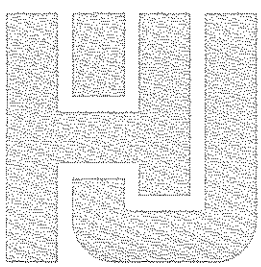
TRAFFIC STUDY
AND RAILROAD CROSSING ANALYSIS

FOR THE CITY OF SALISBURY, N.C.
AND NORTH CAROLINA
DEPARTMENT
OF TRANSPORTATION



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PAVEMENT MARKING

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INTRODUCTION

The City of Salisbury, along with the N.C. Department of Transportation, has requested an analysis of the roadway network in relation to the North Carolina Railroad in the City of Salisbury, North Carolina. The North Carolina Railroad runs from Raleigh to Charlotte via a route directly through the center of the City of Salisbury. Because this rail line runs directly through the center of town, the railroad intersects the existing roadway network frequently. In fact, along a three-mile stretch within the city limits, the railroad crosses Salisbury roads seventeen (17) times. This is the highest concentration of railroad-roadway intersections on the entire rail corridor.

The purpose of this study is to analyze all intersections and determine if any are candidates for closure and/or could be made into grade-separated intersections. Therefore, this report will include:

* Inventory of the existing physical and operating characteristics of the surrounding road system and transportation network. The inventory includes completion of Manual Turning Movements counts during the afternoon (4:00 p.m. until 6:00 p.m.) peak period at key intersections and Automated Traffic Recorder (ATR) counts at other key intersections.

* Evaluation of existing conditions on the key intersections including a detailed Level-of-Service Analysis.

* Determination of travel characteristics of the proposed intersection closures and/or grade separated intersections, including vehicular trip distribution and redistribution along adjacent roadways. In addition, existing traffic will be projected upward to reflect traffic growth within the area to produce future volumes in the two (2) year and ten (10) year time frames.

* Future condition analysis including detailed Level-of-Service Analysis of various key intersections in the influenced area.

* Conclusions and recommendations to facilitate safe and expeditious access throughout the roadway-railroad network and to insure the smooth functioning of the area roadway and railroad network.

* Completion of a signal warrant analysis, if needed, to determine if additional signalized intersections will be warranted due to intersection and railroad closures.

EXISTING TRANSPORTATION SETTING

The City of Salisbury is located approximately forty minutes south of Greensboro, N.C. and one hour north of Charlotte, N.C. in the heart of the North Carolina Piedmont. (See Figure 1.) The North Carolina Railroad, which runs from Raleigh to Charlotte, runs directly through the heart of the City. Within the City limits, there are seventeen (17) intersections of the railroad with the area roadways - the highest concentration of any roadway network with the railroad. Because of this fact, the City of Salisbury, along with the North Carolina Department of Transportation, has requested an analysis of the roadways and railroad to determine intersections which could be closed or converted into a grade-separated intersections.

Roadway Characteristics

The North Carolina Railroad is paralleled by two of Salisbury's major streets. To the southeast of the railroad is Long Street (SR2100). Long Street is primarily a 2-lane road east of the intersection with Council Street and a 4 to 5 lane road west of this intersection. The posted speed limit along Long Street is 35 mph. To the northwest of the railroad is Main Street (U.S.29). Main Street is primarily a 4 lane roadway with a section of 2 lane road between Knox Street intersection and "D" Avenue intersection. The Speed limit on Main Street varies from 20 mph to 45 mph. There are several crossroads that run between Main Street and Long Street that intersect the railroad as well as Main Street and Long Street. These roads include: Eleventh Street, Henderson Street/Bringle Ferry Road, Kerr Street/Park Avenue, Council Street (all at-grade), Innes Street, Fisher Street, Bank Street (grade-separated), Horah Street and Monroe Street (at-grade). Speed limits on these roads vary from 20 mph to 35 mph.

Main Street continues southwest and has intersections with Military Avenue (grade-separated), Knox Street, Crawford Street, East Harrison Street, Lumber Street, Mildred Avenue, Vance Avenue, Klumac Road, "C" Avenue, "D" Avenue, Julian Road (all at-grade) and Jake Alexander Boulevard (grade-separated). Speed limits on these roads are 35 mph, except Jake Alexander Boulevard (50 mph).

Existing Traffic

To establish the relationship between traffic projections and existing traffic on the surrounding roadway network, Manual Turning Movement counts, as well as ATR counts were collected at the following intersections:

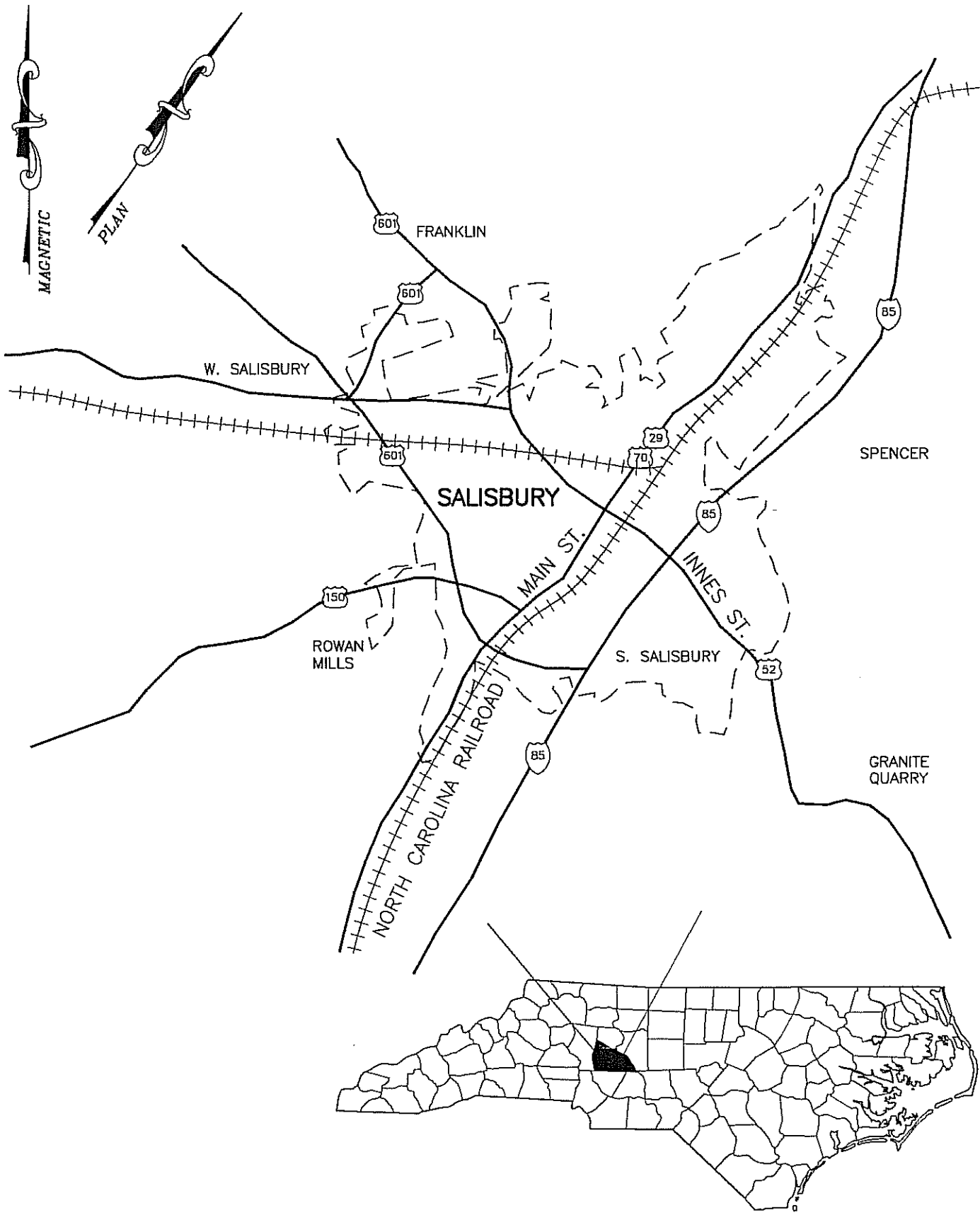

FIG. 1

SITE LOCATION MAP

SCALE 1" = 1 MILE

Intersections Counted

Manual Turning

Mildred & Main
Lumber & Main
Crawford & Main
Crawford & Railroad
Knox & Main
Military & Main
Monroe & Main
Horah & Main
Bank & Main
Fisher & Main
Innes & Main
Council & Main
Liberty & Main
Kerr & Main

Lafayette & Main
11th & Main
Richard & 11th
11th & Long
Henderson & Long
Henderson & Railroad
Kerr & Long
Council & Long
Innes & Long
Fisher & Long
Bank & Long
Horah & Long
Monroe & Long

ATR's

Monroe & Lee
Horah & Lee
Bank & Lee
Council & Lee

Innes & Lee
Fisher & Lee
Kerr & Lee

All Public At-Grade Intersections with the Railroad

*Underlined streets are grade separated

A map of these intersections is shown on Figure 2.

The results of the Manual Turning Movement counts are provided in Appendix "A" of the supplement. Historically, during normal business days, traffic demand peaks in the morning between 7:00 and 9:00 a.m. when many people travel to work and again during the afternoon between 4:00 and 6:00 p.m. when many people travel home from work. The afternoon peak was analyzed for this study.

The Manual Turning Movement counts were tabulated by fifteen (15) minute periods between 4:00 p.m. and 6:00 p.m. and were conducted during the first two (2) weeks of June, 1994. The four (4) highest consecutive fifteen (15) minutes periods during each traffic count constitutes the peak hour which will be the basis of this traffic analysis. The Manual Traffic Movement counts were supplemented with ATR counts placed at intermediate intersections within the roadway network. The resulting peak hour traffic flows are depicted in Figures 3, 4, 5 and 6.

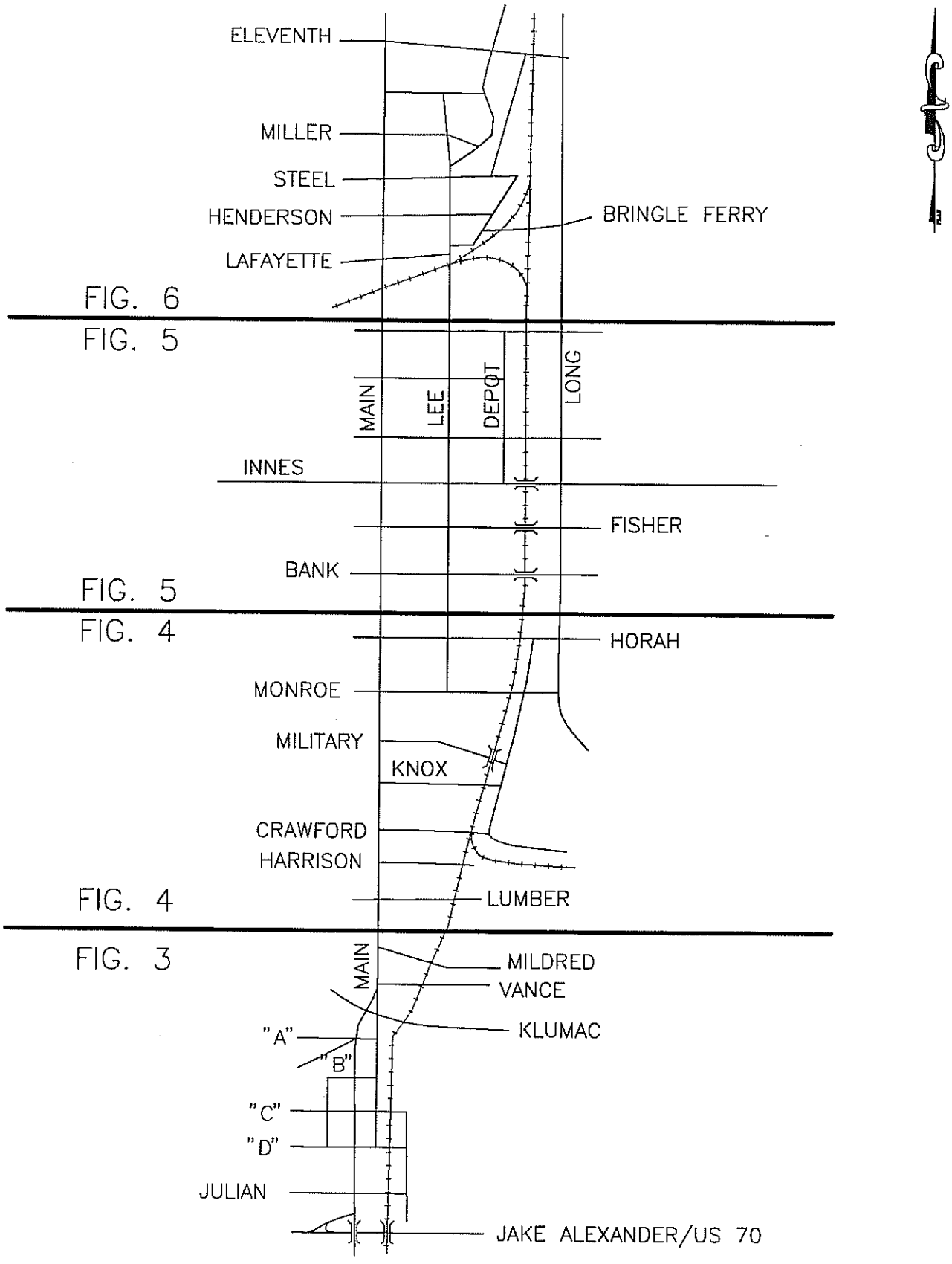

FIG. 2

OVERALL PLAN

N.T.S.

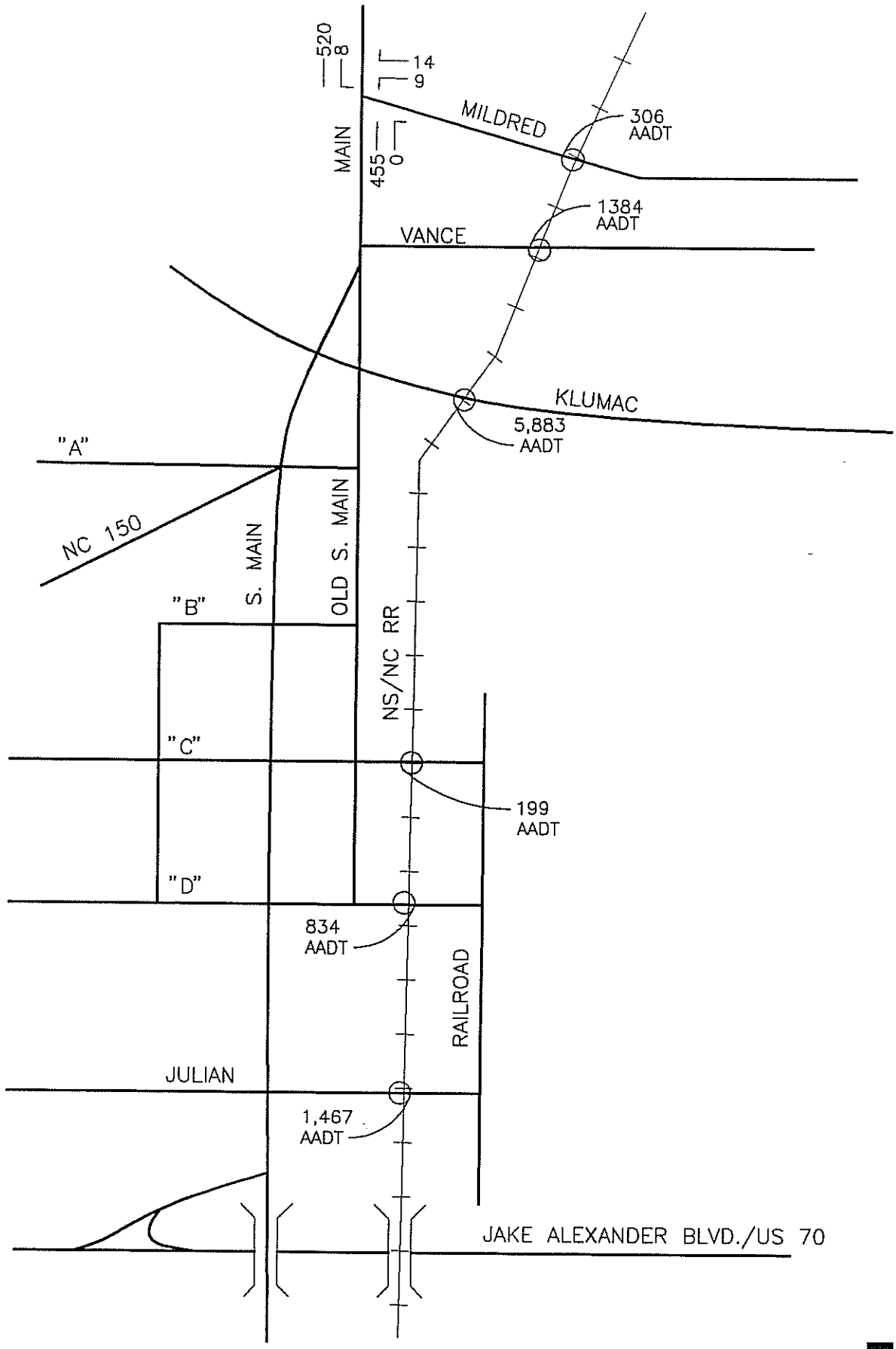

FIG. 3

EXISTING AFTERNOON PEAK HOUR TRAFFIC

N.T.S.

