TRAFFIC SEPARATION STUDY

FOR

CHARLOTTE, NORTH CAROLINA

AND

THE NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

RAIL DIVISION

ENGINEERING AND SAFETY BRANCH

VOLUME VI

PREPARED BY

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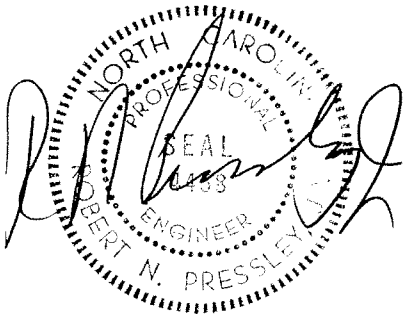

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CONCLUSIONS:

Accommodating the **Transit 2001 Plan** goal of two-hour passenger train service between Raleigh, Greensboro, and Charlotte will require a substantial reduction in the number of streets that cross the railroad at grade, as well as major modifications to many of those that remain.

Rail freight traffic along the Norfolk Southern (NS) will increase due to the division of CONRAIL routes between Norfolk Southern (NS) and CSX.

Vehicular traffic in the Charlotte Metropolitan Area will continue to increase as growth and expansion to the northeast continues.

Safety concerns at the Sugar Creek Rd. and Craighead Rd. crossings have been considerably mitigated by the installation of Advanced Crossing Protection Devices and the same affect is anticipated for 36th St. and on Orr Rd. These are significant safety issues requiring treatment at the four remaining crossings.

Mobility is an issue at the Sugar Creek Rd. crossing due to the high volume of trains (42/day) and the high volume (>26,000 VPD) of roadway traffic. As the area served by Newell-Hickory Grove Rd., Rocky River Rd., McLean Rd., and Back Creek Church Rd. continues to develop, mobility will become an issue at these crossings as well.

RECOMMENDATIONS:

Near-term

- Resurface and remark **36th Street** to a three-lane roadway $15,000.00
  Install 4-quad gates $125,000.00
- Close the **Craighead Road** crossing and cul-de-sac $100,000.00
  Realign **Davidson Street** east of crossing $550,000.00
- Install long-gate arms at **Rocky River Road** $15,000.00
  Widen westbound approach $20,000.00
- Widen the westbound approach of **Back Creek Church Rd.** $25,000.00
  Install median barrier $10,000.00

Total Estimated Cost $860,000.00

Long-term

- Consolidate the crossings at **Newell-Hickory Grove Rd., Rocky River Rd. and McLean Rd.** into a single grade-separated crossing at **Rocky River Rd. West.**

  Total Estimated Cost $8,250,000.00

- Build an overpass for the **NS** at **Sugar Creek Road.**
  Widen **Sugar Creek Road** to a 5-lane section.

  Total Estimated Cost $10,000,000.00

- Close the **Back Creek Church Road** crossing at such time as the connection to **Mallard Creek Church Road** is constructed.

TRAFFIC SEPARATION STUDY
FOR CHARLOTTE, NORTH CAROLINA
AND THE
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION

PURPOSE OF THE STUDY

The **City of Charlotte** and the **North Carolina Department of Transportation (NCDOT)** have entered into a cooperative agreement to evaluate certain local street at-grade crossings of the **Norfolk Southern Railway** in **Charlotte**. The purpose of the evaluation is to determine if any of the crossings are candidates for closure or grade separation, or if not, are there improvements that can be made to the local street and crossing network that will enhance public safety. The study includes eight (8) public street crossings of the railroad from 36th St. north to Back Creek Church Rd.

Preamble

Highway/railway at-grade crossing collisions are the number one cause of death in the railroad industry. In 1996, there were 4,159 train-vehicle collisions with 471 deaths nationwide. North Carolina had 140 collisions, 9 deaths and 53 injuries.

Deaths and injuries at grade crossings have steadily declined in this country since 1978 due to an aggressive safety program by the United States Department of Transportation, the various state Departments of Transportation and the railroad companies. These efforts have included improved automatic warning devices, roadway improvements, elimination of sight obstructions, construction of crossing separation structures, and closure of some crossings.

The **NCDOT**, through its **Rail Division** has a substantial program in place to improve rail crossing safety. The program is endorsed and supported by the **USDOT**, **Federal Railroad Administration** and **Federal Highway Administration**, and the various railroad operating companies. To be successful, however, requires the support of local government and the citizens of North Carolina. Highway/railway safety cannot be mandated from Raleigh, but must be endorsed, supported and enforced at the local level. These series of studies, undertaken through a cooperative agreement between state and local government, are part of a continuing effort to enhance the safety of all who travel North Carolina's streets, highways and railways.

The Charlotte Study

The City of Charlotte is a major operations center for the Norfolk Southern (NS) Railway*. Daily train movements over the eight crossings included in this study, range

*For purposes of this study, the railroad will be referred to as the Norfolk Southern (NS); however, Norfolk Southern (NS) is the operating company with the railroad right-of-way being owned by the North Carolina Railroad (NCRR), which is owned by the State of North Carolina (75%) and private shareholders (25%).

from a high of 58 at 36th St. to 34 from Newell-Hickory Grove Rd. north to Back Creek Church Rd. While most of the crossings have vehicular crossing volumes ranging from 4,000 to 8,000 per day, Sugar Creek Rd. has a 24 hour volume that exceeds 26,000 vehicles per day. **See Figures 1 through 5.**

Accidents are a problem at several of the crossings with three fatalities having occurred at Craighead Rd. and one at Sugar Creek Rd. in the last ten years.

Motorists and pedestrians intentionally violating traffic control devices at the crossings has also been an issue that has caused the NCDOT Rail Division, Norfolk Southern (NS) Railway, and the City to install Advanced Crossing Protection Devices at the Craighead Rd., Sugar Creek Rd., and Orr Rd. crossings and to begin the implementation of such devices at the 36th St. crossing.

The evaluation of the Charlotte crossings included the following:

- Twenty-four hour automatic traffic counts were obtained for the crossings as well as other streets within the network.
- Due to the nearness of the McLean Rd. crossing to the signalized intersection of Old Concord Rd./McLean Rd., a Level of Service (LOS) analysis was conducted for this intersection.
- Interviews with local transportation officials (NCDOT & CDOT) were conducted to gain local insight into problems and potential improvements to each crossing.
- Data was collected from the Charlotte-Mecklenburg School System, the Charlotte Fire Department, and the Mecklenburg County Emergency Medical Service as to frequency of use of each crossing, as well as service impacts that might occur should a crossing be closed or modified.
- Available historic information and mapping was utilized in the development of report conclusions and recommendations.

Based upon the above described evaluation, this report will:

- Identify impacts of any proposed crossing closure on adjacent property and the roadway network.
- Include conclusions and recommendations necessary to accommodate any proposed crossing closure.
- Identify candidate crossings for grade separation.

- Recommend corrective action for any identified safety issues relating to the eight (8) crossings.

- Include preliminary cost estimates for recommended improvements.

EXISTING TRANSPORTATION SETTING

The City of Charlotte is the largest city in the Carolinas with a population that approaches 475,000. Traffic volumes on the roadway network have continued to grow with annual increases of 2-4%.

Railroad traffic along the Norfolk Southern (NS) has also continued to grow with the advent of a major multi-modal facility south of Craighead Rd. as well as the expansion of NCDOT sponsored rail passenger service in the corridor.

Of the eight (8) crossings evaluated, Sugar Creek Rd. is the only major thoroughfare while 36th St. and Back Creek Church Rd. are both minor thoroughfares. Craighead Rd., Orr Rd., and Newell-Hickory Grove Rd. provide industrial access while Rocky River Rd. is designated as a collector. McLean Rd. provides access primarily to residential property. Paralleling roadways are not adjacent to any of the crossings with the exception of a segment of Orr Rd. that extends southerly from Newell-Hickory Grove Rd. and Old Concord Rd. which parallels the tracks on the westside and intersects with Newell-Hickory Grove Rd., Rocky River Rd., and McLean Rd.

While traffic signals are close to the crossings at 36th St., Orr Rd., McLean Rd., and Back Creek Church Rd., spacing between the tracks and the signalized intersection does not appear to be an issue.

Norfolk Southern (NS) operates two main line tracks from south of 36th St. to just south of the Orr Rd. crossing where it drops to a single track. Freight train operating speeds range from 25 MPH at 36th St. to 50 MPH for merchandise trains and 60 MPH for intermodal trains, while passenger trains operate at a maximum of 79 MPH over the entire segment.

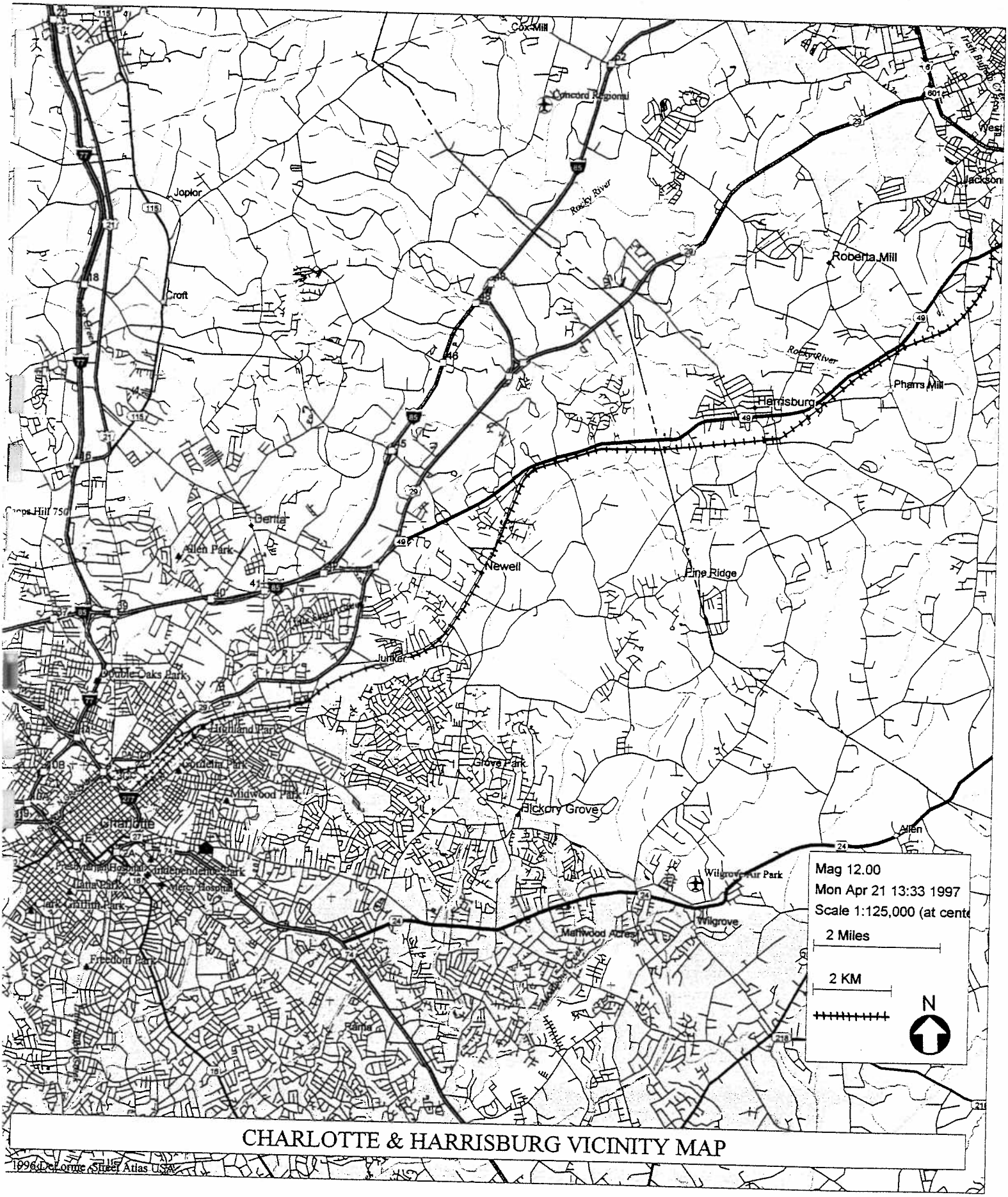
EVALUATION CRITERIA

All crossings were initially evaluated using the criteria developed for the NCDOT rail crossing closure program.

Criteria used in evaluating the Charlotte crossings include:

- Accident history

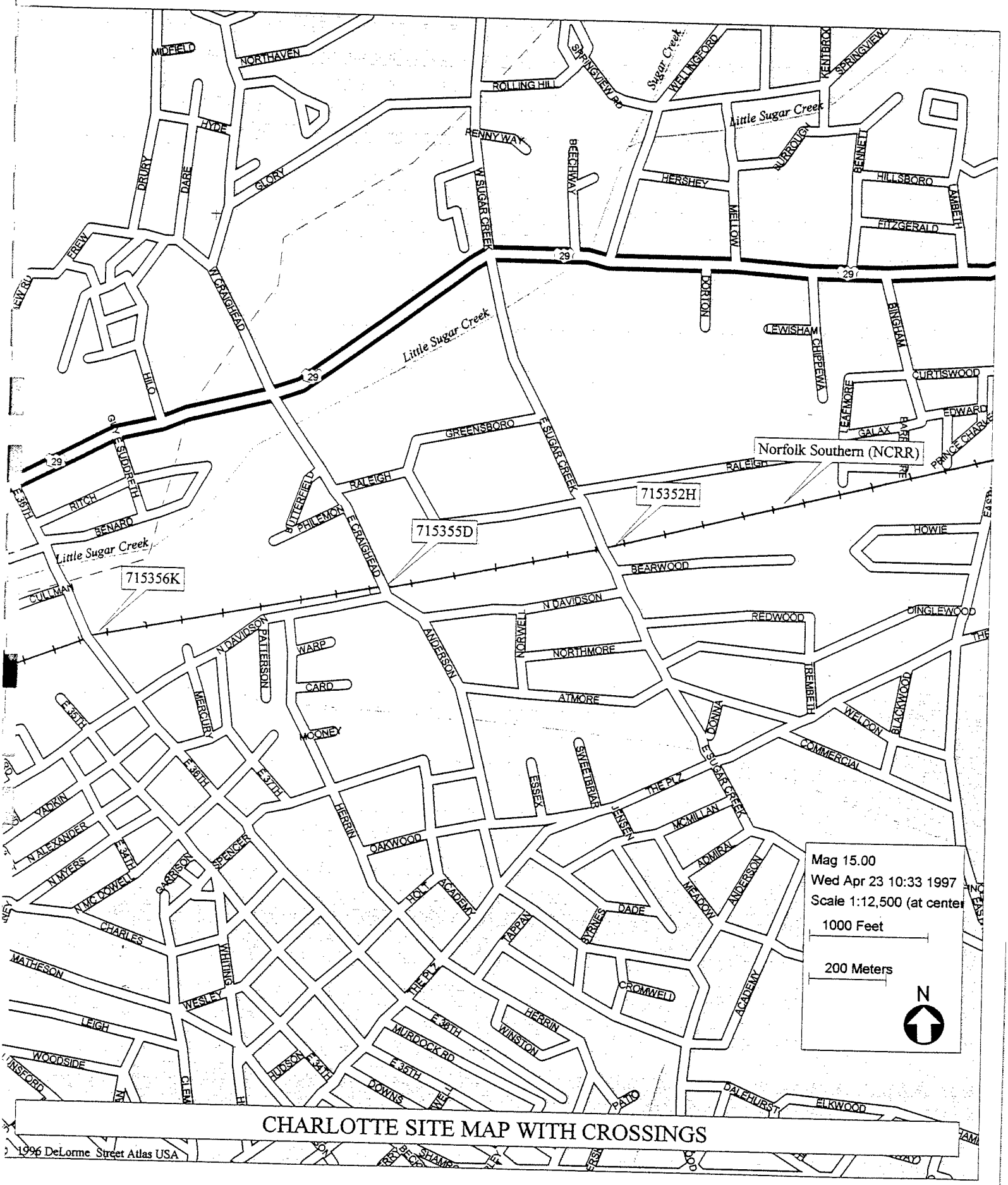
  This report utilizes the accident classification system developed by the Federal Highway Administration and others and in general use around the country. Under



CHARLOTTE & HARRISBURG VICINITY MAP

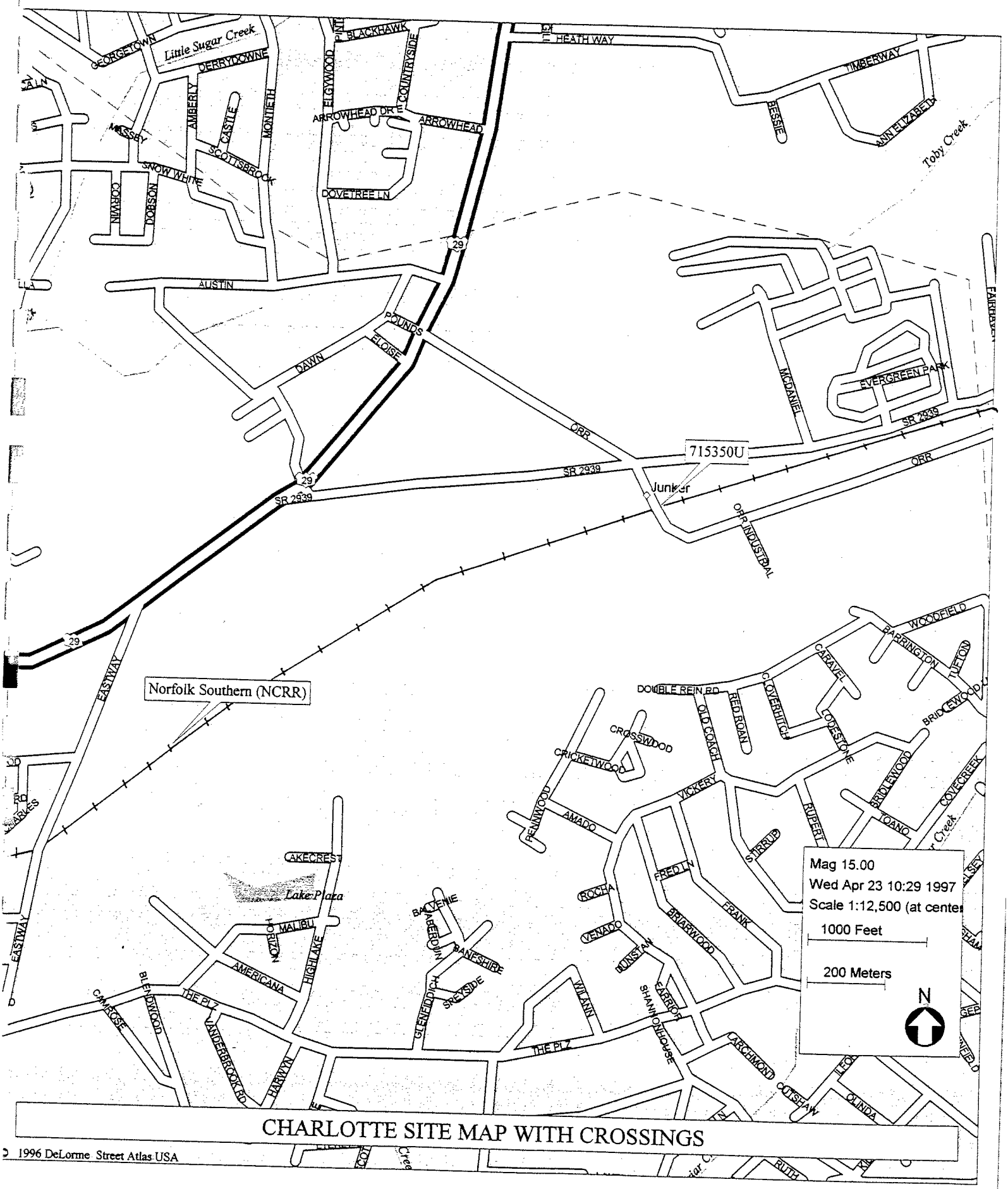
1996 DeLorme Street Atlas USA

FIGURE 1



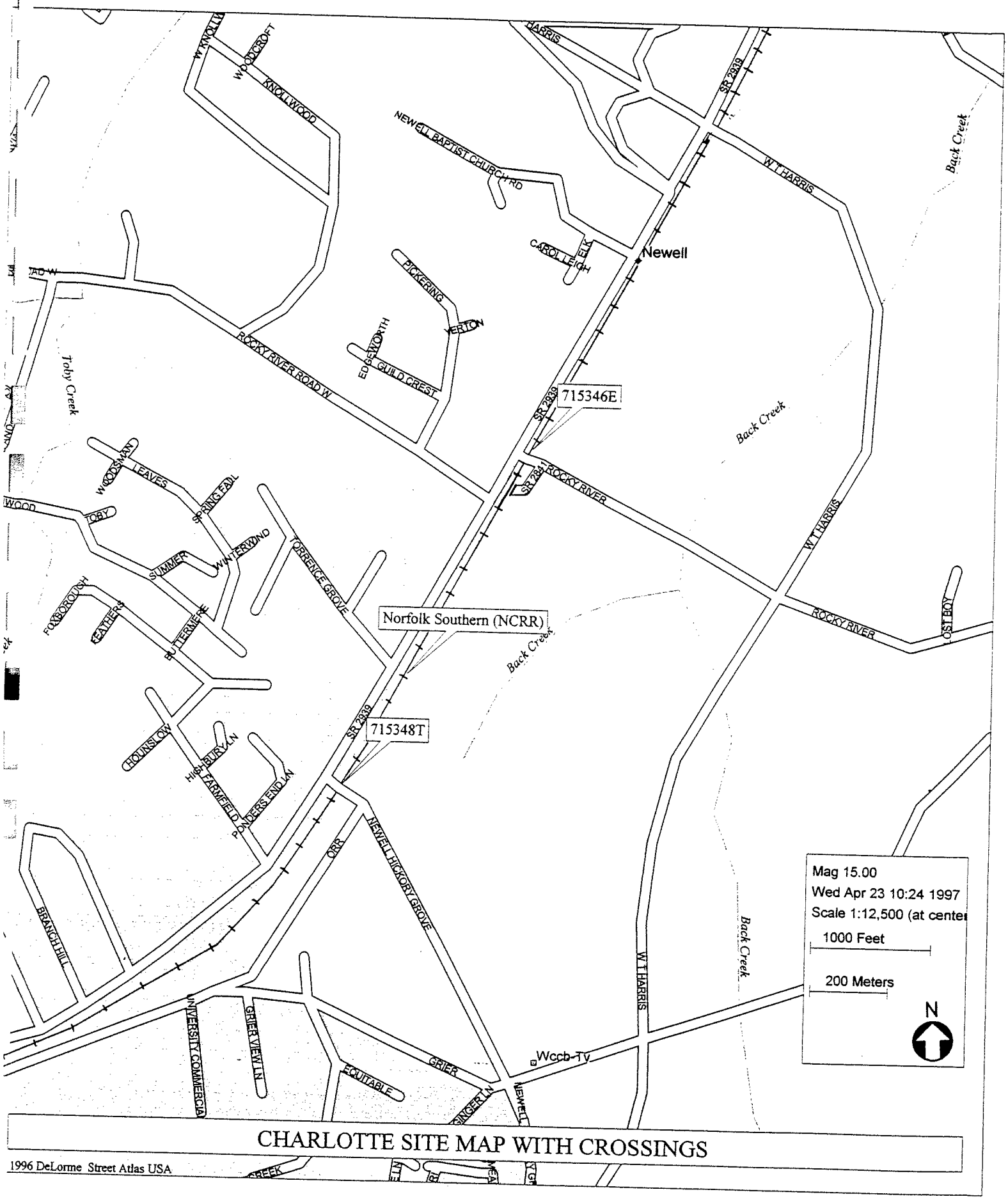
CHARLOTTE SITE MAP WITH CROSSINGS

FIGURE 2



CHARLOTTE SITE MAP WITH CROSSINGS

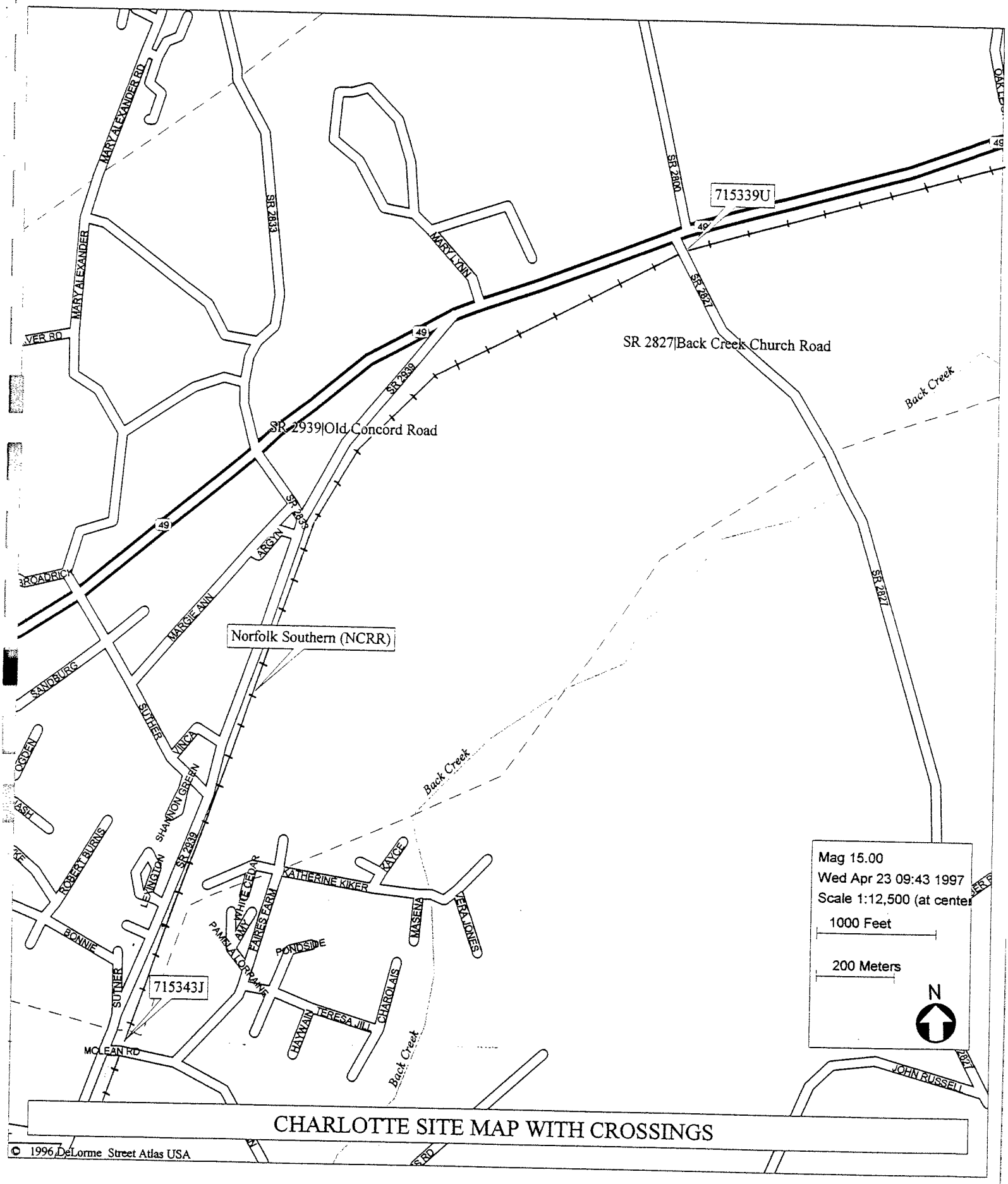
FIGURE 3



CHARLOTTE SITE MAP WITH CROSSINGS

1996 DeLorme Street Atlas USA

FIGURE 4



CHARLOTTE SITE MAP WITH CROSSINGS

FIGURE 5

this system, accidents are classified as follows:

- K - Killed
- Class A - Injured and transported to hospital
- Class B - Injured and treated on-scene
- Class C - Complains of injury but not treated
- PDO - Property damage only

- Vehicle traffic - Present and future
- Train traffic
- Truck traffic/Truck route
- Hazardous materials
- Type roadway (thoroughfare, collector, local access, etc.)
- Type of property being served (residential, industrial, commercial)
- School bus route
- Emergency route
- Type warning devices present
- Redundant crossing (yes/no)
- Potential for grade separation (high, med, low)
- Feasibility of implementing roadway improvements (high, med, low)
- Economic impact if crossing closed (high, med, low)

The evaluations are shown on **Table 1**.

