1730	2110
4- 5 PM	5520	3060	3010	2970	3820	3340	3830	3480	3780	4830	4310	4810
5- 6 PM	4310	2560	2510	2480	3330	2870	3370	3060	3310	4710	4190	4650
6- 7 PM	4430	2510	2460	2410	3110	2660	3040	2710	2910	3550	3070	3540



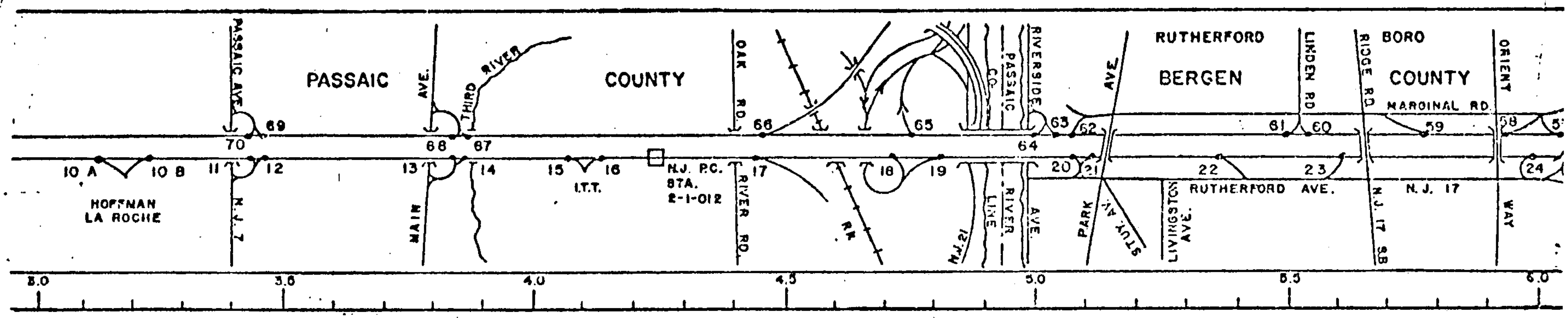
EASTBOUND

HOUR	1	2	3	4	5	6	7	8	9	10	10A	10B
7- 8 AM	3660	4020	3970	4090	4280	3780	4140	3470	4570	4120	4880	4740
8- 9 AM	3320	3720	3660	3790	4050	3590	3930	3300	4520	3940	4660	4570
9-10 AM	2230	2440	2390	2470	2640	2470	2720	2360	3080	2790	3230	3160
4- 5 PM	2470	2720	2600	2670	2780	2430	2750	2200	3080	2700	3240	3240
5- 6 PM	2280	2490	2370	2430	2540	2300	2550	2110	3090	2710	3170	3170
6- 7 PM	1530	1710	1630	1690	1790	1600	1760	1450	2080	1850	2190	2190

(CON'T.) TABLE III. 19[illegible]2 ROUTE 3 VOLUMES

WESTBOUND

	70	69	68	67	66	65	64	63	62	61	60	59	58	57
7- 8 AM	3050	3270	2920	3190	2230	3420	3180	3280	2880	2630	2640	2710	2010	
8- 9 AM	2720	3020	2700	3020	2150	3520	3270	3370	2950	2720	2750	2850	2200	
9-10 AM	1940	2090	1860	2120	1510	2440	2310	2400	2180	2020	2050	2130	1590	
4- 5 PM	4330	4610	4170	4570	3060	4100	3890	4010	3530	3210	3290	3560	2760	
5- 6 PM	4270	4530	4070	4470	3090	4190	3990	4080	3630	3380	3410	3640	2950	
6- 7 PM	3260	3460	3030	3280	2400	3120	2940	3040	2720	2540	2580	2700	2280	



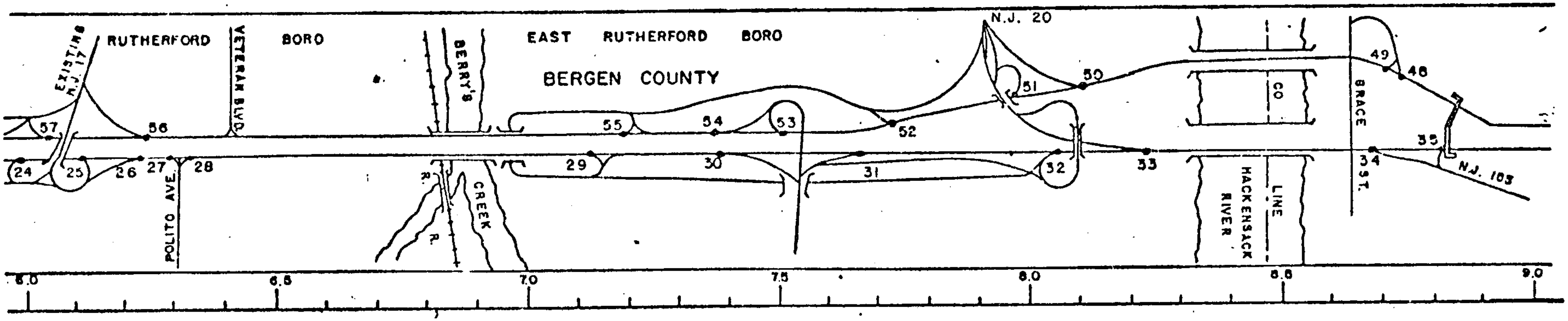
EASTBOUND

	10B	11	12	13	14	15/16	17	18	19	20	21	22	23	24
7- 8 AM	4740	4490	4730	4490	4700	4480	3350	3180	3930	3280	3410	3210	3350	
8- 9 AM	4570	4170	4410	4050	4250	4130	3230	3060	3780	3020	3140	2940	3060	
9-10 AM	3160	2930	3100	2880	3060	3060	2480	2340	2940	2460	2550	2390	2460	
4- 5 PM	3600	2910	3160	2870	3120	3150	2520	2330	3380	2660	2750	2500	2560	
5- 6 PM	3490	2930	3190	2920	3100	3100	2560	2340	3410	2660	2740	2470	2530	
6- 7 PM	2240	1970	2120	1910	2100	2100	1740	1620	2280	1840	1920	1790	1850	

(CON'T.) TABLE T-1. 1[illegible]-2 ROUTE 3 VOLUMES

WESTBOUND

	57–56/55	56/55–54	54–53	53–52	52–51	51–50	50–49	49–48	48–47
7- 8 AM	2260	2750	2050	2050	2050	2050	3700	3560	3710
8- 9 AM	2530	3010	1920	1920	1920	1920	2870	2780	2880
9-10 AM	1870	2320	1550	1550	1550	1550	2210	2150	2220
4- 5 PM	3240	3720	2880	2880	2880	2880	4000	3790	4000
5- 6 PM	3470	3860	3100	3100	3100	3100	4340	4160	4340
6- 7 PM	2590	2910	2470	2470	2470	2470	3570	3450	3570