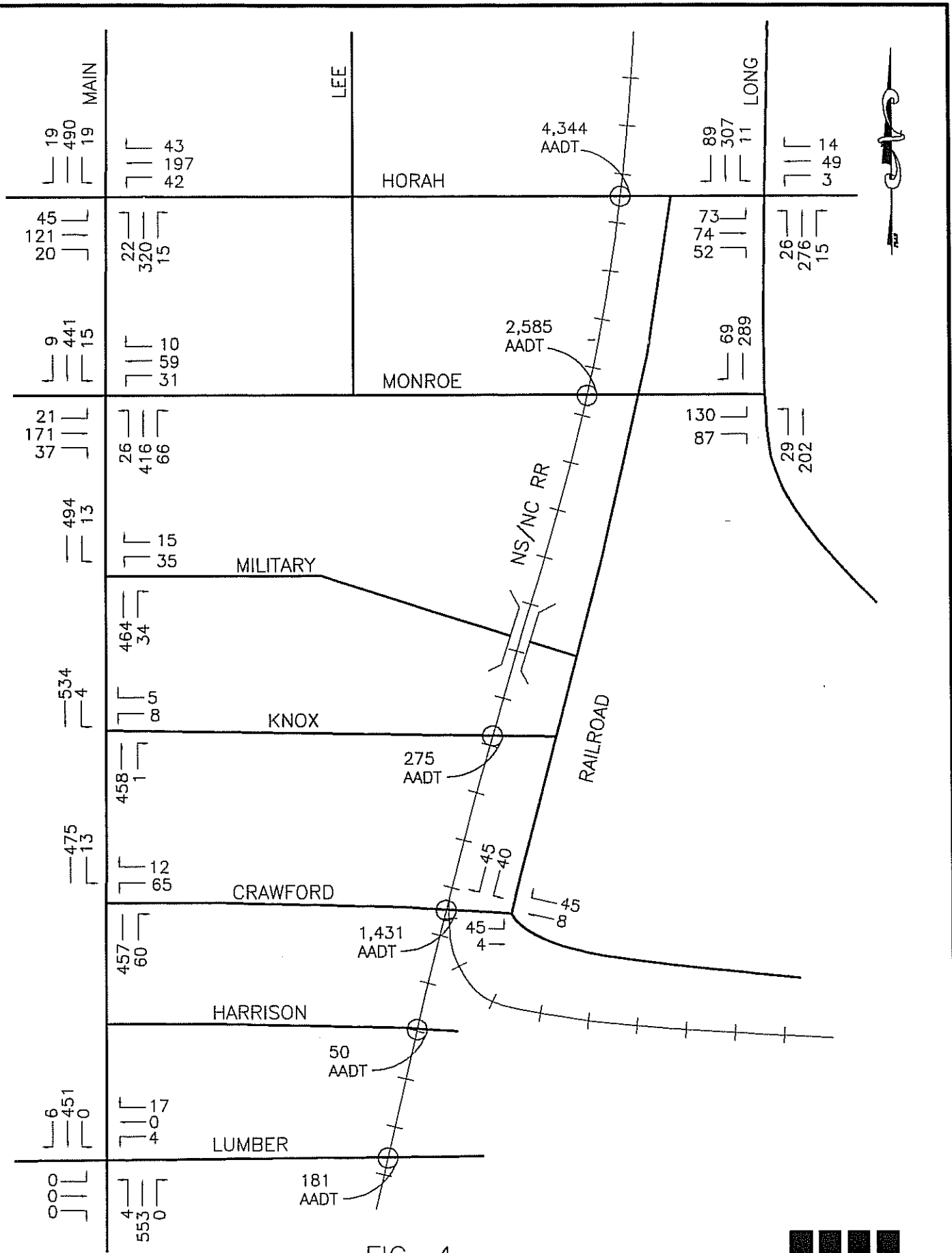

FIG. 4

EXISTING AFTERNOON PEAK HOUR TRAFFIC

N.T.S.

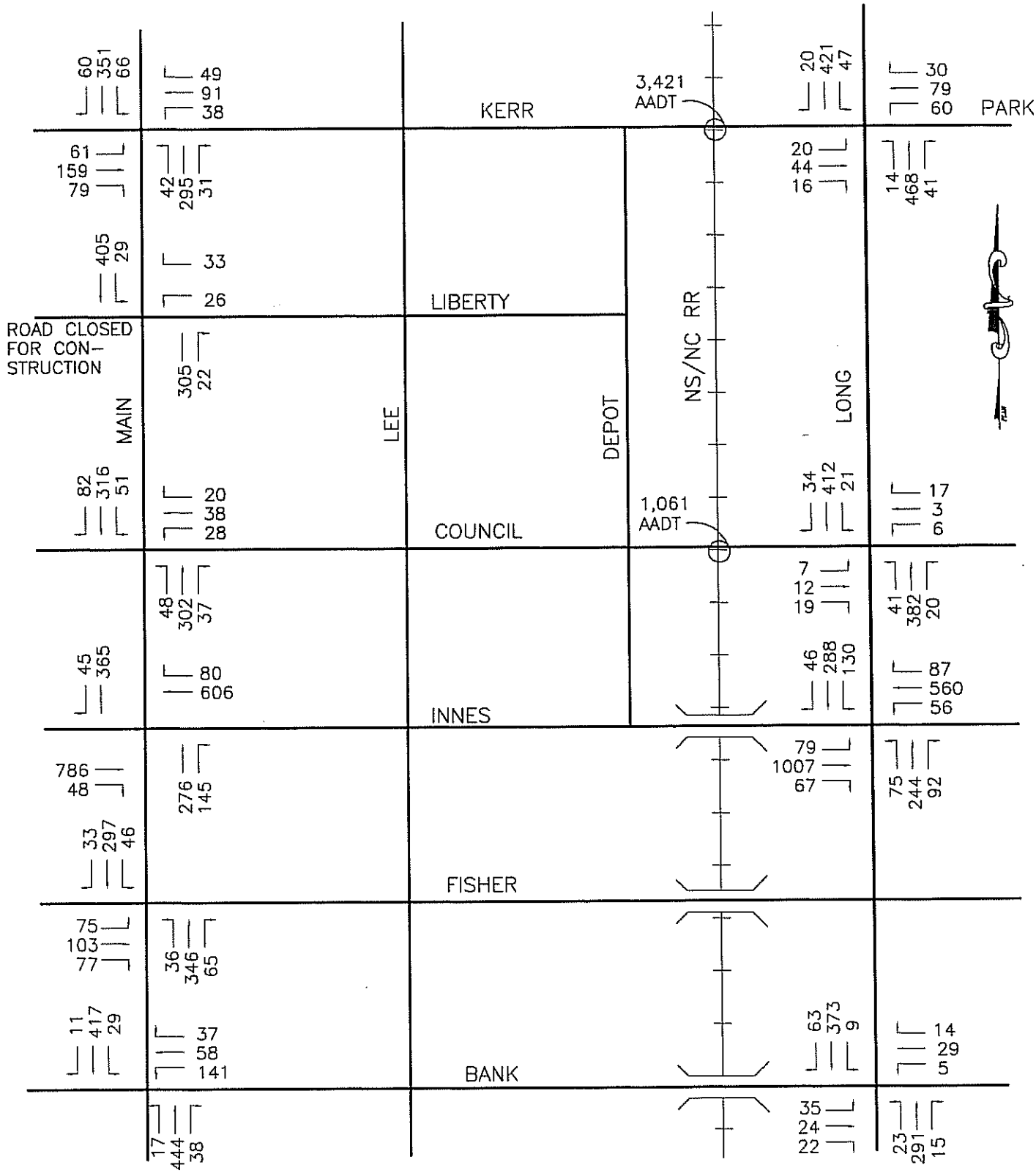

FIG. 5

EXISTING AFTERNOON PEAK HOUR TRAFFIC

N.T.S.

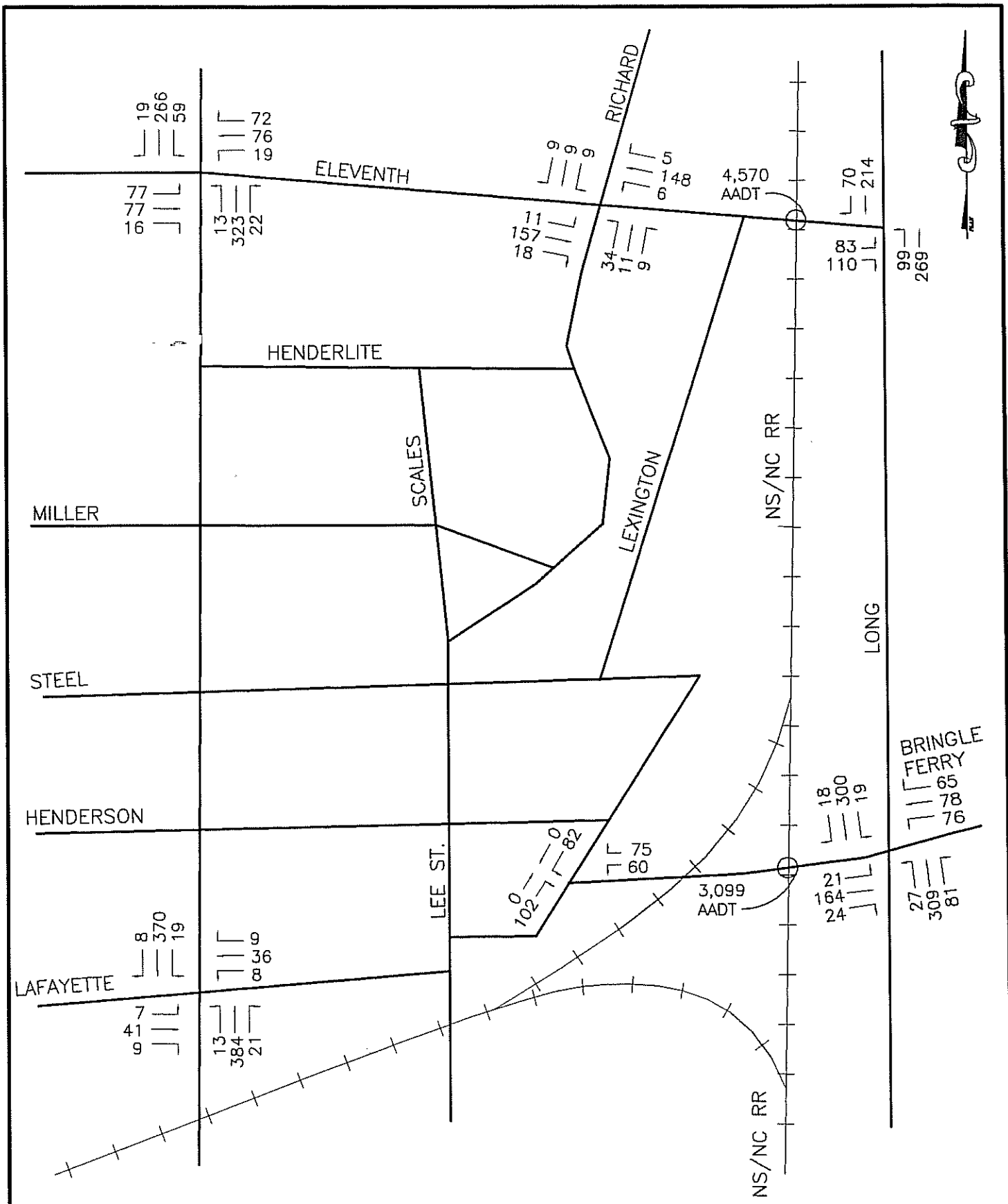

FIG. 6

EXISTING AFTERNOON PEAK HOUR TRAFFIC

N.T.S.

Present Level-of-Service Analysis

The volumes in Figures 3, 4, 5 and 6 were subjected to a detailed Volume/Capacity Analysis in accordance with the standard techniques contained in the "Highway Capacity Manual"[1]. By definition Capacity represents the "maximum rate of flow that can reasonably be expected to pass a point on a uniform section of land or roadway under prevailing roadway, traffic, and controlled conditions". The functioning level of an intersection or a uniform section of lane or roadway can be expressed in terms of levels of service. A level of service is defined as a "qualitative measure describing operational conditions within a traffic stream, or the perception by motorists and/or passengers. Such measures include speed and travel time, freedom to maneuver, traffic interruptions, comfort and convenience and safety."

At unsignalized intersections a methodology for evaluating the relative functioning of intersections controlled by stop signs or yield signs has been developed and is based on several assumptions including:

* Major street flows are not affected by minor (stop sign controlled) street movements.

* Left turns from the major street to the minor street are influenced only by opposing major street thru-flow.

* Minor street right turns are impeded only by the major street traffic coming from the left.

* Minor street left turns are impeded by all major street traffic plus opposing minor street traffic.

* Minor street thru traffic is impeded by all major street traffic.

The concept of stop-controlled or yield-controlled intersection capacity analysis is based on the distribution of gaps in the major street traffic stream and driver judgement selecting gaps through which to execute desired maneuvers. The result of the analysis provides an estimate of excessive or reserved capacity for the various critical movements at unsignalized intersections. Correlations between reserved capacity and the respective levels of service are provided for unsignalized intersections in Table 1.

At signalized intersections, an additional element must be considered - time allocation. Conversely, the level of service is based on the average stop delay for various movements within the intersection. While volume/capacity relationships affect delay, other

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[1]Transportation Research Board, Special Report 209, Highway Capacity Manual for 1985, published by the Transportation Research Board, Washington, D.C., 1985.

TABLE 1

LEVEL OF SERVICE CRITERIA

UNSIGNALIZED INTERSECTIONS[2]

Reserve Capacity3 (PCPH)	Level of Service	Expected Delay to[3] Minor Street Traffic
400	A	Little or no delay
300-399	B	Short traffic delays
200-299	C	Average traffic delays
100-199	D	Long traffic delays
0-99	E	Very Long traffic delays

[2]Transportation Research Board, Special Report 209, Highway Capacity Manual 1985, published by the Transportation Research Board, Washington, DC, 1985.

[3]When demand volume exceeds the capacity of the lane, extreme delays will be encountered with queuing which may cause severe congestion affecting other traffic movements in the intersection. This condition usually warrants improvement to the intersection.

parameters which more strongly affect delay must be considered. Thus, both capacity and level of service must be considered to evaluate the overall operation of the signalized intersection. Correlations between average delay per vehicle and the respective levels of service are provided for signalized intersections in Table 2.

TABLE 2

LEVEL OF SERVICE CRITERIA[4]

SIGNALIZED INTERSECTIONS

Level of Service	Description	Stopped Delay Per Vehicle (Sec.)
A	Very low delay, good progression; most vehicles do not stop at intersection.	5.0
B	Generally good signal progression and/or short cycle length; more vehicles stop at intersection than level of service A.	5.1 to 15.0
C	Fair progression and/or longer cycle length: significant number of vehicles stop at intersection than level of service A.	15.1 to 25.0
D	Congestion becomes noticeable; individual cycle failures; longer delays from unfavorable progression, long cycle length, or high volume/capacity ratios; most vehicles stop at intersection.	25.1 to 40.0
E	Considered limit of acceptable delay, indicative of poor progression, long cycle length, high volume/capacity ratio; frequent individual cycle failures.	40.1 to 60.0
F.	Unacceptable delay, frequently an indication of oversaturation (i.e., arrival flow exceeds capacity).	>60.0

[4]Transportation Research Board, Special Report 209, Highway Capacity Manual 1985, published by the Transportation Research Board, Washington, DC, 1985.

Application of the methodology to the signalized and unsignalized intersections within the Salisbury roadway network, as presented in Table 3, indicate the intersections presently experience delays ranging from little (level of service A) to very long (levels of service E). On average, the existing roadway network operates at adequate Levels-of-Service.

The following sections include an analysis of railroad intersections and recommendations for closure and/or grade separations. Using those recommendations, traffic throughout the roadway network will be redistributed and a new Level-of-Service Analysis will be conducted. Existing traffic volumes, as shown in this section, will be projected upward two (2) percent to represent 1996 traffic and eleven (11) percent to represent 2005.

Appendix "B" shows the detailed computer analysis of the existing Level-of-Service of the intersections.

Table 3
Existing Afternoon Level of Service Analysis
Unsignalized Intersections

Crawford/Railroad

Direction	Delay	Level of Service
Southbound	Little	A
Eastbound Left	Little	A

11th/Richard

Direction	Delay	Level of Service
Northbound	Little	A
Eastbound Left	Little	A
Westbound Left	Little	A
Southbound	Little	A

Knox/Main

Direction	Delay	Level of Service
Westbound Left	Long	D
Westbound Right	Little	A
Southbound Left	Little	A

Military/Main

Direction	Delay	Level of Service
Southbound Left	Little	A
Westbound Left	Long	D

Lafayette/Main

Direction	Delay	Level of Service
Southbound Left	Little	A
Northbound Left	Little	A
Eastbound	Average	C
Westbound	Average	C

Railroad/Henderson

Direction	Delay	Level of Service
Southbound	Little	A
Eastbound Left	Little	A

Council/Long

Direction	Delay	Level of Service
Westbound	Short	B
Eastbound	Average	C
Northbound Left	Little	A
Southbound Left	Little	A

Fisher/Long

Direction	Delay	Level of Service
Northbound Left	Little	A
Eastbound	Long	D
Westbound	Average	C
Southbound Left	Little	A

Table 3 (Cont.)
Existing Afternoon Level of Service Analysis
Unsignalized Intersections

Horah/Long

Direction	Delay	Level of Service
Westbound	Average	C
Eastbound	Very Long	E
Northbound Left	Little	A
Southbound Left	Little	A

Lumber/Main

Direction	Delay	Level of Service
Westbound	Short	B
Southbound Left	Little	A

Mildred/Main

Direction	Delay	Level of Service
Westbound	Average	C
Southbound Left	Little	A

Monroe/Long

Direction	Delay	Level of Service
Eastbound Left	Long	D
Eastbound Right	Little	A
Northbound Left	Little	A

Table 3 (Cont.)
Existing Afternoon Level of Service Analysis
Signalized Intersections

11th/Main

Direction	Delay (sec.)	Level of Service
Southbound	3.4	A
Northbound	3.3	A
Eastbound	13.2	B
Westbound	13	B

Crawford/Main

Direction	Delay (sec.)	Level of Service
Westbound	10.6	B
Northbound	3.5	A
Southbound	3	A

Monroe/Main

Direction	Delay (sec.)	Level of Service
Southbound	3.5	A
Northbound	3.6	A
Eastbound	23.1	C
Westbound	17.2	C

Bank/Long

Direction	Delay (sec.)	Level of Service
Westbound	21	C
Eastbound	22.1	C
Northbound Left	1.7	A
Southbound Left	1.6	A

11th/Long

Direction	Delay (sec.)	Level of Service
Northbound Left	7.5	B
Southbound	6.7	B
Eastbound	17.6	C

Horah/Main

Direction	Delay (sec.)	Level of Service
Eastbound	16.2	C
Westbound	17.4	C
Northbound	4.8	A
Southbound	4.7	A

Bank/Main

Direction	Delay (sec.)	Level of Service
Southbound	5.2	B
Northbound	5.3	B
Westbound	25.3	D

Innes/Main

Direction	Delay (sec.)	Level of Service
Eastbound	7.8	B
Westbound	7	B
Northbound	10.5	B
Southbound	10.3	B

Table 3 (Cont.)
Existing Afternoon Level of Service Analysis
Signalized Intersections

Kerr/Long

Direction	Delay (sec.)	Level of Service
Westbound	15.4	C
Eastbound	12.5	B
Northbound Left	3.4	A
Southbound Left	3.6	A

Henderson/Long

Direction	Delay (sec.)	Level of Service
Eastbound	15.9	C
Westbound Left	11.5	B
Westbound Thru	12.7	B
Northbound Left	2.5	A
Northbound Thru	3.5	A
Southbound Left	2.7	A
Southbound Thru	3.2	A

Innes/Long

Direction	Delay (sec.)	Level of Service
Eastbound Left	50.6	E
Eastbound Thru	27.7	D
Westbound Left	45.7	E
Westbound Thru	19.1	C
Northbound Left	42.2	E
Northbound Thru	26.3	D
Southbound Left	51	E
Southbound Thru	26.2	D

Fisher/Main

Direction	Delay (sec.)	Level of Service
Eastbound Thru	20.5	C
Eastbound Left	16.1	C
Southbound	3.4	A
Northbound	3.5	A

Kerr/Main

Direction	Delay (sec.)	Level of Service
Southbound	5.4	B
Northbound	5.1	B
Westbound	15.7	B
Eastbound	21	C

Liberty/Main

Direction	Delay (sec.)	Level of Service
Southbound	5	B
Northbound	4.9	A
Eastbound	18.1	C
Westbound	13.1	B

Council/Main

Direction	Delay (sec.)	Level of Service
Westbound	16.7	C
Northbound	3.4	A
Southbound	3.6	A

FUTURE CONDITIONS ANALYSIS

The existing roadway network has been modeled and Levels-of-Service shown in previous sections, and future traffic projections can now be made based on calculated growth rates supplied by the North Carolina Department of Transportation and adjusted by the consultant. For this analysis, the Design Year will be 1996. Traffic is projected to grow at approximately 2% during this period. Additional analysis will be conducted for the year 2004, when traffic is expected to grow at approximately 10% to 12%. For this report, 11% growth was used.