Level of Service Analysis

Level of Service (LOS) is a measure of congestion for signalized and unsignalized intersections as well as roadway segments. To the motorist, an intersection or road operating at an LOS of A, would be virtually free of congestion with almost no delay or interruption to travel. On the other hand, an LOS of F would mean considerable delay, stop and go driving and could require the motorist to sit through 2 or 3 red signal indications before clearing a signalized intersection.

A network Level of Service (LOS) analysis was conducted for 36th St., N. Tryon St., Sugar Creek Rd., Davidson St. and Craighead Rd. in order to determine current conditions within the network as well as certain future "build" options. The future conditions were analyzed using projected 2010 traffic volumes. (2010 volumes were derived by projecting current volumes at an annual growth rate of 2%). Also, an analysis of the Old Concord Rd./McLean Rd. intersection was conducted for current and 2010 conditions. All analyses were conducted in accordance with the procedures contained in the Highway Capacity Manual Special Report 209 (1994) as published by the Transportation Research Board, Washington, D.C. The procedures contained in the Manual for Level of Service Analysis (LOS) have been validated by considerable research and field testing and have been further enhanced by modern computer analysis techniques.

Analysis techniques are prescribed in the Highway Capacity Manual for both unsignalized and signalized intersections. The analysis determines the amount of delay the motorist experiences in clearing the intersection which determines its Level of Service.

Unsignalized Intersections

Operating characteristics of roadway intersections and driver behavior are mandated by the traffic laws of the State of North Carolina. These laws require traffic from minor or side streets to yield right-of-way to traffic on the major or through street. This basic "rule of the road" has yielded the following assumptions being used in the analysis of unsignalized intersections.

- 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 through-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 through traffic is impeded by all major street traffic.

The LOS for both unsignalized and signalized intersections is based upon the amount of delay (calculated in seconds/vehicle) to a motorist waiting to execute a maneuver. Delay is calculated for all vehicles through the intersection during the peak hour or peak 15-minute analysis period. Criteria used to determine LOS of unsignalized intersections are as follows:

Level of Service	Average Total Delay (Sec/Veh)
A	≤5
B	>5 ≤10
C	>10 ≤20
D	>20 ≤30
E	>30 ≤45
F	>45

As part of the network analysis conducted for 36th St., Craighead Rd., and Sugar Creek Rd., an LOS analysis of the unsignalized intersection of Craighead Rd. and N. Davidson St. was conducted.

Signalized Intersections

The LOS criteria for signalized intersections is based upon stopped delay per vehicle in seconds. The criteria from the Highway Capacity Manual are:

Level of Service	Description	Stopped Delay Per Vehicle (Seconds)
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≤15
C	Fair progression and/or longer cycle length: significant number of vehicles stop at intersection than level of service A.	>15≤25
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≤40
E	Considered limit of acceptable delay, indicative of poor progression, long cycle length, high volume/ capacity ratio; frequent individual cycle failures.	>40≤60
F	Unacceptable delay, frequently an indication of oversaturation (i.e. arrival flow exceeds capacity.)	>60

Results of Level of Service Analysis

Various scenarios were analyzed to determine **Level of Service** for the street network including:

N. Tryon St. from Craighead Rd. to Sugar Cr. Rd.;
N. Davidson St. from Craighead Rd. to Sugar Cr. Rd.;
36th St. from N. Tryon St. to N. Davidson St.;
Craighead Rd. from N. Tryon St. to N. Davidson St.;
Sugar Creek Rd. from N. Tryon St. to N. Davidson St.

The scenarios analyzed were:

(1) The above street network with 1997 traffic volumes and existing conditions;

(2) The above street network with 2010 traffic volumes and planned street improvements including:
   a. The addition of a northbound left-turn lane on N. Tryon St. at Sugar Cr. Rd. and an exclusive right-turn-only lane on westbound Sugar Cr. Rd. at N. Tryon St.;
   b. The addition of an exclusive right-turn-only lane on Craighead Rd. at N. Tryon St.;
   c. A **grade-separation** in place at **Sugar Cr. Rd.** and the **Norfolk Southern Railway**; and,
   d. **Craighead Rd. closed at N. Davidson St..**

(3) The above street network with 2010 traffic volumes, planned street improvements and proposed additional street improvements including:

   a. Additional through lanes in each direction on both N. Tryon St. and Sugar Cr. Rd. with signal retiming;
   b. Signalizing the intersection of Sugar Cr. Rd. and N. Davidson St. as well as an additional eastbound through lane on Sugar Cr. Rd. and a northbound left-turn lane on N. Davidson St.;
   c. At N. Tryon St. and Craighead Rd., an exclusive northbound right-turn-only lane on N. Tryon St., an additional southbound through lane on N. Tryon St. as well as an exclusive right-turn-only lane and signal rephasing and retiming; and,
   d. At N. Tryon St. and 36th St., an additional northbound through lane as well as signal rephasing and retiming.

The results of the analyses are as follows:

INTERSECTION	SCENARIO 1	SCENARIO 2	SCENARIO 3
N. Tryon/Sugar Cr.	Exceeds F	No Change	No Change
N. Davidson/Sugar Cr.	F	No Change	C
N. Tryon/Craighead	Exceeds F	No Change	D
N. Davidson/Craighead	C	N/A	N/A
N. Tryon/36th St.	Exceeds F	No Change	D
N. Davidson/36th St.	B	C	C

The Level of Service for Old Concord Road and McLean Road was determined using volumes from the 5-6 P.M. peak period. The same volumes were projected for the 2010 analysis. The results are as follows:

1997 (Minimum green)	Exceeds F
1997 (Maximum green/Old Concord)	C
1997 (Maximum green/Old Concord & McLean	D
2010 (Maximum green/Old Concord)	C

Traffic Volume

Based on the 24-hr. traffic volumes, the 8 at-grade crossings in Charlotte rank in terms of vehicles served:

1. Sugar Creek Rd. (SR2975)	26,100 VPD
2. 36th St.	7,000 VPD
3. Craighead Rd.	6,890 VPD
4. Orr Rd. (SR2848)	6,300 VPD
5. McLean Rd. (SR2831)	5,100 VPD
6. Rocky River Rd. (SR2828)	4,000 VPD
7. Back Creek Church Rd. (SR2827)	3,500 VPD
8. Newell-Hickory Grove Rd. (SR2853)	3,400 VPD

Accident History

Three of the crossings have had three or more train-vehicle collisions over the last ten years. Craighead Rd. has had a total of five in which three fatalities occurred, one in 1987 and two in 1989. Three collisions have occurred at the Sugar Creek Rd. crossing with one fatality in 1994. The crossing at Newell-Hickory Grove Rd. has had three "Property Damage Only" accidents.

Advanced Crossing Protection Devices were installed at the Sugar Creek Rd. crossing (Quad gates, median barrier) and at Craighead Rd. (Quad gates) in September of 1995. No

accidents have been reported at either crossing since these installations occurred.

A Class A accident occurred at the Back Creek Church Rd. crossing in 1994. "Property Damage Only" accidents (one each) have occurred at 36th St. and Rocky River Rd. during the ten-year period while no accidents have been reported at Orr Rd. and McLean Rd.

Cost of Railway/Highway Collisions

According to a report prepared by, and first published by, the Federal Highway Administration in 1991, accident costs by 1995 were as follows:

Fatal accident	$2,780,000.00
Injury accident	$55,000.00
Property damage only accident	$3,000.00

Utilizing these numbers, the fatal accidents at the Craighead Rd. crossing have cost the community, in addition to the pain and suffering of the survivors, over $8,000,000.00. Total costs for all accidents at the eight crossings exceeds $11,000,000.00 during the last ten years.

MENU OF AVAILABLE TRANSPORTATION SYSTEM ENHANCEMENTS

As the Charlotte Metropolitan area continues to grow and expand, and with train traffic expected to increase along the Norfolk Southern (NS) due to the recent agreement between Norfolk Southern (NS) and CSX to purchase CONRAIL, traffic delays and accidents at the crossings are certain to increase.

The Norfolk Southern (NS) line from Washington, D.C. to Charlotte, including the segment that comprises this report, has been designated by the USDOT as a **High Speed Rail Corridor**. Governor Jim Hunt has declared the line from Raleigh to Charlotte as a vital link in the **Transit 2001 Program.** A significant objective of the Program is to have two-hour passenger train service in place between Raleigh and Charlotte early in the next century. In order to accomplish this goal, significant changes will have to be made to the rail line that will affect many of the crossing streets and the communities they serve. The menu of system enhancements available for consideration follows:

- **Grade Separation Structures**

In recommending highway/railroad grade separation structures, there are many factors that must be considered. Among these factors are:

TABLE 1
EVALUATION OF STREET/RAILROAD AT-GRADE CROSSINGS

CROSSING #	RAILROAD	MUNICI-PALITY OR COUNTY	STREET NAME	MAINTENANCE RESPONSIBILITY (CITY/NCDOT)	SECONDARY ROAD NUMBER	STREET CLASS.	WARNING DEVICES (TYPE)*	24 HR ADT	2010 ADT (PRO-JECTED)	24 HR TRAIN VOL.	12 YR ACCIDENT HISTORY (NUMBER) 1984-95	SCHOOL BUS ROUTE (Y/N)	EMER-GENCY ROUTE (Y/N)
715339U	NS	CLT (NR)	Back Cr.Ch.	NCDOT	2827	Minor T'fare	5	3500	4410	34	1(A)	Y	Y
715343J	NS	Charlotte	McLean	NCDOT	2831	Local	5	5100	—	34	0	Y	Y
715346E	NS	Charlotte	Rocky River	NCDOT	2828	Coll.	5	4000	7500	34	1	Y	Y
715348T	NS	Charlotte	Hky. Gr. Rd.	NCDOT	2853	Local	5	3400	—	34	3	Y	Y
715350U	NS	Charlotte	Orr Rd.	NCDOT	2848	Coll.	5***	6300	7940	42	0	Y	Y
715352H	NS	Charlotte	Sugar Cr. Rd.	NCDOT	2975	Art.	5**	26100	33000	42	3(1K)(94)	Y	Y
715355D	NS	Charlotte	Craighead	City	—	Coll.	5**	6890	—	50	(1K)(87) 5(2K)(84)	Y	Y
715356K	NS	Charlotte	36th St.	City	—	Art.	5** (pending)	7000	8800	58	1	Y	Y

* Type 1: Unmarked
Type 2: Crossbucks
Type 3: Stop signs/Crossbucks
Type 4: Flashing signals & bells
Type 5: Flashing signals, bells & gates
** 4 Quad gates
*** Long-gate arms

TABLE 1
EVALUATION OF STREET/RAILROAD AT-GRADE CROSSINGS

STREET NAME	DESIG-NATED TRUCK ROUTE (Y/N) ****	% TRUCKS	HAZARDOUS MATERIALS (Y/N)	CROSSING CONDITION (GOOD, FAIR, POOR)		REDUN-DANT CROSSING (Y/N)	ADEQUATE STORAGE SPACE (Y/N)	PROPERTY SERVED	ECONOMIC IMPACT IF CLOSED (HI,MED, LOW)	NEED FOR ENHANCED WARNING DEVICES	NEED FOR ROADWAY IMPVTS (HI, MED, LOW)	FEASI-BILITY OF IMPLE-MENTING RDWAY IMPVTS (HI,MED, LOW)	POTEN-TIAL FOR GRADE SEPARA-TION (HI,MED, LOW)
				GEOMETRY	SIGHT DISTANCE								
Bk. Cr. Ch. Rd.	N	1%	N	Poor	Fair	N	Y	Res	High	Signals	Med	High	Low
McLean	N	1%	N	Good	Fair	N	N	Res	High	Signs	Low	High	Low
Rocky River	N	1%	N	Poor	Good	N	N	Mixed	High	S&M	High	Low	High
Hky. Gr. Rd.	N	2%	Y	Poor	Good	N	N	Mixed	Low	Markings	High	Low	Low
Orr Rd.	N	3%	Y	Fair	Fair	N	Y	Ind	High	Markings	Low	High	Low
Sugar Cr. Rd.	Y	5%	Y	Fair	Poor	N	Y	Ind	High	Markings	High	Med	Med
Craighead	Y	12%	Y	Poor	Fair	Y	Y	Ind	Med	Sig & Mkngs	High	High	Low
36th St.	N	5%	Y	Fair	Fair	N	Y	Ind	High	Signs	Med	High	Low

**** Trucks can legally operate over all State maintained roads.

- Traffic volumes (both vehicle & train)
- Accident history
- Topography
- Construction impacts
- Costs

Traffic Volumes in the 15,000 to 20,000 vehicles per day (VPD) range and above are generally considered to be the threshold for consideration of a grade separation structure for local streets. Volumes of 30,000 VPD and more can be accommodated without significant delay provided train traffic is low.

The **NCDOT** uses an **"exposure index"** to determine whether or not a grade separation structure is warranted at either an existing or proposed railway/highway crossing. The exposure index is determined by multiplying the number of trains per day over the railroad by the number of vehicles per day (in the design year)* on the roadway. In other words, for a railroad with 5 trains per day and a roadway with 2,000 vehicles per day, the exposure index would be 10,000. The threshold for consideration for construction of either an overpass or an underpass is an exposure index of 15,000 in rural areas and 30,000 in urban areas.

Accident History is another of the factors used when considering grade separation structures. Even though traffic volumes for vehicles and trains may be low, if frequent collisions between railroad and highway traffic is occurring, then a separation structure may be warranted.

Topography, or the lay of the land, is another important consideration. Where the street, railroad and surrounding land are all at about the same elevation, the construction of grade separation structures is made considerably more difficult.

Construction Impacts are of considerable importance in that they may be of such a magnitude as to do greater harm to the community than if the present conditions remain. Construction impacts can include acquisition and the subsequent relocation of families and businesses; destruction of the natural environment such as woodlands and wetlands; and, disruption of historical and archaeological sites. While the effects of some of the impacts may only be temporary, some can forever alter the character of a neighborhood or community.

Costs for grade separation structures can easily exceed $1 million and must, therefore, receive careful consideration before proceeding with funding and construction.

*The Design Year is that future year when the improved roadway is expected to reach its theoretical vehicle carrying capacity. In other words, a roadway designed with a 20-year design life, and constructed in 1997, would reach its capacity in 2017. In computing the exposure index, the projected traffic volumes for 2017 would be used in the formula.

- **Crossing Protection Devices Upgrade**

Generally, the most cost effective way to deal with safety issues at an at-grade railroad crossing is to upgrade the crossing protection devices.

Crossing protection devices include signs, signals, bells and gates used to warn motorists of the pending crossing and, in the case of bells, signals and gates, alert the motorist to the train approaching the crossing. Passive devices, which include advance warning signs, railroad crossbucks and standard stop signs, are generally used on low volume crossings with good site distance. Active devices, which include signals, bells and gates, are used on higher volume crossings with greater accident potential or where existing conditions warrant more positive control. These devices rank from lowest to highest as follow:

Type	Description
1.	Unmarked
2.	Railroad crossbucks
3.	Standard stop signs (limited sight distance) & crossbucks
4.	Flashing signals and bells
5.	Flashing signals, bells & gates

The crossings in Charlotte are protected as follows:

36th St.	Flashing signals, bells & gates, (4-quad gates pending)
Craighead Rd.	Flashing signals, bells, 4-quad gates
Sugar Creek Rd.	Flashing signals, bells, 4-quad gates with median barrier
Orr Rd.	Flashing signals, bells & gates, (Long gate arms installed 3/31/97)
Newell-Hickory Grove Rd.	Flashing signals, bells & gates
Rocky River Rd.	Flashing signals, bells & gates
McLean Rd.	Flashing signals, bells & gates
Back Creek. Church Rd.	Flashing signals, bells & gates

- **Advanced Crossing Protection Devices**

The NCDOT Rail Division has recently completed testing of more advanced crossing protection devices in the form of four-quadrant gates and barrier medians. These devices are appropriate for use on multi-lane, high-volume crossings of high-speed mainline railroads where significant numbers of motorists are ignoring the existing devices. The installation consists of dual gates across the entire approach width, and a barrier median on each approach to prevent motorists from crossing the roadway centerline in an attempt to get around the gates.

In tests recently completed at Sugar Creek Rd. (1996) by the NCDOT in cooperation with Norfolk Southern (NS), violations dropped from almost 45 per week with standard gates and signals, to less than 2 per week with the advanced protection devices.

Other advanced crossing protection devices available for installation include:

- Articulated gates (hinged in the middle)
- Long-gate arms (33' versus 28' for standard gate)
- Warning device revisions (larger signal lenses)
- Special signage (Low Vehicles May Drag)
- Pavement marking revisions (supplemental RXR)

Video imaging is another technique that is being used to improve crossing safety. Under this program, video cameras are set up at certain crossings to record events as well as the vehicle and license plate of violators. This information is then provided to law enforcement officials for enforcement purposes.

- **Crossing Closure/Crossing Consolidation**

The most effective way to deal with railroad/highway crossing safety issues is to close low-volume redundant crossings. Crossings that connect to the same street network and are within a quarter mile (+/- 1300 feet) of each other, are considered to be redundant. Crossing consolidation is another way to treat crossings that may be relatively close to each other. Consolidation of two or more crossings into one can be accomplished by utilizing or building roads that parallel the tracks or by replacing several crossings with a grade separation structure.

- **Street Improvements**

Street improvements are an effective way to treat capacity and safety problems associated with a particular section of roadway, an intersection or a railroad crossing. These improvements can range from simply remarking the existing pavement to obtain a turn lane to total reconstruction of the roadway. In many cases, the more minor the improvement, the greater the benefits.

- **Traffic Signals**

As traffic volumes increase within a roadway network or at a particular intersection, the addition of a traffic signal(s) to the system may be warranted. Traffic signals are not a "cure-all" for traffic problems. Signals have distinct advantages and disadvantages. They are:

Advantages[1]

1. They can provide for the orderly movement of traffic.
2. Where proper physical layouts and control measures are used, they can increase the traffic-handling capacity of the intersection.
3. They can reduce the frequency of certain types of accidents, especially the right-angle type.
4. Under favorable conditions, they can be coordinated to provide for continuous or nearly continuous movement of traffic at a definite speed along a given route.
5. They can be used to interrupt heavy traffic at intervals to permit other traffic, vehicular or pedestrian, to cross.

Disadvantages[1]

1. Excessive delay may be caused.
2. Disobedience of the signal indications is encouraged.
3. The use of less adequate routes may be induced in an attempt to avoid such signals.
4. Accident frequency (especially the rear-end type) can be significantly increased.

Because of these advantages/disadvantages, it became necessary to develop a series of "warrants" for signal installation. The warrants are prescribed in the Manual on Uniform Traffic Control Devices (MUTCD) and are:

Warrant 1 - Minimum vehicular volume
Warrant 2 - Interruption of continuous traffic
Warrant 3 - Minimum pedestrian volume
Warrant 4 - School crossings
Warrant 5 - Progressive movement
Warrant 6 - Accident experience
Warrant 7 - Systems
Warrant 8 - Combination of warrants
Warrant 9 - Four hour volumes
Warrant 10 - Peak hour delay
Warrant 11 - Peak hour volume

(1) Manual on Uniform Traffic Control Devices, USDOT, Federal Highway Adm., Washington, D.C. 1988.

Minimum criteria are established for each of the warrants and one or more must be met before installation of a new traffic signal can be considered.

SAFETY AND MOBILITY ISSUES

- Vehicles Queuing Across Railroad Tracks

Queuing of vehicles across the tracks usually occurs due to the nearby presence of traffic signals, intersections or paralleling roadways.

Due to the nearby presence of Old Concord Rd., as well as the traffic signal at McLean and Old Concord Rd., the potential for vehicles to que across the tracks at Newell-Hickory Grove Rd., Rocky River Rd., and McLean Rd. exists and will be more likely to occur as traffic volumes increase.

- Traffic Signal Preemption

Preemption of the nearby traffic signal by train operations is in place at McLean/Old Concord, and Back Creek Church/NC 49. Field observations show the equipment to be operating properly.

The Manual on Uniform Traffic Control Devices requires that preemption of traffic signals occur when the signal is within 200 feet or less of the crossing. Other than the two described immediately above, no other crossings meet this criteria.

- Humped Crossings

A "humped" crossing is one at which the elevation of the railroad is generally higher than that of the approaching roadway. This humped affect causes cars and trucks to ascend on one approach to cross the track and descend on the other side. When the humping is severe enough, vehicles, especially low-hanging trucks, tend to drag over the crossing and can become hung such that the vehicle can go neither forward nor backwards. Maintenance of the railroad tends to exacerbate the hump over time in that work on the track ballast generally raises the roadbed about three inches per occurrence. Over a ten-year period, the railroad will rise about one foot (1').

The approach grade on the Charlotte crossings is rated "fair" to "good" on four crossings, while Craighead Rd., Newell-Hickory Grove Rd., Rocky River Rd. and Back Creek Church Rd. are all rated "poor". Rocky River Rd. is "humped" on both approaches which severely limits a driver's ability to see the roadway on the opposite side of the tracks. The westbound approach is poor for both Craighead and Back Creek while the eastbound approach is poor at Newell-Hickory Grove Rd. There is evidence of vehicles dragging over the crossing at Rocky River Rd. and Back Creek Church Road.

- Grade Crossing Condition

The condition of the grade crossing surface can affect both safety and mobility. A poorly maintained crossing surface can contribute to accidents that may or may not involve a train. Also, a crossing in poor condition may cause operating speeds over the crossing to be lowered, thereby, impacting roadway capacity.

All crossings in the Charlotte Study, with the exception of Sugar Creek Rd. which has rubberized crossings, have recently been reworked and are in good condition.

- Vehicles Driving Around Automatic Gates

This occurs when motorists perceive that the automatic gates have lowered but a train is not approaching the crossing; when the gates fail in the lowered position (Fail Safe); or when impatience causes a driver or pedestrian to maneuver around the gates even when an approaching train is in sight.

Installation of 4-quad gates (with or without barrier medians) has proved to be very effective in treating this safety issue. Occurrences of this type have been virtually eliminated at Sugar Creek Rd. and Craighead Rd. Problems of this type at 36th St. and Orr Rd. should be either eliminated or considerably reduced by the installation of 4-quad gates and long-gate arms respectively. As a matter of fact, the NS reports that violations at Orr Rd. dropped from 20 per day to 2 per day immediately upon installation of the long-gate arms. Field observations did not indicate a problem of this nature at the four remaining crossings.