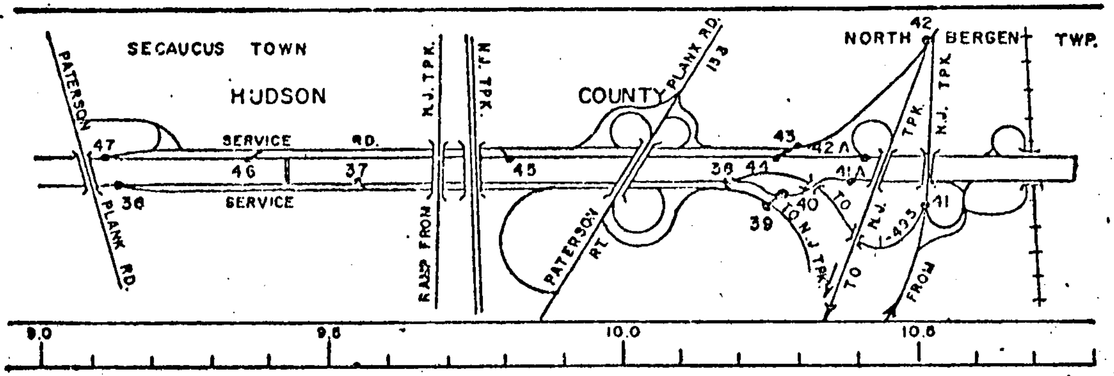
EASTBOUND

	24–25	25–26	26–27	27–28	28–29	29–30	30–31	31–32	32–33	33–34	34–35	35–36
7- 8 AM	3810	3390	4040	3900	3990	3780	3080	3140	3300	4630	3830	3890
8- 9 AM	3530	3010	3560	3320	3460	3130	2560	2600	2720	3760	3210	3270
9-10 AM	2830	2430	2730	2560	2640	2490	2010	2030	2090	2840	2400	2420
4- 5 PM	2980	2350	2700	2630	2700	2580	1930	1960	2070	3540	3270	3330
5- 6 PM	2900	2280	2710	2640	2720	2620	1930	1950	2030	3130	2870	2900
6- 7 PM	2080	1750	2050	2010	2060	1990	1620	1640	1690	2340	2140	2180

(CON'T.) TABLE I-1. 19[illegible]2 ROUTE 3 VOLUMES

WESTBOUND

	47	46	45	44	43	42/44	42A
7- 8 AM	3100	2600	2600	1800	2300	800	
8- 9 AM	2460	2000	2000	1400	1800	600	
9-10 AM	1860	1500	1500	1050	1350	450	
4- 5 PM	3470	2900	2900	2000	2600	900	
5- 6 PM	3800	3250	3250	2300	2900	950	
6- 7 PM	3130	2630	2630	1850	2400	780	



EASTBOUND

	36	37	38	40/38	41/39	40	41A
7- 8 AM	3170	2900	680	2220	690	1370	
8- 9 AM	2550	2240	900	1340	590	1490	
9-10 AM	2000	1840	620	1220	490	1110	
4- 5 PM	2780	2640	580	2060	710	1290	
5- 6 PM	2470	2340	480	1860	480	960	
6- 7 PM	1910	1820	320	1500	400	720	

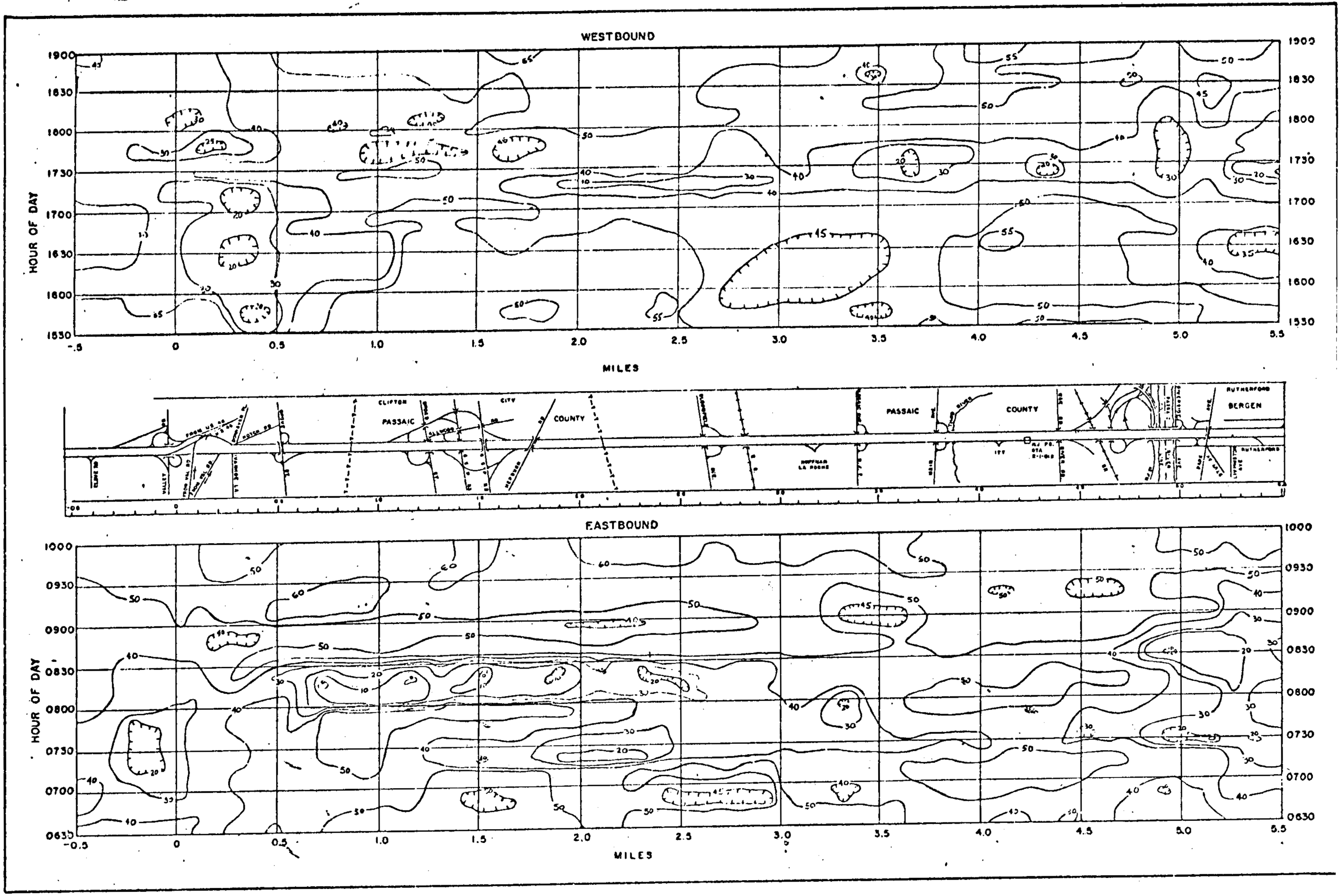
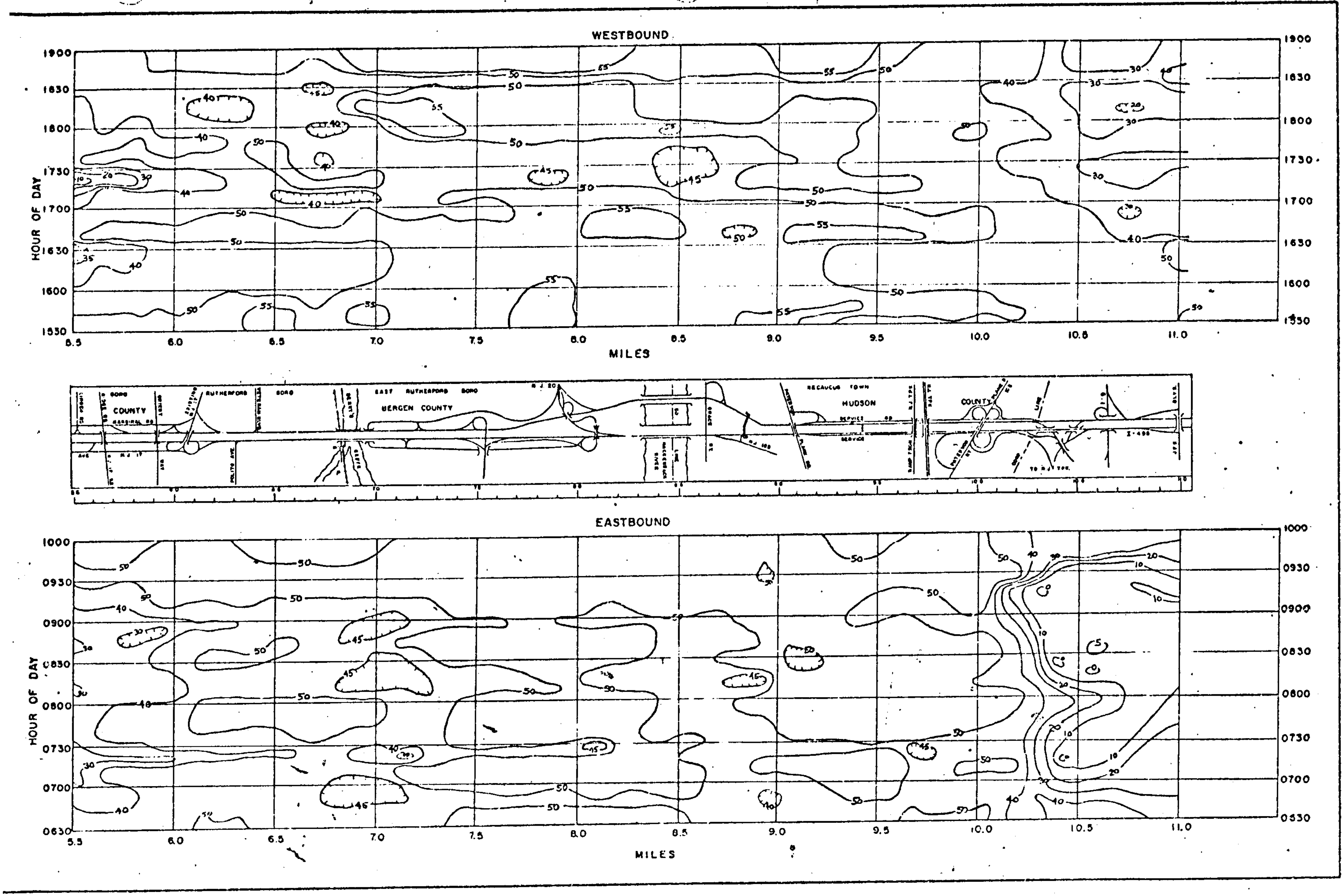