Before implementing the recommended closures and/or grade separations, the existing roadway network was reanalyzed based on the future growth projections noted above. As seen in Table 4, no intersection, under the current roadway configurations, will experience failures in levels of service in either 1996 or 2004. (See Appendix "C" for future Levels-of-Service Analysis without improvements).

It is important to note from Table 4 the existing roadway network in Salisbury is capable of handling additional traffic at key intersections.

Table 4
1996 Afternoon Level of Service Analysis - NO IMPROVEMENTS
Unsignalized Intersections

Crawford/Railroad

Direction	Delay	Level of Service
Southbound	Little	A
Eastbound Left	Little	A

Knox/Main

Direction	Delay	Level of Service
Westbound Left	Long	D
Westbound Right	Little	A
Southbound Left	Little	A

Lafayette/Main

Direction	Delay	Level of Service
Southbound Left	Little	A
Northbound Left	Little	A
Eastbound	Average	C
Westbound	Average	C

Council/Long

Direction	Delay	Level of Service
Westbound	Short	B
Eastbound	Average	C
Northbound Left	Little	A
Southbound Left	Little	A

11th/Richard

Direction	Delay	Level of Service
Northbound	Little	A
Eastbound Left	Little	A
Westbound Left	Little	A
Southbound	Little	A

Military/Main

Direction	Delay	Level of Service
Southbound Left	Little	A
Westbound Left	Long	D

Railroad/Henderson

Direction	Delay	Level of Service
Southbound	Little	A
Eastbound Left	Little	A

Fisher/Long

Direction	Delay	Level of Service
Northbound Left	Little	A
Eastbound	Long	D
Westbound	Average	C
Southbound Left	Little	A

Table 4 (Cont.)
1996 Afternoon Level of Service Analysis - NO IMPROVEMENTS
Unsignalized Intersections

Horah/Long

Direction	Delay	Level of Service
Westbound	Average	C
Eastbound	Very Long	E
Northbound Left	Little	A
Southbound Left	Little	A

Lumber/Main

Direction	Delay	Level of Service
Westbound	Short	B
Southbound Left	Little	A

Mildred/Main

Direction	Delay	Level of Service
Westbound	Average	C
Southbound Left	Little	A

Monroe/Long

Direction	Delay	Level of Service
Eastbound Left	Long	D
Eastbound Right	Little	A
Northbound Left	Little	A

Table 4 (Cont.)
1996 Afternoon Level of Service Analysis - NO IMPROVEMENTS
Signalized Intersections

11th/Main

Direction	Delay (sec.)	Level of Service
Southbound	3.5	A
Northbound	3.4	A
Eastbound	13.4	B
Westbound	13.1	B

11th/Long

Direction	Delay (sec.)	Level of Service
Northbound Left	7.6	B
Southbound	6.8	B
Eastbound	17.8	C

Crawford/Main

Direction	Delay (sec.)	Level of Service
Westbound	10.7	B
Northbound	3.6	A
Southbound	3	A

Horah/Main

Direction	Delay (sec.)	Level of Service
Eastbound	16.4	C
Westbound	17.7	C
Northbound	4.8	A
Southbound	4.8	A

Monroe/Main

Direction	Delay (sec.)	Level of Service
Southbound	3.5	A
Northbound	3.6	A
Eastbound	23.6	C
Westbound	17.3	C

Bank/Main

Direction	Delay (sec.)	Level of Service
Southbound	5.3	B
Northbound	5.4	B
Westbound	26.6	D

Bank/Long

Direction	Delay (sec.)	Level of Service
Westbound	21	C
Eastbound	22.2	C
Northbound Left	1.7	A
Southbound Left	1.6	A

Innes/Main

Direction	Delay (sec.)	Level of Service
Eastbound	7.9	B
Westbound	7.1	B
Northbound	10.5	B
Southbound	10.3	B

Table 4 (Cont.)
1996 Afternoon Level of Service Analysis - NO IMPROVEMENTS
Signalized Intersections

Kerr/Long

Direction	Delay (sec.)	Level of Service
Westbound	15.6	C
Eastbound	12.5	B
Northbound Left	3.4	A
Southbound Left	3.6	A

Henderson/Long

Direction	Delay (sec.)	Level of Service
Eastbound	16.1	C
Westbound Left	11.5	B
Westbound Thru	12.8	B
Northbound Left	2.5	A
Northbound Thru	3.6	A
Southbound Left	2.7	A
Southbound Thru	3.2	A

Innes/Long

Direction	Delay (sec.)	Level of Service
Eastbound Left	51.3	E
Eastbound Thru	28.9	D
Westbound Left	45.9	E
Westbound Thru	19.3	C
Northbound Left	42.3	E
Northbound Thru	26.4	D
Southbound Left	52	E
Southbound Thru	26.3	D

Fisher/Main

Direction	Delay (sec.)	Level of Service
Eastbound Thru	20.9	C
Eastbound Left	16.2	C
Southbound	3.4	A
Northbound	3.5	A

Kerr/Main

Direction	Delay (sec.)	Level of Service
Southbound	5.4	B
Northbound	5.1	B
Westbound	15.9	B
Eastbound	21.7	C

Liberty/Main

Direction	Delay (sec.)	Level of Service
Southbound	5.1	B
Northbound	4.9	A
Eastbound	18.1	C
Westbound	13.2	B

Council/Main

Direction	Delay (sec.)	Level of Service
Westbound	16.8	C
Northbound	3.5	A
Southbound	3.6	A

Table 4 (Cont.)
2004 Afternoon Level of Service Analysis - NO IMPROVEMENTS
Unsignalized Intersections

Crawford/Railroad

Direction	Delay	Level of Service
Southbound	Little	A
Eastbound Left	Little	A

Knox/Main

Direction	Delay	Level of Service
Westbound Left	Long	D
Westbound Right	Little	A
Southbound Left	Little	A

Lafayette/Main

Direction	Delay	Level of Service
Southbound Left	Little	A
Northbound Left	Little	A
Eastbound	Average	C
Westbound	Average	C

Council/Long

Direction	Delay	Level of Service
Westbound	Average	C
Eastbound	Average	C
Northbound Left	Little	A
Southbound Left	Little	A

11th/Richard

Direction	Delay	Level of Service
Northbound	Little	A
Eastbound Left	Little	A
Westbound Left	Little	A
Southbound	Little	A

Military/Main

Direction	Delay	Level of Service
Southbound Left	Little	A
Westbound Left	Long	D

Railroad/Henderson

Direction	Delay	Level of Service
Southbound	Little	A
Eastbound Left	Little	A

Fisher/Long

Direction	Delay	Level of Service
Northbound Left	Little	A
Eastbound	Very Long	E
Westbound	Long	D
Southbound Left	Little	A

Table 4 (Cont.)
2004 Afternoon Level of Service Analysis - NO IMPROVEMENTS
Unsignalized Intersections

Horah/Long

Direction	Delay	Level of Service
Westbound	Long	D
Eastbound	Very Long	E
Northbound Left	Little	A
Southbound Left	Little	A

Mildred/Main

Direction	Delay	Level of Service
Westbound	Average	C
Southbound Left	Little	A

Lumber/Main

Direction	Delay	Level of Service
Westbound	Short	B
Southbound Left	Little	A

Monroe/Long

Direction	Delay	Level of Service
Eastbound Left	Long	D
Eastbound Right	Little	A
Northbound Left	Little	A

Table 4 (Cont.)

2004 Afternoon Level of Service Analysis - NO IMPROVEMENTS

Signalized Intersections

11th/Main

Direction	Delay (sec.)	Level of Service
Southbound	3.5	A
Northbound	3.4	A
Eastbound	14.2	B
Westbound	13.6	B

Crawford/Main

Direction	Delay (sec.)	Level of Service
Westbound	18.9	C
Northbound	4	A
Southbound	3.2	A

Monroe/Main

Direction	Delay (sec.)	Level of Service
Southbound	3.5	A
Northbound	3.7	A
Eastbound	26.9	D
Westbound	17.7	C

Bank/Long

Direction	Delay (sec.)	Level of Service
Westbound	21.1	C
Eastbound	22.6	C
Northbound Left	1.7	A
Southbound Left	1.7	A

11th/Long

Direction	Delay (sec.)	Level of Service
Northbound Left	8.2	B
Southbound	7	B
Eastbound	18.7	C

Horah/Main

Direction	Delay (sec.)	Level of Service
Eastbound	17.5	C
Westbound	19.3	C
Northbound	4.9	A
Southbound	4.9	A

Bank/Main

Direction	Delay (sec.)	Level of Service
Southbound	5.4	B
Northbound	5.5	B
Westbound	33.5	D

Innes/Main

Direction	Delay (sec.)	Level of Service
Eastbound	8.4	B
Westbound	7.4	B
Northbound	10.8	B
Southbound	10.6	B

Table 4 (Cont.)
2004 Afternoon Level of Service Analysis - NO IMPROVEMENTS
Signalized Intersections

Kerr/Long

Direction	Delay (sec.)	Level of Service
Westbound	17.1	C
Eastbound	12.7	B
Northbound Left	3.4	A
Southbound Left	3.7	A

Henderson/Long

Direction	Delay (sec.)	Level of Service
Eastbound	18.1	C
Westbound Left	11.6	B
Westbound Thru	13.1	B
Northbound Left	2.5	A
Northbound Thru	3.7	A
Southbound Left	2.8	A
Southbound Thru	3.3	A

Innes/Long

Direction	Delay (sec.)	Level of Service
Eastbound Left	54.2	E
Eastbound Thru	37.9	D
Westbound Left	46.6	E
Westbound Thru	19.9	C
Northbound Left	42.8	E
Northbound Thru	26.9	D
Southbound Left	56.7	E
Southbound Thru	26.7	D

Fisher/Main

Direction	Delay (sec.)	Level of Service
Eastbound Thru	22.4	C
Eastbound Left	16.2	C
Southbound	3.5	A
Northbound	3.6	A

Kerr/Main

Direction	Delay (sec.)	Level of Service
Southbound	5.6	B
Northbound	5.2	B
Westbound	16.4	C
Eastbound	21.3	C

Liberty/Main

Direction	Delay (sec.)	Level of Service
Southbound	5.2	B
Northbound	4.9	A
Eastbound	21.3	C
Westbound	13.2	B

Council/Main

Direction	Delay (sec.)	Level of Service
Westbound	17	C
Northbound	3.5	A
Southbound	3.7	A

RECOMMENDATIONS

The purpose of this study is to carefully analyze the intersections of the railroad with the Salisbury roadway network. Thorough analysis will lead to recommendations of intersections for closure and others for construction of a grade-separated intersection. It should be strongly emphasized the recommendations are based on safety for drivers and passengers in vehicles as well as for the railroad and its operators.

The North Carolina Department of Transportation and the State of North Carolina intend to develop a high speed rail corridor between Raleigh and Charlotte. Only with safe railroad and roadway intersections will the project become a reality.

As a first step towards implementation of the high speed rail corridor, the North Carolina Department of Transportation, along with Hobbs, Upchurch & Associates, P.A. conducted a detailed survey of private and public intersections along the North Carolina Railroad between Raleigh and Charlotte. Complete files were developed for each intersection, including ATR counts over the railroad, site distance analysis, signage and signalization analysis, and an overall safety analysis. The survey is the basis of this study.

The consultant cannot stress enough the importance of safety in establishing closure recommendations. While Salisbury is an older, well-established community, drivers and business people must realize safety, not convenience, must be the paramount concern. In most cases, intersections recommended for closure will have an alternative crossing, usually on both sides of the closed intersection, one city block away. In other words, alternate access routes across the railroad will be less than one quarter mile and usually one eighth or one sixteenth of a mile from the closed intersection. Drivers must realize the inconvenience of losing 1 to 3 minutes of travel time is offset by the overall added safety of crossing the railroad.

With the above ideas in mind, and after careful analysis of various scenarios, the following pages provide three phases of recommendations based on this study's results.

Phase 1 consists of recommendations which can be implemented almost immediately at low relative cost. Phase 2 improvements can be implemented within the next 5 years with moderate to high costs, depending on the improvement. Phase 3 recommendations can be implemented within the next 10-15 years and will have higher costs due to structural changes.

Please note the NCDOT should coordinate and fund all recommended improvements that include new pavement markings and new/improved railroad warning signalization, either in whole or in large part.

PHASE 1

1. CLOSURE OF "C" AVENUE INTERSECTION: "C" Avenue and "D" Avenue operate as access to an industry east of the railroad. Both intersections have low AADT counts. From information provided by local users, "C" Avenue is used primarily by the industry for commercial purposes. Combining the crossings into one intersection at "D" Avenue should not affect the area's roadway accessibility. The two streets are only a block - less than 1/8th of a mile - apart. Traffic volumes in the area were low enough not to warrant a detailed Level-of-Service Analysis.

   The intersections at "D" Avenue and Julian Street should also be brought up to standard in signage, pavement markings, and signalization. Foliage should be trimmed to facilitate maximum site distance, and the grade of "D" Avenue should be adjusted to allow larger vehicles to cross more easily and safely. Signage and signalization improvements should be coordinated with the NCDOT, with costs incurred through the NCDOT.

   Figure 7 shows the new roadway configuration. Figures 8 and 9 show the proposed intersection improvements.

   Approximate Costs for Improvements

   "D" Avenue

   Grade adjustment, including grading and paving = $7,000.00

   Julian Road

   Foilage trimming = $600.00

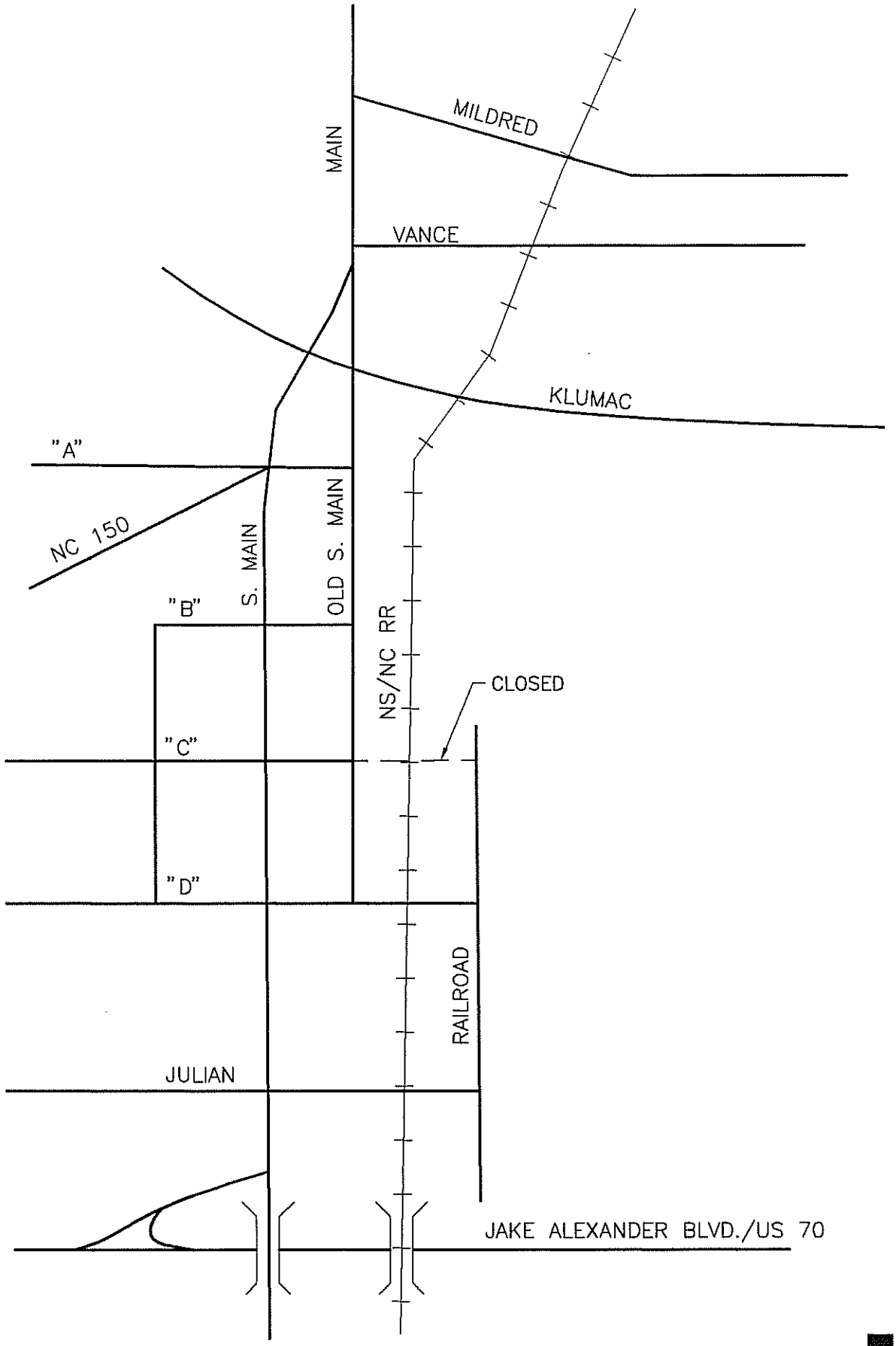

FIG. 7

CLOSURE OF "C" AVENUE

N.T.S.