- Improved Signs and Markings

Installation and maintenance of required traffic control signs and markings is consistently an issue with state and municipal street and highway departments. And, to some extent, maintenance of the railroad signs, signals, and gates at crossings can be an issue with the railroad company.

At 36th St. and McLean Rd., advance warning signs were either missing or needed replacement. At Craighead and Rocky River, signs and pavement markings needed attention. At Newell-Hickory Grove Rd., markings needed to be replaced. At Back Creek Church Rd., the railroad signals needed some minor repairs in the form of sign and hood replacements.

- Roadway Improvements

Widening - Rocky River Rd. with a nine foot lane on the westbound approach, and Back Creek Church Rd. with a 10 foot lane on the same approach, should both be widened to 12 foot lanes with four foot paved shoulders.

36th St. has 10 foot lanes on both approaches and is operating as a four lane roadway. However, given existing traffic volumes, the roadway could be remarked to three lanes with a center two-way left turn lane, and achieve proper lane width.

Grade - The westbound approach grade at Craighead Rd.; the east- and westbound approach grades at Rocky River Rd.; and, the westbound approach grade at Back Creek Church Rd. all need to be improved to enhance safety and mobility.

- Roadway Grade Separation

Providing a roadway grade separation can eliminate safety, queuing and delay problems at a railroad grade crossing. Highway grade separations can either be on a bridge over the railway or the roadway can cross beneath the rail line.

Overpasses require greater length for the same design speed. The total elevation difference is greater because the standard rail vertical clearance of 23 feet exceeds the typical highway clearance of 16 or 16-1/2 feet (even though the structure depth is usually greater for the rail bridge typically provided at an underpass). More importantly, the vertical curve in the middle of the facility, the "crest" curve on an overpass is longer for a given design speed than the "sag" curve at an underpass, due to stopping sight distance requirements.

The visual and noise impacts associated with overpasses can make them undesirable for use in residential zones, downtown zones, or near historic structures. For the Charlotte study, underpasses at Sugar Creek Rd. and Rocky River Rd. were considered and will be discussed in the Recommendations Section of this report.

The design, and ultimately the feasibility, of a highway grade separation is heavily influenced by property access considerations and the location and connectivity of roadways which parallel the tracks and connect to the cross street. Where an existing frontage road is immediately adjacent to the railroad, the street crossing can clear this facility as well. If necessary, a connection to the frontage road can be provided by directional ramps similar to freeway on-and-off ramps that provide access to the frontage road for traffic to-and-from points on the same side of the railway line as the frontage roadway.

Design standards for mainline railroads are very restrictive as far as the ability to modify the railroad grade or profile. For purposes of the study, changes in the profile of the Norfolk Southern (NS) line were not considered.

- Other Mobility Factors

All crossings included in this report are used on a daily basis by the school system and emergency responders. See Table 1.

- **MECKLENBURG-UNION THOROUGHFARE PLAN** - there are two future projects on the local thoroughfare plan that will impact the recommendations contained in the **Recommendations Section** that follows below, as well as the feasibility of implementing the **Piedmont High Speed Rail Corridor.** The projects are:

  Back Creek Church Rd. is to be relocated south from its current intersection with NC 49 and connected to Mallard Cr. Ch. Rd. The project, as proposed, includes a grade separation structure at the NS.

  East Charlotte Outer Loop is currently under construction to the east of Back Creek Church Rd. The project is a multi-lane freeway on new location and includes a grade separation with the NS.

- Other than those improvements in grade crossing safety equipment (4-quad gates) programmed for the crossing at 36th St., there are no other projects programmed in the **NCDOT Transportation Improvement Program** that will affect any of the crossings included in this report.

CONCLUSIONS

Accommodating the **Transit 2001 Plan** goal of two-hour passenger train service between Raleigh and Charlotte will require a substantial reduction in the number of streets that cross the railroad at grade, as well as major modifications to many of those that remain.

Freight train traffic along the Norfolk Southern (NS) will increase due to the division of CONRAIL routes between Norfolk Southern (NS) and CSX.

Vehicular traffic in the Charlotte Metropolitan Area will continue to increase as growth and expansion to the northeast continues.

Safety concerns at the Sugar Creek Rd. and Craighead Rd. crossings have been considerably mitigated by the installation of Advanced Crossing Protection Devices and the same affect is anticipated for 36th St. and on Orr Rd. These are significant safety issues requiring treatment at the four remaining crossings.

Mobility is an issue at the Sugar Creek Rd. crossing due to the high volume of trains (42/day) and the high volume (>26,000 VPD) of roadway traffic. As the area served by Newell-Hickory Grove Rd., Rocky River Rd., McLean Rd., and Back Creek Church Rd. continues to develop, mobility will become an issue at these crossings as well.

RECOMMENDATIONS

For purposes of this report, recommendations are classified as follows:

Near-term (0-2 years)
Mid-term (2-5 years)
Long-term (5+ years)

I. 36th St., Craighead Rd. and Sugar Creek Rd.

a. 36th St.

The NCDOT is planning to install Advanced Crossing Protection Devices at the 36th St. crossing. Field observations show violations of the existing devices approach 20 per week.

Due to the success of the 4-quad gates previously discussed, the NCDOT and NS have selected this option for 36th St. The project is funded from the **Transportation Improvement Program High Speed Rail Account.**

Near Term Recommendation:

36th St. is currently operating as a four-lane roadway at an **LOS** of **F** at its intersection with N. Tryon St. and an **LOS** of **B** at Davidson St. It is recommended that the segment between the intersections at N. Tryon St. and Davidson St. (2100 LF) be resurfaced and re-marked to a three-lane section with a center two-way left-turn lane. Given that this section of roadway accesses mostly industrial property served by tractor-trailers, the wider lanes will allow for safer maneuvering of large vehicles.

Estimated Cost:

Install 4-quad gates $125,000.00
Resurface & remark 3-lane roadway $15,000.00

See Figures 6 and 7.

The intersection of N. Tryon and 36th St. can be improved to an **LOS** of **D** by adding a NB thru-lane on Tryon and rephasing and re-timing the signal.

Impacts of Recommendation: All impacts associated with the above recommendations are deemed to have a positive effect. The installation of Advanced Crossing Protection Devices will enhance public safety both from a highway and railway perspective by reducing the potential for rail/highway collisions. The re-marking of 36th St. to a three-lane roadway will improve maneuverability for large vehicles and, thereby enhance roadway safety and improve access to abutting property.

(b.) Craighead Rd.

Near Term Recommendation:

A system LOS analysis which included 36th St., Craighead Rd., Sugar Creek Rd., N. Tryon St. and N. Davidson St. is shown in the Appendix. The only impact closing Craighead Rd. will have on the network is that the Level of Service at the 36th St./Davidson St. intersection will drop from B to C.

Given the poor geometry at this crossing, its safety record and the fact that it can be closed without a serious impact to the level of service of the area street system, it is recommended that Craighead Rd. be closed and a cul-de-sac constructed west of the NS. It is further recommended that Davidson St. be realigned as shown on **Figure 9**.

Estimated Costs:

1.	Remove existing crossing and equipment	$ 8,000.00
2.	Construct cul-de-sac	$92,000.00
3.	Realign Davidson St.	$550,000.00
	Total	$650,000.00

TOTAL ESTIMATED PROJECT COST $650,000.00

Impacts of Recommendation: Even though this recommendation will close a crossing of the railroad and will require an increased travel time and distance for some area businesses, overall impacts are positive. For example, vehicles leaving Abernathy Lumber Co. and wishing to access Sugar Creek Rd. at N. Davidson St. will have to use Raleigh and Greensboro Sts. and drive an additional quarter mile to reach the intersection. The recommendation will also require the taking of approximately one acre of privately held property for public right-of-way, but an equivalent amount of right-of-way can be abandoned.

The greatest overall impact of the recommendation is significantly enhanced public safety. The Craighead Rd. crossing is the most dangerous of all evaluated in this study. It can be closed with no appreciable impact on area Level of Service. Furthermore, the intersection of Craighead Rd. with N. Davidson St. can be demolished and Davidson St. can be realigned, resulting in improved roadway geometry and sight distance. Closing Craighead Rd. will eliminate the potential for rail/highway collisions, will eliminate the noise impacts associated with the blowing of train horns and will enhance the implementaion of the **Piedmont High Speed Rail Corridor.**

(c.) Sugar Creek Rd.

Long-Term Recommendation:

Given that Sugar Creek Rd. will soon have volumes approaching 30,000 vehicles per day and the potential increase in train traffic, the likelihood of increased mobility delay is high. Projecting the current traffic volumes to 2017 and assuming a growth in rail traffic to 50 per day from the current 42, yields an **"exposure index"** of **1,827,000** versus a threshold

number of 30,000. It is recommended that a grade separation structure be constructed that will allow Sugar Creek Rd. to pass beneath the NS mainline. It is further recommended that the spur line west of the mainline be severed at Sugar Creek Rd. and the line remaining north of Sugar Creek Rd. be connected to the mainline. In order to build the overpass, approximately 2,000 LF of the railroad will have to be temporarily relocated. **See Figure 11.**

Estimated Cost:

Right-of-way	$2,500,000
Roadway Construction-L Line	$3,500,000
Roadway Construction-Y Lines	$325,000
Railroad Bridge	$2,500,000
Railroad Track-Mainline	$900,000
Railroad Track-Spur	$72,000
TOTAL	$9,797,000

TOTAL ESTIMATED PROJECT COST $10,000,000

Impacts of Recommendation: Building a grade-separation structure at Sugar Creek Rd. and the NS will have considerable positive and negative impacts on the community. However, the long-term positive benefits far outweigh the short-term costs. To build the overpass will require the taking of a considerable amount of privately held property and converting it into public right-of-way. Several modest residential structures (8) will have to be acquired and demolished as well as all, or portions, of six commercial buildings. Construction will also cause significant delays and/or detours for traffic in the area and will require some disruption in rail operations from time to time. However, the resultant project will eliminate the possibility of rail/vehicle collisions at the crossing as well as future mobility delays that will become more significant as rail and highway traffic continues to increase. The grade separation will also eliminate the noise impacts associated with the blowing of train horns at a grade crossing and will enhance the implementaion of the **Piedmont High Speed Rail Corridor.** Air quality is an issue in the Charlotte/Mecklenburg Urbanized Area, and the pollution caused by idling vehicles queued at a signalized intersection or a railroad grade crossing is a significant concern. The construction of the overpass will enhance overall air quality for the community.

II. Orr Rd.

The Orr Rd. crossing has had no reported accidents over the last ten years. Data review and field investigations revealed no safety or other issues at the crossing. The NCDOT and NS began testing long gate arms at this crossing on March 31, 1997.

To close Orr Rd. at this time would not be reasonable since the nearest available crossing on either side of Orr Rd. is over a mile away. While train volumes are high (42/day), the

crossing volume is only 6,300/day. Most of the land being served is in commercial or industrial use and the expected growth in traffic volume is modest. Therefore, a recommendation for a grade separation structure at Orr Rd. is not warranted. No other changes or improvements are recommended. **See Figures 12 and 13.**

III. Newell-Hickory Grove Rd., Rocky River Rd., McLean Rd.

Long-Term Recommendation:

It is recommended that the above three crossings be consolidated into a single crossing with a grade separation structure being provided where Rocky River Rd. West intersects with Old Concord Rd. The recommendation includes overpasses for Old Concord Rd. and the NS Railroad with Rocky River Rd. West passing underneath and connecting to Rocky River Rd. East. Also included is a paralleling roadway that would connect Newell-Hickory Grove Rd. to the new Rocky River Rd., which would extend beyond the existing Rocky River Rd. and connect to the University Business Park currently under construction by the Crosland Group. It is also recommended that McLean Rd. be connected to Harris Blvd. by way of a new roadway. **See Figures 16 through 23.** The basis for this recommendation is as follows:

- Train traffic in the area is high at 34/day and is expected to increase.
- Traffic volumes on the three roads are relatively low, ranging from 3,400 VPD on Newell-Hickory Grove Rd. to 5,100 VPD on McLean Rd with a total volume of 12,500 vehicles per day. Some drivers will chose another route once the **Consolidation Project** is complete. Assuming that the remaining volume will be 10,000 vehicles per day and projecting that to 2010, yields volumes at the crossing of 14,000VPD. A modest growth in train traffic from 34 to 40 per day is also projected in computing the **"exposure index"**. Using these numbers yields an index of **560,000** versus a 30,000 threshold number.
- Newell-Hickory Grove Rd. connects to Grier Rd. at its easterly end and also has access directly to Harris Blvd. by way of District Dr.
- The topography in the area lends itself to the construction of the overpasses for Old Concord Rd. and the NS. Also, the existing development patterns in the area do not preclude the taking of the necessary right-of-way for the project construction.
- The Level of Service Analysis at Old Concord Rd. and McLean Rd. indicates that it is currently operating at an **LOS** of **C**, and is expected to deteriorate over time.

Given the current development patterns and the anticipated growth in the area, the proposed consolidation of the three crossings into one should be placed on the local transportation plan such that right-of-way can be protected and future development patterns can accommodate the proposed consolidation.

Rocky River Rd. Crossing Consolidation

Estimated Cost:

Rocky River Rd. West Extension	$2,500,000
Old Concord Rd. and Ramps	$580,000
Railroad Bridge	$1,900,000
Railroad Track	$600,000
Highway Bridge	$750,000
Right-of-way	$400,000
Sub-total	$6,730,000
SAY	**$7,000,000**
South Connector (Newell-Hickory Grove Rd. to Rocky River Rd.)	$435,000
Right-of-way	$180,000
Sub-total	$615,000
SAY	**$600,000**
North Connector (Rocky Riv. Rd. to Univ. E. Dr)	$462,000
Right-of-way	$192,000
Sub-total	$654,000
SAY	**$650,000**
McLean Rd./Harris Blvd. Connector	$200,000
Right-of-way	$84,000
Sub-total	$284,000
SAY	**$300,000**
TOTAL ESTIMATED PROJECT COST	**$8,250,000**

Impacts of Recommendation: To consolidate the above three crossings into a single crossing of the NS will have short-term negative impacts which will be overridden by the long-term benefits. To implement the project will require the taking of privately held property and turning it into public right-of-way. It will also require a possible change in land development plans as well as an alteration in local travel patterns. The most significant impact will be to those residential properties near or planned for construction near the current McLean Rd. crossing of the NS. Implementation of the recommendation will require a considerable alteration in their driving and travel habits.

The positive aspects of the recommendation are considerable, however. The elimination of the potential for rail/highway collisions at three crossings provides substantial benefit to the community at large. The elimination of future mobility delays will also yield positive benefits in improved travel time as well as a benefit to overall air quality by the associated

reduction in idling time for queued automobiles. Elimination of the three grade crossings will also eliminate the noise impacts associated with the blowing of train horns which is a considerable issue for the Newell Community since the three existing crossings are so close together. The **Consolidation Project** will also enhance the implementation of the **Piedmont High Speed Rail Corridor.**

Near-term Recommendations:

Recognizing that the **Consolidation Project** will require several years to implement, other near-term issues must be dealt with in order to guard public safety. The **Rocky River Road** crossing is severly humped, as discussed previously, which results in poor sight distance at the crossing. In order to mitigate these conditions, it is recommended that **long-gate arms** be installed at the crossing and the roadway on the westbound approach needs to be widened.

Newell-Hickory Grove Road has seen a significant decline in traffic volume due to the modifications in the street network caused by the construction of **W. T. Harris Boulevard.** While there have been three "Property Damage Only" accidents at the crossing, there have been none reported since 1991. W. T. Harris Blvd. opened to traffic in 1992 and the Newell-Hickory Grove Rd. connection to W.T. Harris Blvd. was severed north of The Plaza. Therefore, the only **near-term recommendation** as a result of this analysis, is to continue to monitor the crossing in case a safety issue developes in the future.

McLean Road serves a developing residential area and currently carries over 5000 vehicles per day. However, there have been no reported accidents at the crossing and no unsafe vehicle maneuvers were observed during preparation of this report. As a **near-term recommendation,** the crossing should continue to be monitored for any safety issues that may develope in the future.

Estimated Cost:

Install long-gate arms at Rocky River Rd $15,000.00
Widen westbound approach at Rocky River Rd $20,000.00

Impacts of Recommendation: other than the necessary and temporary traffic delays associated with roadway construction, there are no other negative impacts associated with this recommendation. Positive benefits include enhanced roadway safety and maneuverability associated with the improvements.

IV. Back Creek Church Rd.

Train volumes at the Back Creek Church Rd. crossing are high at 34/day and expected to increase. Traffic volume at the crossing however, is only 3,500 VPD. The area is growing with several new subdivisions having been recently completed or begun along Back Creek Church Rd. and traffic volumes are expected to increase at more than 2% per annum. There

has been one grade crossing collision in the last ten years, resulting in a Class A Injury Accident.

The Mecklenburg-Union Thoroughfare Plan calls for this portion of Back Creek Church Rd. to be relocated to the south and connected to Mallard Creek Church Rd. at NC 49. This relocation, should it occur, also proposes a grade separation structure at the NS Railway.

Near-Term Recommendation:

The westbound approach lane on Back Creek Church Rd. is only 10 feet wide and should be widened to a minimum of 11 feet with a 4-foot paved shoulder. As part of the **Sealed Corridor Program**, the NCDOT Rail Division also plans to install a barrier median at the crossing to restrict motorists' ability to maneuver around lowered gates. **See Figures 24 and 25.**

Estimated Cost:

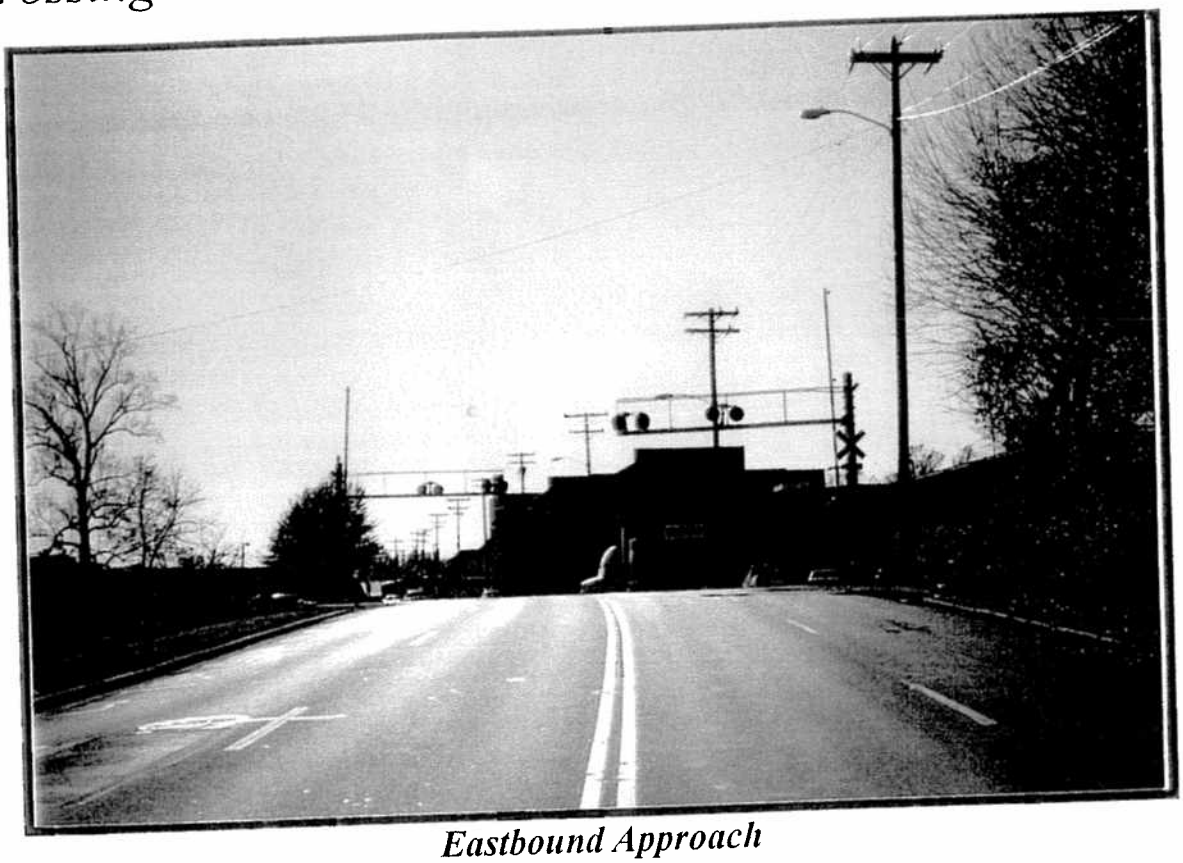
Install median barrier	$10,000.00
Widen westbound approach	$25,000.00

Impacts of Recommendation: Other than the necessary and temporary traffic delays associated with roadway construction, there are no other negative impacts associated with this recommendation. Positive benefits include enhanced roadway safety and maneuverability associated with wider travel lanes.

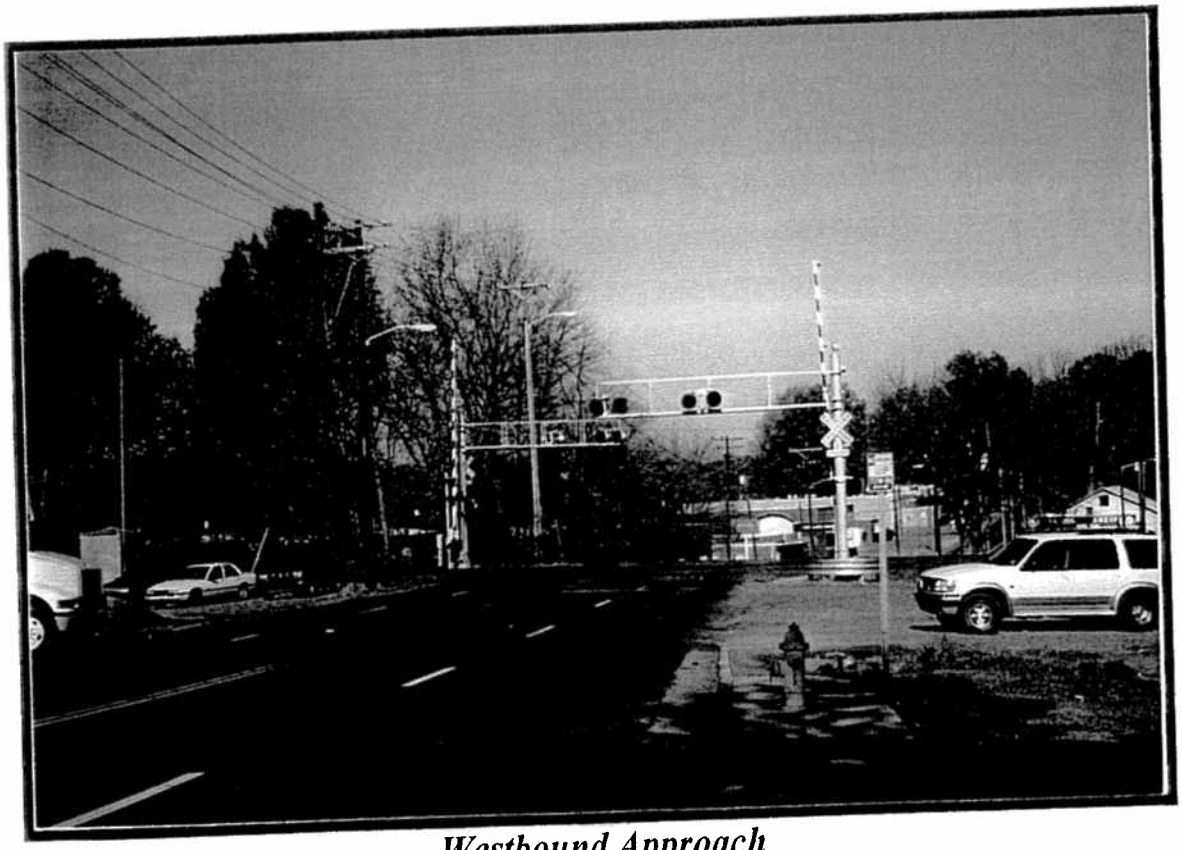
Long-term Recommendation: The **Mecklenburg-Union Thoroughfare Plan** anticipates that Back Creek Church Rd. can be closed at the railroad at such time as the road is re-routed to connect to Mallard Creek Church Rd. However, with the recent completion of Pavilion Boulevard and its connection to Back Creek Church Rd. at University City Blvd. (NC 49), it may not be feasible to sever the connection in the future. It will be necessary, therefore, to continue to monitor the crossing as the Thoroughfare Plan is periodically updated and a future study may be required to determine the feasibility of a grade separation at Back Creek Church Rd. and the NS.

Municipality: Charlotte

Crossing Number: 715356K *Street Name:* 36th St.