FIGURE 1-2 N.J. ROUTE 3 SPEED CONTOURS



(CON'T) FIGURE 1-2 N.J. ROUTE 3 SPEED CONTOURS

SECTION 2

SUMMARY OF TRAFFIC DEMONSTRATIONS

2.1 Introduction

Improvements to the operation of traffic movement on Route 3 are seen as necessary, after studying the speed contours in Figure 1-2. The road sections indicative of needing improvements are as follows:

1. Route 3 eastbound at Garden State Parkway (G.S.P.) entrance ramp.
2. Route 3 eastbound - within the Rutherford cut.
3. Route 3 eastbound at the merge with the N.J. Turnpike ramps at I-495.
4. Route 3 westbound - within the Rutherford cut.
5. Route 3 and Route 46 merge.

Each of these roadway sections is discussed in detail in Volume II, Route 3 Traffic Demonstrations, except for the Route 3 and I-495 merge.

The Route 3 and I-495 congestion is a situation that exists because of downstream toll collection and geometric conditions. Hence, improvements to this area are outside the purview of this study.

For those areas at which temporary demonstrations have been conducted the following paragraphs summarize the conclusions and subsequent recommendations emanating from the studies.

2.2 Summary and Conclusions

2.2.1 Route 3 Eastbound at Garden State Parkway Entrance Ramp

2.2.1.1 The Problem

One of the most serious areas of traffic conflict on eastbound Route 3 is at the Garden State Parkway entrance ramp during the morning peak period. Referring to the "Speed Contours (Figure 1-2)," it can be seen where the speeds have been reduced from 50 to 60 miles per hour to as low as 5 miles per hour for as much as a half-hour in duration. Mainline Route 3 volumes upstream of the merge are in excess of 3,400 vehicles per hour. The entrance ramp volumes are approximately 1,200 vehicles per hour. The ramp itself has a merging condition just prior to its merge with Route 3. The ramp merge with Route 3 has a very short acceleration lane, causing the ramp traffic to queue while sufficient gaps are found on the mainline. Between the hours of 0800 and 0830, the queue length on the ramp was found to range from 6 to 31 vehicles in length, during one day's operation.

2.2.1.2 Design of Temporary Demonstration

The large volume merge from each of the roadways led to considering the use of a dedicated entrance lane for the Garden State Parkway ramp. Although the mainline Route 3 roadway had an hourly volume in excess of 3,400 vehicles per hour, and was to be forced into two lanes, a similar situation exists at the western terminus of the road. Downstream of the bifurcation of eastbound Route 3 and 46, on the two-lane Route 3 roadway, speeds are seldom lower than 40 miles per hour, and the volumes is in excess of 3,600 vehicles per hour. The demonstration was signed and coned as shown in Figure 2-1.

Cameras were installed on the Garden State Parkway overhead bridge to record traffic, upstream of the merge and at the merge. Observations were made on a Tuesday, Wednesday and Thursday prior to the demonstration and the demonstration was conducted on Monday, July 31, 1972.

2.2.1.3 Evaluation of Demonstration

The extent of congestion caused on the day of the demonstration led to the cancellation of a continued experiment. It had been anticipated that mainline Route 3 volumes, upstream of the merge, would have formed relatively short backup with the closing of the right lane. However, the solid roadway backup extended for over one mile and the effects of the experiment were felt as far upstream as three miles.

The time delay to the merging traffic was determined for both the normal operation of the road and for the experiment. With the closing of the right lane of Route 3, obviously the only traffic delayed was mainline Route 3 traffic. Even with the free moving entry traffic from the ramp, total delay was over fifteen times greater during the experiment than during normal operation.

The far reaching effects of the closing of the right lane of Route 3 were felt to be the result of shock waves. The lane closure was 1.5 miles downstream of a major bifurcation of Route 3 and Route 46. Upstream of this point, approximately 5,500 vehicles diverge during the morning peak hour. This diverge, of itself, causes traffic slow-ups. With the shock waves from a backup, which was only 0.4 miles downstream, the right lanes upstream of the diverge experienced stop and go conditions for almost two miles.

Within a 1.5 mile section of Route 3, just upstream of the entry ramp, over 2,200 vehicles per hour either enter or leave the road. This merging and diverging volume takes place at two exit and four entry ramps. The effect these movements had on the demonstration could not be measured, but because of the increased lane density, the upstream condition may only have been exacerbated because of the merging and diverging traffic.

2.2.1.4 Conclusions

Merely closing the right lane to effect an overall benefit has not been considered practical at this location. The closure of the right lane, upstream of the ramp entry caused excessive mainline delays.

2.2.2 Route 3 Eastbound - Within the Rutherford Cut

2.2.2.1 The Problem

Traffic delays occur on Route 3 eastbound prior to and within the cut section, during the morning peak periods. The two access ramps within this area, at milepost 5.08 and 5.60 have light volumes. The egress ramp at milepost 5.08, referred to as the Park-Rutherford ramp, has a heavy volume: 650 (7-8 a.m.) and 760 (8-9 a.m.). The traffic exiting Route 3 on this ramp must cross both the on ramp traffic and westbound Rutherford Avenue traffic, merge with Rutherford Avenue eastbound traffic, and stop at the five-legged intersection of Park, Rutherford and Stuyvesant Avenues. This difficult egress produces backup on mainline Route 3 eastbound, immediately upstream of the Park-Rutherford ramp.

Evening peak period backup is also observed. Although mainline Route 3 eastbound volumes are lighter in the evening, ramp volumes are comparable to those in the morning: 720 (4-5 p.m.) and 750 (5-6 p.m.).

2.2.2.2 Design of Temporary Demonstration

A more expeditious movement was provided for the exiting ramp traffic in an effort to relieve the backups on mainline Route 3. These included the following items which are shown on Figure 2-2.

1. Close the on ramp at this location with barricades; mark the pavement for two exiting lanes.

2. Remove the yield control at the Park-Rutherford ramp and put it on Rutherford Avenue eastbound to allow the off traffic to move unimpeded.