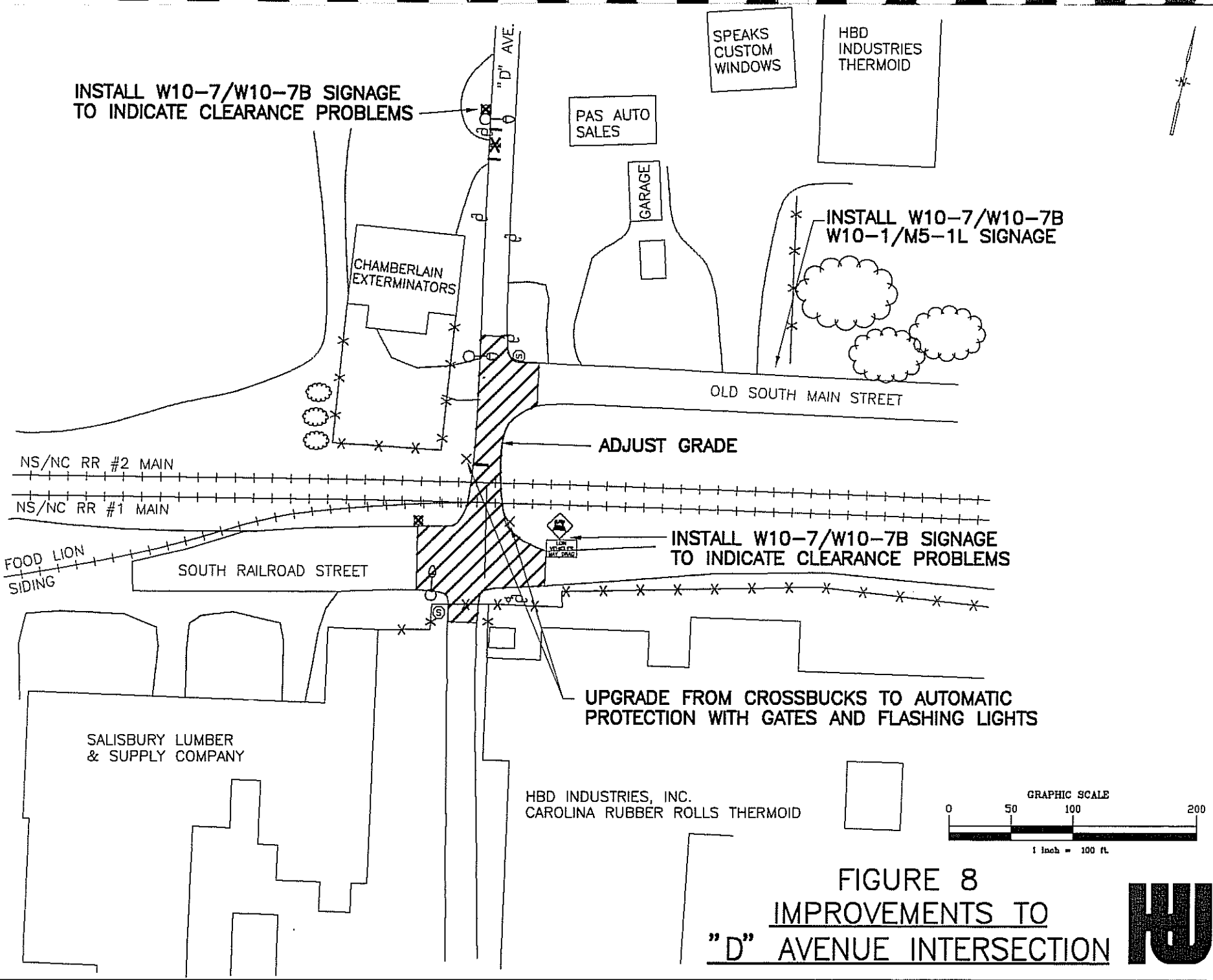

FIGURE 8
IMPROVEMENTS TO
"D" AVENUE INTERSECTION

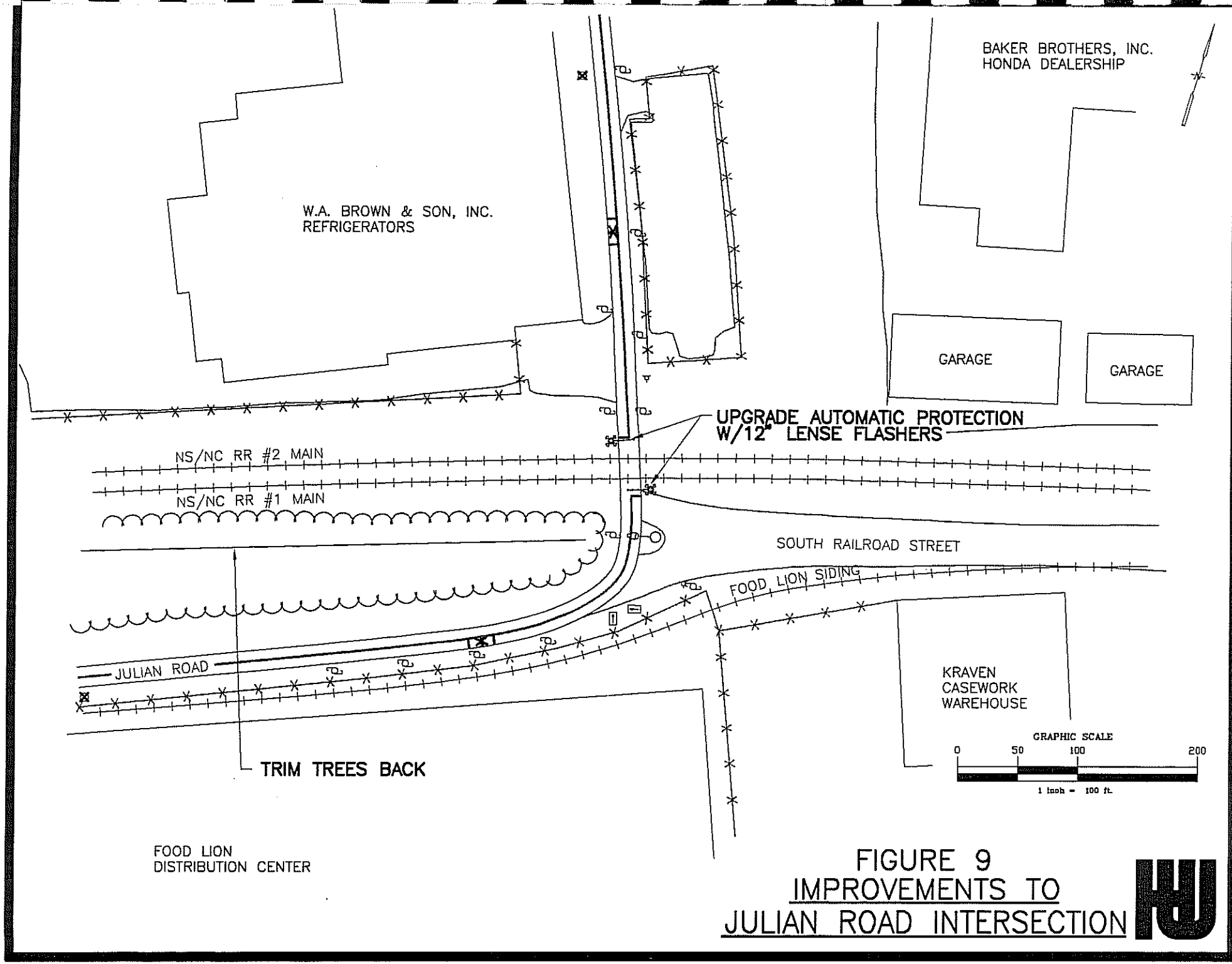

FIGURE 9
IMPROVEMENTS TO
JULIAN ROAD INTERSECTION

2. CLOSURE OF KNOX STREET: Because of the low AADT volumes at Knox Street, the presence of a grade-separated intersection on Military Avenue less than 1/8th of a mile away and a signalized intersection at Crawford Street and Main Street, also less than 1/8th of a mile away, Knox Street could be closed with relatively little impact to the area. As a further analysis, the traffic was redistributed on Crawford Street and Military Avenue, shown in Figure 10, and a Level-of-Service Analysis was conducted. Table 5 shows the Level-of-Service Analysis for the intersections of Crawford and Main and Military and Main in 1996 and 2004. As shown in Table 5, by closing Knox Street and redistributing traffic on Military Avenue and Crawford Street, there is little to no difference in the Levels-of-Service from existing conditions shown in Table 3.

The peak periods that were used for the Level-of-Service Analysis at Crawford Street not only accounted for the normal peak period between 4:00 - 6:00 p.m., but also for the peak period of an industrial plant in the area. The plant's shifts are 7:00 a.m. to 3:00 p.m. and 3:00 p.m. to 11:00 p.m. The 3:00 p.m. peak, which is the plant's highest traffic peak, has approximately the same counts as the normal afternoon peak, therefore, the Level-of-Service will not be affected.

In addition, foliage trimming for sight distance, earthwork construction and grade repairs should be completed at Crawford Street to facilitate safer crossings, as shown in Figure 11.

Approximate Costs for Improvements

Crawford Street

Foilage Trimming =	$600.00
Earthwork and Grading =	$8,000.00

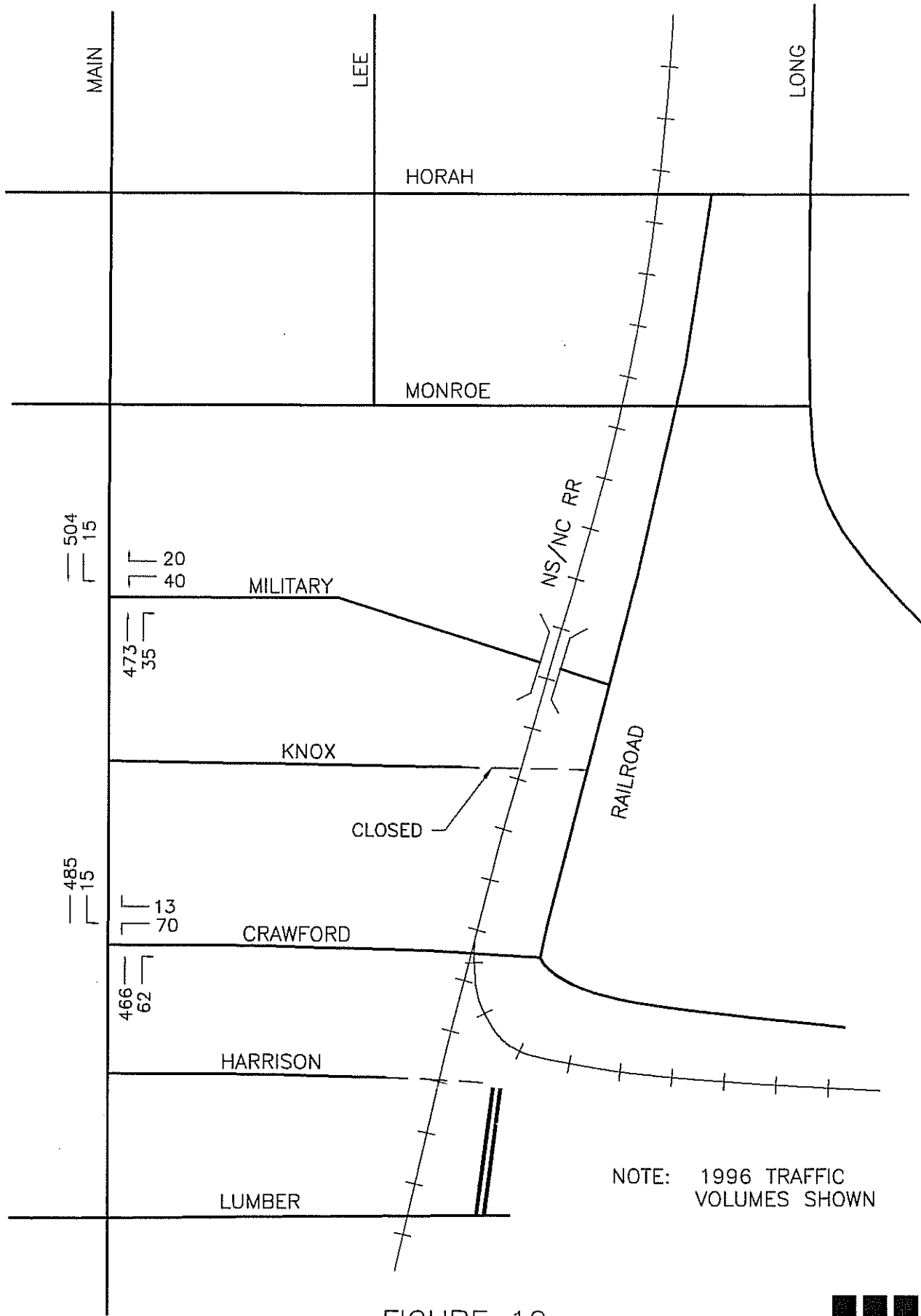

FIGURE 10

CLOSURE OF KNOX STREET

N.T.S.

Table 5

RECOMMENDATION #3 - Closure of Knox Street

Level of Service Analysis for Unsignalized and Signalized Intersections

1996

Military/Main

Direction	Delay	Level of Service
Westbound	Long	D
Southbound Left	Little	A

Crawford/Main

Direction	Delay	Level of Service
Southbound Left	3	A
Westbound	10.7	B
Northbound	3.6	A

2004

Military/Main

Direction	Delay	Level of Service
Westbound	Long	D
Southbound Left	Little	A

Crawford/Main

Direction	Delay	Level of Service
Southbound Left	3.2	A
Westbound	10.8	B
Northbound	4	A

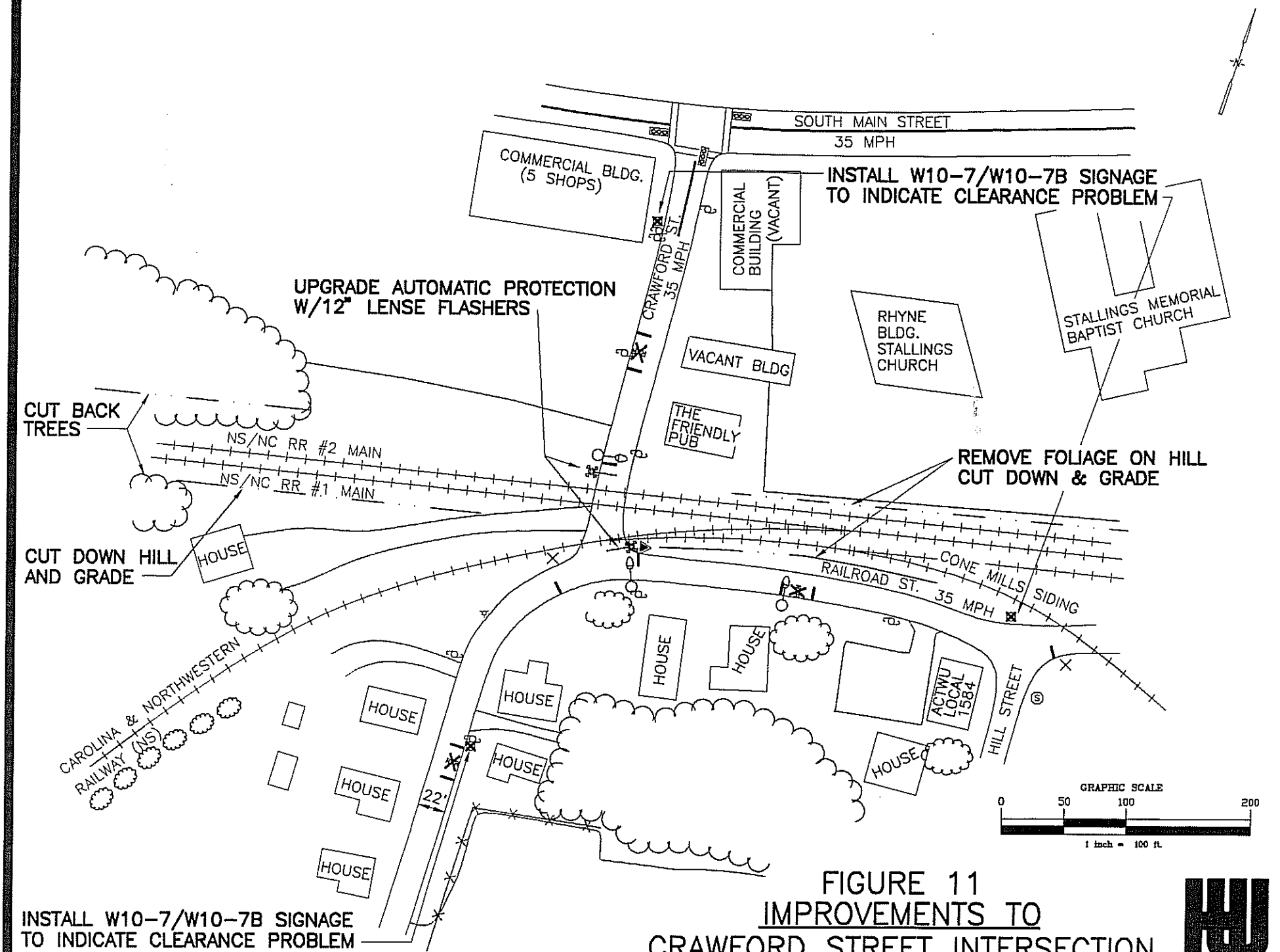

FIGURE 11
IMPROVEMENTS TO
CRAWFORD STREET INTERSECTION

PHASE 1

3. CLOSURE OF MONROE STREET: After very careful and detailed analyses of the combination Monroe/ Horah roadway network, it is recommended the Monroe Street intersection be closed and the traffic rerouted through the Horah Street intersection. After discussions with the engineering staff of the City of Salisbury, site visits and conducting Manual Turning Movement Counts, it is determined that closing Monroe Street and rerouting the traffic will not have an adverse impact on the surrounding intersections. Table 6 shows a detailed Level-of-Service Analysis for the redistribution of the traffic in 1996 and in 2004, as shown in Figure 12. Please note that signal timings were optimized in order to facilitate the optimum Level-of-Service for the intersections. Figure 13 shows recommended improvements at the Horah Street intersection.