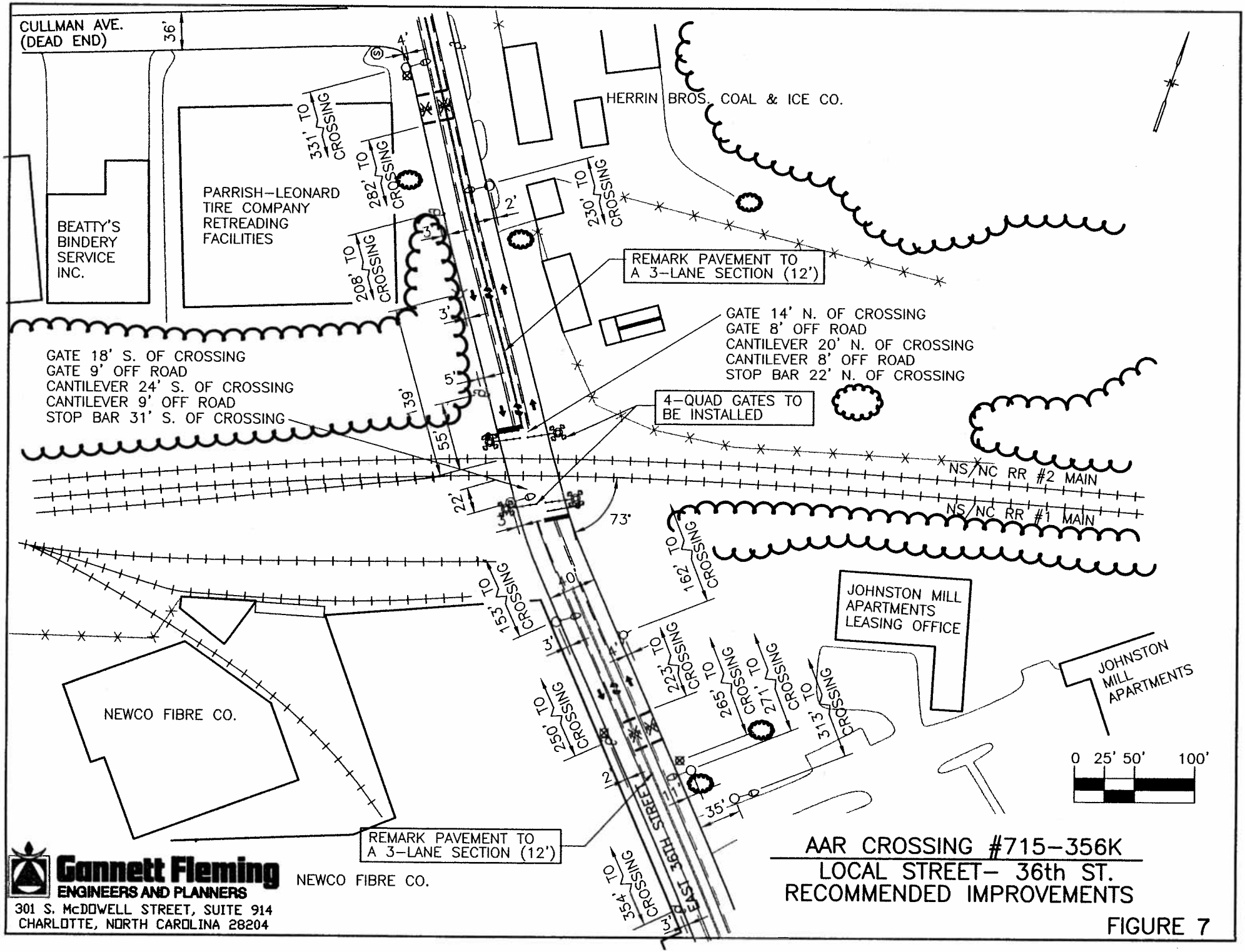


Eastbound Approach



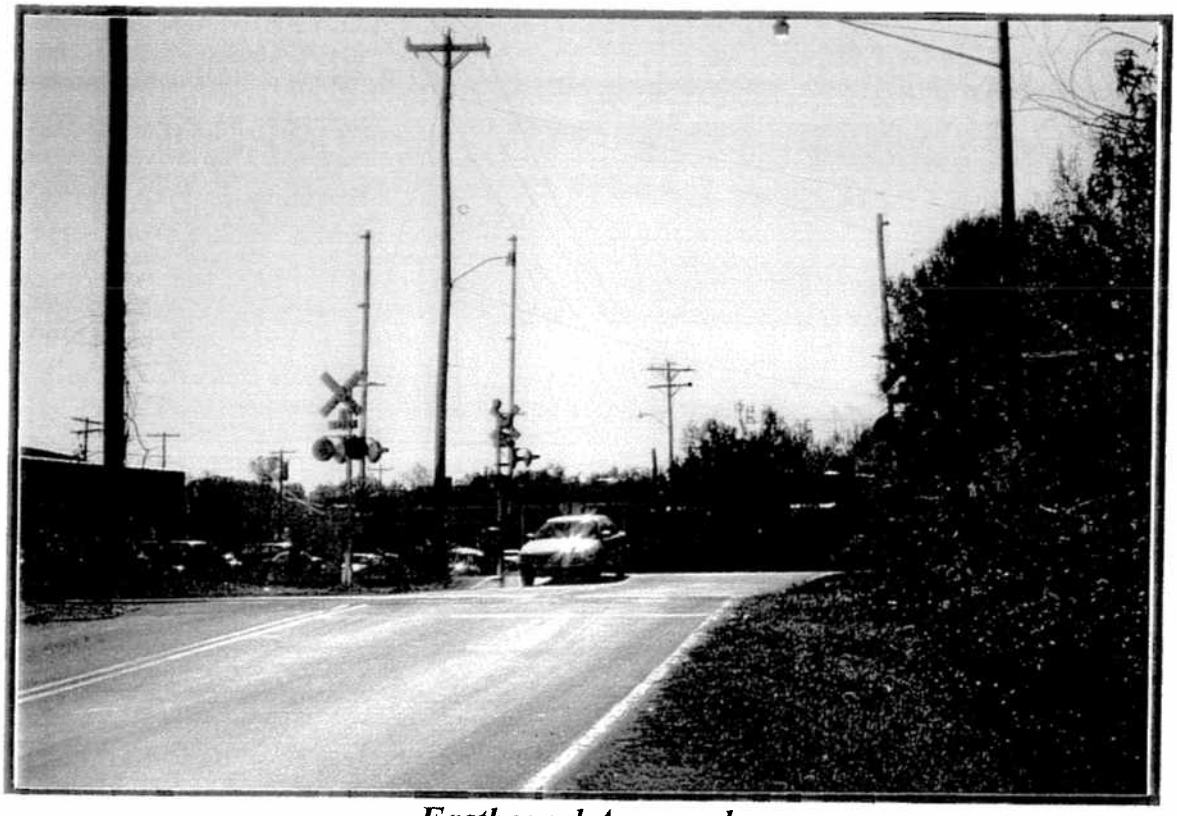
Westbound Approach

FIGURE 6

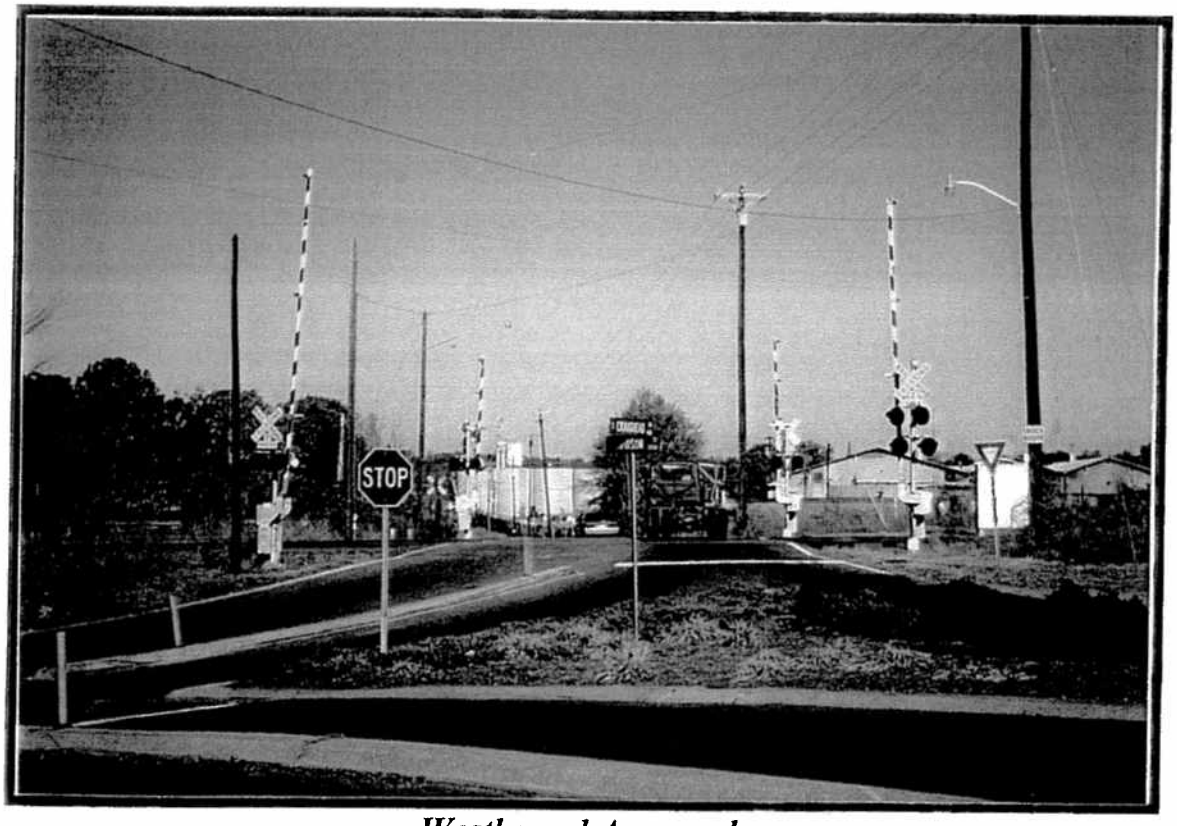

CULLMAN AVE.
(DEAD END)
36'
HERRIN BROS. COAL & ICE CO.
BEATTY'S BINDERY SERVICE INC.
PARRISH–LEONARD TIRE COMPANY RETREADING FACILITIES
331' TO CROSSING
282' TO CROSSING
208' TO CROSSING
230' TO CROSSING
REMARK PAVEMENT TO A 3–LANE SECTION (12')
GATE 14' N. OF CROSSING
GATE 8' OFF ROAD
CANTILEVER 20' N. OF CROSSING
CANTILEVER 8' OFF ROAD
STOP BAR 22' N. OF CROSSING
GATE 18' S. OF CROSSING
GATE 9' OFF ROAD
CANTILEVER 24' S. OF CROSSING
CANTILEVER 9' OFF ROAD
STOP BAR 31' S. OF CROSSING
4–QUAD GATES TO BE INSTALLED
NS/NC RR #2 MAIN
NS/NC RR #1 MAIN
73'
162' TO CROSSING
153' TO CROSSING
JOHNSTON MILL APARTMENTS LEASING OFFICE
JOHNSTON MILL APARTMENTS
223' TO CROSSING
265' TO CROSSING
271' TO CROSSING
313' TO CROSSING
250' TO CROSSING
NEWCO FIBRE CO.
EAST 36TH STREET
354' TO CROSSING
REMARK PAVEMENT TO A 3–LANE SECTION (12')
0 25' 50' 100'
Gannett Fleming
ENGINEERS AND PLANNERS
301 S. McDOWELL STREET, SUITE 914
CHARLOTTE, NORTH CAROLINA 28204
NEWCO FIBRE CO.
AAR CROSSING #715–356K
LOCAL STREET– 36th ST.
RECOMMENDED IMPROVEMENTS
FIGURE 7

Municipality: Charlotte

Crossing Number: 715355D *Street Name:* Craighead Rd.

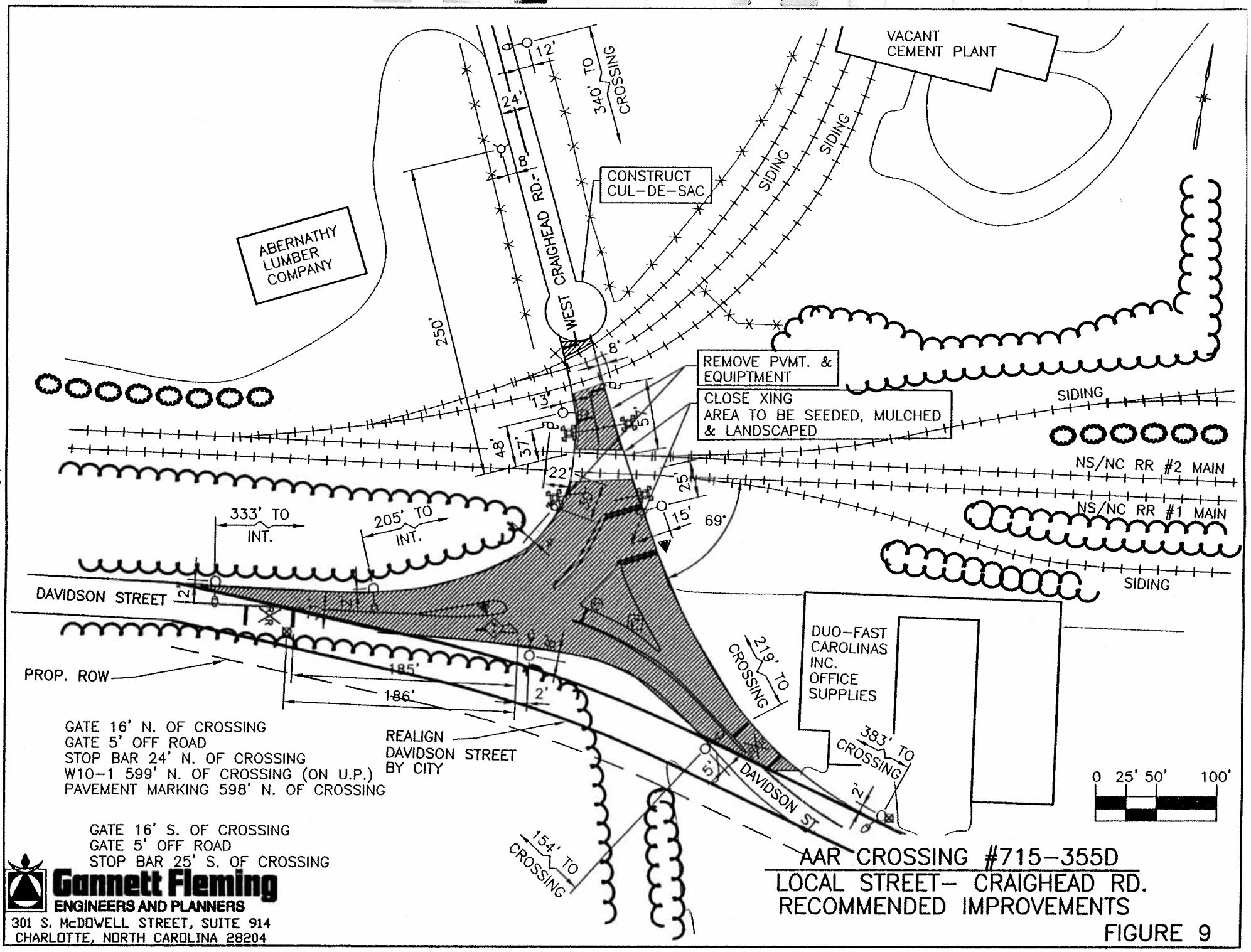


Eastbound Approach



Westbound Approach

FIGURE 8


VACANT
CEMENT PLANT
ABERNATHY
LUMBER
COMPANY
CONSTRUCT
CUL-DE-SAC
WEST CRAIGHEAD RD.
340' TO
CROSSING
SIDING
SIDING
SIDING
SIDING
REMOVE PVMT. &
EQUIPTMENT
CLOSE XING
AREA TO BE SEEDED, MULCHED
& LANDSCAPED
NS/NC RR #2 MAIN
NS/NC RR #1 MAIN
333' TO
INT.
205' TO
INT.
DAVIDSON STREET
PROP. ROW
185'
186'
2'
GATE 16' N. OF CROSSING
GATE 5' OFF ROAD
STOP BAR 24' N. OF CROSSING
W10-1 599' N. OF CROSSING (ON U.P.)
PAVEMENT MARKING 598' N. OF CROSSING
REALIGN
DAVIDSON STREET
BY CITY
GATE 16' S. OF CROSSING
GATE 5' OFF ROAD
STOP BAR 25' S. OF CROSSING
219' TO
CROSSING
DUO-FAST
CAROLINAS
INC.
OFFICE
SUPPLIES
383' TO
CROSSING
DAVIDSON ST.
154' TO
CROSSING
0 25' 50' 100'
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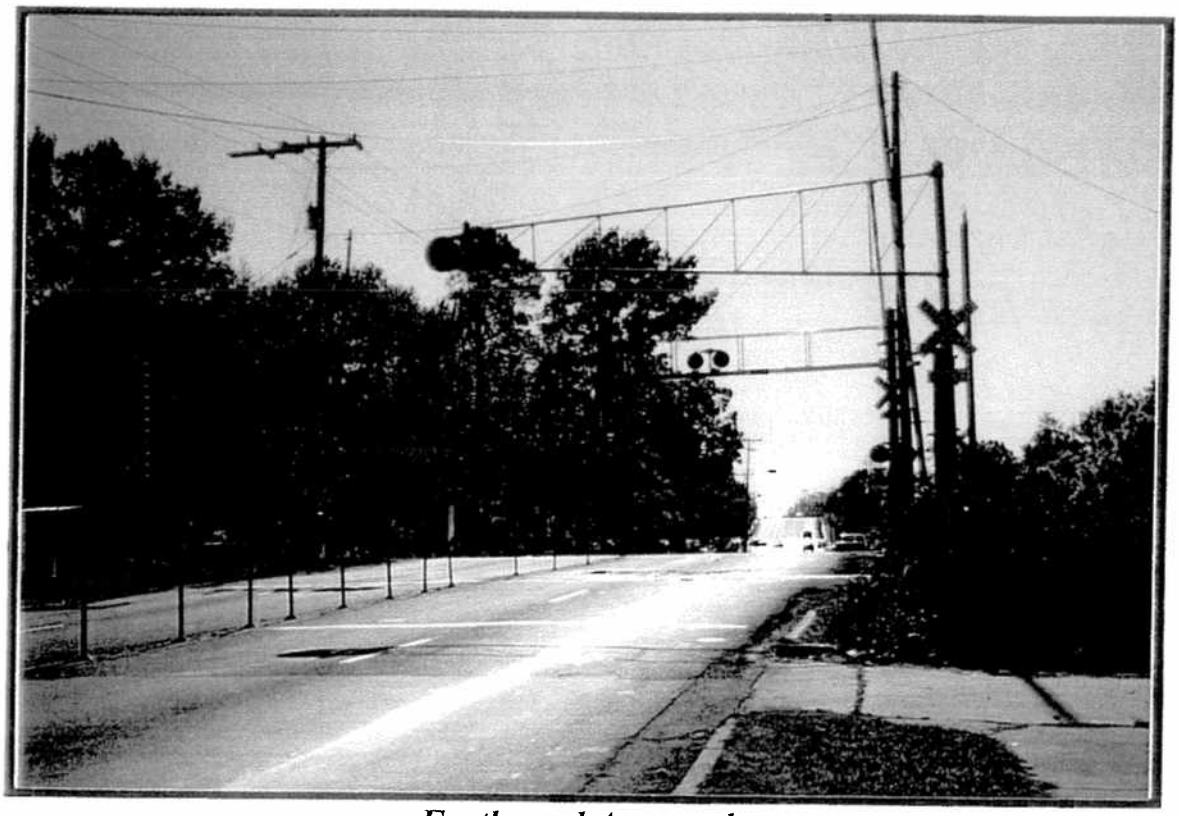
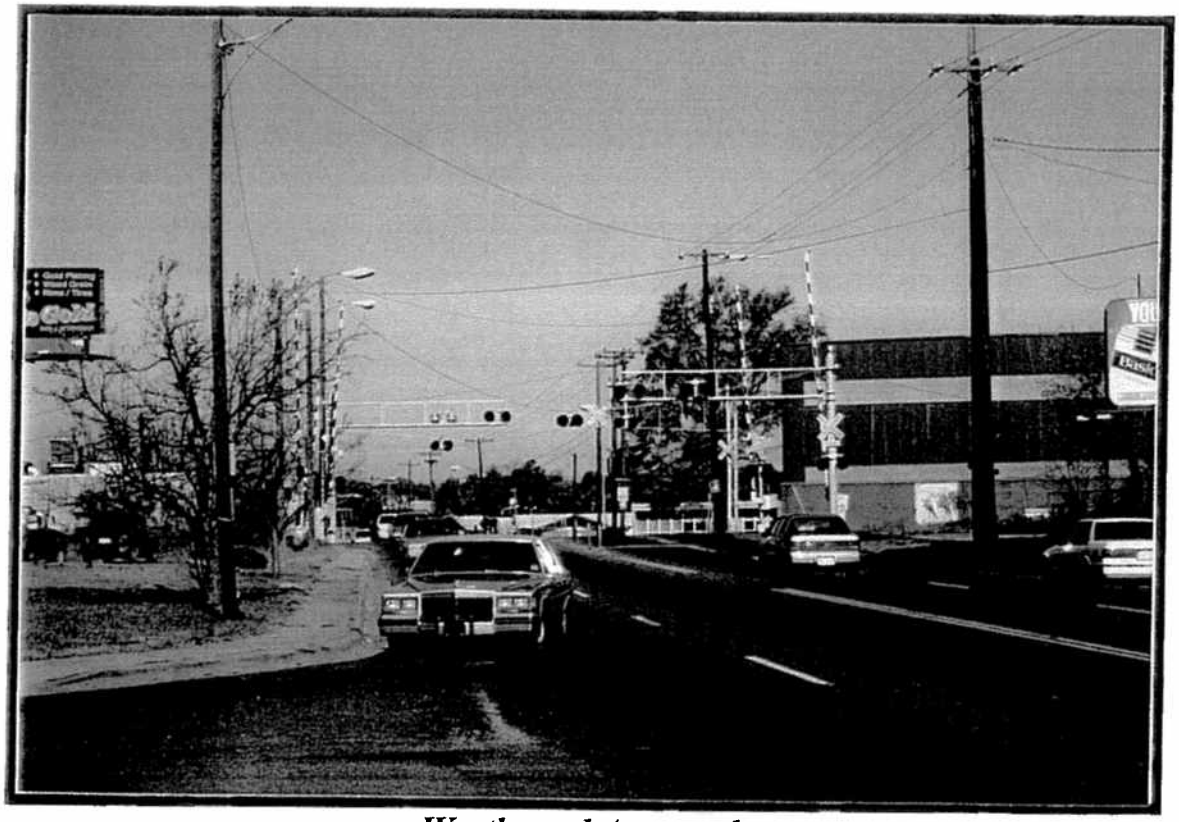
301 S. McDOWELL STREET, SUITE 914
CHARLOTTE, NORTH CAROLINA 28204
AAR CROSSING #715-355D
LOCAL STREET- CRAIGHEAD RD.
RECOMMENDED IMPROVEMENTS
FIGURE 9

Municipality: Charlotte

Crossing Number: 715352H *Street Name:* Sugar Creek Rd.