3. Make Rutherford Avenue one-way from the Park-Rutherford ramp to Park Avenue, a distance of 150 feet.

4. Remove stop control from Rutherford Avenue eastbound and put stop control at Park Avenue southbound at the five-legged intersection of Park-Rutherford-Stuyvesant.

5. Barricade the ramp downstream at milepost 5.60.

6. Install and replace signing to guide traffic along Rutherford eastbound to merge with Route 3 at milepost 6.2.

7. Install pavement marking on Rutherford Avenue eastbound to delineate two traffic lanes for a distance of 300 feet prior to the signalized intersections with Ridge Road and Orient Way, and install no parking signs 200 feet in advance of the intersections.

8. During the operation, signs were added to divert truck traffic from residential areas because of citizen comment to Rutherford police.

Approval for this demonstration was given by Bergen County, Lyndhurst and Rutherford in May 1972. It was implemented on May 13, 1972 and studies began May 22, 1972. The demonstration was terminated June 24, 1972.

2.2.2.3 Evaluation of Demonstration

Details of the analysis are seen in a following subsection. In summary, the average eastbound travel times for all traffic had been reduced during the demonstration. This can be translated into an annual savings of $16,000 based on the morning peak period only. Additional savings should be realized if the evening peak period is also included.

A traffic signal capacity analysis at the two traffic signals along Rutherford Avenue showed additional capacity being afforded on eastbound Rutherford Avenue by striping and by adding parking regulations.

Although time savings were noted for the Route 3 eastbound right lane exiting traffic, the full savings have not been realized. Visual observations showed a reluctance of the exiting traffic to proceed through uncontrolled Rutherford Avenue eastbound at the five-legged intersection. Many motorists on the other four legs were neglecting to obey the stop control on those approaches. The installation of a signal at this intersection should improve the situation.

2.2.2.4 Conclusions

It was concluded that this demonstration would be an effective method of giving Route 3 eastbound exiting traffic good egress without significantly inducing delay to local traffic. It was recommended to the Department's design engineers that the widening plans for the Rutherford cut and the Park-Rutherford ramp be redesigned for egress traffic only. Emergency vehicles could enter Route 3 eastbound against the ramp traffic if necessary.

A signal should be installed at the Park-Rutherford-Stuyvesant intersection to permit a smoother crossing for all traffic. The eastbound Rutherford Avenue approach to this intersection should be made one-way eastbound from the Route 3 egress ramp.

It is further recommended that Rutherford Avenue eastbound striping and parking regulations continue in effect, in advance of the two signals as this has increased capacity on these approaches.

The final design which has been implemented at the ramp from Route 3 eastbound to Rutherford Avenue just west of Park Avenue is shown in Figure 2-3. The channelization and signing shown is to ameliorate the congestion caused by exit ramp traffic which backed up from the ramp intersection with Rutherford Avenue and from what was a stop at the intersection of Rutherford Avenue eastbound and Park Avenue.

2.2.3 Route 3 Westbound - Within the Rutherford Cut

2.2.3.1 The Problem

A major bottleneck exists at the narrowing of three lanes of traffic to two lanes in the westbound direction (see Figure 2-4, Milepost 5.5). To further aggravate the condition, there is an access ramp at this point (Linden Road ramp). The evening peak hour volume upstream of the ramp is in excess of 3,400 vehicles per hour. The Linden Road ramp volume of over 300 vehicles per hour is a substantial increase at a point where only two lanes of travel exist, causing an over-capacity condition. The peak period problems on this section of road are very visible.

Further downstream, at milepost 5.05, another access ramp (Park Avenue ramp) merges with Route 3 westbound after the roadway has widened to three lanes. This ramp has a volume of almost 500 vehicles per hour during each of the evening peak hours and is controlled by a stop sign. Further, a severe sag condition exists on the ramp. In addition, it is only 200 feet from the egress ramp to Riverside Avenue with peak hour volumes of about 100 vehicles per hour.

Thus at the Park Avenue ramp merge with Route 3 westbound, the third or outside lane of Route 3 serves as a weaving lane. In addition, a portion of the through traffic is moving into this lane in anticipation of the downstream egress ramp to Route 21, 0.4 miles away. Exiting volumes exceed 1,000 vehicles per hour at this latter ramp during each of the evening peak hours.

2.2.3.2 Design of the Temporary Demonstration

The merge of ramp mainline traffic, at the section of Route 3 westbound where the roadway narrowed to two lanes, was overcome by denying access at this point. As shown in Figure 2-4, this required the following action.

1. Close the Linden Road access ramp to westbound Route 3 from Marginal Road. The diverted traffic can enter downstream at the Park Avenue ramp.

2. Change the Stop Control to Yield Control at the Park Avenue ramp.

3. Simulate a signal at the intersection of Park and Marginal since an additional 300 vehicles per hour would cross this intersection in the evening peak hours. This was accomplished by police control, furnished by the Rutherford Police force.

4. Erect and install the necessary traffic controls for the demonstration, including:

   a. A barricade at the Linden Road ramp,

   b. Lane markings on the Park Avenue overpass to provide better traffic delineation for the northbound left turn, and