This determination was made based on the following observations:

A. Monroe Street west of the tracks was utilized by vehicles to a greater extent than Horah Street.

B. Horah Street east of the tracks was utilized to a greater extent than Monroe Street.

C. Traffic will make the transition from Monroe to Horah Street mostly on Main Street, while some vehicles will travel along further to Lee Street. Figure 10 shows the traffic volumes in 1996 redistributed to reflect the closure of Monroe Street.

Additional recommendations that are included in Table 6 are:

A. Installation of signalization at Horah and Long.

B. Adding left turn lanes to the east and west bound approaches at Horah and Main. (Optional)

Approximate Costs for Improvements

Horah Street

Foilage Trimming =	$500.00
Building Demolition and Removal =	$4,000.00
Signal installation at Long Street =	$48,000.00
Lane additions at Long Street (not including right-of-way) =	$8,000.00

Table 6

RECOMMENDATION #4 - Closure of Monroe Street
Level of Service Analysis for Unsignalized and Signalized Intersections

1996

Horah/Long (Unsignalized)

Direction	Delay	Level of Service
Westbound	Long	D
Eastbound	Very Long	F
Northbound	Little	A
Southbound	Little	A

Horah/Long (Signalized)

Direction	Delay	Level of Service
Westbound	11.5	B
Eastbound	24.1	C
Southbound	8.1	B
Northbound	7.6	B

Monroe/Main

Direction	Delay	Level of Service
Southbound	8.9	B
Northbound	9.3	B
Eastbound	12.9	B
Westbound	23.9	C

Horah/Main

Direction	Delay	Level of Service
Southbound	8.9	B
Northbound	9.4	B
Eastbound	12.4	B
Westbound	21.4	C

Horah/Main (added E/W left turn lanes)

Direction	Delay	Level of Service
Northbound	6.5	B
Eastbound	14.1	B
Westbound	15.5	C
Southbound	5.2	B

Table 6 (Cont.)

RECOMMENDATION #4 - Closure of Monroe Street

Level of Service Analysis for Unsignalized and Signalized Intersections

2004

Horah/Long (Unsignalized)

Direction	Delay	Level of Service
.	Long	D
Eastbound	Very Long	F
Northbound	Little	A
Southbound	Little	A

Horah/Long (Signalized)

Direction	Delay	Level of Service
Westbound	10.9	B
Eastbound	23.5	C
Southbound	9.9	B
Northbound	9.3	B

Monroe/Main

Direction	Delay	Level of Service
Southbound	7.6	B
Northbound	7.5	B
Eastbound	10.2	B
Westbound	13.3	B

Horah/Main

Direction	Delay	Level of Service
Southbound	8.4	B
Northbound	8.9	B
Eastbound	12.2	B
Westbound	22.3	C

Horah/Main (added E/W left turn lanes)

Direction	Delay	Level of Service
Northbound	5	A
Eastbound	14.2	B
Westbound	15.9	C
Southbound	4.7	A

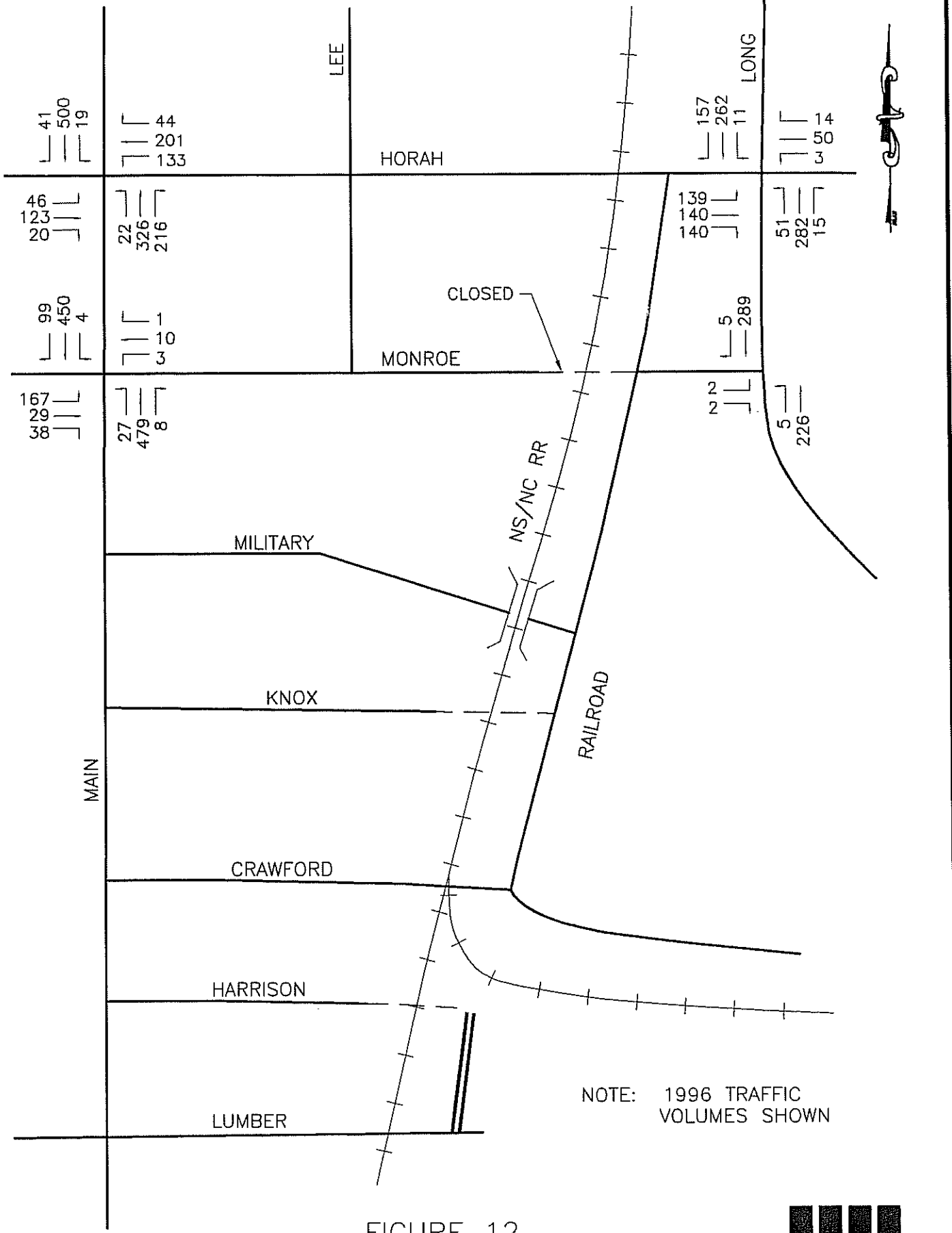

FIGURE 12

CLOSURE OF MONROE STREET

N.T.S.

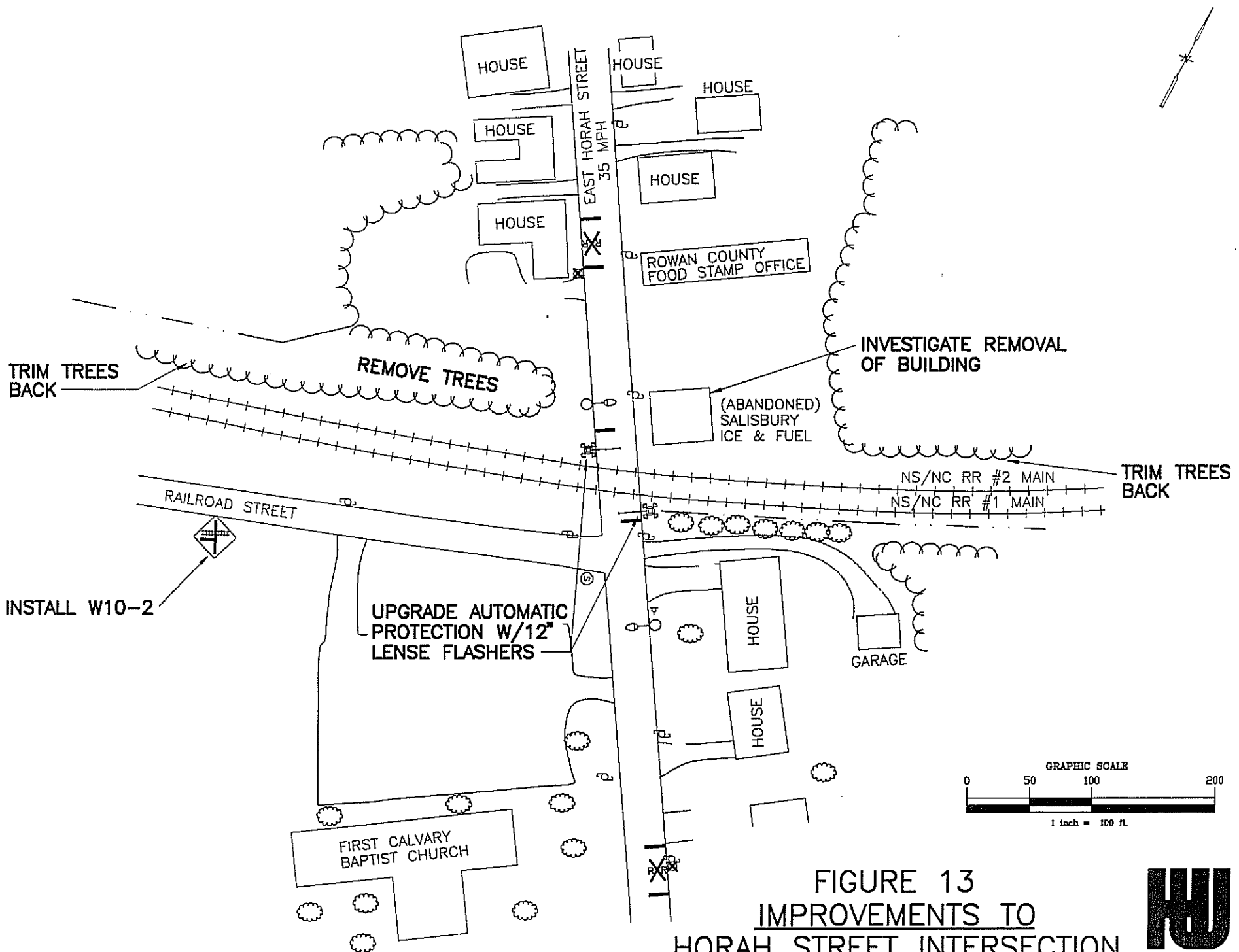

FIGURE 13
IMPROVEMENTS TO
HORAH STREET INTERSECTION

4. OTHER IMPROVEMENTS: Other intersections in the area which are not candidates for closure in Phase 1 require improvements. These intersections and cost estimates are shown in the following pages.

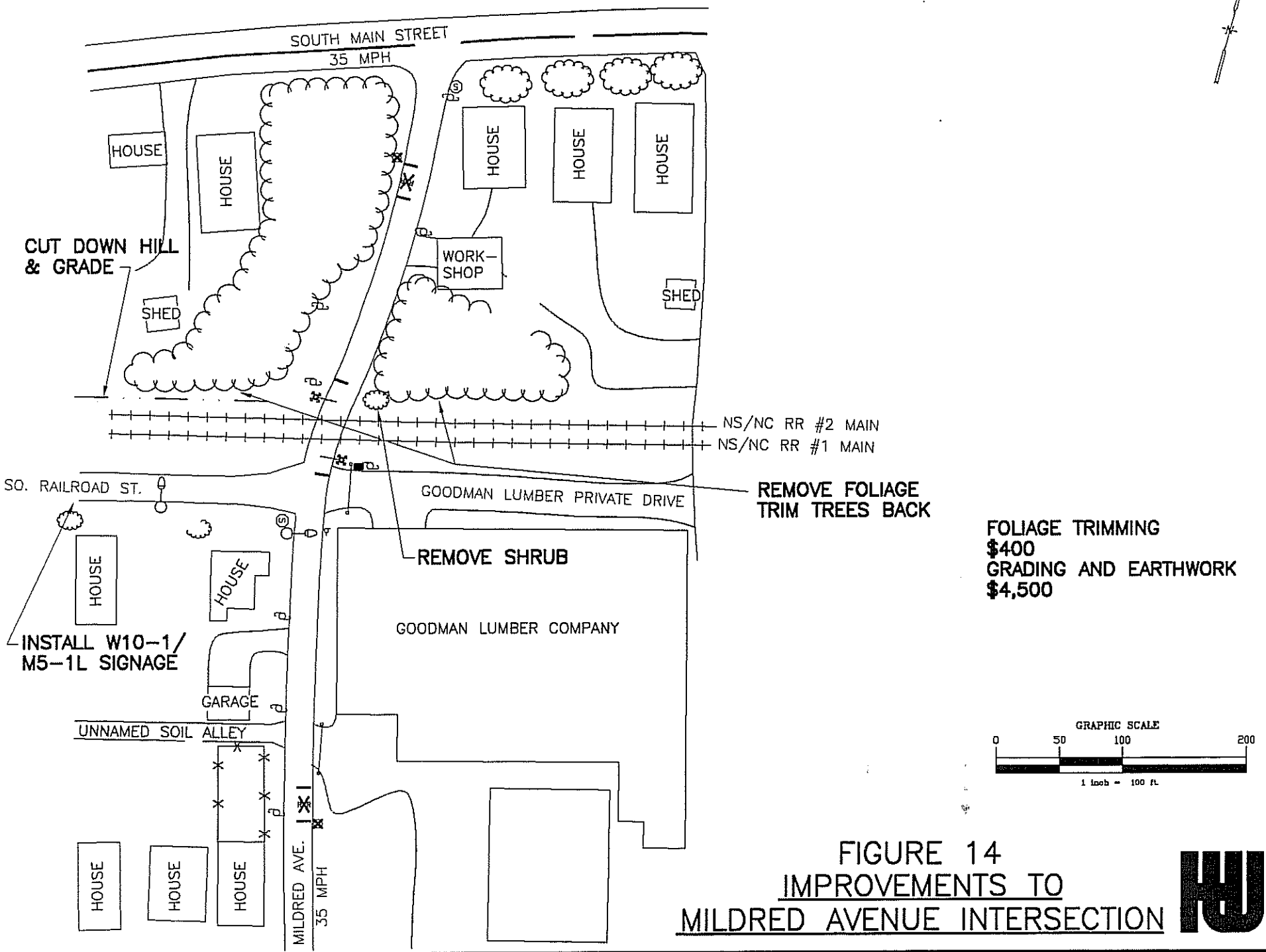

FIGURE 14
IMPROVEMENTS TO MILDRED AVENUE INTERSECTION

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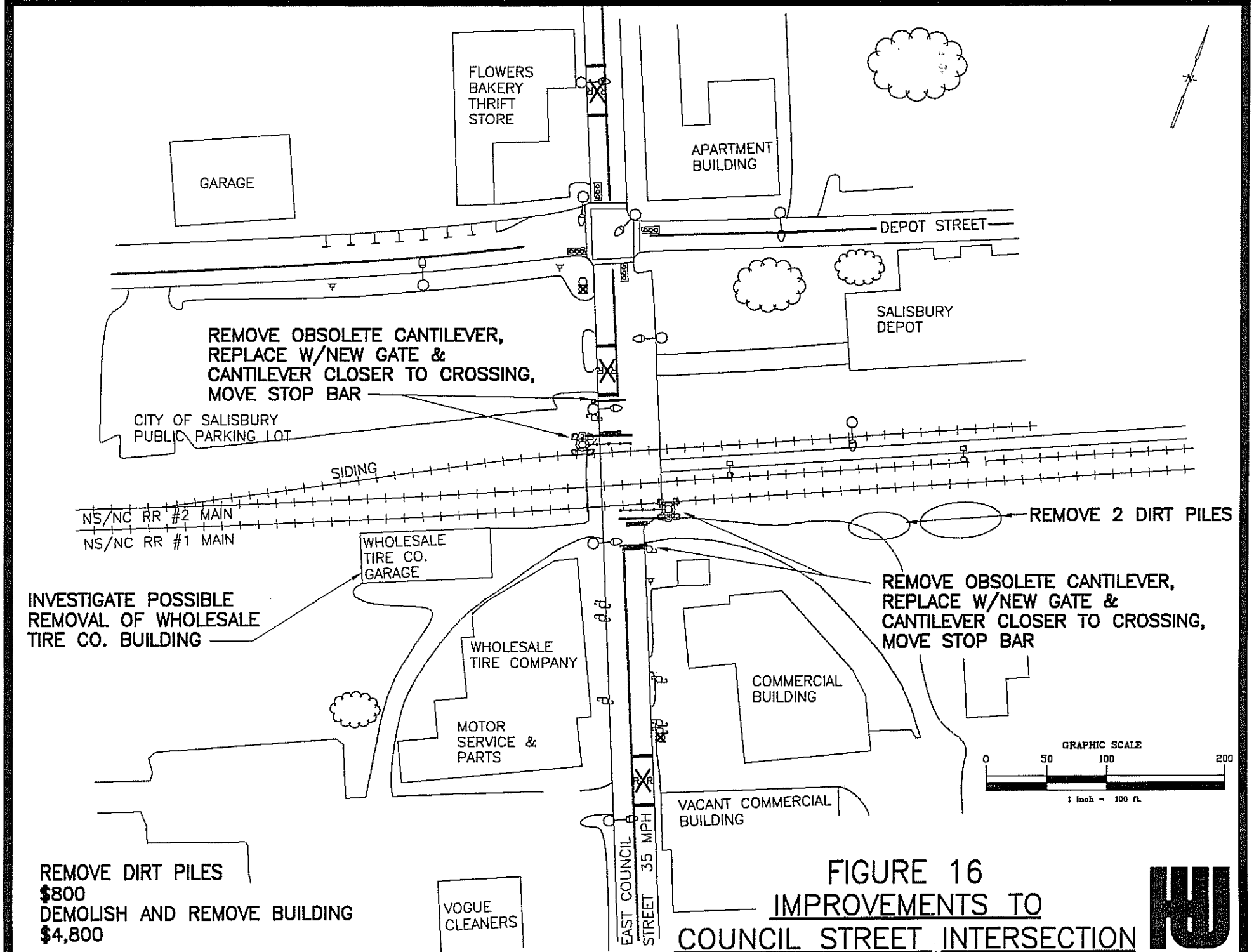