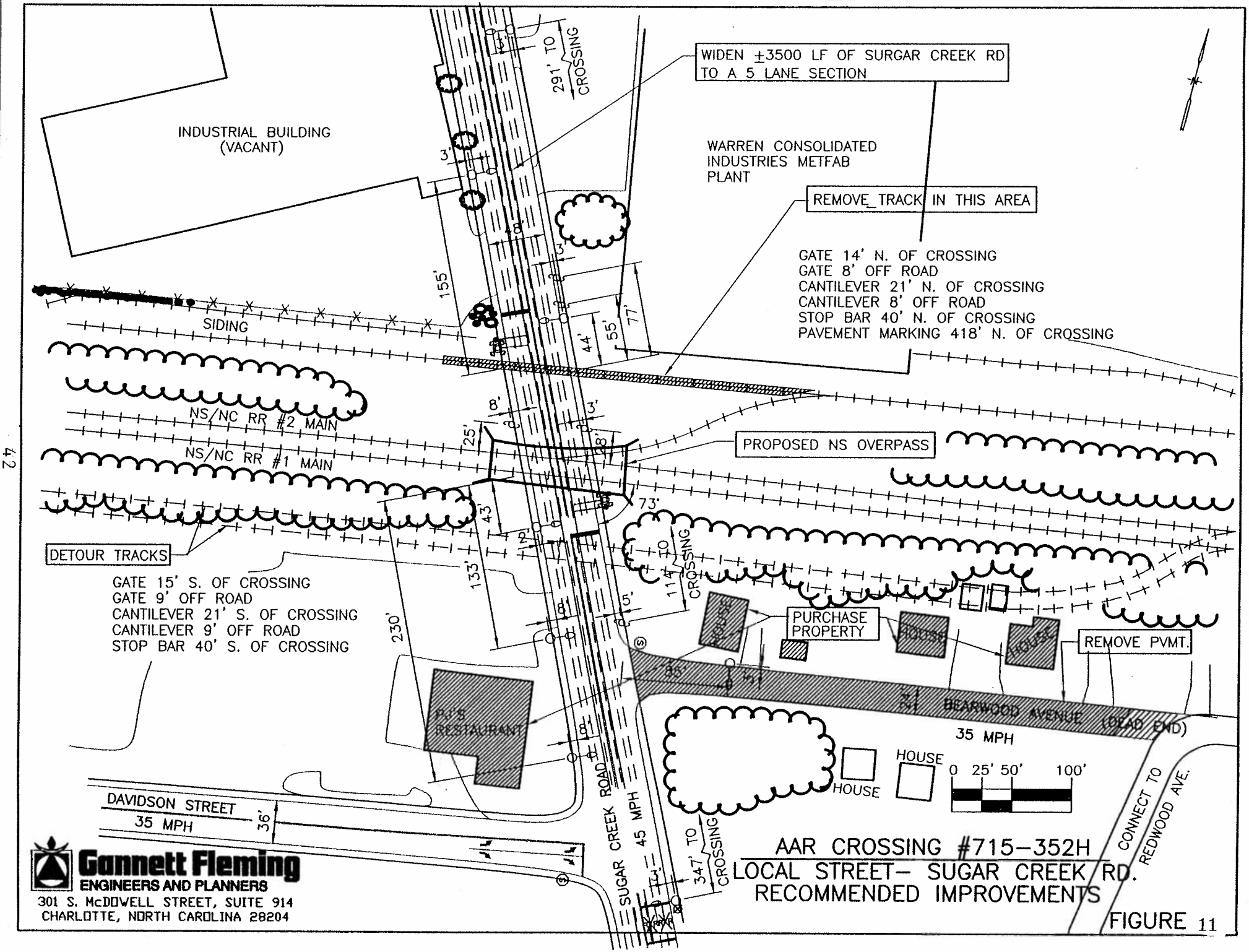


Eastbound Approach



Westbound Approach

FIGURE 10


WIDEN ±3500 LF OF SURGAR CREEK RD TO A 5 LANE SECTION
INDUSTRIAL BUILDING (VACANT)
WARREN CONSOLIDATED INDUSTRIES METFAB PLANT
REMOVE TRACK IN THIS AREA
GATE 14' N. OF CROSSING
GATE 8' OFF ROAD
CANTILEVER 21' N. OF CROSSING
CANTILEVER 8' OFF ROAD
STOP BAR 40' N. OF CROSSING
PAVEMENT MARKING 418' N. OF CROSSING
291' TO CROSSING
SIDING
NS/NC RR #2 MAIN
NS/NC RR #1 MAIN
PROPOSED NS OVERPASS
DETOUR TRACKS
GATE 15' S. OF CROSSING
GATE 9' OFF ROAD
CANTILEVER 21' S. OF CROSSING
CANTILEVER 9' OFF ROAD
STOP BAR 40' S. OF CROSSING
114' TO CROSSING
PURCHASE PROPERTY
HOUSE
REMOVE PVMT.
BEARWOOD AVENUE (DEAD END)
35 MPH
PJ'S RESTAURANT
SUGAR CREEK ROAD
45 MPH
DAVIDSON STREET
35 MPH
347' TO CROSSING
CONNECT TO REDWOOD AVE.
0 25' 50' 100'
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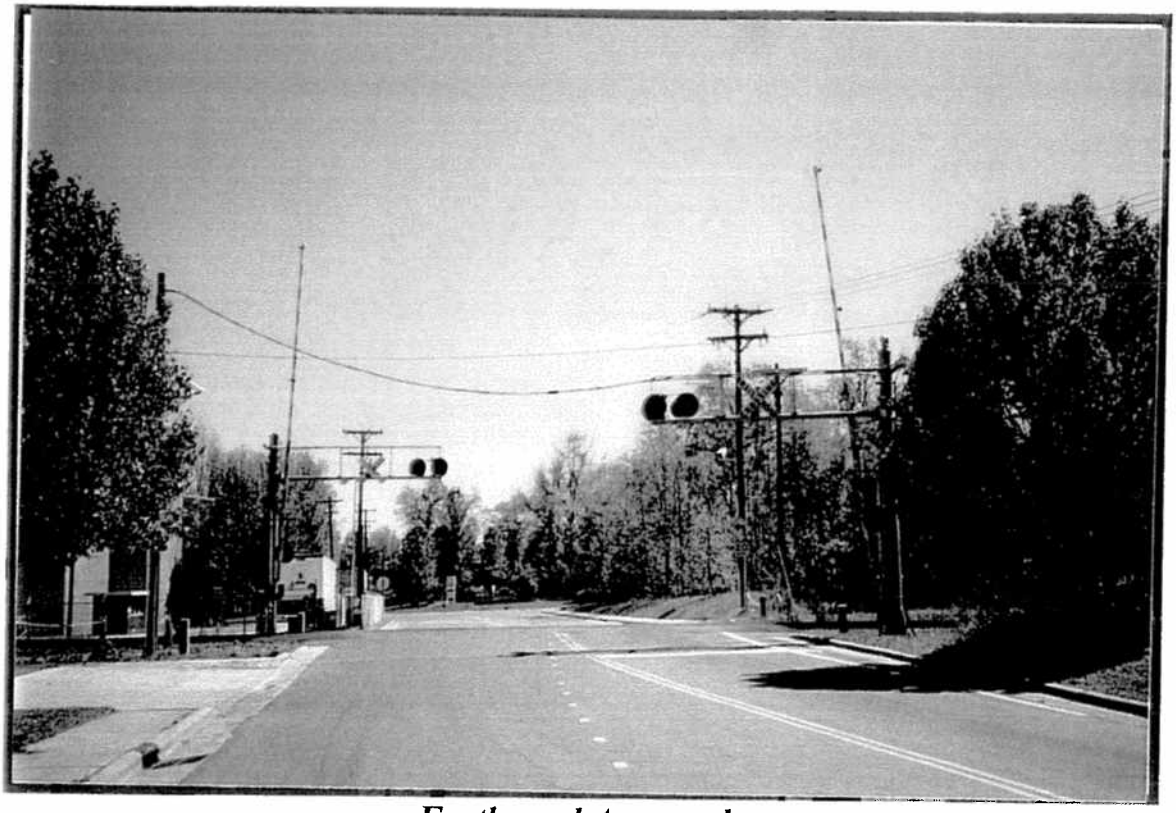
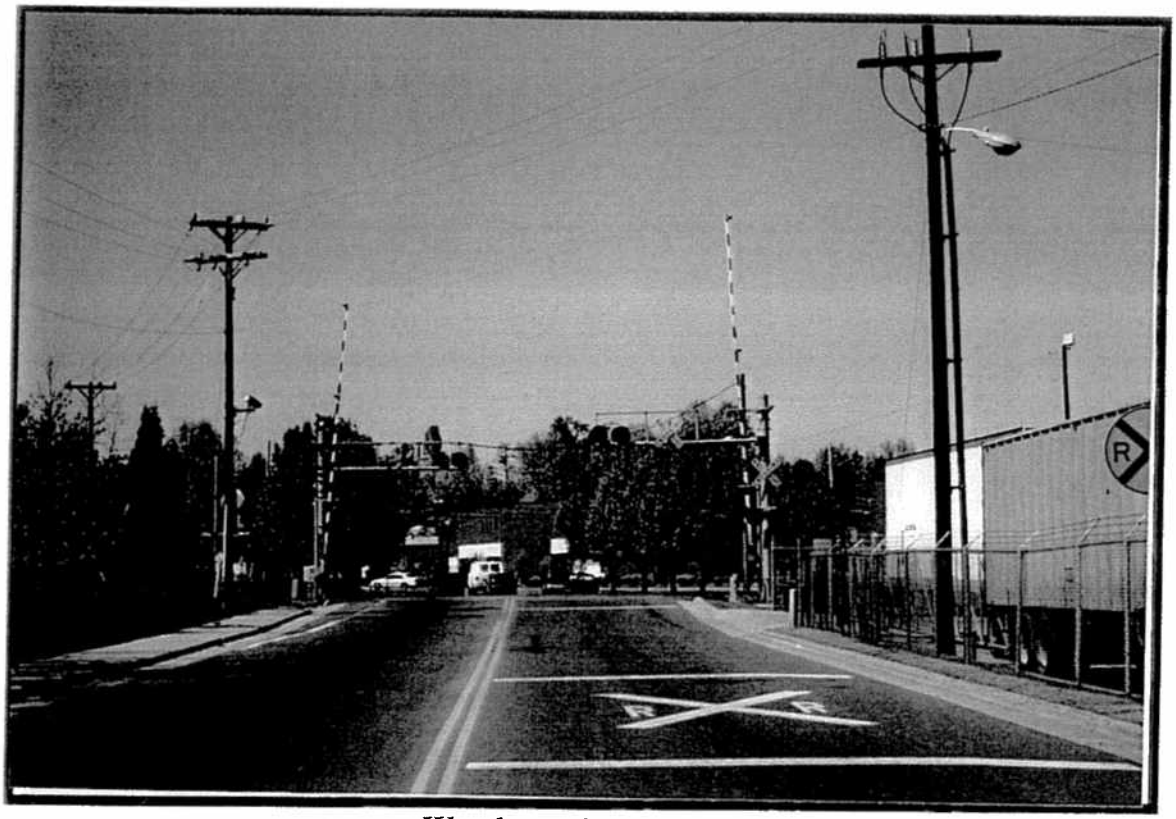
301 S. McDOWELL STREET, SUITE 914
CHARLOTTE, NORTH CAROLINA 28204
AAR CROSSING #715-352H
LOCAL STREET- SUGAR CREEK RD.
RECOMMENDED IMPROVEMENTS
FIGURE 11

Municipality: Charlotte

Crossing Number: 715350U *Street Name:* Orr Rd.

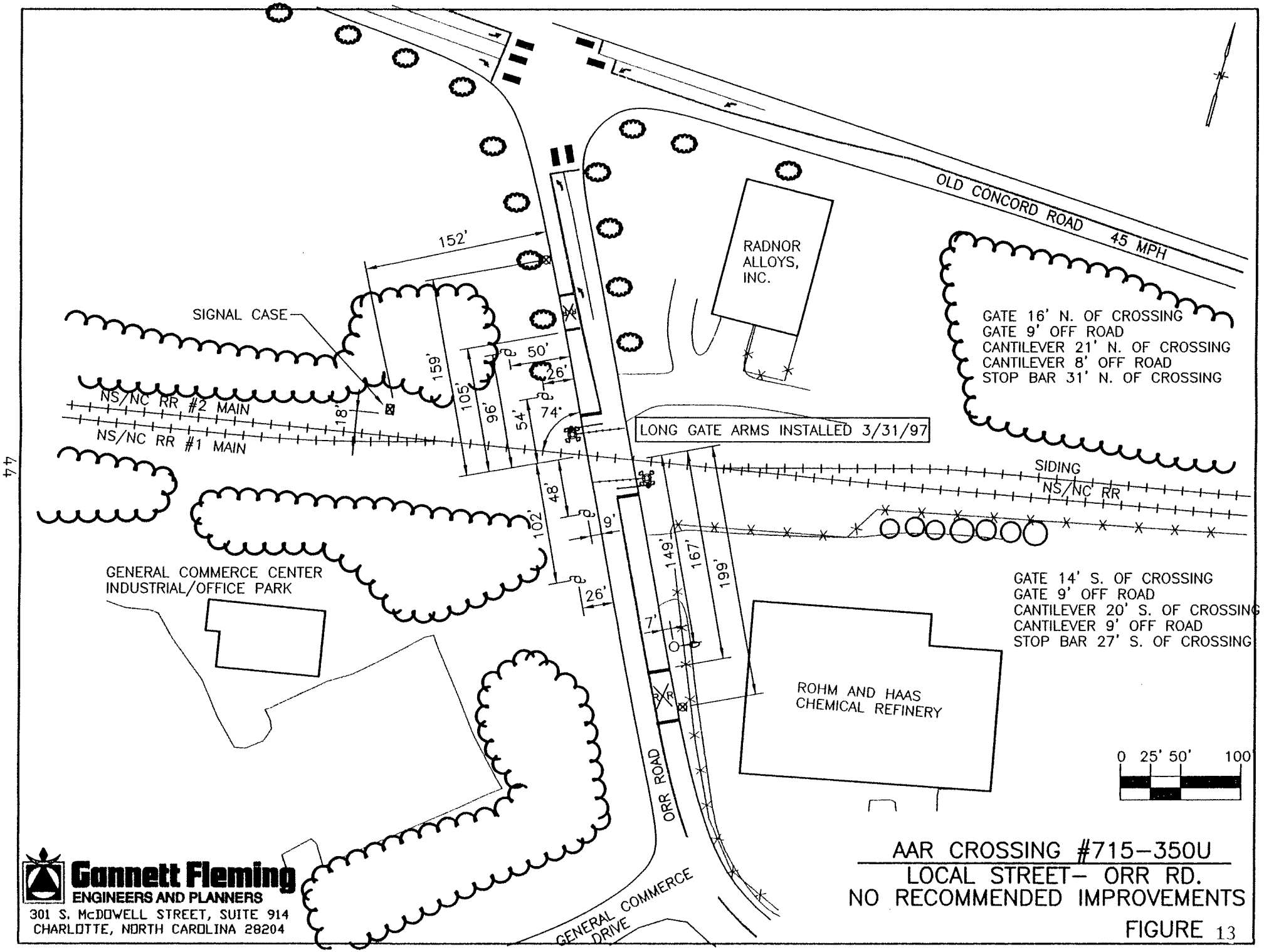


Eastbound Approach



Westbound Approach

FIGURE 12



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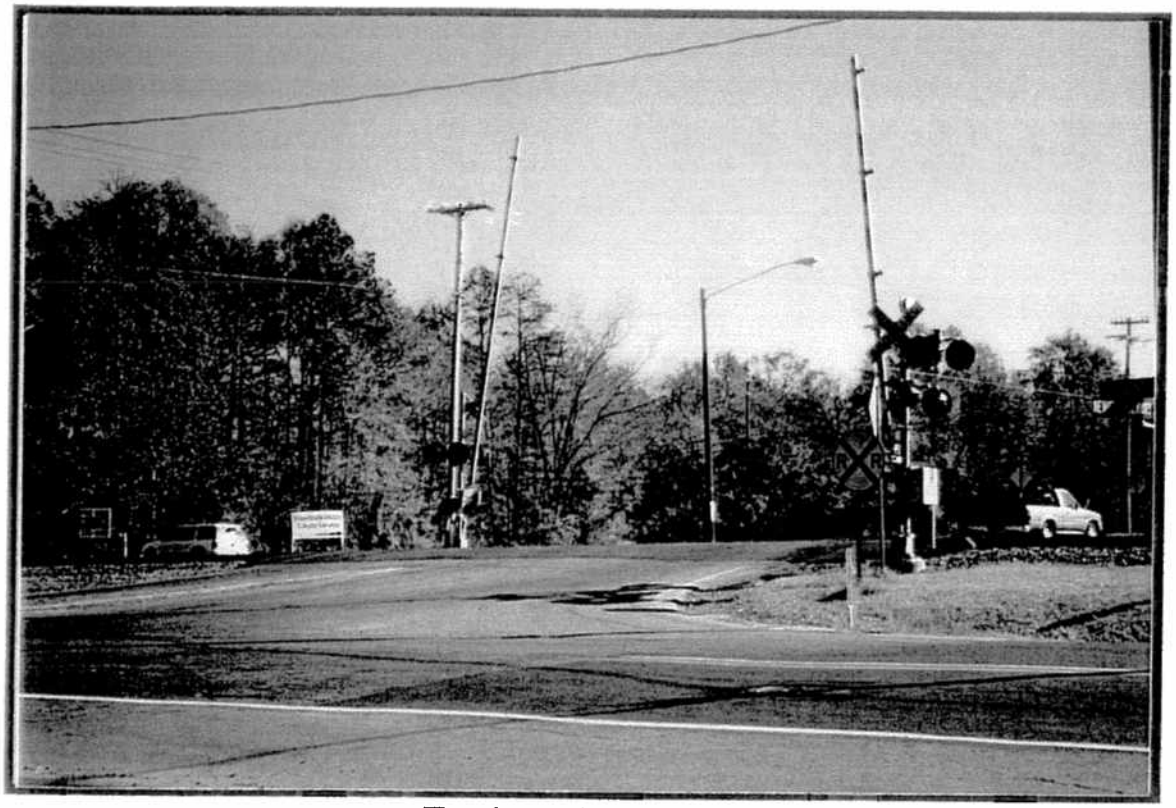
AAR CROSSING #715-350U
LOCAL STREET- ORR RD.
NO RECOMMENDED IMPROVEMENTS

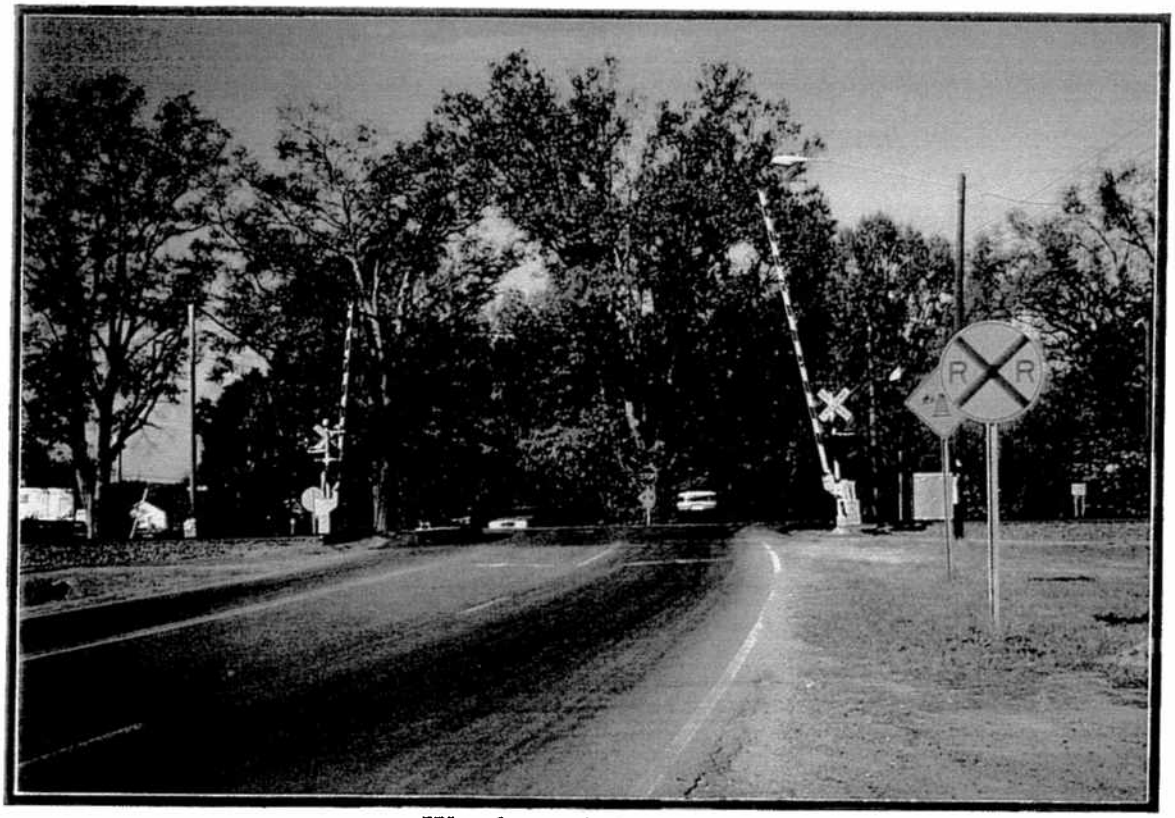
FIGURE 13

Municipality: Charlotte

Crossing Number: 715348T *Street Name:* Nwl.-Hky. Gr. Rd.

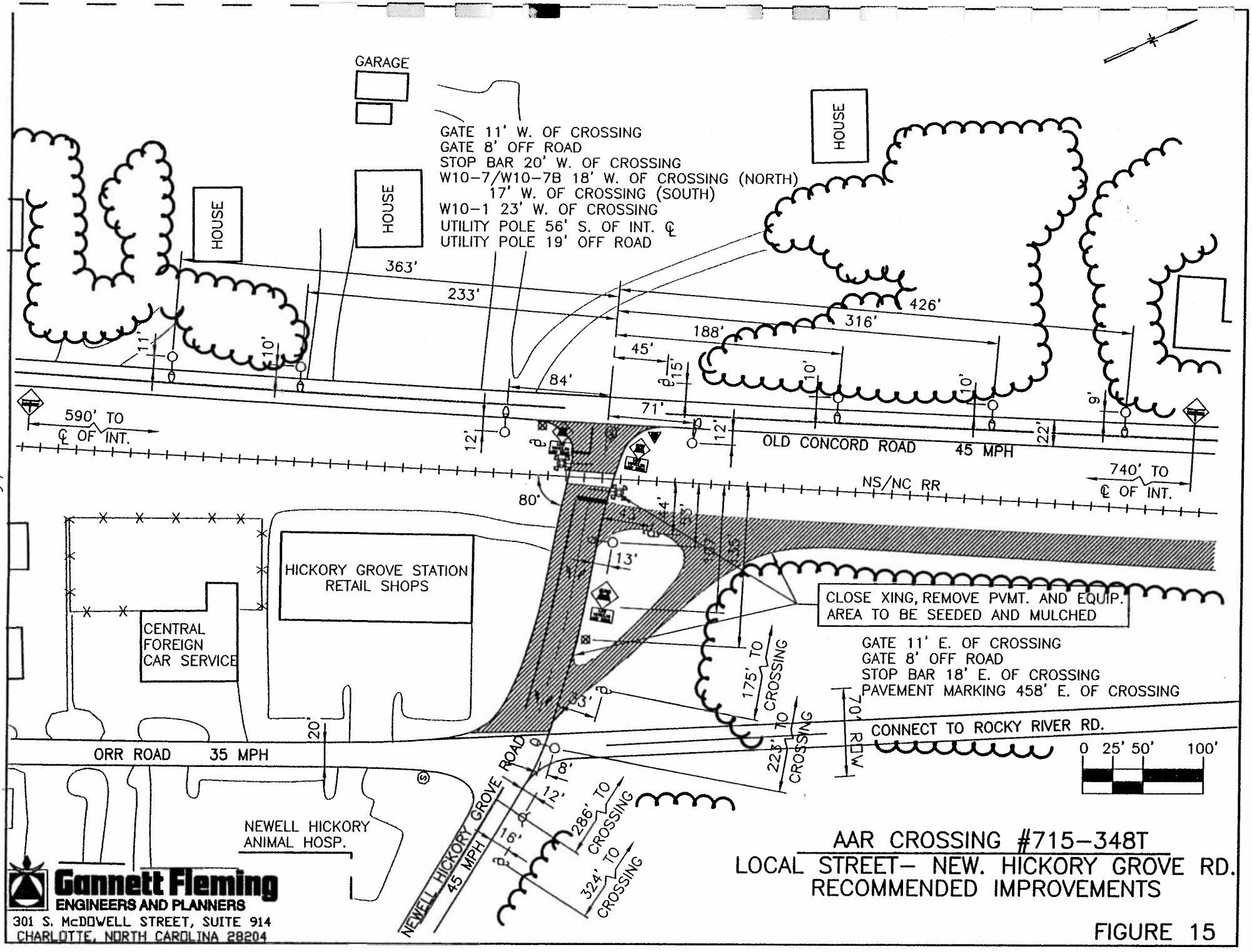


Eastbound Approach



Westbound Approach

FIGURE 14



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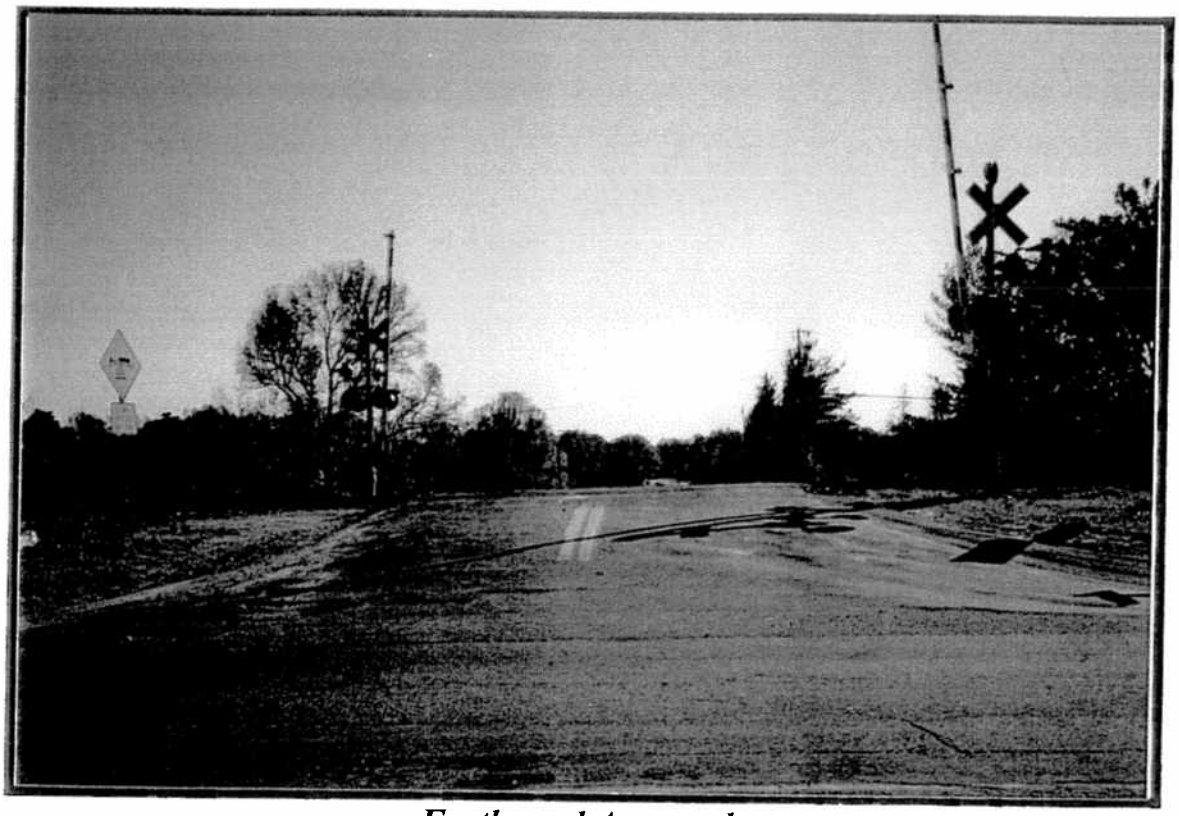
CHARLOTTE, NORTH CAROLINA 28204