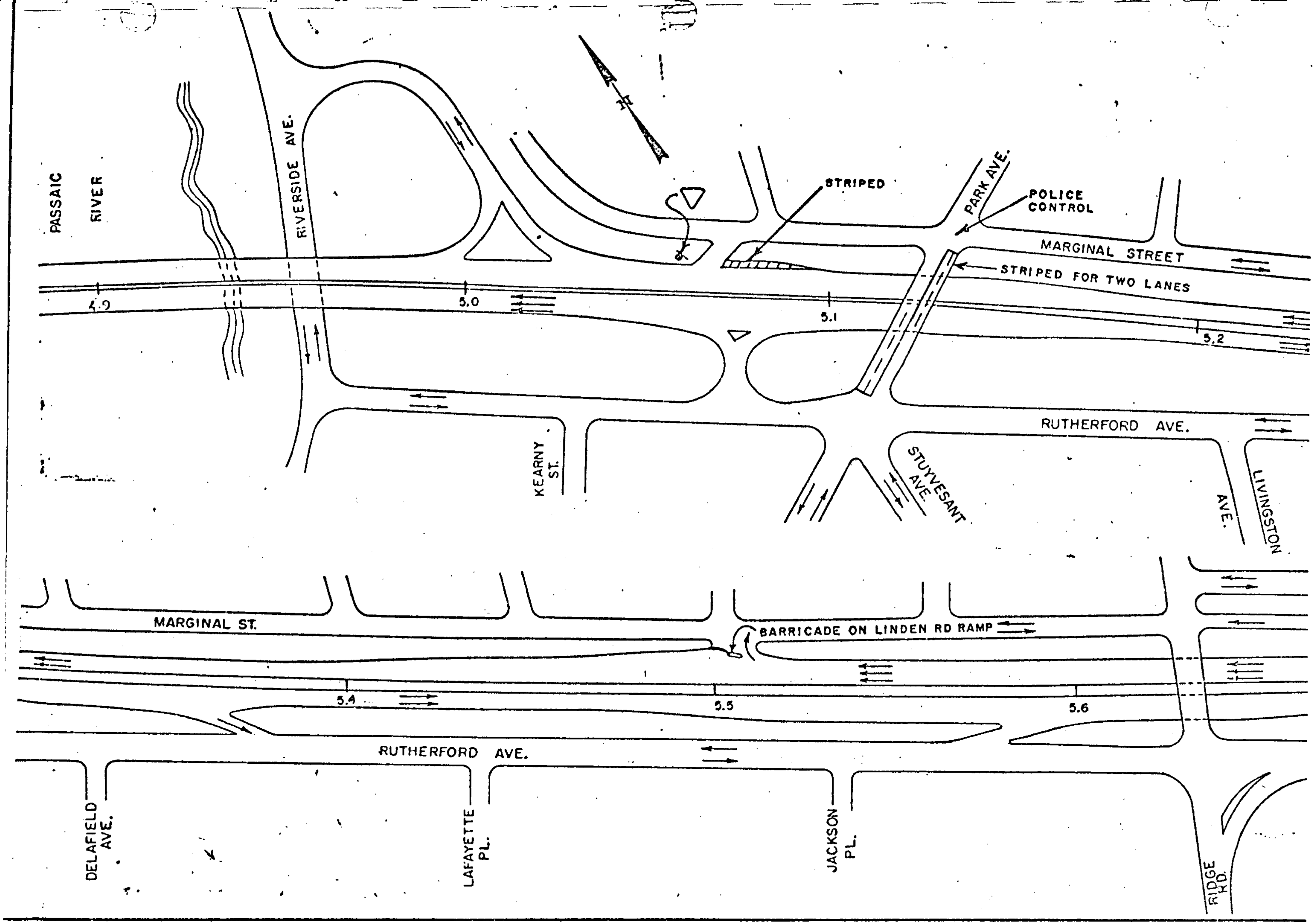


FIGURE 2-4 : TEMPORARY DEMONSTRATION ON RT. 3 WESTBOUND IN RUTHERFORD.

c. Erection of required signs and the changing of directional signs, including New Jersey Turnpike markers.

A meeting was held with officials of Bergen County, Lyndhurst and Rutherford on November 23, 1971 to explain the purpose and details of the demonstration. Permission to conduct the demonstration was granted in April 1972.

Studies were conducted during the first two weeks of May 1972, during the evening peak hours of 4 to 7 p.m., only when police control was provided. The barricade at the Linden Road ramp was removed for the remainder of the day.

2.2.3.3 Evaluation of Demonstration

In summary, travel times were reduced in the "after" period at an annual driver savings of over $75,000, based solely on the 4 to 6 p.m. peak period. Additional savings would probably be realized if non-peak hour traffic had also been included.

A study of conflicts affecting the right and center lanes of Route 3, caused by the Park Avenue ramp, was performed. The additional diverted traffic on the Park Avenue ramp caused a doubling in conflict rate. In addition, queueing on this ramp increased exponentially during the period of the demonstration.

2.2.3.4 Conclusions

It was concluded that the additional time savings to the motorists were more than offset by the increase in conflicts in the weaving area immediately downstream of the Park Avenue ramp.

It is recommended that the Linden Road ramp be designed as an access ramp only in the future plans that also call for the widening of Route 3 to a full 3 lanes throughout.

For a more expeditious movement of traffic in the vicinity of the Park Avenue ramp, design studies were made which may allow the closing of the egress ramp to Riverside Avenue. The design studies had to consider using an access ramp to Riverside Avenue from Marginal Road. Two problems affected this approach since property would not be taken. First, the road geometry proved to be too narrow to allow both a Riverside Avenue and westbound Route 3 ramp side-by-side. Second, an extremely high retaining wall would have to be constructed. The scheme was thus discarded.

2.2.4 Route 3 and Route 46 Merge

2.2.4.1 The Problem

Congestion on westbound Route 3 is experienced daily in the afternoon from 3:30 to 6:00 p.m. at the merge with Route 46 (Figure 2-5). Three lanes of Route 3 westbound merge to two lanes approximately 0.3 miles upstream of the merge with Route 46 westbound. At the time of the volume study in October 1971, prior to the opening of I-80 in December (which reduced Route 46 traffic considerably), the 4 to 5 p.m. volume on Route 3 was 3,060; on Route 46 the volume was 2,460. Although Route 3 comprised 56% of the total traffic at the merge, Route 46 was in effect striped for two of the three lanes downstream of the merge.

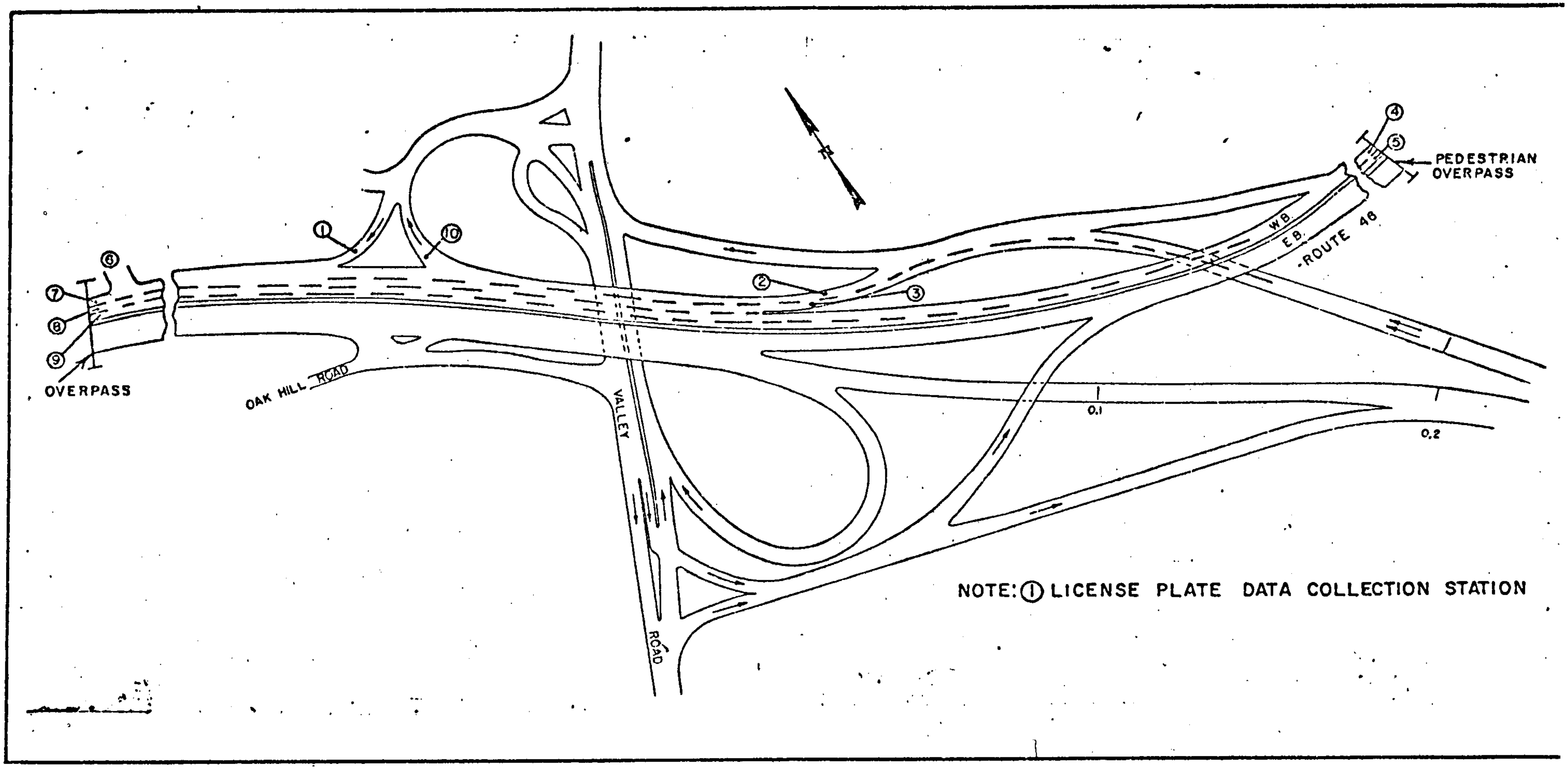


FIGURE 2-5: ROUTES 3 & 46 MERGE "BEFORE" IMPROVEMENTS.