FIGURE 16
IMPROVEMENTS TO COUNCIL STREET INTERSECTION

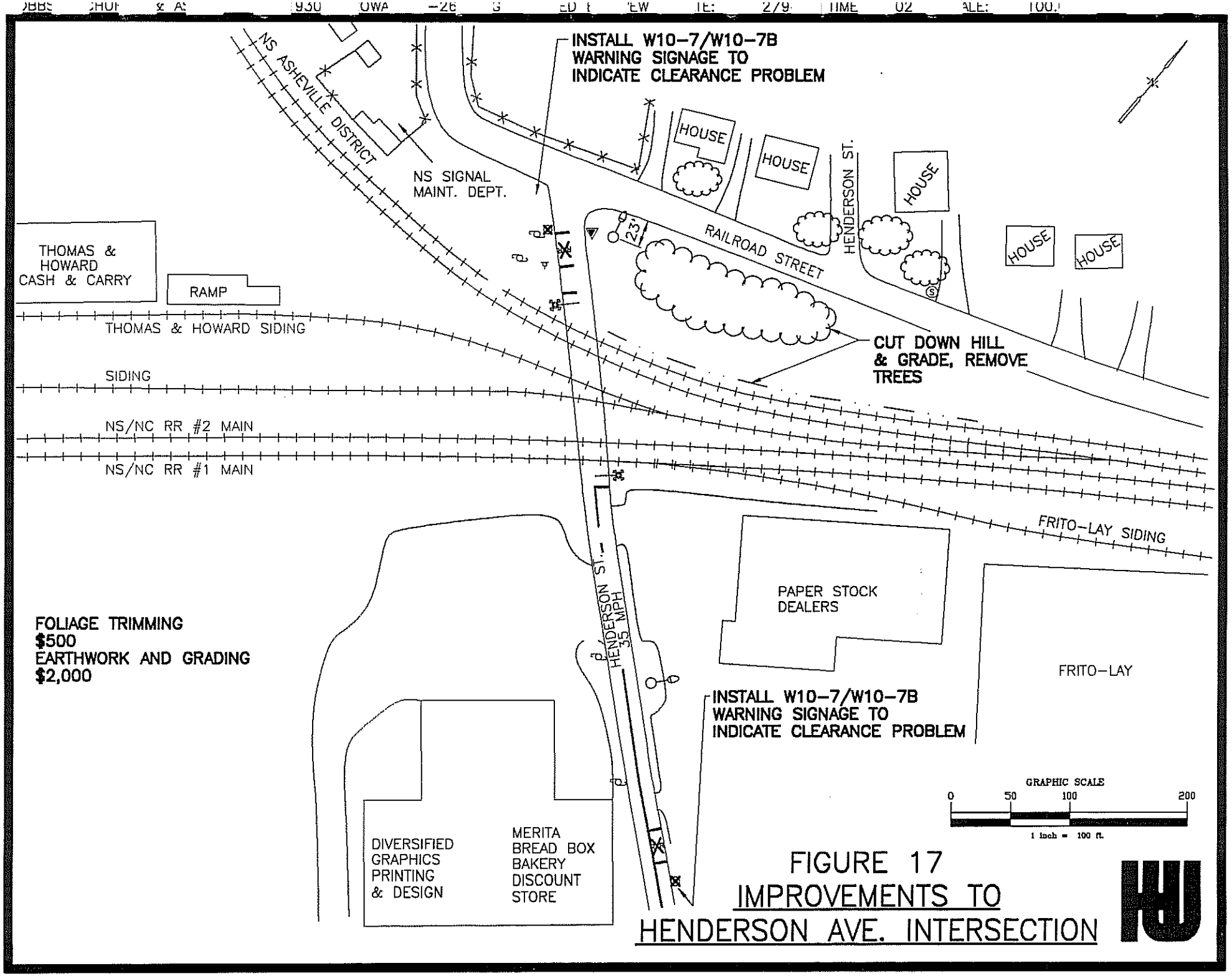

FIGURE 17
IMPROVEMENTS TO HENDERSON AVE. INTERSECTION

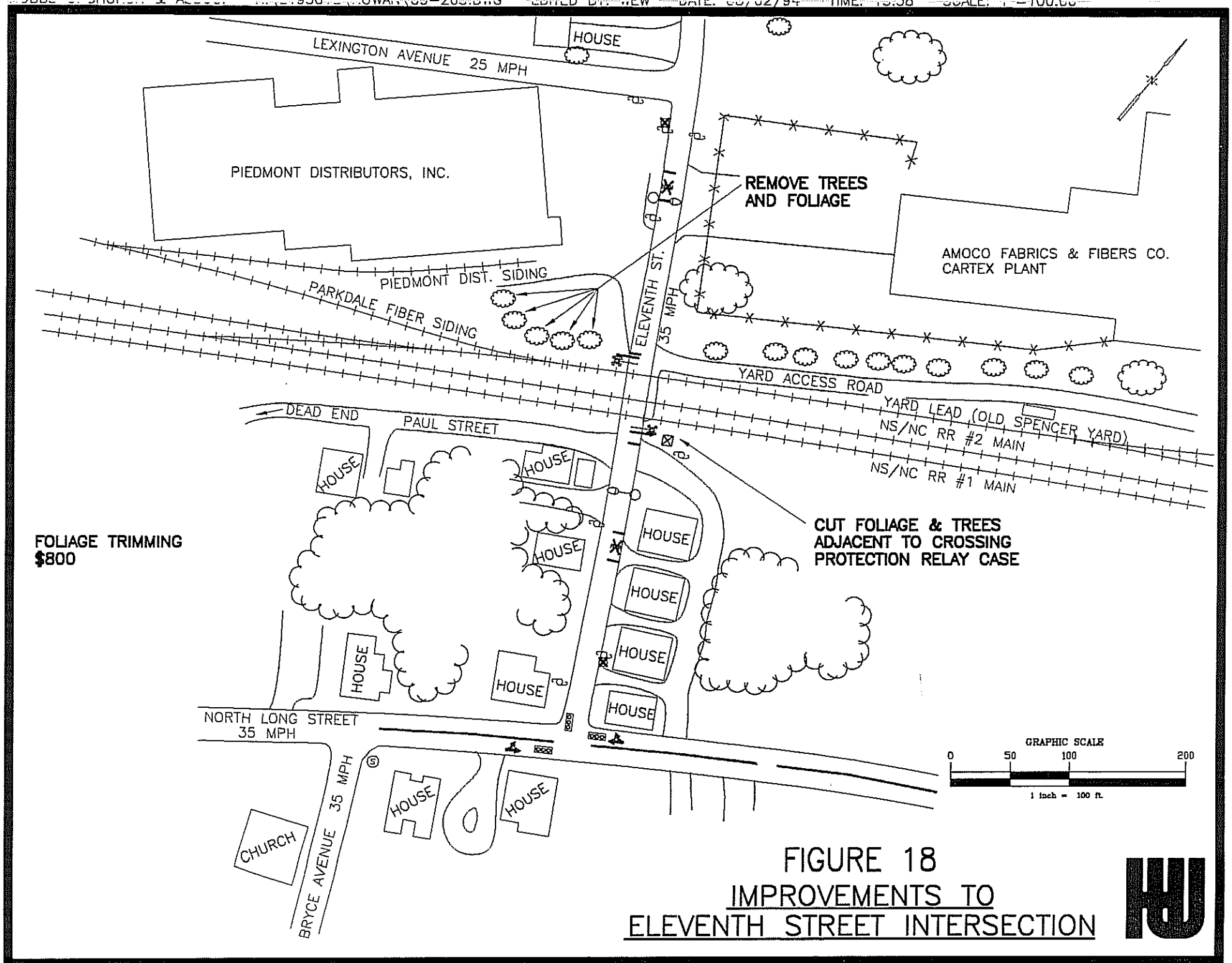

FIGURE 18
IMPROVEMENTS TO ELEVENTH STREET INTERSECTION

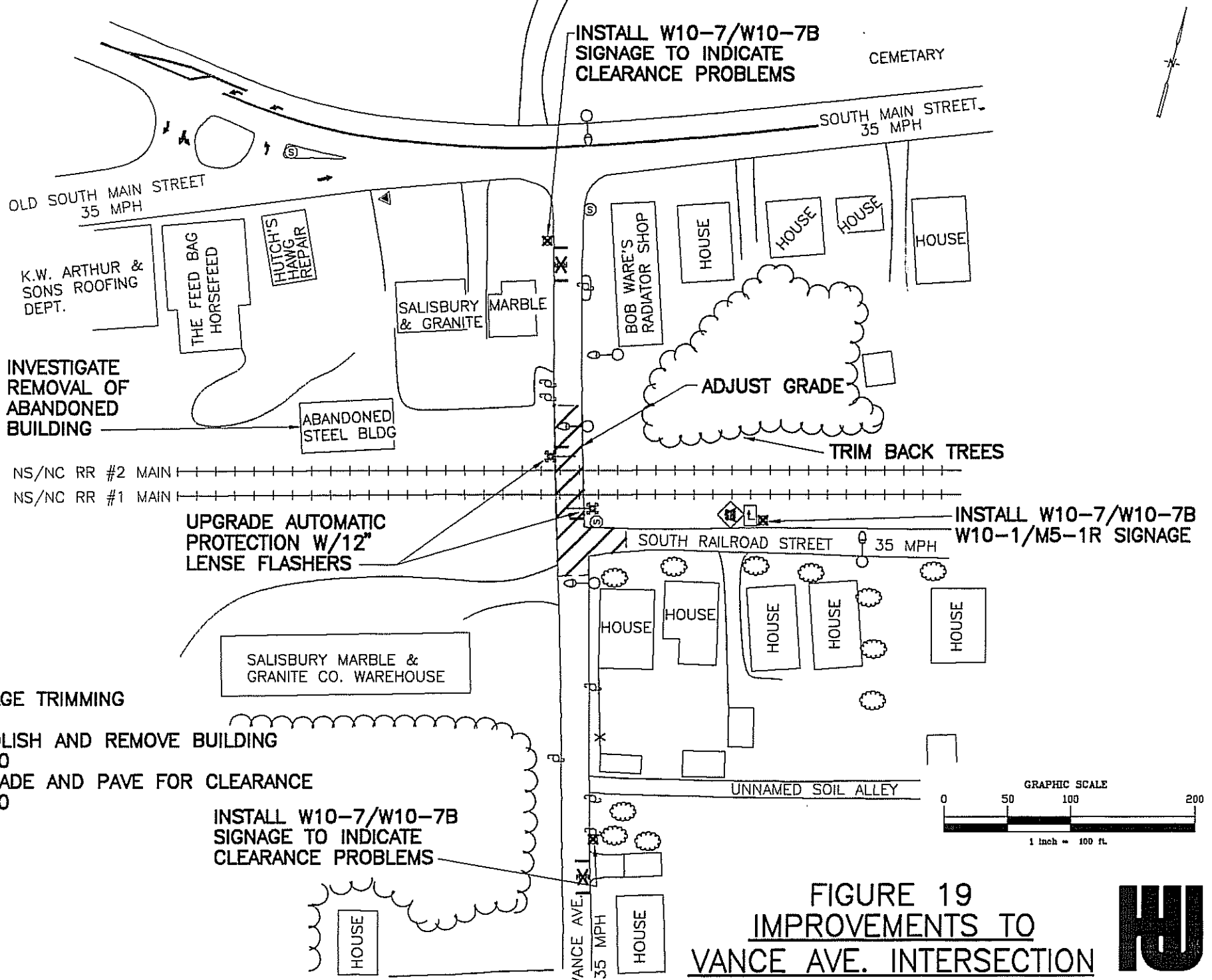

FIGURE 19
IMPROVEMENTS TO VANCE AVE. INTERSECTION

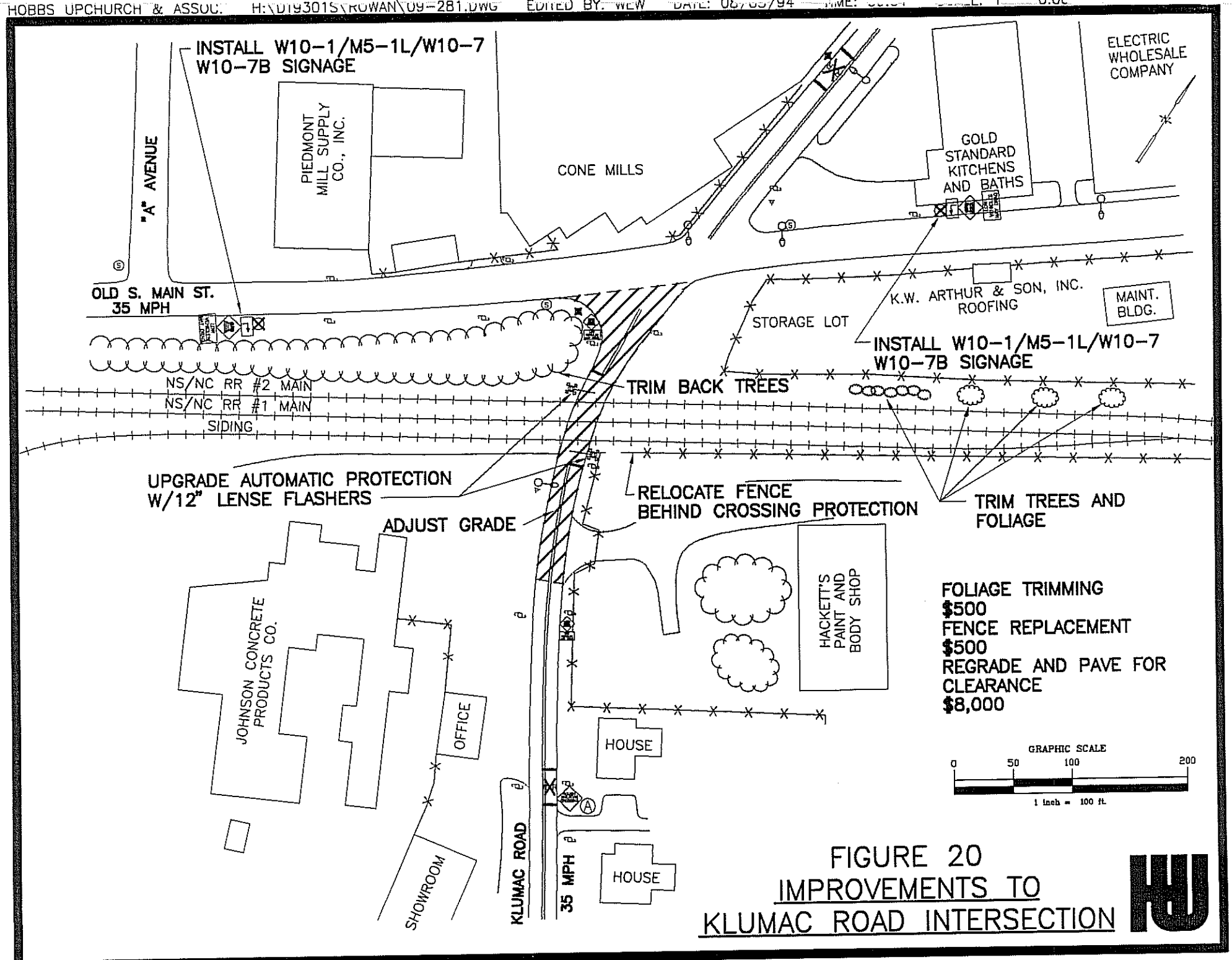

FIGURE 20
IMPROVEMENTS TO KLUMAC ROAD INTERSECTION

PHASE 2

5. CLOSURE OF MILDRED AVENUE AND CLOSURE OF HARRISON STREET: Due to low AADT volumes at Harrison Street and Mildred Avenue, better intersections at Vance Avenue, and the improved intersection at Lumber Street, the intersections at Mildred and Harrison can be closed. The intersections at Vance Avenue and Klumac Road should both be maintained from overgrown foliage to retain maximum site distance. In addition, pavement markings, signage, and signalization should all be brought to standard to facilitate the safety of these intersections.

Because of the closure of these intersections, access to this area must be provided from an alternate route. After consulting with the engineering staff of the City of Salisbury and doing preliminary site reconnaissance and preliminary design and analysis, the following recommendations should be included with the closure of Harrison and Mildred Streets:

2.A. New Access Road: As shown in Figure 21, an access road, 20 to 24 feet wide, can be constructed to link Harrison and Lumber Streets. The ATR counts over the railroad show very little usage of Harrison Street. Therefore, traffic along this access road should be light.

2.B. Link Lumber Street with Boundary Street: Lumber Street can be extended to Boundary Street to provide access not only to Lumber Street but to Mildred Avenue from Boundary Street. This link will require an additional 300+ feet of pavement. This is a relatively inexpensive improvement that could greatly improve access to this area for the circulation of truck traffic while at the same time protect the residential neighborhood to the south from the trucks. Since the Lumber Street intersection is being widened and improved, this recommendation seems logical.