AAR CROSSING #715-348T
LOCAL STREET- NEW. HICKORY GROVE RD.
RECOMMENDED IMPROVEMENTS

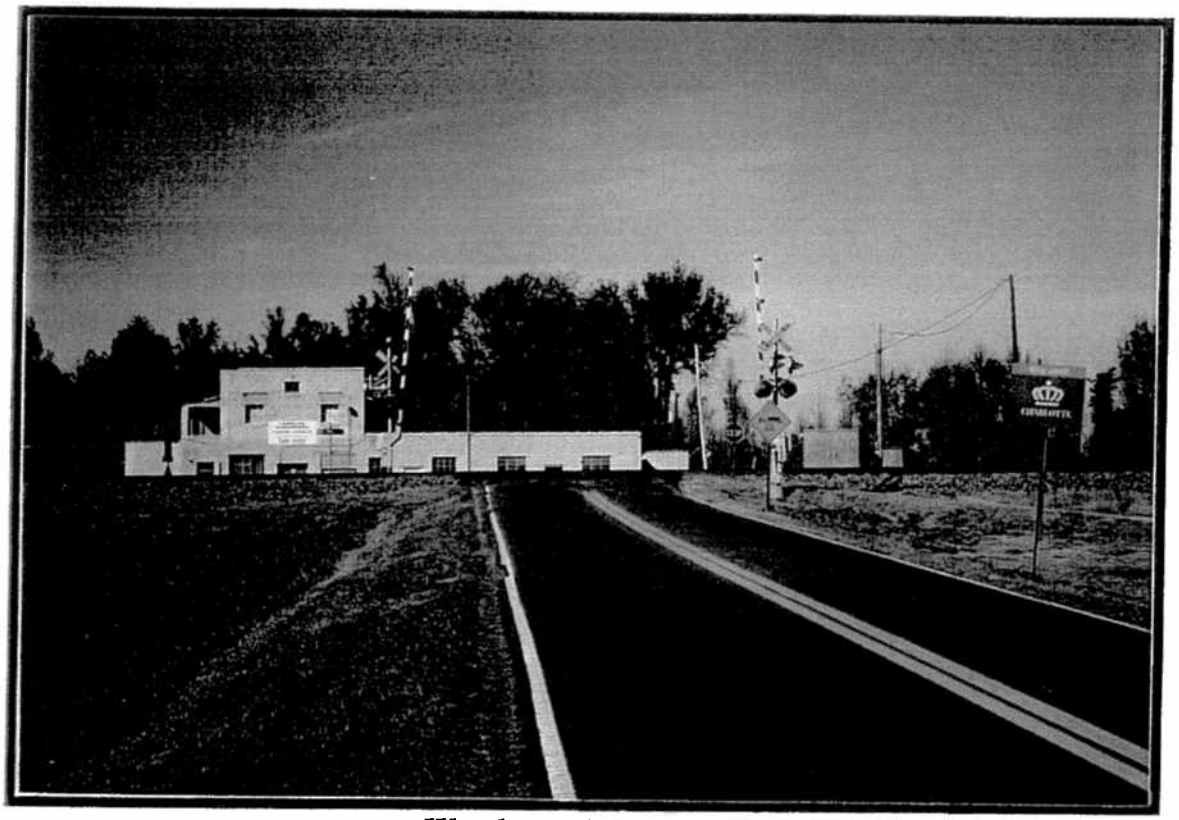
FIGURE 15

Municipality: Charlotte

Crossing Number: 715346E *Street Name:* Rocky River Rd.

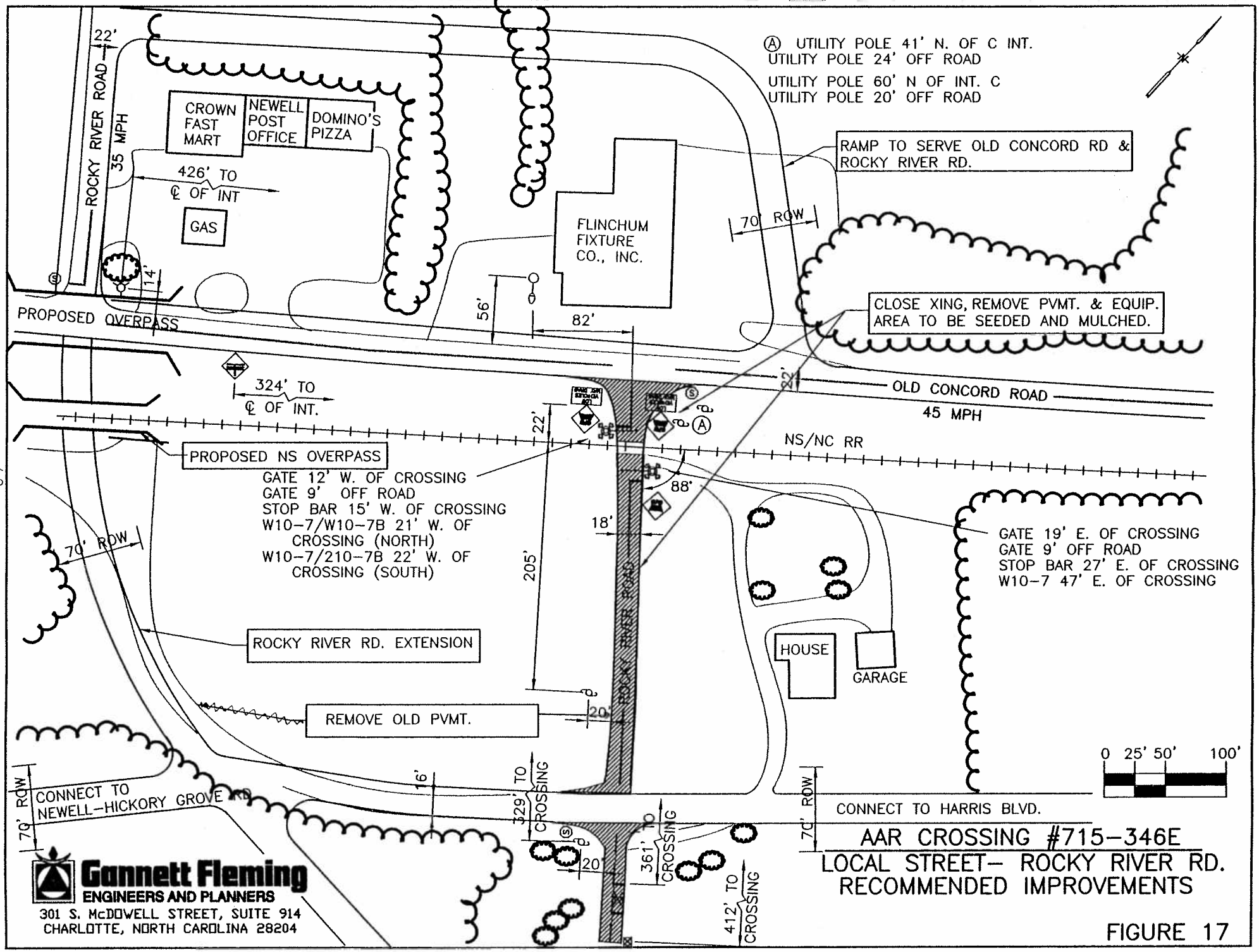


Eastbound Approach



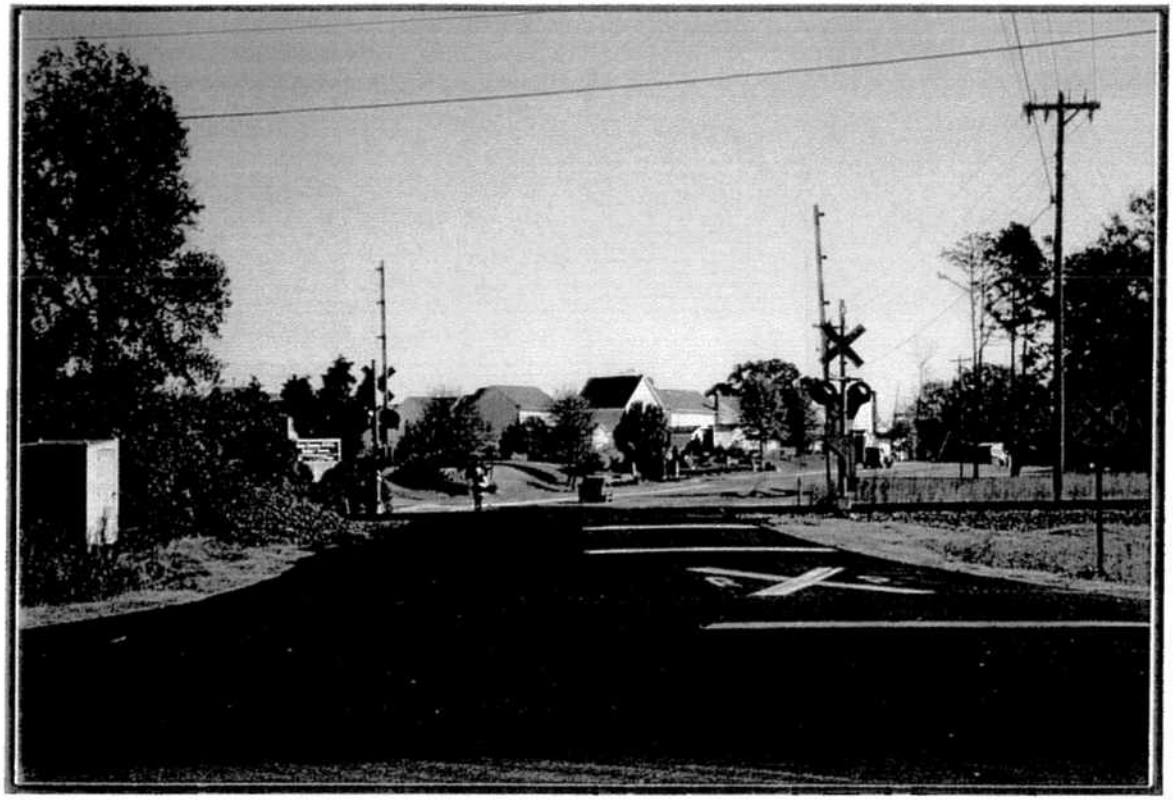
Westbound Approach

FIGURE 16

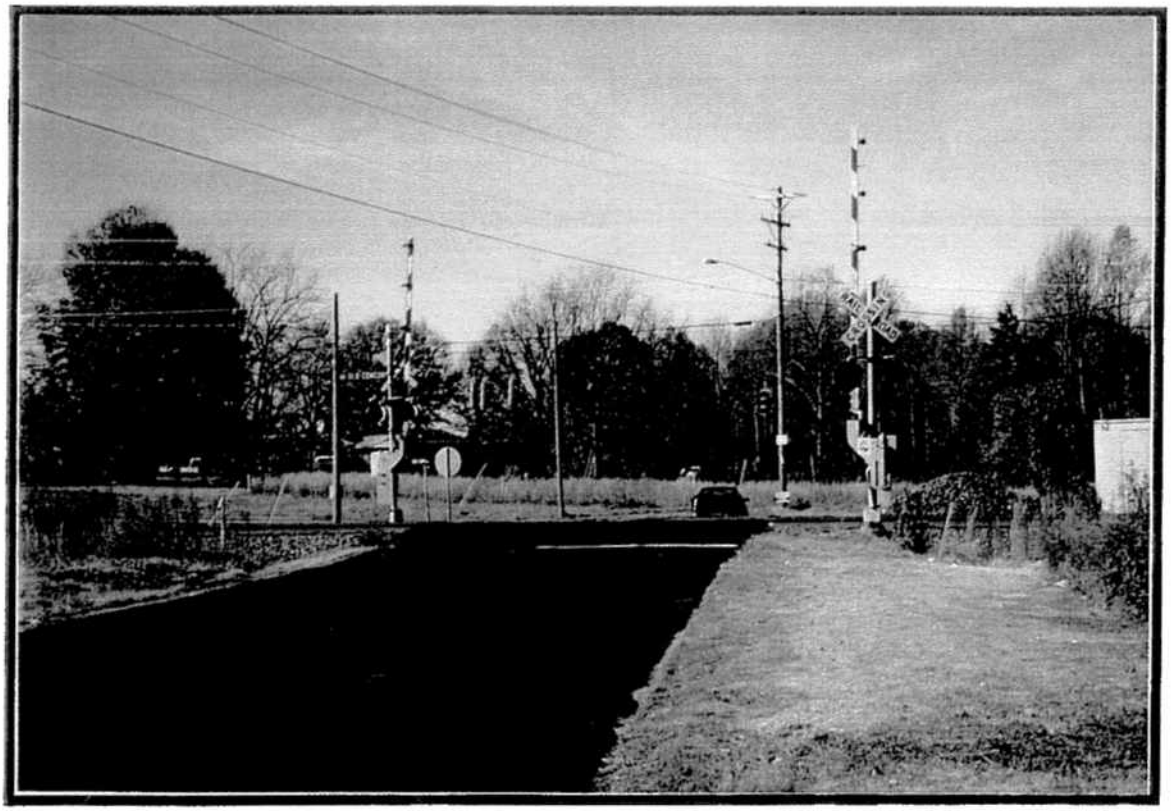

Ⓐ UTILITY POLE 41' N. OF C INT.
UTILITY POLE 24' OFF ROAD
UTILITY POLE 60' N OF INT. C
UTILITY POLE 20' OFF ROAD
22'
ROCKY RIVER ROAD
35 MPH
CROWN FAST MART
NEWELL POST OFFICE
DOMINO'S PIZZA
426' TO ℄ OF INT
GAS
FLINCHUM FIXTURE CO., INC.
70' ROW
RAMP TO SERVE OLD CONCORD RD & ROCKY RIVER RD.
CLOSE XING, REMOVE PVMT. & EQUIP. AREA TO BE SEEDED AND MULCHED.
14'
56'
82'
PROPOSED OVERPASS
324' TO ℄ OF INT.
OLD CONCORD ROAD
45 MPH
NS/NC RR
PROPOSED NS OVERPASS
GATE 12' W. OF CROSSING
GATE 9' OFF ROAD
STOP BAR 15' W. OF CROSSING
W10-7/W10-7B 21' W. OF CROSSING (NORTH)
W10-7/210-7B 22' W. OF CROSSING (SOUTH)
88'
18'
205'
GATE 19' E. OF CROSSING
GATE 9' OFF ROAD
STOP BAR 27' E. OF CROSSING
W10-7 47' E. OF CROSSING
ROCKY RIVER ROAD
ROCKY RIVER RD. EXTENSION
HOUSE
GARAGE
REMOVE OLD PVMT.
20'
16'
329' TO CROSSING
361' TO CROSSING
412' TO CROSSING
CONNECT TO NEWELL-HICKORY GROVE RD
CONNECT TO HARRIS BLVD.
0 25' 50' 100'
Gannett Fleming
ENGINEERS AND PLANNERS
301 S. McDOWELL STREET, SUITE 914
CHARLOTTE, NORTH CAROLINA 28204
AAR CROSSING #715-346E
LOCAL STREET- ROCKY RIVER RD.
RECOMMENDED IMPROVEMENTS
FIGURE 17

Municipality: Charlotte

Crossing Number: 715343J *Street Name:* McLean Rd.

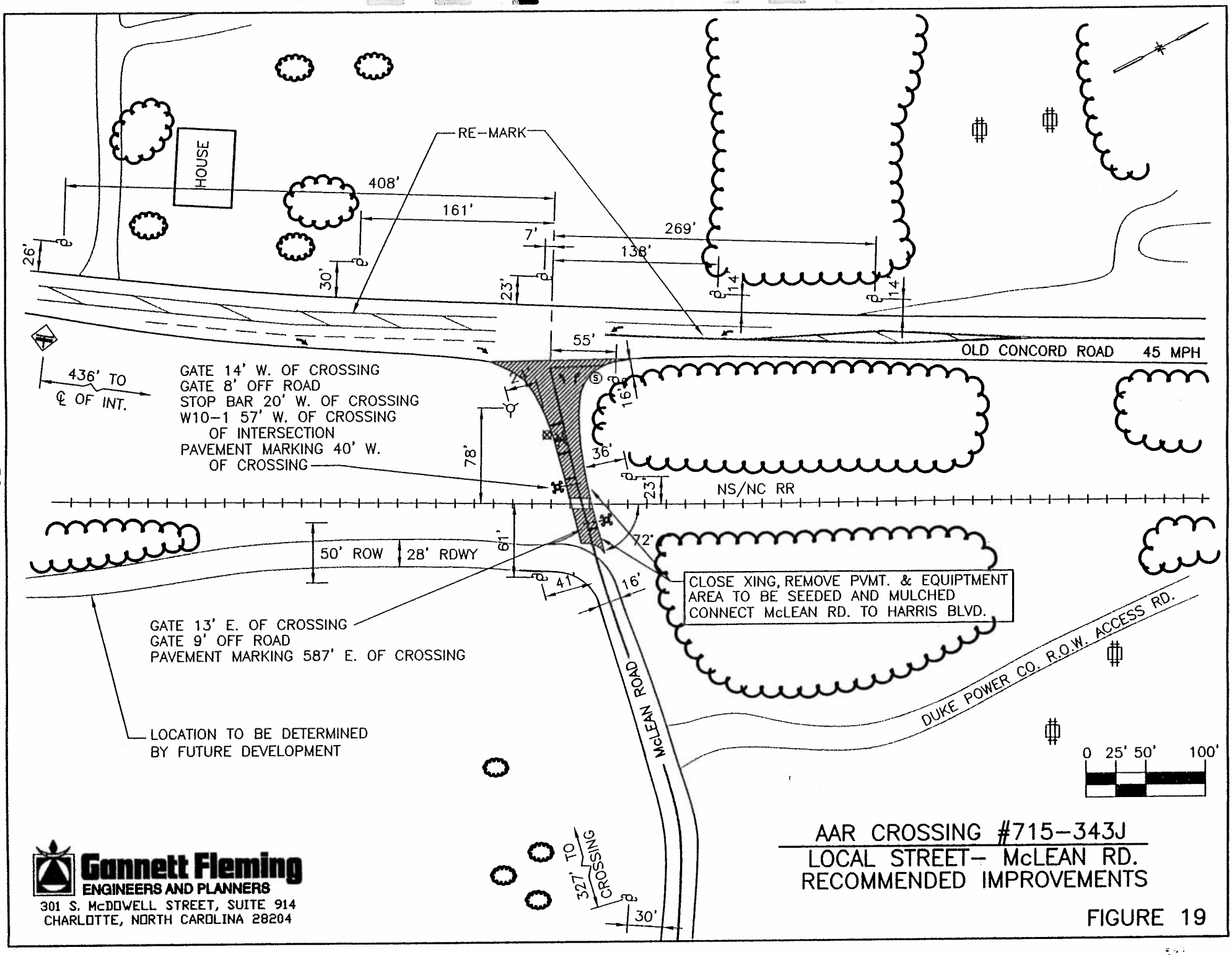


Eastbound Approach



Westbound Approach

FIGURE 18



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CHARLOTTE, NORTH CAROLINA 28204

AAR CROSSING #715-343J
LOCAL STREET- McLEAN RD.
RECOMMENDED IMPROVEMENTS

FIGURE 19

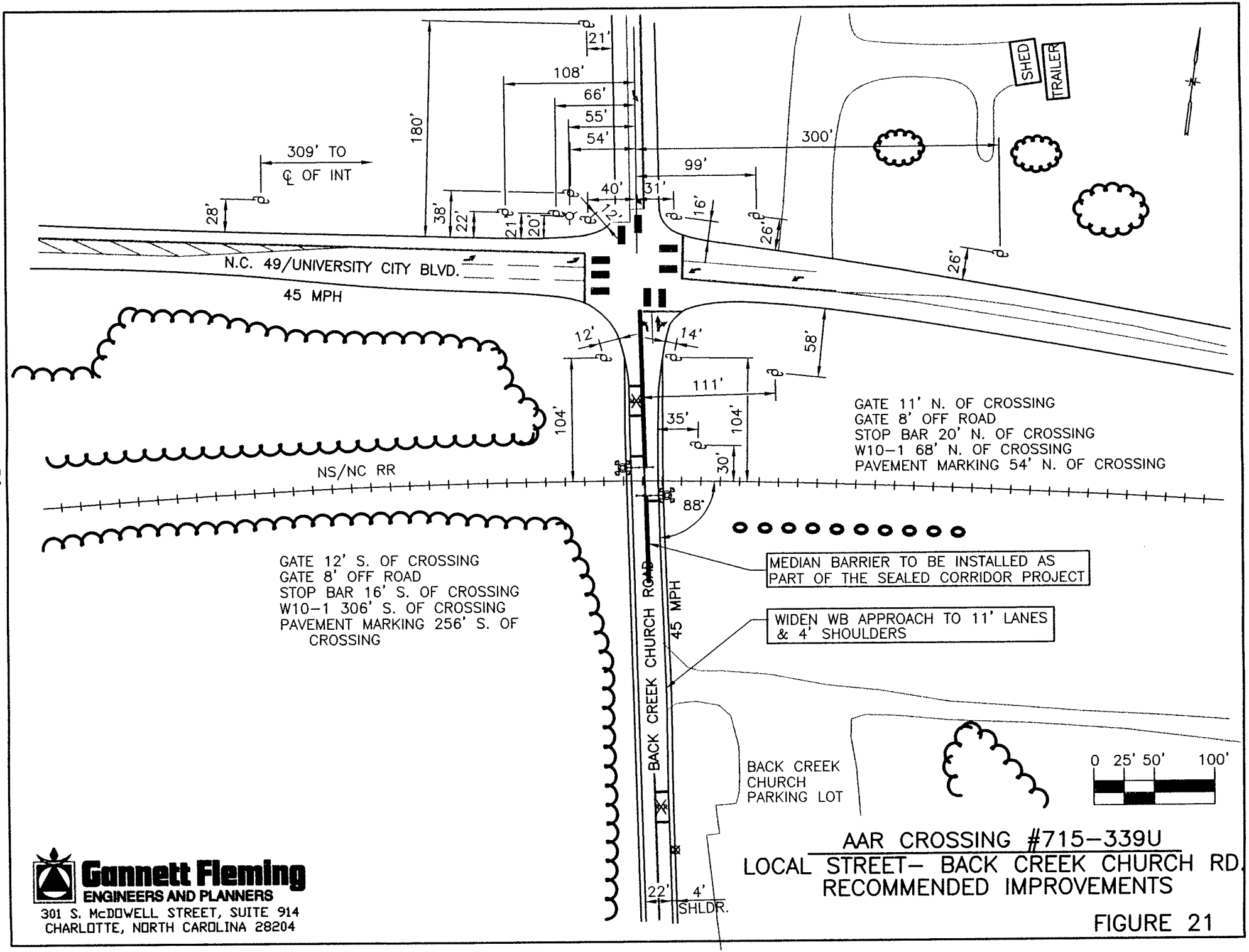
Municipality: Near Charlotte

Crossing Number: 715339U *Street Name:* Back Cr. Ch. Rd.