Since the opening of I-80, in December 1971, westbound Route 46 traffic has decreased to 1,800 vehicles between 4 to 5 p.m. and travel times along Route 3 have decreased. The two lanes of Route 3 were still "striped" for a single lane downstream of the merge. In addition, an access ramp (shown as number 1 on Figure 2-5) added over 400 more vehicles during the peak hour. The total effect of these conditions was to reduce Route 3 speeds and cause backups of up to 0.5 miles upstream on Route 3. Route 46 rarely experienced these congestion conditions.

2.2.4.2 Design of Improvement

A plan to restripe the merge area was implemented on March 26, 1972, (Figure 2-6). With the restriping, the two adjoining lanes (left lane of Route 3 westbound and the right lane of Route 46 westbound) are striped to merge over a distance of approximately 500 feet. The right lane at the merge (right lane of Route 3) is striped to be given its own through lane.

2.2.4.3 Evaluation of Improvement

Travel times were collected on both Route 3 and Route 46 westbound for a comparable distance of approximately 1.7 miles in length "before" and "after" restriping. License plate data were collected to observe merging behavior over a distance of approximately 0.5 miles "before" and "after" the striping.

Route 3 travel times were reduced significantly between 3:30 to 4:45 and from 5:45 to 6:30 p.m. Route 46 travel times were reduced significantly for the entire study period 3:30 to 6:30 p.m.

In addition, better merging conditions resulted. There was an increase in the number of vehicles from both Route 3 and 46 that were able to get to the left lane of Route 46 downstream of the merge.

2.2.4.4 Conclusions

It was concluded that the restriping should be continued on a permanent basis to reduce travel times and improve merging conditions. The accident experience of this improvement will only be evident after a few years.

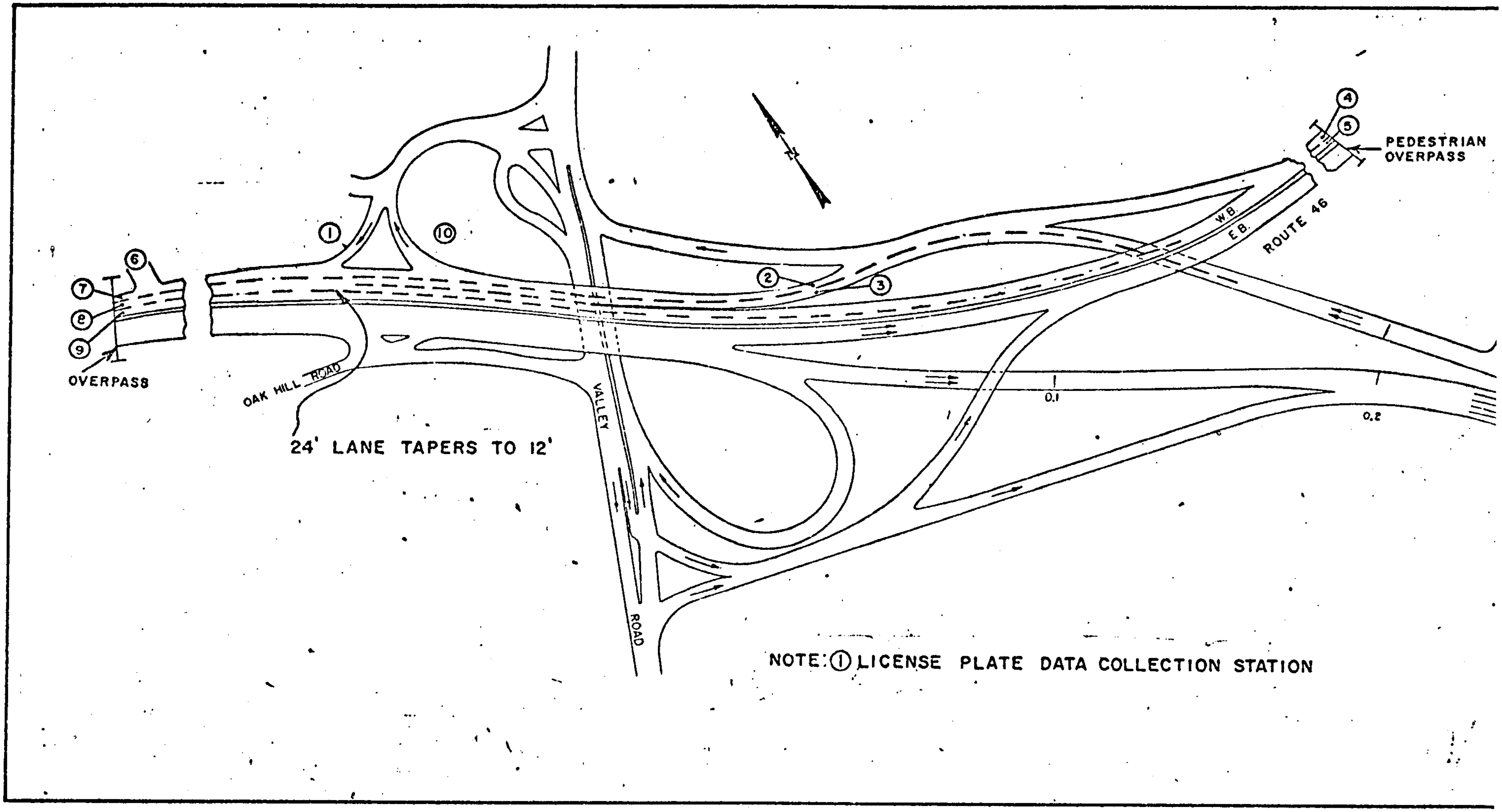


FIGURE 2-6: ROUTES 3 & 46 MERGE "AFTER" IMPROVEMENTS.

SECTION 3

SUMMARY OF SURVEILLANCE AND CONTROL DESIGN

3.1 Introduction

The primary objectives of a surveillance and control system for the Route 3 corridor are:

a. provide prompt detection of congestion producing incidents, thus facilitating their rapid removal and reducing overall delay,

b. improve the quality of flow on the mainline through appropriate control measures,

c. provide priority service to buses, thus expediting the movement of people through the corridor, and

d. provide information and guidance to motorists in advance of congestion.

Studies of existing and planned conditions for Route 3 and the needs of both the motorist and operations personnel, have resulted in a specific control design. A summary of the design requirements and recommendations follows.

3.2 Summary and Recommendations

3.2.1 Ramp Metering

Restrictive and non-restrictive ramp metering has been recommended at 13 ramps, as shown in Figure 3-1. Restrictive Metering implies releasing vehicles onto the mainline at a lower rate than their arrival at the ramp. Non-restrictive Metering implies that over a period of time, say 15 minutes, the number of vehicles released onto the mainline will equal the number arriving at the ramp.

3.2.2 Alternate Routing

The alternate routing of traffic using Allwood Road to divert vehicles prior to their entry onto Route 3 has been recommended, during times of traffic congestion. A total of 23 variable message signs are required, examples of which are shown in Figure 3-2.