Figure 8 shows the new roadway configuration. The traffic volumes were not high enough to warrant a detailed Level-of-Service Analysis.

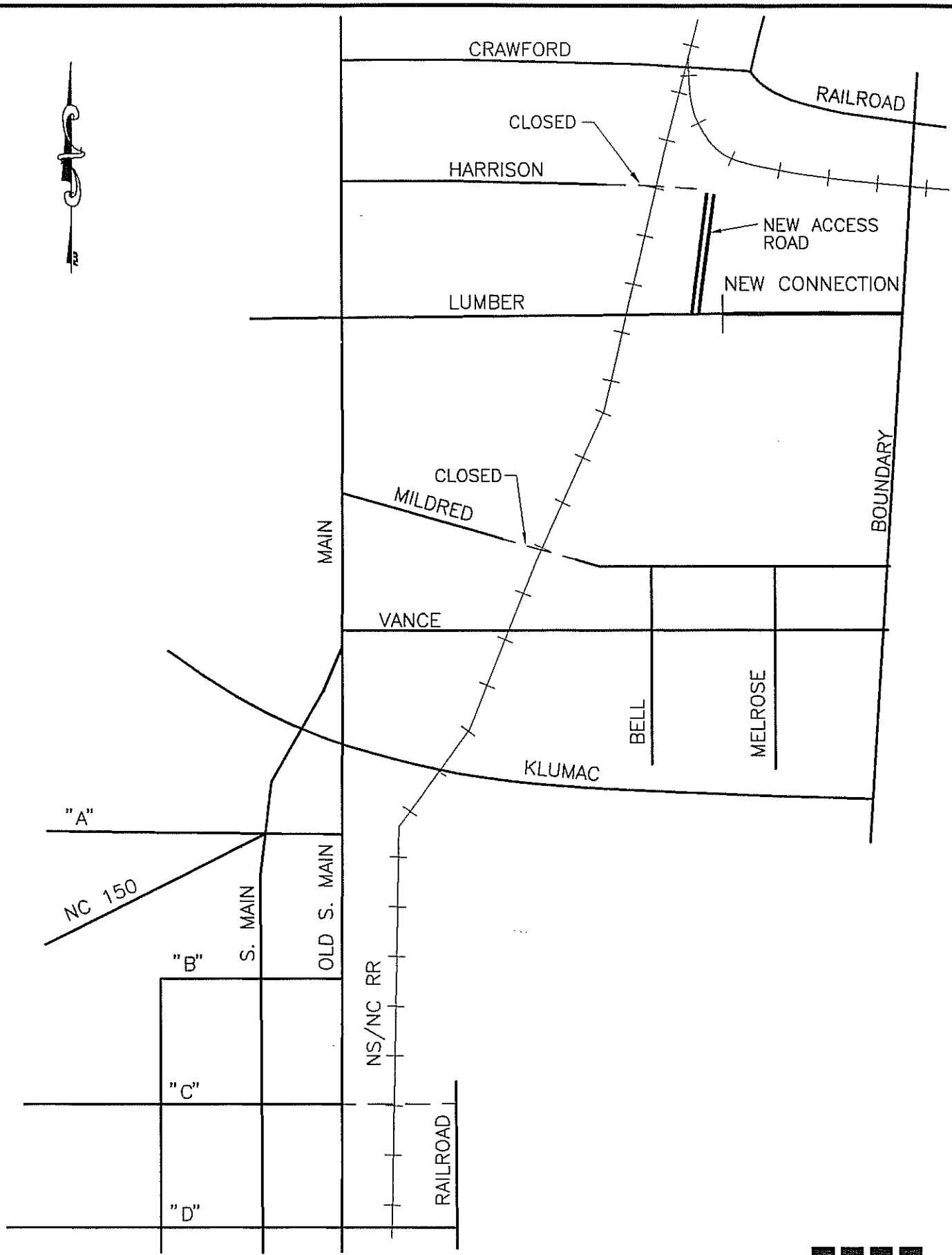

FIGURE 21

CLOSURE OF MILDRED AND HARRISON

N.T.S.

PHASE 2

6. GRADE-SEPARATED INTERSECTION OF HENDERSON STREET/BRINGLE FERRY ROAD WITH NORTH CAROLINA RAILROAD: Bringle Ferry Road intersects Long Street east of the railroad tracks, then enters a maze of roadways west of the tracks that include Lafayette Street, Henderson Street and Steel Street. The recommendation is to construct a grade-separated intersection over the railroad and realign Henderson Street to become the access west of the railroad. This option was preferred because Bringle Perry Road is a thru corridor east of the tracks, while Eleventh Street is not. This would require the purchasing of right-of-way, including homes and businesses, west of the railroad tracks. Henderson Street would then become the main corridor west of the railroad. Figure 22 shows this new configuration.

Table 7 shows the Level-of-Service Analysis in 1996 and 2004 for the proposed grade-separated intersection. In addition, it shows the redistribution of traffic volumes on the Henderson/Main Street intersection. Those volumes are depicted in Figure 22.

6.A. Closure of Eleventh Street. Once the new grade-separated intersection is constructed from Bringle Ferry Road to Henderson Street over the railroad, the Eleventh Street intersection could be closed. While the reality is that the high traffic volumes and the accessibility of Eleventh Street to the surrounding area is important, safety is the main reason for recommending closure of this intersection. Figure 23 shows the redistribution of traffic from Eleventh Street to the grade-separated intersection at Henderson Street. Table 7 shows the Level-of-Service Analysis for this recommendation. As shown, the intersections of Henderson with Long and Main can handle the additional traffic with little to no effects to the Level-of-Service.

The North Carolina T.I.P. includes a study of relocating Highway 52 to a location near Bringle Perry Road. This probable alignment reinforces Henderson Street as the choice for the grade separation. However, if the new Highway 52 alignment chosen is closer to Eleventh Street, Eleventh Street could be the better choice for grade separation. In either scenario, the intersections along Main and Long can handle additional traffic.

While this recommendation is made under the premise of safety, local officials must consider the economic importance of access to this area. If businesses and industries in the vicinity of Eleventh Street would suffer because of traffic rerouting, it may be necessary to keep Eleventh Street open. Under either scenario (Eleventh Street open or closed), the transportation network in the area is capable of handling the traffic.

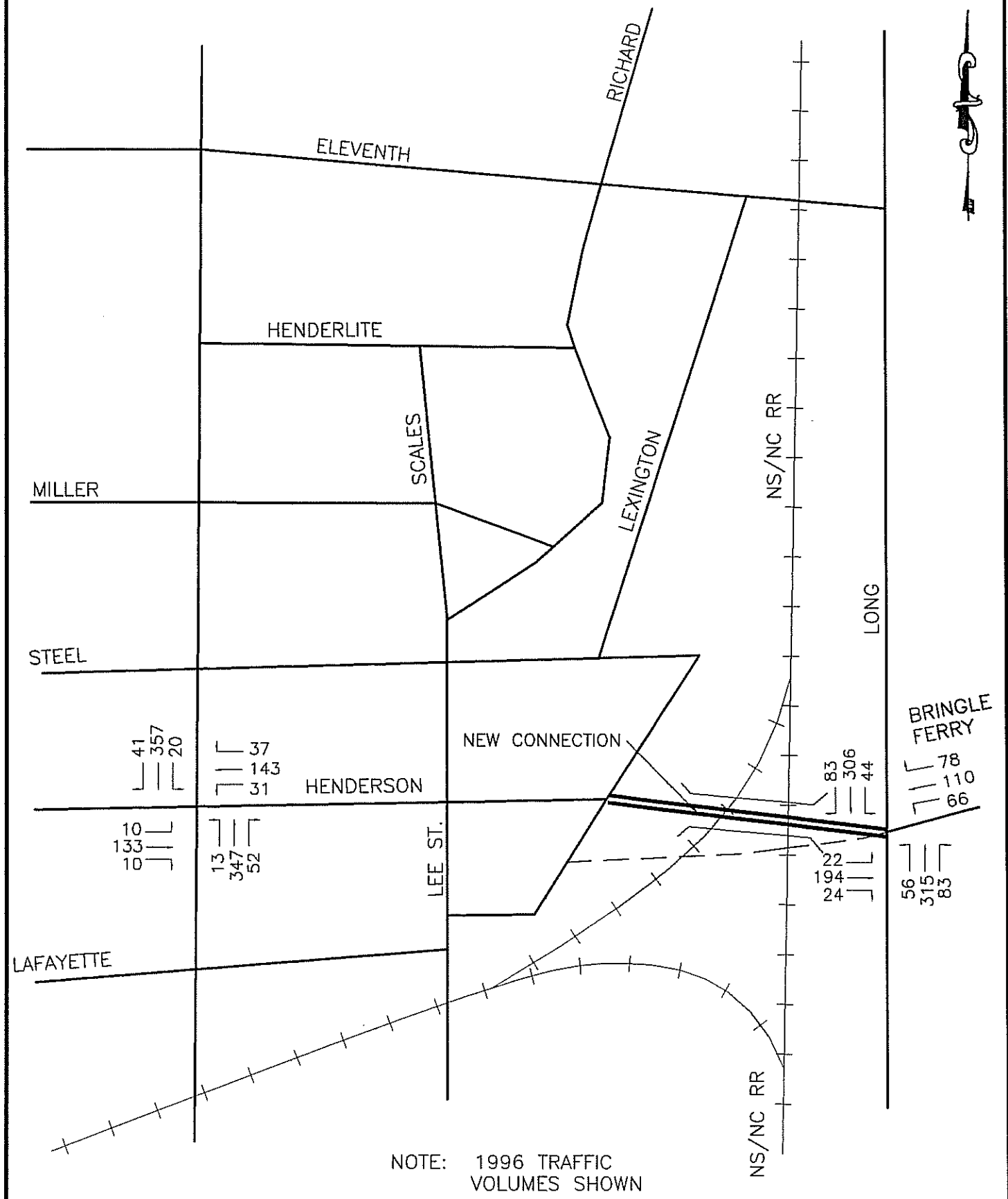

FIGURE 22

HENDERSON STREET GRADE SEPARATED INTERSECTION

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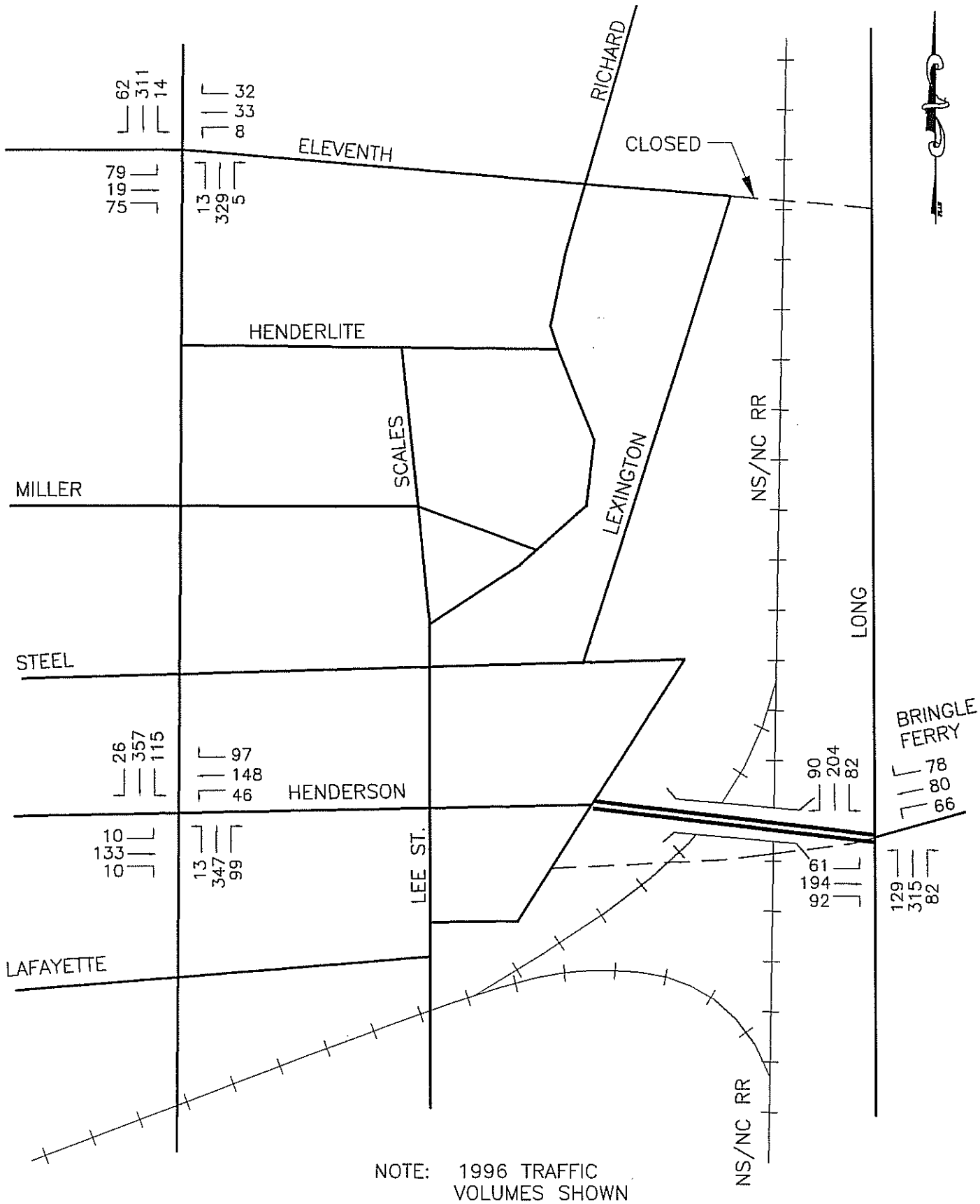

FIGURE 23

CLOSURE OF ELEVENTH STREET

N.T.S.

Table 7
RECOMMENDATION #5 - Grade Separation at Henderson Street and Optional Closure of 11th Street
Level of Service Analysis for Unsignalized and Signalized Intersections

1996

Henderson/Long

Direction	Delay	Level of Service
Westbound	9.6	B
Eastbound	10.6	B
Northbound	9.1	B
Southbound	9	B

Henderson/Main (11th crossing closed)

Direction	Delay	Level of Service
Westbound	14.3	B
Eastbound	14.1	B
Northbound	11.5	B
Southbound	10.6	B

Henderson/Main

Direction	Delay	Level of Service
Westbound	14.2	B
Eastbound	14.2	B
Northbound	10	B
Southbound	8.7	B

Henderson/Long (11th crossing closed)

Direction	Delay	Level of Service
Eastbound	13.3	B
Westbound	9.4	B
Southbound	8	B
Northbound	8.9	B

Henderson/Long EB left turn added (11th crossing closed)

Direction	Delay	Level of Service
Eastbound	10.9	B
Westbound	9.5	B
Northbound	9.2	B
Southbound	7.1	B

Eleventh/Main

Direction	Delay	Level of Service
Westbound	11.2	B
Eastbound	13.2	B
Northbound	3.3	A
Southbound	3.4	A

Table 7 (Cont.)

RECOMMENDATION #5 - Grade Separation at Henderson Street and Optional Closure of 11th Street

Level of Service Analysis for Unsignalized and Signalized Intersections

2004

Henderson/Long

Direction	Delay	Level of Service
Westbound	9.8	B
Eastbound	10.9	B
Northbound	9.5	B
Southbound	9.4	B

Henderson/Main (11th crossing closed)

Direction	Delay	Level of Service
Westbound	14.6	B
Eastbound	9.7	B
Northbound	9.6	B
Southbound	9.7	B

Henderson/Main

Direction	Delay	Level of Service
Westbound	14.2	B
Eastbound	10.6	B
Northbound	7.9	B
Southbound	7.5	B

Henderson/Long (11th crossing closed)

Direction	Delay	Level of Service
Eastbound	10	B
Westbound	7.2	B
Southbound	11.1	B
Northbound	13.3	B

Henderson/Long EB left turn added (11th crossing closed)

Direction	Delay	Level of Service
Eastbound	10.6	B
Westbound	9.4	B
Northbound	8.9	B
Southbound	8	B

Eleventh/Main

Direction	Delay	Level of Service
Westbound	11.3	B
Eastbound	13.7	B
Northbound	3.4	A
Southbound	3.4	A

PHASE 3

7. CONSTRUCT PARALLEL CORRIDOR TO MAIN STREET EAST OF THE RAILROAD TRACKS: Main Street is the primary corridor through Salisbury which runs west of the railroad tracks from roughly northeast to southwest. Similar routing is provided east of the railroad tracks via Long Street. Long Street provides that access to approximately a point where the railroad and Monroe Street intersect. Long Street then veers east and no longer continues as a parallel roadway. In order to provide this parallel roadway, and also provide access to properties east of the railroad, and south to Jake Alexander Boulevard, a continuation of a parallel roadway should be considered.

   Boundary Street could act as a parallel roadway if it is widened and upgraded to a point where it intersects Vance Street. From that point right-of-way would need to be acquired and a roadway constructed to allow access south to the intersection of Jake Alexander Boulevard. This access road could be used as part of the roadway network that would link industrial sites between the proposed roadway and the railroad. In addition, property west of that proposed road could be utilized for industrial park development. From a transportation standpoint, this project would greatly facilitate the traffic access surrounding the railroad and lead to safer operations. It would also help with the industries along "C" and "D" Avenue by providing them alternate access routes from crossing the railroad.

   An added benefit of the improvements to Boundary Street would be the ability to close Crawford Street, Vance Avenue, "D" Avenue and Julian Road. Vehicles could use the grade separated- intersections, such as at Klumac (see following pages), to cross the railroad tracks.

   Figure 24 shows this proposed roadway configuration.