Eastbound Approach

Westbound Approach

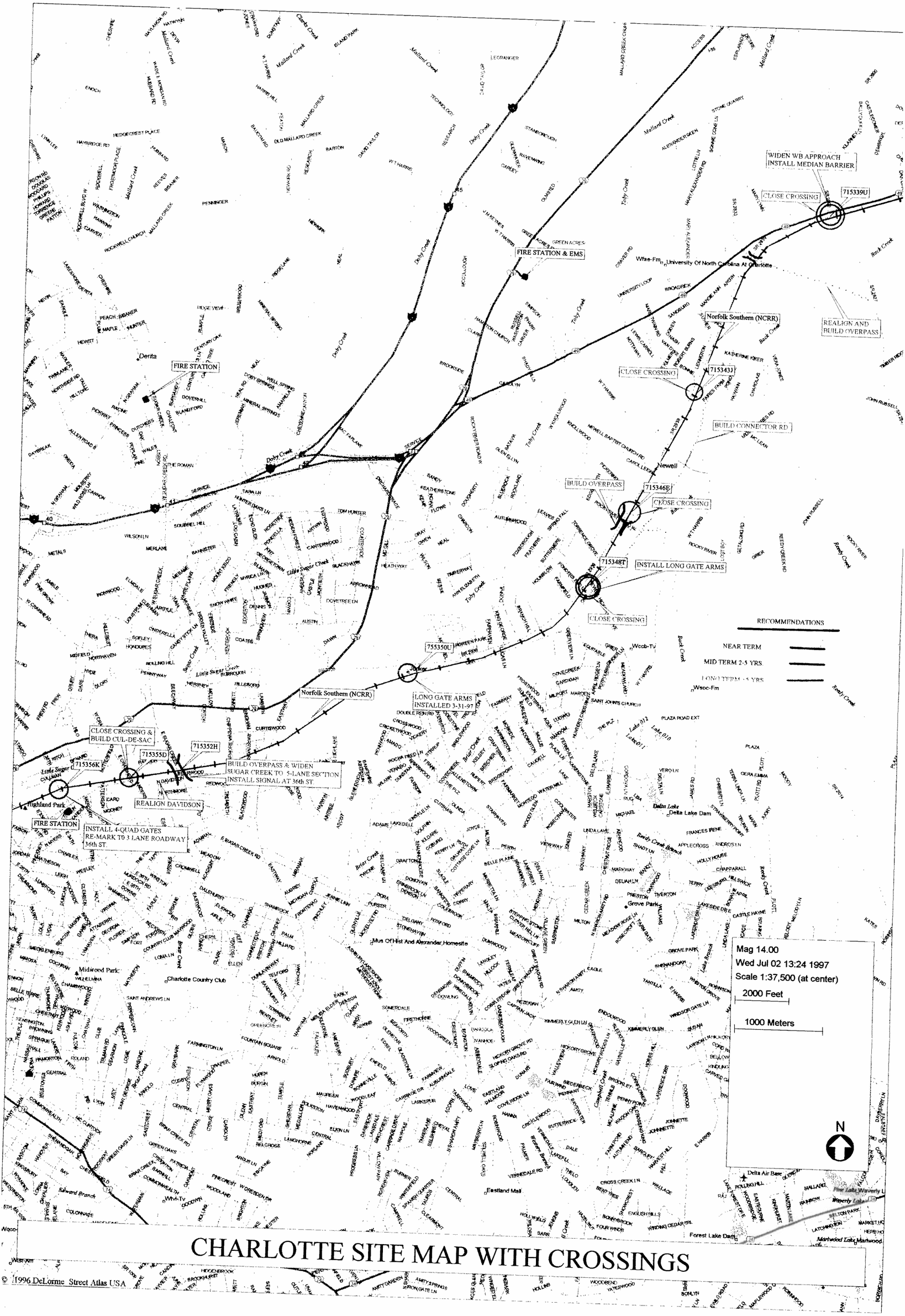
FIGURE 20



Gannett Fleming
ENGINEERS AND PLANNERS
301 S. McDOWELL STREET, SUITE 914
CHARLOTTE, NORTH CAROLINA 28204

AAR CROSSING #715-339U
LOCAL STREET- BACK CREEK CHURCH RD.
RECOMMENDED IMPROVEMENTS

FIGURE 21



CHARLOTTE SITE MAP WITH CROSSINGS

FIGURE 22

APPENDIX

EXHIBIT 3. CAPACITY ANALYSES SUMMARY (Tryon Street Study Section)

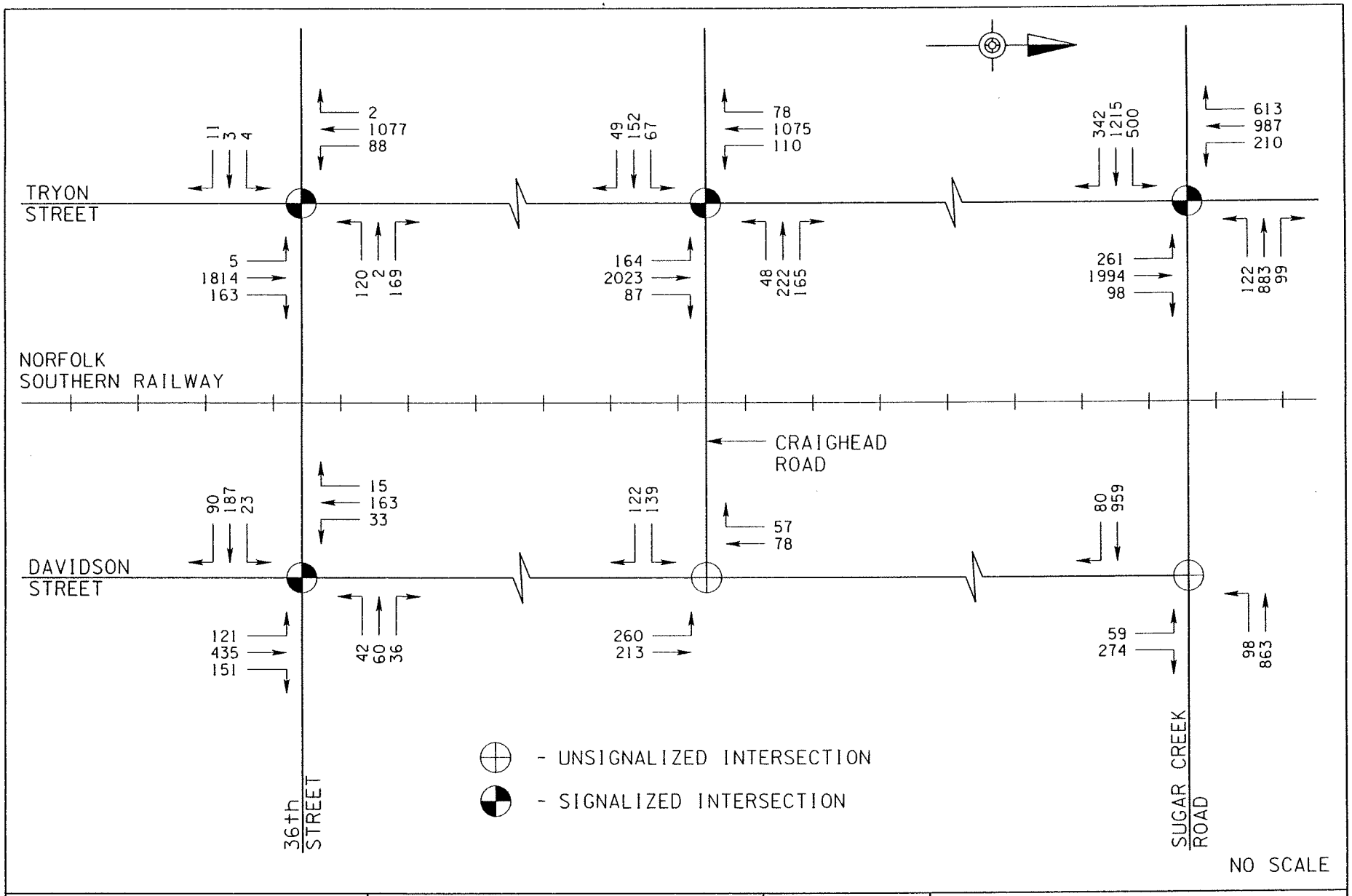
Intersection	Peak Hour	1997 Existing Conditions	2010 Build Conditions	2010 Build Conditions W/Improvements
Tryon Street and Sugar Creek Road (signalized)	PM	*	* (1)	* (2)
Davidson Street and Sugar Creek Road (unsignalized)	PM	F	F	C (3)
Tryon Street and Craighead Road (signalized)	PM	*	* (4)	D (5)
Davidson Street and Craighead Road (unsignalized)	PM	C	N/A	N/A
Tryon Street and 36th Street (signalized)	PM	*	*	D (6)
Davidson Street and 36th Street (signalized)	PM	B	C	No Improvements

NOTES:

1. Capacity analysis results shown as Level of Service (LOS) for worst approach/ movement for unsignalized intersections and overall LOS for signalized intersections.
2. " * " means that LOS exceeds capacity.
3. N/A - not applicable

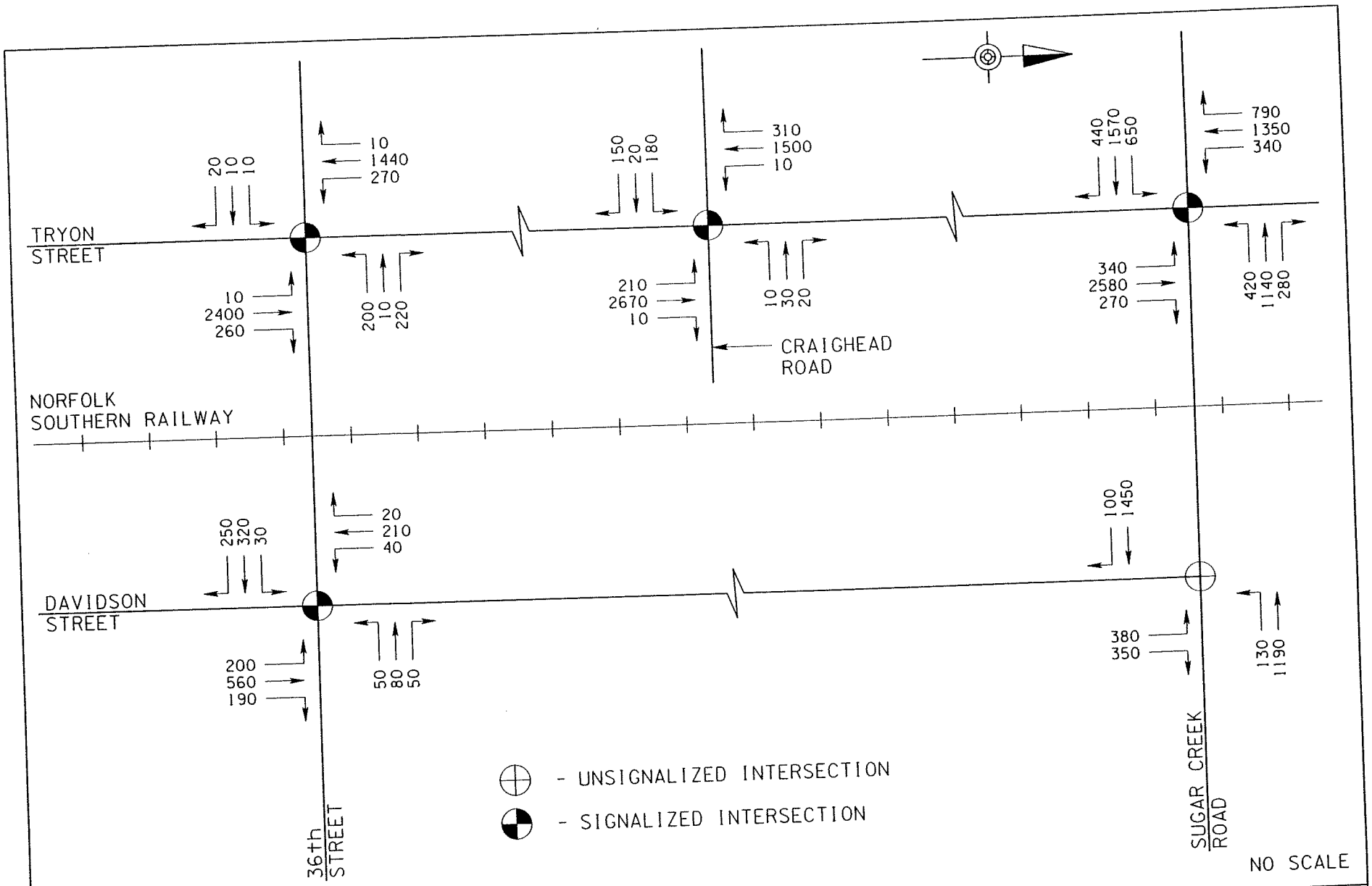
Improvements:

(1) Additional NB left and WB right turn lanes
(2) Additional thru lane in each direction, signal retiming
(3) Signalization and an additional EB through and NB left-turn lane
(4) Additional WB right turn lane
(5) Additional NB right, SB thru, and SB right turn lanes, signal rephasing and retiming
(6) Additional NB thru lane, signal rephasing and retiming.



Gannett Fleming ENGINEERS AND PLANNERS	PIEDMONT HIGH SPEED RAIL CORRIDOR STUDY	APRIL 1997	EXHIBIT 1 1997 EXISTING PM PEAK HOUR TRAFFIC VOLUMES

FILE: c:\traffic\30709\us29nc6.dgn
DATE: 23-Apr-97 15:29



Gannett Fleming ENGINEERS AND PLANNERS	PIEDMONT HIGH SPEED RAIL CORRIDOR STUDY	APRIL 1997	EXHIBIT 2 2010 BUILD PM PEAK HOUR TRAFFIC VOLUMES

FILE: c:\traffic\30709\us29nc6a.dgn
DATE: 23-Apr-97 15:38

ICM: SIGNALIZED INTERSECTION SUMMARY Version 2.4 04-18-1997
Center For Microcomputers In Transportation

Streets: (N-S) TRYON ST. (E-W) SUGAR CREEK RD.
Analyst: GMC File Name: SUGT97EX.HC9
Area Type: Other 4-18-97 1997 PM
Comment: EXISTING CONDITIONS

	Northbound			Southbound			Eastbound			Westbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	3	<	1	2	1	2	2	1	2	2	<
Volumes	261	1994	98	210	987	613	500	1215	342	122	883	99
Lane Width	10.0	12.0		10.0	12.0	12.0	11.0	12.0	13.0	11.0	12.0	
RTOR Vols			10			70			40			10
Lost Time	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
NB Left	*	*			*	*		
Thru		*	*			*	*	
Right		*	*			*	*	
Peds								
SB Left	*							
Thru			*				*	
Right			*				*	
Peds								
EB Right	*	*						
WB Right								
Green	13.0A	13.0A	50.0P		14.0A	14.0A	41.0A	
Yellow/AR	6.6	6.6	6.6		6.5	6.5	6.5	

Cycle Length: 184 secs Phase combination order: #1 #2 #3 #5 #6 #7

Intersection Performance Summary

	Lane Mvmts	Group: Cap	Adj Sat Flow	v/c Ratio	g/C Ratio	Delay	LOS	Approach: Delay	LOS
NB	L	306	1557	0.948	0.196	83.1	F	*	*
	TR	2079	5234	1.224	0.397	*	*		
SB	L	140	1557	1.661	0.090	*	*	*	*
	T	1021	3512	1.128	0.291	*	*		
	R	766	1492	0.787	0.513	31.7	D		
EB	L	665	3225	0.862	0.206	61.5	F	*	*
	T	1239	3512	1.144	0.353	*	*		
	R	847	1542	0.397	0.549	18.4	C		
WB	L	306	3225	0.457	0.095	60.7	F	*	*
	TR	836	3463	1.356	0.241	*	*		

Intersection Delay = * (sec/veh) Intersection LOS = *
(g/C)*(V/c) is greater than one. Calculation of D1 is infeasable.

HCM: SIGNALIZED INTERSECTION SUMMARY Version 2.4d 04-23-1997
Gannett Fleming, Inc.

Streets: (N-S) TRYON ST. (E-W) SUGAR CREEK RD.
Analyst: GMC File Name: SUGT20BD.HC9
Area Type: Other 4-23-97 2010 PM
Comment: BUILD CONDITIONS

	Northbound			Southbound			Eastbound			Westbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	2	3	<	1	2	1	2	2	1	2	2	1
Volumes	340	2580	270	340	1350	790	650	1570	440	420	1140	280
PHF or PK15	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Lane W (ft)	10.0	12.0		10.0	12.0	12.0	11.0	12.0	13.0	11.0	12.0	12.0
Grade		1			1			1			1	
% Heavy Veh	2	2	2	2	2	2	2	2	2	2	2	2
Parking	(Y/N)	N		(Y/N)	N		(Y/N)	N		(Y/N)	N	
Bus Stops			0			0			0			0
Con. Peds			0			0			0			0
Ped Button	(Y/N)	N		(Y/N)	N		(Y/N)	N		(Y/N)	N	
Arr Type	3	3		3	3	3	3	3	3	3	3	3
RTOR Vols			10			70			40			10
Lost Time	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Prop. Share												
Prop. Prot.												

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
NB Left	*	*						
Thru		*	*					
Right		*	*					
Peds								
SB Left	*							
Thru			*					
Right			*					
Peds								
EB Right		*	*					
WB Right	*							
Green	13.0A	13.0A	50.0P					
Yellow/AR	6.6	6.6	6.6					
EB Left					*	*		
Thru						*	*	
Right						*	*	
Peds								
WB Left					*			
Thru							*	
Right							*	
Peds								
NB Right								
SB Right					*	*		
Green					14.0A	14.0A	41.0A	
Yellow/AR					6.5	6.5	6.5	

Cycle Length: 184 secs Phase combination order: #1 #2 #3 #5 #6 #7

Intersection Performance Summary

	Lane Mvmts	Group: Cap	Adj Sat Flow	v/c Ratio	g/C Ratio	Delay	LOS	Approach: Delay	LOS
NB	L	646	3287	0.603	0.196	44.8	E	*	*
	TR	2178	5484	1.594	0.397	*	*		
SB	L	148	1643	2.554	0.090	*	*	*	*
	T	1078	3707	1.461	0.291	*	*		
	R	808	1575	0.990	0.513	50.7	E		
EB	L	702	3404	1.060	0.206	91.3	F	*	*
	T	1307	3707	1.400	0.353	*	*		
	R	894	1628	0.498	0.549	17.0	C		
WB	L	323	3404	1.488	0.095	*	*	*	*
	T	895	3707	1.486	0.241	*	*		
	R	548	1575	0.548	0.348	32.2	D		

Intersection Delay = * (sec/veh) Intersection LOS = *

(g/C)*(V/c) is greater than one. Calculation of D1 is infeasable.

HCM: SIGNALIZED INTERSECTION SUMMARY Version 2.4d 04-23-1997
Gannett Fleming, Inc.

Streets: (N-S) TRYON ST. (E-W) SUGAR CREEK RD.
Analyst: GMC File Name: SUGT20B2.HC9
Area Type: Other 4-23-97 2010 PM
Comment: BUILD CONDITIONS W/IMPROVEMENTS

	Northbound			Southbound			Eastbound			Westbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	2	4	<	1	3	1	2	3	1	2	3	1
Volumes	340	2580	270	340	1350	790	650	1570	440	420	1140	280
PHF or PK15	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Lane W (ft)	10.0	12.0		10.0	12.0	12.0	11.0	12.0	13.0	11.0	12.0	12.0
Grade		1			1			1			1	
% Heavy Veh	2	2	2	2	2	2	2	2	2	2	2	2
Parking	(Y/N)	N		(Y/N)	N		(Y/N)	N		(Y/N)	N	
Bus Stops			0			0			0			0
Con. Peds			0			0			0			0
Ped Button	(Y/N)	N		(Y/N)	N		(Y/N)	N		(Y/N)	N	
Arr Type	3	3		3	3	3	3	3	3	3	3	3
RTOR Vols			10			70			40			10
Lost Time	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Prop. Share												
Prop. Prot.												

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
NB Left	*	*						
Thru		*	*					
Right		*	*					
Peds								
SB Left	*							
Thru			*					
Right			*					
Peds								
EB Right		*	*					
WB Right		*						
Green	25.0A	15.0A	40.0P					
Yellow/AR	6.6	6.6	6.6					

		5	6	7	8
EB	Left	*	*		
	Thru		*	*	
	Right		*	*	
	Peds				
WB	Left	*			
	Thru			*	
	Right			*	
	Peds				
NB	Right				
SB	Right	*	*		
Green		15.0A	15.0A	30.0A	
Yellow/AR		6.5	6.5	6.5	

Cycle Length: 179 secs Phase combination order: #1 #2 #3 #5 #6 #7

Intersection Performance Summary

	Lane Mvmts	Group: Cap	Adj Sat Flow	v/c Ratio	g/C Ratio	Delay	LOS	Approach: Delay	LOS
NB	L	920	3287	0.423	0.280	34.3	D	*	*
	TR	2659	7312	1.306	0.364	*	*		
SB	L	262	1643	1.442	0.160	*	*	*	*
	T	1352	5560	1.220	0.243	*	*		
	R	761	1575	1.052	0.483	69.9	F		
EB	L	759	3404	0.980	0.223	65.5	F	*	*
	T	1706	5560	1.125	0.307	*	*		
	R	955	1628	0.466	0.587	13.9	B		
WB	L	351	3404	1.370	0.103	*	*	*	*
	T	1039	5560	1.342	0.187	*	*		
	R	572	1575	0.525	0.363	29.7	D		

Intersection Delay = * (sec/veh) Intersection LOS = *

(g/C)*(V/c) is greater than one. Calculation of D1 is infeasable.

****

File Name SUGD97EX.HC0
Streets: (N-S) DAVIDSON ST. (E-W) SUGAR CREEK RD.
Major Street Direction.... EW
Length of Time Analyzed... 60 (min)
Analyst..... GMC
Date of Analysis..... 4/18/97
Other Information..... 1997 PM EXISTING CONDITIONS

Two-way Stop-controlled Intersection

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	1	1	1	0	1	0	1	0	0	0
Stop/Yield			N			N						
Volumes		959	80	98	863		59		274			
PHF		.9	.9	.9	.9		.9		.9			
Grade		1			1			1			0	
MC's (%)		0	0	0	0		0		0			
SU/RV's (%)		4	0	0	4		4		4			
CV's (%)		4	0	0	4		4		4			
PCE's		1.1	1.1	1.1	1.1		1.1		1.1			

Adjustment Factors

Vehicle Maneuver	Critical Gap (tg)	Follow-up Time (tf)
Left Turn Major Road	5.00	2.10
Right Turn Minor Road	5.50	2.60
Through Traffic Minor Road	6.00	3.30
Left Turn Minor Road	6.50	3.40

****

WorkSheet for TWSC Intersection

Step 1: RT from Minor Street	NB	SB
Conflicting Flows: (vph)	959	
Potential Capacity: (pcph)	452	
Movement Capacity: (pcph)	452	
Prob. of Queue-free State:	0.26	

Step 2: LT from Major Street	WB	EB
Conflicting Flows: (vph)	1039	
Potential Capacity: (pcph)	548	
Movement Capacity: (pcph)	548	
Prob. of Queue-free State:	0.78	

Step 4: LT from Minor Street	NB	SB
Conflicting Flows: (vph)	1920	
Potential Capacity: (pcph)	82	
Major LT, Minor TH Impedance Factor:	0.78	
Adjusted Impedance Factor:	0.78	
Capacity Adjustment Factor due to Impeding Movements	0.78	
Movement Capacity: (pcph)	64	

****

Intersection Performance Summary

Movement		FlowRate v(pcph)	MoveCap Cm(pcph)	SharedCap Csh(pcph)	Avg.Total Delay	LOS	Delay By App
NB	L	73	64		545.5	F	*
NB	R	334	452		29.5	D	
WB	L	120	548		8.4	B	0.8

Intersection Delay = 189.9

* The calculated delay was greater than 999.9 sec.

Gannett Fleming, Inc.
209 Senate Avenue
Camp Hill, PA 17011-
Ph: (717) 763-7211

Streets: (N-S) DAVIDSON ST. (E-W) SUGAR CREEK RD.
Major Street Direction.... EW
Length of Time Analyzed... 60 (min)
Analyst..... GMC
Date of Analysis..... 4/23/97
Other Information.....2010 PM BUILD CONDITIONS
Two-way Stop-controlled Intersection

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	0	1	1	1	1	0	1	0	1	0	0	0
Stop/Yield			N			N						
Volumes		1450	100	130	1190		380		350			
PHF		.9	.9	.9	.9		.9		.9			
Grade		1			1			1				
MC's (%)												
SU/RV's (%)												
CV's (%)												
PCE's				1.10			1.10		1.10			

Adjustment Factors

Vehicle Maneuver	Critical Gap (tg)	Follow-up Time (tf)
Left Turn Major Road	5.00	2.10
Right Turn Minor Road	5.50	2.60
Through Traffic Minor Road	6.00	3.30
Left Turn Minor Road	6.50	3.40

Worksheet for TWSC Intersection

Step 1: RT from Minor Street	NB	SB
Conflicting Flows: (vph)	1611	
Potential Capacity: (pcph)	211	
Movement Capacity: (pcph)	211	
Prob. of Queue-Free State:	0.00	

Step 2: LT from Major Street	WB	EB
Conflicting Flows: (vph)	1722	
Potential Capacity: (pcph)	259	
Movement Capacity: (pcph)	259	
Prob. of Queue-Free State:	0.39	

Step 4: LT from Minor Street	NB	SB
Conflicting Flows: (vph)	3076	
Potential Capacity: (pcph)	18	
Major LT, Minor TH Impedance Factor:	0.39	
Adjusted Impedance Factor:	0.39	
Capacity Adjustment Factor due to Impeding Movements	0.39	
Movement Capacity: (pcph)	7	

Intersection Performance Summary

Movement	Flow Rate (pcph)	Move Cap (pcph)	Shared Cap (pcph)	Avg. Total Delay (sec/veh)	95% Queue Length (veh)	LOS	Approach Delay (sec/veh)
NB L	464	7		*	228.5	F	*
NB R	428	211		*	111.3	F	
WB L	158	259		35.0	4.4	E	3.4

Intersection Delay = *

* The calculated value was greater than 999.9.

HCM: SIGNALIZED INTERSECTION SUMMARY Version 2.4d 04-23-1997

Gannett Fleming, Inc.