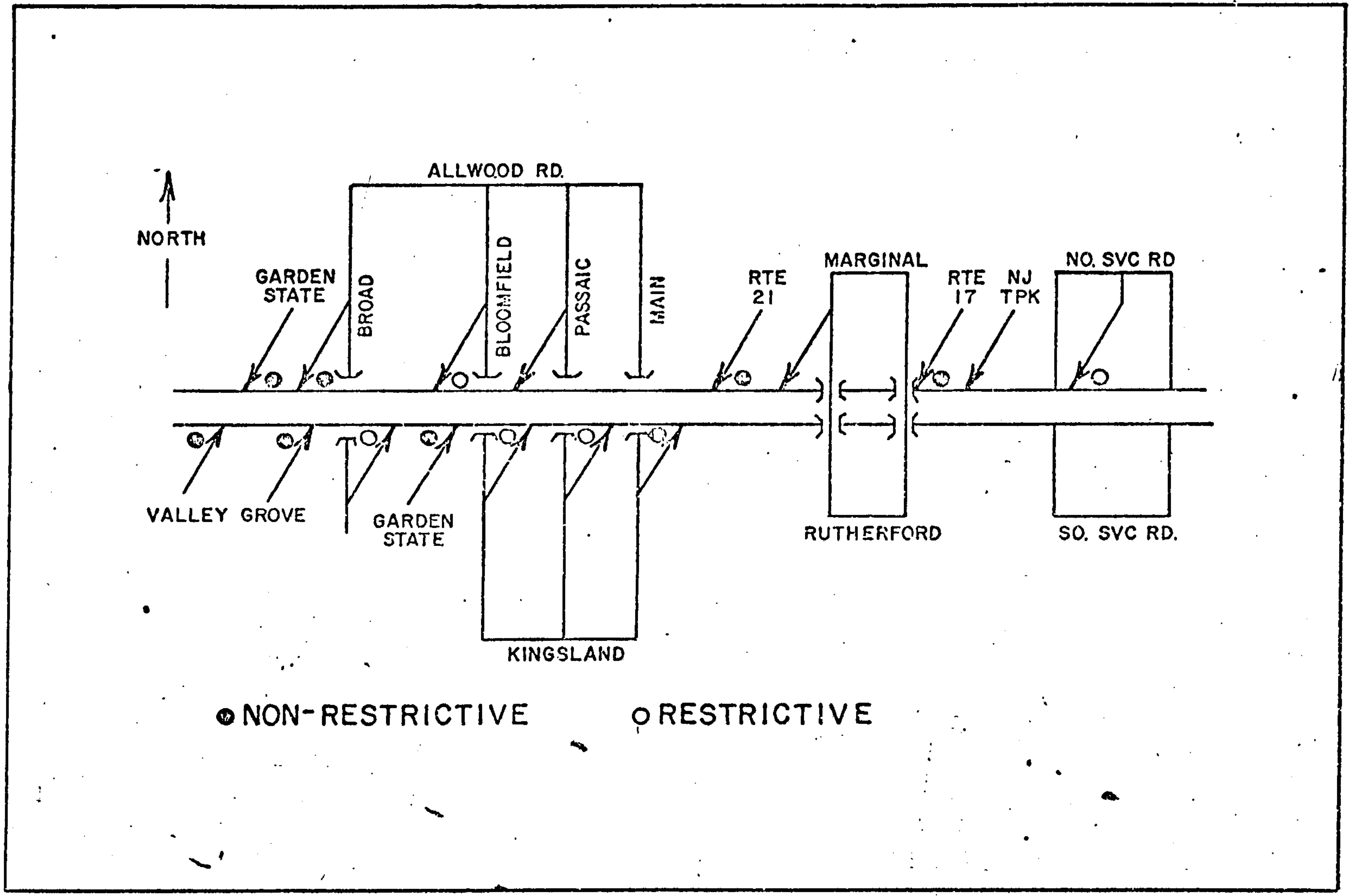


FIGURE 3-1: ROUTE 3 METERED RAMPS

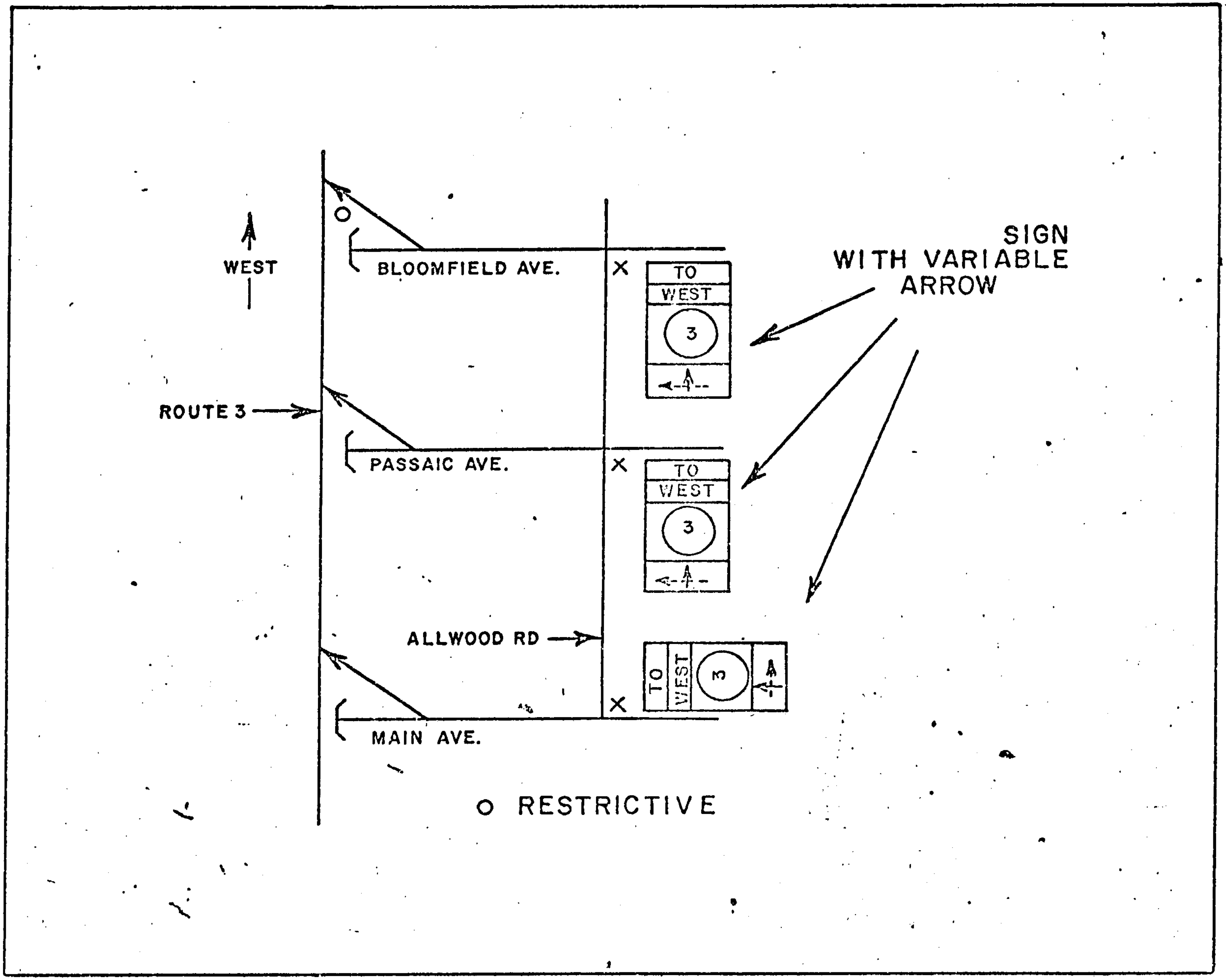


FIGURE 3-2 VARIABLE MESSAGE SIGNING

3.2.3 Bus Diversion

Diverting only buses to an alternate route results in significant savings of passenger delay in the corridor. To implement the bus diversion, signals are placed at key locations which will not be readily interpretable by other than bus drivers. When the travel time on an alternate is better than on the mainline, the bus signal will be energized. Nine signals have been located along the corridor, as shown in Figure 3-3.

Other schemes of bus priority such as exclusive bus lanes and priority lanes on ramps were studied and found not to be feasible.

3.2.4 Surveillance Requirements

The surveillance requirements on Route 3 are dictated by the requirements to develop:

Mainline demand, capacity and measures of travel time;

Mainline vehicle classification;

Incident detection;

On and off ramp demand;

On ramp queue detection;

Ramp metering actuation;

Alternate route demand.

The spacing between mainline detector locations depends primarily on the desired speed of incident detection and the cost of the detector complement. An approximate detector spacing of 1/2 mile was selected as being a good compromise.

Detector traps (2 detectors in the same lane approximately 15 feet apart) have been specified at key locations to provide classification capability and hence a measurement of the car-bus-truck mix on the mainline.