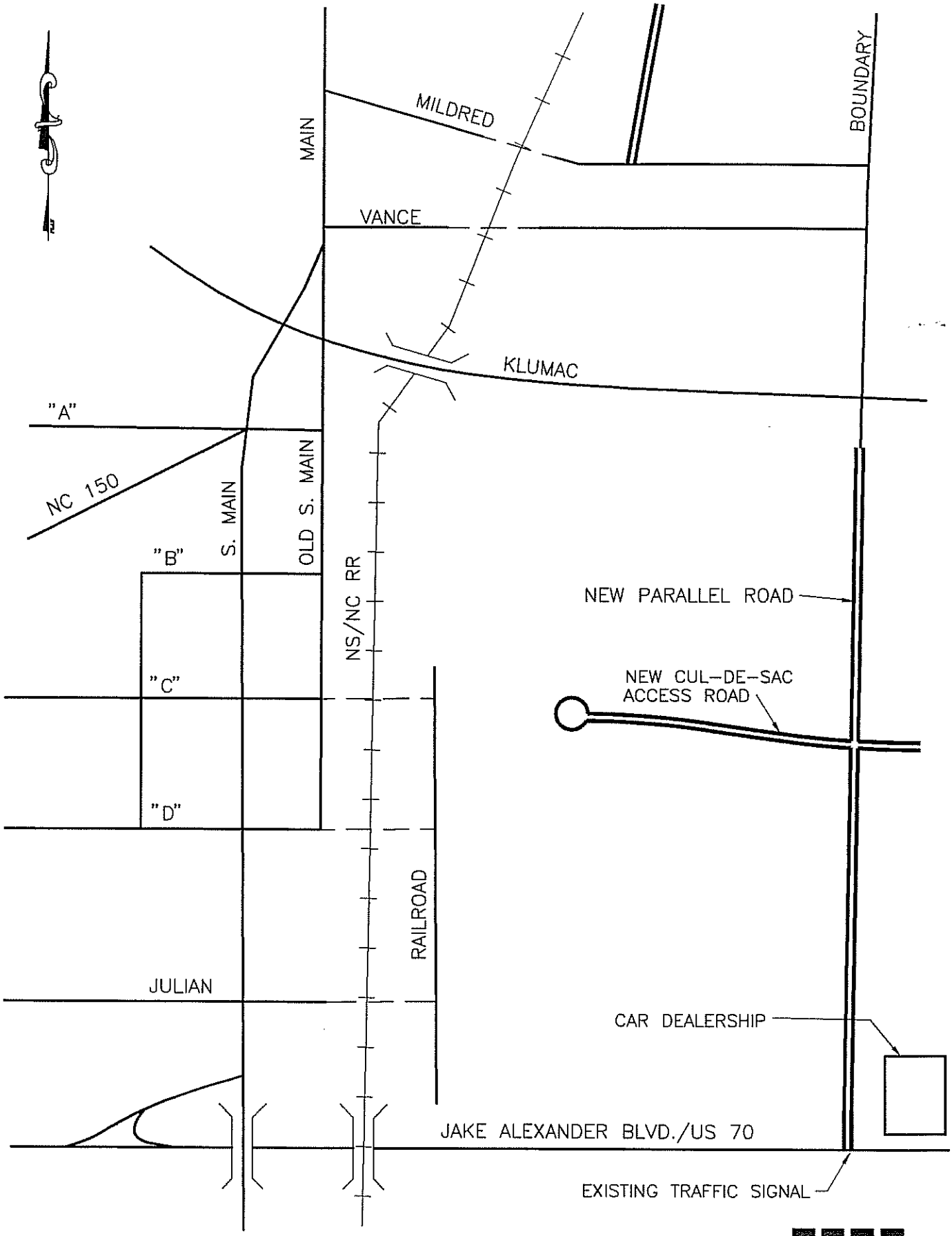

FIGURE 24

PARALLEL CORRIDOR TO MAIN STREET

N.T.S.

PHASE 3

8. GRADE-SEPARATED INTERSECTION AT KLUMAC ROAD: The traffic volumes on Klumac Road are one of the highest counts along the network. Construction of a grade-separated intersection would greatly facilitate the safety of vehicles crossing the railroad. Additional right-of-way would need to be acquired at this intersection, including many established businesses west of the railroad.

PHASE 3

9. GRADE SEPARATED INTERSECTION OF MONROE STREET: While this analysis has shown the roadway network can safely handle the additional traffic burden caused by the closure of Monroe Street, the intersection with the railroad and Horah Street still poses problems. The Horah Street intersection should be widened to facilitate maximum site distance. Pavement markings, signage, and signalization should be implemented. However, because the AADT over Horah Street will become over 7,000 vehicles in 1996, these streets are a prime candidate for a grade-separated intersection. The need to acquire the right-of-way for a grade-separation will affect the cost; the City would have to purchase businesses and houses closely linked to this area. The topography and location of structures indicate Monroe Street is the better candidate for grade separation, and thus Horah Street would be closed. A benefit/cost analysis could be conducted at a later date in order to determine if a grade-separation would be warranted in this case. From the traffic numbers, a grade-separation in this location would be warranted before 2004.

PHASE 3

10. DEVELOPMENT OF HENDERSON STREET EAST OF THE RAILROAD AS ALTERNATE ROUTE 70: Once the grade-separated intersection on Henderson Street is constructed, Henderson Street can become an alternate access route to NC70. Various scenarios, including Lake Drive, Steel Street, and Eleventh Street were analyzed.

    The best scenario is the utilization of Henderson Street. As a secondary alternative, it is also possible to route the traffic from Henderson to Main Street, then to Eleventh Street, around the park to Confederate Street and then to NC 70. Eleventh Street could also be used if the grade-separation occurs at its intersection with the railroad.

    Henderson Street is an established residential area west of the railroad. However, this route must be considered as the main alternative for an alternate NC70.

CONCLUSIONS

This traffic study shows area roadways can handle the closures of several of the intersections of the roads with the railroads. The figures and tables show the Levels-of-Service will not be affected to any significant degree.

In summary, the following intersections are recommended for closure:

PHASE I	PHASE 2	PHASE 3
"C" Avenue	Mildred Avenue	Horah Street
Knox Street	Harrison Street	Crawford Street
Monroe Street	Eleventh Street (optional)	Vance Avenue
		"D" Avenue
		Julian Road

In addition the following intersections are recommended for grade-separated intersections:

PHASE I	PHASE 2	PHASE 3
None	Henderson Street	Monroe Street
		Klumac Road

Figures 25, 26 and 27 highlight these recommendations.

While the traffic volumes and Levels-of-Service show these closures and grade-separated intersections can work within the Salisbury network, it is once again emphasized that safety is the driving force behind these considerations. Many traffic patterns have been established throughout the years and many mindsets will have to changed in order to accept these recommendations. However, when one compares increased safety to the inconvenience of 1 to 2 additional minutes of travel time by driving no more than 1 city block, these recommendations are only logical.

At some future date, further consideration should be given to closing Council Street in the center of town. Council Street has limited sight distances. It could be closed and cars re-routed on Kerr Street, which is due to be improved in the near future. However, because Council Street is a major access for the police and fire department, it is not recommended for closure for this time.

In conclusion, recommendations in this report are all based on traffic and safety, and are subject to further discussion with City officials and the North Carolina Department of Transportation.

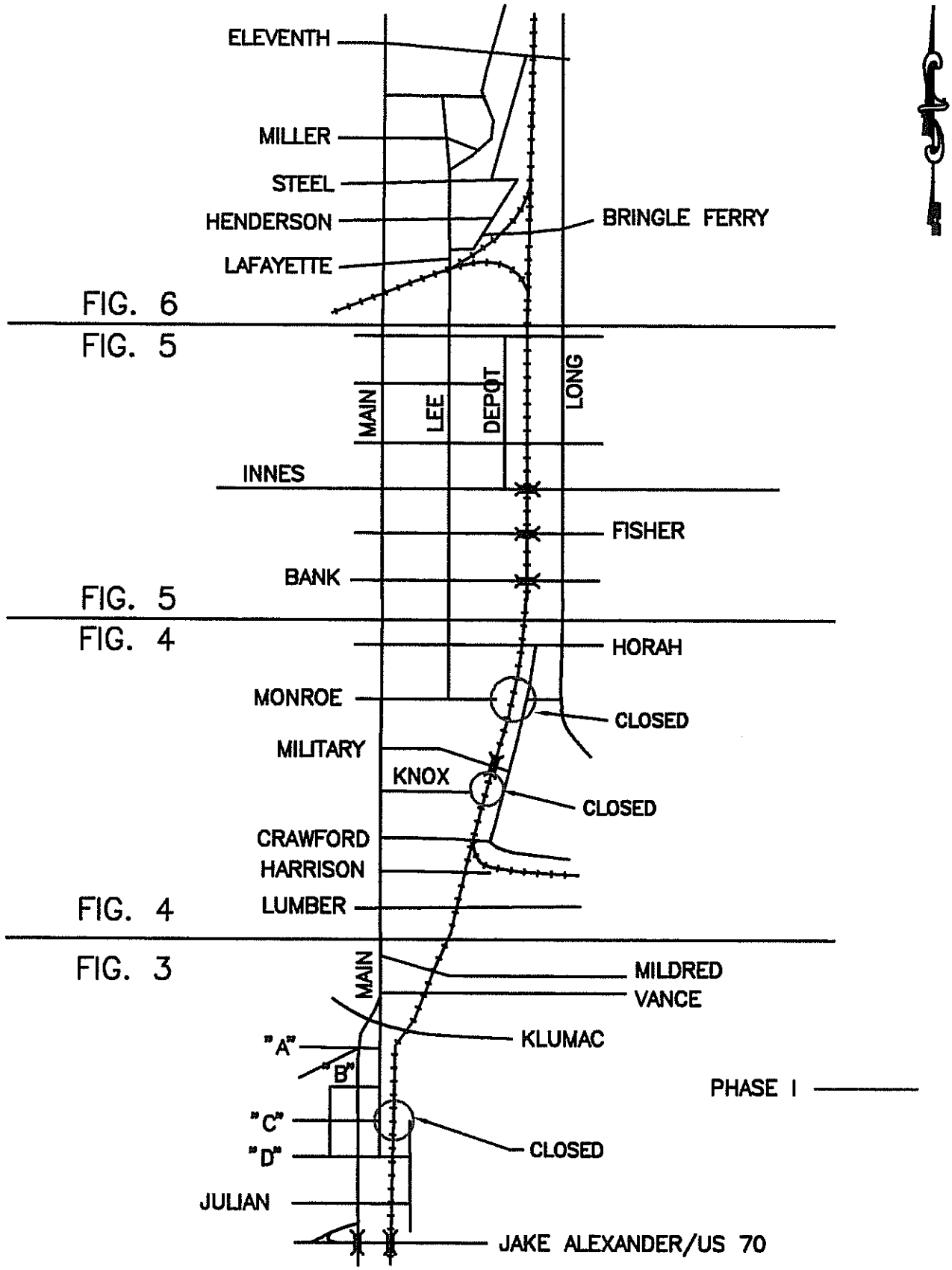

FIGURE 25

PHASE 1 RECOMMENDATIONS

N.T.S.

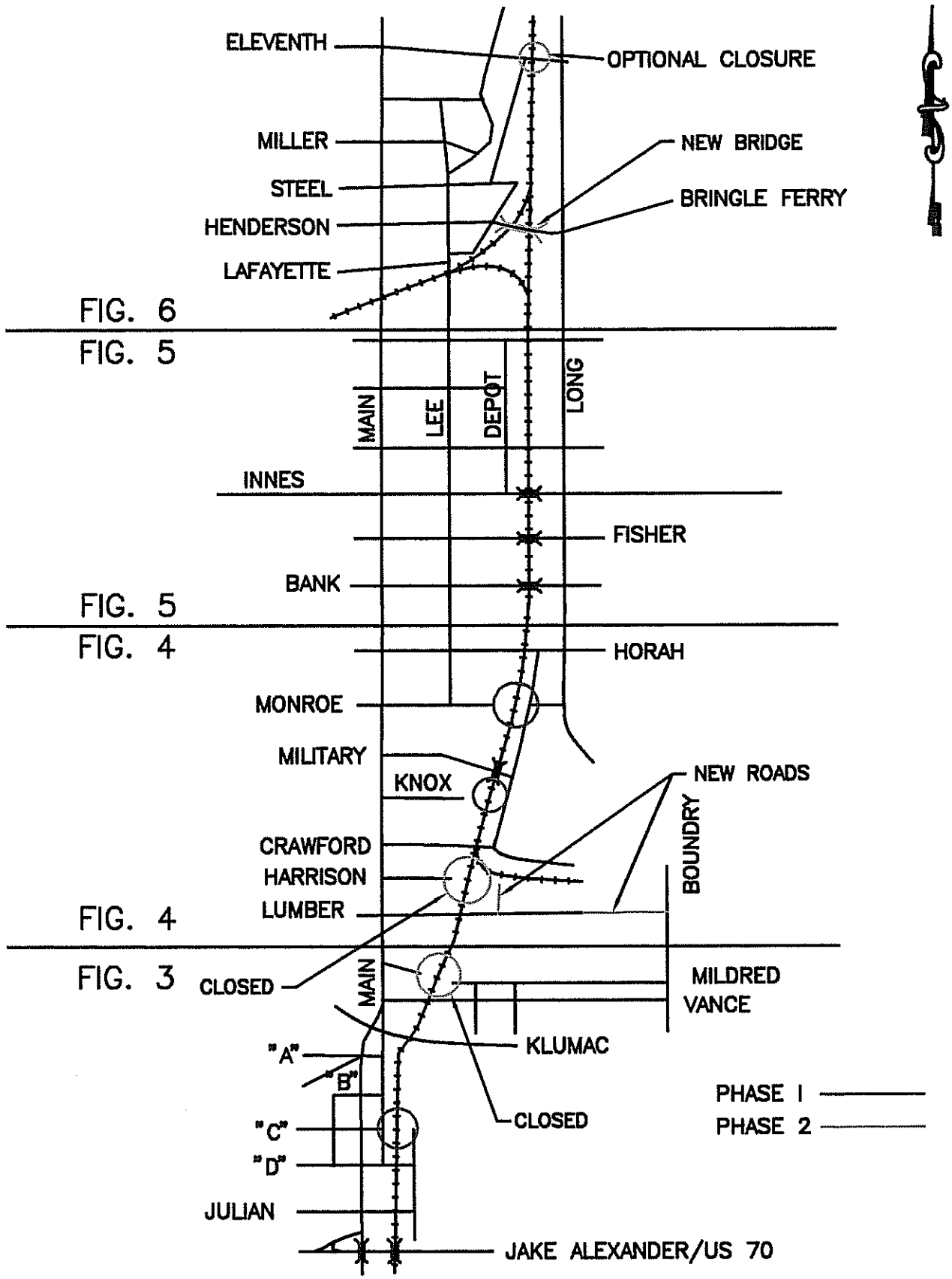

FIGURE 26

PHASE 2 RECOMMENDATIONS

N.T.S.

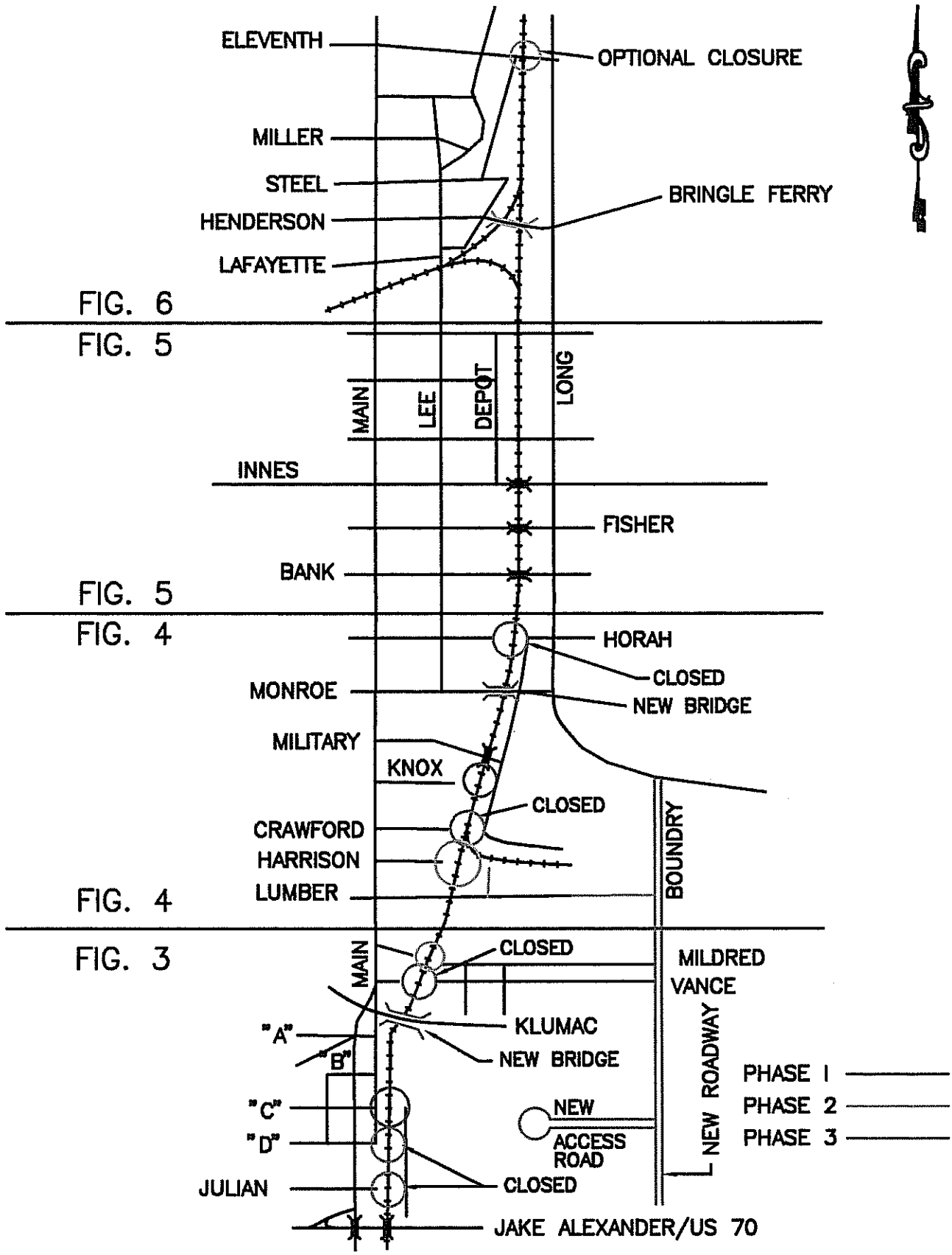

FIGURE 27

PHASE 3 RECOMMENDATIONS

N.T.S.