Virtually all on and off ramps will be detectorized to provide complete input and output counts. Each metered ramp will have a demand and passage detector for efficient signal operation. In addition, metered ramps will have queue detectors so that the system can ensure that queues do not back up beyond specified points. The alternate routes are detectorized to provide both demand and travel time information.

To provide the data necessary for system surveillance, a complement of loop detectors is recommended as follows:

metering actuation;

mainline;

ramp;

alternate route and local street turning lane.

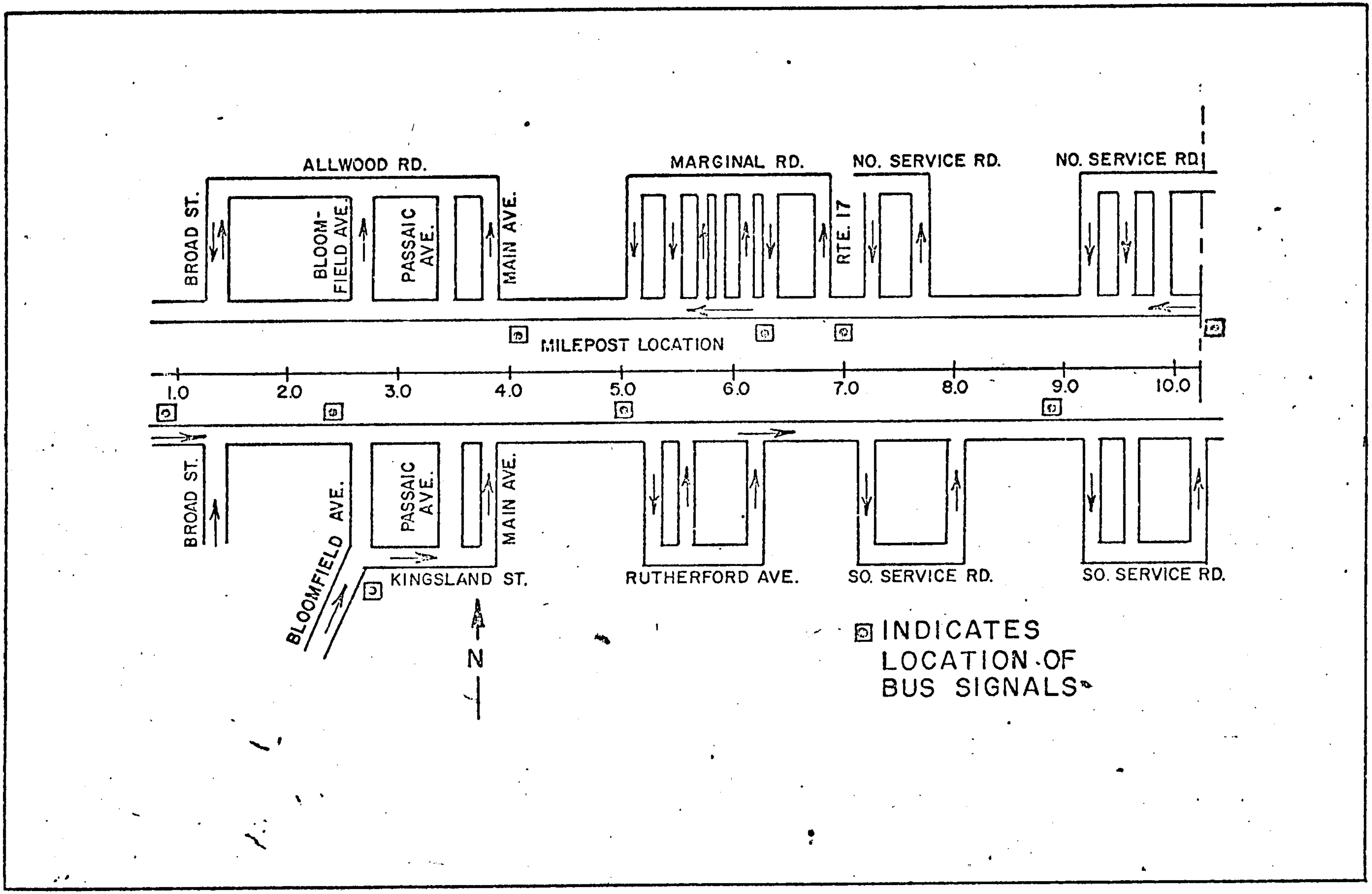


FIGURE 3-3 BUS DIVERSION ROUTES

3.2.5 Equipment Requirements

The control and surveillance functions in turn dictate the equipment required in the system. The overall equipment complement consists of central office equipment, field equipment and interconnect. Major design decisions include the following:

a. Detectors should be of the inductive loop type on the basis of performance, experience of other surveillance systems, maintenance aspects and cost.

b. Interconnect between field equipment and the central office should be over leased telephone lines for minimum cost, with the central office to be located within the Rutherford telephone exchange. The most cost effective communications technique for the Route 3 system is frequency division multiplexing.

c. Ramp signal controllers should be solid-state and operate in a locally actuated mode with the minimum cycle time to be transmitted from central. Using this technique, the metering rate can be remotely controlled with minimum processing of ramp detector data. Local timing circuits should also be provided for fail-safe operation.

d. Variable message signs should be internally illuminated to gain attention from the motorist, and be consistent with signing standards.

e. A minicomputer will be required for the Route 3 system.

A total of 13 equipment specifications have been prepared for the system components. Volume IV details these specifications. Recommended communications are over leased telephone lines with the central site located within the Rutherford telephone exchange area.

3.2.6 Software Requirements

The software package defines the logic necessary so that a computer program can be written to perform the following functions:

Process detector data;

Evaluate computer performance;

Detect and compensate for failures;

Control ramp controllers, variable signs and bus signals;

Compute traffic parameters;

Analyze data to determine occurrence and location of incidents;

Provide logic to select metering rates and sign messages;

Drive control center displays;

Write traffic reports;

Interface with other New Jersey Surveillance Systems, and with appropriate Police Departments.

A set of 17 routines, detailed in Volume V , will perform the required software functions.

3.2.7 Geometric Improvements

It was determined during the study that at several locations on Route 3, operations are severely hampered by geometric conditions. This is particularly true at locations where an insufficient acceleration lane exists resulting in extremely poor merging operation. Particularly severe locations were identified and improvements recommended.

Channelization, marking and signing improvements are recommended at five intersections with Route 3, namely:

Grove Street

Broad Street

Bloomfield Avenue

Passaic Avenue

Main Avenue

Geometric changes to enhance merging operations are recommended at 5 locations on Route 3, namely:

Garden State Parkway (E/B)

Passaic Avenue (E/B and W/B)

Main Avenue (E/B and W/B)

Bloomfield Avenue (E/B)

Route 21 (W/B).

3.3 System Costs

The cost to install the surveillance and control system was estimated to be $1,839,800 in 1973. This cost did not include the geometric changes listed in Section 3.2.7.

The annual cost to operate the system was estimated to be $123,500 including $25,000 for maintenance. Over a ten year life time the estimated benefit to cost ratio is 2.9 to 1, thus justifying the installation of the system. This benefit cost ratio does not include the geometric changes.

The original estimate for the geometric improvements was $555,870. However, more recent estimates developed by the New Jersey Department of Transportation indicate a cost of $1,456,000 would be required. This additional cost could reduce the benefit-to-cost ratio to approximately 2 to 1 which still would be cost beneficial.

SECTION 4

FUTURE PLANS

4.1 Priority Bus-Carpool Lane Study

Because of the negative results obtained from investigations into methods of providing priority services to buses only, a project is underway to investigate the feasibility of providing priority service to buses and carpools. Federal funding in the amount of $360,000 has been requested to determine the feasibility of such a concept on Route 3 and, if feasible, implement and evaluate such a system. The feasibilty study is expected to be complete in early 1975 and, if feasible, the demonstration would begin in early 1976.