Streets: (N-S) DAVIDSON ST. (E-W) SUGAR CREEK RD.
Analyst: GMC File Name: SUGD20B2.HC9
Area Type: Other 4-23-97 2010 PM
Comment: BUILD CONDITIONS W/IMPROVEMENTS

	Northbound			Southbound			Eastbound			Westbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	2		1					2	1	1	1	
Volumes	380		350					1450	100	130	1190	
PHF or PK15	0.90		0.90					0.90	0.90	0.90	0.90	
Lane W (ft)	12.0		12.0					12.0	12.0	12.0	12.0	
Grade		1						1			1	
% Heavy Veh	2		2					2	2	2	2	
Parking	(Y/N)	N					(Y/N)	N		(Y/N)	N	
Bus Stops			0						0			0
Con. Peds			0			0			0			0
Ped Button	(Y/N)	N					(Y/N)	N		(Y/N)	N	
Arr Type	3		3					3	3	3	3	
RTOR Vols			40						10			0
Lost Time	3.00		3.00					3.00	3.00	3.00	3.00	
Prop. Share												
Prop. Prot.												

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
NB Left	*							
Thru								
Right	*							
Peds								
SB Left								
Thru								
Right								
Peds								
EB Right	*							
WB Right								
Green	18.0A							
Yellow/AR	5.0							
EB Left								
Thru					*			
Right					*			
Peds								
WB Left					*	*		
Thru					*	*		
Right								
Peds								
NB Right					*			
SB Right								
Green					7.0A	55.0P		
Yellow/AR					5.0	5.0		

Cycle Length: 95 secs Phase combination order: #1 #5 #6

Intersection Performance Summary

	Lane Group: Mvmts	Cap	Adj Sat Flow	v/c Ratio	g/C Ratio	Delay	LOS	Approach: Delay	LOS
NB	L	741	3522	0.587	0.211	22.7	C	21.2	C
	R	531	1575	0.650	0.337	19.3	C		
EB	T	2224	3707	0.761	0.600	10.2	B	9.6	B
	R	1326	1575	0.075	0.842	0.8	A		
WB	L	245	1761	0.588	0.726	14.4	B	22.5	C
	T	1346	1853	0.982	0.726	23.3	C		

Intersection Delay = 16.5 sec/veh Intersection LOS = C

Lost Time/Cycle, L = 6.0 sec Critical v/c(x) = 0.893

HCM: SIGNALIZED INTERSECTION SUMMARY Version 2.4 04-18-1997
Center For Microcomputers In Transportation

Streets: (N-S) TRYON ST. (E-W) CRAIGHEAD RD.
Analyst: GMC File Name: TRYC97EX.HC9
Area Type: Other 4-18-97 1997 PM
Comment: EXISTING CONDITIONS

	Northbound			Southbound			Eastbound			Westbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	3	<	1	2	<	1	1	<	1	1	<
Volumes	164	2023	87	110	1075	78	67	152	49	48	222	165
Lane Width	11.0	10.0		11.0	12.0		10.0	10.0		10.0	11.0	
RTOR Vols			10			10			5			17
Lost Time	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
NB Left		*	*		EB Left	*		
Thru	*		*		Thru	*	*	
Right	*		*		Right	*	*	
Peds					Peds			
SB Left		*			WB Left	*		
Thru	*				Thru	*		
Right	*				Right	*		
Peds					Peds			
EB Right					NB Right			
WB Right					SB Right			
Green	68.0A	12.0A	6.0P		Green	31.0A	12.0A	
Yellow/AR	5.7	5.1	5.8		Yellow/AR	5.0	5.0	

Cycle Length: 156 secs Phase combination order: #1 #2 #3 #5 #6

Intersection Performance Summary

	Lane Group: Mvmts	Adj Sat Flow Cap	v/c Ratio	g/C Ratio	Delay	LOS	Approach: Delay	LOS
NB	L	272	1637	0.668	0.166	50.4	E	37.2	D
	TR	2631	4963	0.976	0.530	36.3	D		
SB	L	148	1629	0.826	0.091	73.2	F	34.7	D
	TR	1597	3515	0.835	0.454	31.2	D		
EB	L	144	1596	0.515	0.090	53.9	E	37.4	D
	TR	522	1624	0.416	0.321	31.8	D		
WB	L	115	541	0.462	0.212	42.8	E	*	*
	TR	330	1556	1.245	0.212	*	*		

Intersection Delay = * (sec/veh) Intersection LOS = *

(g/C)*(V/c) is greater than one. Calculation of D1 is infeasable.

HCM: SIGNALIZED INTERSECTION SUMMARY Version 2.4d 04-23-1997
Gannett Fleming, Inc.

Streets: (N-S) TRYON ST. (E-W) CRAIGHEAD RD.
Analyst: GMC File Name: TRYC20BD.HC9
Area Type: Other 4-23-97 1997 PM
Comment: BUILD CONDITIONS

	Northbound			Southbound			Eastbound			Westbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	3	<	1	2	<	1	1	<	1	1	1
Volumes	210	2670	10	10	1500	310	180	20	150	10	30	20
PHF or PK15	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Lane W (ft)	11.0	10.0		11.0	12.0		10.0	10.0		10.0	11.0	12.0
Grade		-2			-1			-4			6	
% Heavy Veh	2	2	2	2	2	2	2	2	2	2	2	2
Parking	(Y/N)	N		(Y/N)	N		(Y/N)	N		(Y/N)	N	
Bus Stops			0			0			0			0
Con. Peds			0			0			0			0
Ped Button	(Y/N)	N		(Y/N)	N		(Y/N)	N		(Y/N)	N	
Arr Type	3	3		3	3		3	3		3	3	3
RTOR Vols			1			35			15			2
Lost Time	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Prop. Share												
Prop. Prot.												

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
NB	Left		*	*					
	Thru	*		*					
	Right	*		*					
	Peds								
SB	Left		*						
	Thru	*							
	Right	*							
	Peds								
EB	Right								
WB	Right								
Green		68.0A	12.0A	6.0P					
Yellow/AR		5.7	5.1	5.8					

		5	6	7	8
EB	Left		*		
	Thru	*	*		
	Right	*	*		
	Peds				
WB	Left	*			
	Thru	*			
	Right	*			
	Peds				
NB	Right				
SB	Right				
Green		31.0A	12.0A		
Yellow/AR		5.0	5.0		

Cycle Length: 156 secs Phase combination order: #1 #2 #3 #5 #6

Intersection Performance Summary

	Lane Mvmts	Group: Cap	Adj Sat Flow	v/c Ratio	g/C Ratio	Delay	LOS	Approach: Delay	LOS
NB	L	288	1728	0.810	0.166	51.1	E	*	*
	TR	2792	5265	1.173	0.530	*	*		
SB	L	156	1719	0.071	0.091	41.8	E	*	*
	TR	1662	3657	1.246	0.454	*	*		
EB	L	152	1685	1.319	0.090	*	*	*	*
	TR	495	1541	0.347	0.321	26.2	D		
WB	L	159	749	0.069	0.212	31.7	D	31.7	D
	T	371	1747	0.089	0.212	31.8	D		
	R	326	1536	0.061	0.212	31.6	D		

Intersection Delay = * (sec/veh) Intersection LOS = *

(g/C)*(V/c) is greater than one. Calculation of D1 is infeasable.

HCM: SIGNALIZED INTERSECTION SUMMARY Version 2.4d 04-23-1997
Gannett Fleming, Inc.

Streets: (N-S) TRYON ST. (E-W) CRAIGHEAD RD.
Analyst: GMC File Name: TRYC20B2.HC9
Area Type: Other 4-18-97 2010 PM
Comment: BUILD CONDITIONS W/IMPROVEMENTS

	Northbound			Southbound			Eastbound			Westbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	3	1	1	3	1	1	1 <		1	1	1
Volumes	210	2670	10	10	1500	310	180	20	150	10	30	20
PHF or PK15	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Lane W (ft)	11.0	10.0	12.0	11.0	12.0	12.0	10.0	10.0		10.0	11.0	12.0
Grade		-2			-1			-4			6	
% Heavy Veh	2	2	2	2	2	2	2	2	2	2	2	2
Parking	(Y/N)	N		(Y/N)	N		(Y/N)	N		(Y/N)	N	
Bus Stops			0			0			0			0
Con. Peds			0			0			0			0
Ped Button	(Y/N)	N		(Y/N)	N		(Y/N)	N		(Y/N)	N	
Arr Type	3	3	3	3	3	3	3	3		3	3	3
RTOR Vols			1			35			15			2
Lost Time	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Prop. Share												
Prop. Prot.												

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
NB	Left	*	*	*		EB Left	*	*	
	Thru		*	*		Thru	*	*	
	Right		*	*		Right	*	*	
	Peds					Peds			
SB	Left	*		*		WB Left		*	
	Thru			*		Thru		*	
	Right			*		Right		*	
	Peds					Peds			
EB	Right					NB Right			
WB	Right	*				SB Right			
Green		14.0A	8.0A	99.0P		Green	8.0A	36.0A	
Yellow/AR		5.1	5.1	5.8		Yellow/AR	5.0	5.0	

Cycle Length: 191 secs Phase combination order: #1 #2 #3 #5 #6

Intersection Performance Summary

	Lane Mvmts	Group: Cap	Adj Sat Flow	v/c Ratio	g/C Ratio	Delay	LOS	Approach: Delay	LOS
NB	L	333	1728	0.700	0.702	35.1	D	43.7	E
	T	3169	5268	1.030	0.602	44.4	E		
	R	962	1599	0.010	0.602	9.9	B		
SB	L	184	1719	0.060	0.633	25.4	D	19.8	C
	T	2993	5616	0.613	0.533	20.3	C		
	R	848	1591	0.360	0.533	16.8	C		
EB	L	413	1685	0.484	0.267	38.5	D	38.1	D
	TR	411	1541	0.418	0.267	37.7	D		
WB	L	198	995	0.056	0.199	40.0	D	37.3	D
	T	348	1747	0.095	0.199	40.4	E		
	R	459	1536	0.044	0.299	30.7	D		

Intersection Delay = 34.8 sec/veh Intersection LOS = D
Lost Time/Cycle, L = 12.0 sec Critical v/c(x) = 0.803

****

File Name DAVC97E1.HC0
Streets: (N-S) DAVIDSON ST. (E-W) CRAIGHEAD RD.
Major Street Direction.... NS
Length of Time Analyzed... 60 (min)
Analyst..... GMC
Date of Analysis..... 4/18/97
Other Information..... 1997 PM EXISTING CONDITIONS

Two-way Stop-controlled Intersection

	Northbound			Southbound			Eastbound			Westbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	0	1	1	1	0	1	0	0	0
Stop/Yield			N			Y						
Volumes	260	213			78	57	139		122			
PHF	.9	.9			.9	.9	.9		.9			
Grade		1			4			4			0	
MC's (%)	0	0			0	0	0		0			
SU/RV's (%)	4	4			4	4	4		4			
CV's (%)	4	4			4	4	4		4			
PCE's	1.1	1.1			1.3	1.3	1.3		1.3			

Adjustment Factors

Vehicle Maneuver	Critical Gap (tg)	Follow-up Time (tf)
Left Turn Major Road	5.00	2.10
Right Turn Minor Road	5.50	2.60
Through Traffic Minor Road	6.00	3.30
Left Turn Minor Road	6.50	3.40

WorkSheet for TWSC Intersection

Step 1: RT from Minor Street	WB	EB
Conflicting Flows: (vph)		78
Potential Capacity: (pcph)		1264
Movement Capacity: (pcph)		1264
Prob. of Queue-free State:		0.86

Step 2: LT from Major Street	SB	NB
Conflicting Flows: (vph)		78
Potential Capacity: (pcph)		1574
Movement Capacity: (pcph)		1574
Prob. of Queue-free State:		0.80

Step 4: LT from Minor Street	WB	EB
Conflicting Flows: (vph)		552
Potential Capacity: (pcph)		507
Major LT, Minor TH Impedance Factor:		0.80
Adjusted Impedance Factor:		0.80
Capacity Adjustment Factor due to Impeding Movements		0.80
Movement Capacity: (pcph)		405

****

Intersection Performance Summary

Movement		FlowRate v(pcph)	MoveCap Cm(pcph)	SharedCap Csh(pcph)	Avg.Total Delay	LOS	Delay By App
EB	L	200	405		17.5	C	10.9
EB	R	177	1264		3.3	A	
NB	L	318	1574		2.9	A	1.6

Intersection Delay = 4.1

****

File Name DAVC97E2.HC0
Streets: (N-S) DAVIDSON ST. (E-W) CRAIGHEAD RD.
Major Street Direction.... EW
Length of Time Analyzed... 60 (min)
Analyst..... GMC
Date of Analysis..... 4/18/97
Other Information..... 1997 PM EXISTING CONDITIONS

Two-way Stop-controlled Intersection

	Eastbound			Westbound			Northbound			Southbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	0	0	1	1	1	0	1	0	0	0
Stop/Yield			N			Y						
Volumes	260	213			78	57	139		122			
PHF	.9	.9			.9	.9	.9		.9			
Grade		1			4			4			0	
MC's (%)	0	0			0	0	0		0			
SU/RV's (%)	4	4			4	4	4		4			
CV's (%)	4	4			4	4	4		4			
PCE's	1.1	1.1			1.3	1.3	1.3		1.3			

Adjustment Factors

Vehicle Maneuver	Critical Gap (tg)	Follow-up Time (tf)
Left Turn Major Road	5.00	2.10
Right Turn Minor Road	5.50	2.60
Through Traffic Minor Road	6.00	3.30
Left Turn Minor Road	6.50	3.40

WorkSheet for TWSC Intersection

Step 1: RT from Minor Street	NB	SB
Conflicting Flows: (vph)	213	
Potential Capacity: (pcph)	1080	
Movement Capacity: (pcph)	1080	
Prob. of Queue-free State:	0.84	

Step 2: LT from Major Street	WB	EB
Conflicting Flows: (vph)		78
Potential Capacity: (pcph)		1574
Movement Capacity: (pcph)		1574
Prob. of Queue-free State:		0.80

Step 4: LT from Minor Street	NB	SB
Conflicting Flows: (vph)	552	
Potential Capacity: (pcph)	507	
Major LT, Minor TH Impedance Factor:	0.80	
Adjusted Impedance Factor:	0.80	
Capacity Adjustment Factor due to Impeding Movements	0.80	
Movement Capacity: (pcph)	405	

****

Intersection Performance Summary

Movement		FlowRate v(pcph)	MoveCap Cm(pcph)	SharedCap Csh(pcph)	Avg.Total Delay	LOS	Delay By App
NB	L	200	405		17.5	C	
NB	R	177	1080		4.0	A	11.2
EB	L	318	1574		2.9	A	1.6

Intersection Delay = 4.2

HCM: SIGNALIZED INTERSECTION SUMMARY Version 2.4 04-18-1997
Center For Microcomputers In Transportation

Streets: (N-S) TRYON ST. (E-W) 36 th ST.
Analyst: GMC File Name: TRY397EX.HC9
Area Type: Other 4-18-97 1997 PM
Comment: EXISTING CONDITIONS

	Northbound			Southbound			Eastbound			Westbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	2	1	1	2	<	1	1	<	1	1	<
Volumes	5	1814	163	88	1077	2	4	3	11	120	2	169
Lane Width	10.0	10.0	10.0	10.0	11.0		11.0	13.0		10.0	10.0	
RTOR Vols			20			0			1			25
Lost Time	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00

Signal Operations

Phase Combination		1	2	3	4
NB	Left	*			
	Thru	*			
	Right	*			
	Peds				
SB	Left	*	*		
	Thru	*	*		
	Right	*	*		
	Peds				
EB	Right				
WB	Right				
Green		50.0P	20.0A		
Yellow/AR		5.6	5.0		

		5	6	7	8
EB	Left	*			
	Thru	*			
	Right	*			
	Peds				
WB	Left		*		
	Thru		*		
	Right		*		
	Peds				
NB	Right		*		
SB	Right				
Green		20.0A	20.0A		
Yellow/AR		5.1	5.1		

Cycle Length: 131 secs Phase combination order: #1 #2 #5 #6

Intersection Performance Summary

	Lane Mvmts	Group: Cap	Adj Sat Flow	v/c Ratio	g/C Ratio	Delay	LOS	Approach: Delay	LOS
NB	L	55	125	0.109	0.402	18.6	C	*	*
	T	1318	3278	1.606	0.402	*	*		
	R	827	1393	0.192	0.594	9.3	B		
SB	L	353	1557	0.278	0.382	32.1	D	14.9	B
	TR	2014	3394	0.625	0.593	13.5	B		
EB	L	272	1612	0.015	0.169	34.4	D	34.6	D
	TR	271	1601	0.052	0.169	34.6	D		
WB	L	263	1557	0.506	0.169	38.9	D	41.9	E
	TR	236	1396	0.687	0.169	44.3	E		

Intersection Delay = * (sec/veh) Intersection LOS = *
(g/C)*(V/c) is greater than one. Calculation of D1 is infeasable.

HCM: SIGNALIZED INTERSECTION SUMMARY Version 2.4d 04-23-1997

Gannett Fleming, Inc.

Streets: (N-S) TRYON ST. (E-W) 36 th ST.
Analyst: GMC File Name: TRY320BD.HC9
Area Type: Other 4-23-97 2010 PM
Comment: BUILD CONDITIONS

	Northbound			Southbound			Eastbound			Westbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	2	1	1	2	<	1	1	<	1	1	<
Volumes	10	2400	260	270	1440	10	10	10	20	200	10	220
PHF or PK15	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Lane W (ft)	10.0	10.0	10.0	10.0	11.0		11.0	13.0		10.0	10.0	
Grade		1			1			1			1	
% Heavy Veh	2	2	2	2	2	2	2	2	2	2	2	2
Parking	(Y/N)	N		(Y/N)	N		(Y/N)	N		(Y/N)	N	
Bus Stops			0			0			0			0
Con. Peds			0			0			0			0
Ped Button	(Y/N)	N		(Y/N)	N		(Y/N)	N		(Y/N)	N	
Arr Type	3	3	3	3	3		3	3		3	3	
RTOR Vols			20			0			1			25
Lost Time	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Prop. Share												
Prop. Prot.												

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
NB	Left	*				EB Left	*		
	Thru	*				Thru	*		
	Right	*				Right	*		
	Peds					Peds			
SB	Left	*	*			WB Left		*	
	Thru	*	*			Thru		*	
	Right	*	*			Right		*	
	Peds					Peds			
EB	Right					NB Right		*	
WB	Right					SB Right			
Green		50.0P	20.0A			Green	20.0A	20.0A	
Yellow/AR		5.6	5.0			Yellow/AR	5.1	5.1	

Cycle Length: 131 secs Phase combination order: #1 #2 #5 #6

Intersection Performance Summary

	Lane Group: Mvmts	Cap	Adj Sat Flow	v/c Ratio	g/C Ratio	Delay	LOS	Approach: Delay	LOS
NB	L	55	132	0.200	0.402	16.7	C	*	*
	T	1391	3460	2.012	0.402	*	*		
	R	873	1470	0.306	0.594	8.6	B		
SB	L	369	1643	0.813	0.593	40.1	E	18.6	C
	TR	2124	3580	0.797	0.593	14.8	B		
EB	L	288	1702	0.038	0.169	29.4	D	29.6	D
	TR	292	1727	0.110	0.169	29.7	D		
WB	L	278	1643	0.800	0.169	44.1	E	51.0	E
	TR	251	1483	0.906	0.169	57.8	E		

Intersection Delay = * (sec/veh) Intersection LOS = *

(g/C)*(V/c) is greater than one. Calculation of D1 is infeasable.

HCM: SIGNALIZED INTERSECTION SUMMARY Version 2.4d 04-23-1997

Gannett Fleming, Inc.

Streets: (N-S) TRYON ST. (E-W) 36 th ST.
Analyst: GMC File Name: TRY320B2.HC9
Area Type: Other 4-23-97 2010 PM
Comment: BUILD CONDITIONS W/IMPROVEMENTS

	Northbound			Southbound			Eastbound			Westbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	3	1	1	2	<	1	1	<	1	1	<
Volumes	10	2400	260	270	1440	10	10	10	20	200	10	220
PHF or PK15	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Lane W (ft)	10.0	10.0	10.0	10.0	11.0		11.0	13.0		10.0	10.0	
Grade		1			1			1			1	
% Heavy Veh	2	2	2	2	2	2	2	2	2	2	2	2
Parking	(Y/N)	N		(Y/N)	N		(Y/N)	N		(Y/N)	N	
Bus Stops			0			0			0			0
Con. Peds			0			0			0			0
Ped Button	(Y/N)	N		(Y/N)	N		(Y/N)	N		(Y/N)	N	
Arr Type	3	3	3	3	3		3	3		3	3	
RTOR Vols			20			0			1			25
Lost Time	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Prop. Share												
Prop. Prot.												

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
NB	Left	*	*			EB Left	*		
	Thru		*			Thru	*		
	Right		*			Right	*		
	Peds					Peds			
SB	Left	*	*			WB Left	*	*	
	Thru		*			Thru	*	*	
	Right		*			Right	*	*	
	Peds					Peds			
EB	Right					NB Right		*	
WB	Right					SB Right			
Green		20.0P	65.0A			Green	7.0A	15.0A	
Yellow/AR		5.0	5.6			Yellow/AR	5.0	1.0	

Cycle Length: 124 secs Phase combination order: #1 #2 #5 #6

Intersection Performance Summary

	Lane Mvmts	Group: Cap	Adj Sat Flow	v/c Ratio	g/C Ratio	Delay	LOS	Approach: Delay	LOS
NB	L	350	1643	0.031	0.749	9.2	B	36.8	D
	T	2839	5190	1.034	0.547	39.7	D		
	R	959	1470	0.279	0.652	5.9	B		
SB	L	350	1643	0.857	0.749	39.5	D	21.8	C
	TR	1958	3580	0.864	0.547	18.6	C		
EB	L	94	895	0.117	0.105	32.4	D	32.6	D
	TR	182	1727	0.176	0.105	32.6	D		
WB	L	311	1643	0.714	0.202	34.6	D	35.9	D
	TR	300	1483	0.757	0.202	37.2	D		

Intersection Delay = 31.4 sec/veh Intersection LOS = D

Lost Time/Cycle, L = 9.0 sec Critical v/c(x) = 0.966

HCM: SIGNALIZED INTERSECTION SUMMARY Version 2.4 04-18-1997
Center For Microcomputers In Transportation

Streets: (N-S) DAVIDSON ST. (E-W) 36 th ST.
Analyst: GMC File Name: DAV397EX.HC9
Area Type: Other 4-18-97 1997 PM
Comment: EXISTING CONDITIONS

	Northbound			Southbound			Eastbound			Westbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1	<	1	1	<	>	2	<	>	2	<
Volumes	121	435	151	33	163	15	23	187	90	42	60	36
Lane Width	10.0	10.0		10.0	11.0			10.0			10.0	
RTOR Vols			20			5			10			5
Lost Time	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
NB Left	*							
Thru	*							
Right	*							
Peds								
SB Left	*							
Thru	*							
Right	*							
Peds								
EB Right								
WB Right								
Green	74.0P				40.0A			
Yellow/AR	5.3				5.0			

EB Left * / Thru * / Right * / Peds
WB Left * / Thru * / Right * / Peds
NB Right
SB Right

Cycle Length: 124 secs Phase combination order: #1 #5

Intersection Performance Summary

	Lane Group: Mvmts	Cap	Adj Sat Flow	v/c Ratio	g/C Ratio	Delay	LOS	Approach: Delay	LOS
NB	L	585	953	0.229	0.614	8.2	B	11.9	B
	TR	981	1598	0.641	0.614	12.6	B		
SB	L	129	210	0.287	0.614	8.9	B	8.1	B
	TR	1043	1699	0.184	0.614	8.0	B		
EB	LTR	978	2894	0.347	0.338	23.5	C	23.5	C
WB	LTR	802	2375	0.193	0.338	22.2	C	22.2	C

Intersection Delay = 15.0 sec/veh Intersection LOS = B
Lost Time/Cycle, L = 6.0 sec Critical v/c(x) = 0.537

HCM: SIGNALIZED INTERSECTION SUMMARY Version 2.4d 04-23-1997

Gannett Fleming, Inc.

Streets: (N-S) DAVIDSON ST. (E-W) 36 th ST.
Analyst: GMC File Name: DAV320BD.HC9
Area Type: Other 4-23-97 2010 PM
Comment: BUILD CONDITIONS

	Northbound			Southbound			Eastbound			Westbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes	1	1 <		1	1 <			> 2 <			> 2 <	
Volumes	200	560	190	40	210	20	30	320	250	50	80	50
PHF or PK15	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Lane W (ft)	10.0	10.0		10.0	11.0			10.0			10.0	
Grade		1			1			1			1	
% Heavy Veh	2	2	2	2	2	2	2	2	2	2	2	2
Parking	(Y/N)	N		(Y/N)	N		(Y/N)	N		(Y/N)	N	
Bus Stops			0			0			0			0
Con. Peds			0			0			0			0
Ped Button	(Y/N)	N		(Y/N)	N		(Y/N)	N		(Y/N)	N	
Arr Type	3	3		3	3			3			3	
RTOR Vols			20			3			12			6
Lost Time	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
Prop. Share												
Prop. Prot.												

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
NB Left	*				EB Left	*		
Thru	*				Thru	*		
Right	*				Right	*		
Peds					Peds			
SB Left	*				WB Left	*		
Thru	*				Thru	*		
Right	*				Right	*		
Peds					Peds			
EB Right					NB Right			
WB Right					SB Right			
Green	78.0P				Green	36.0A		
Yellow/AR	5.3				Yellow/AR	5.0		

Cycle Length: 124 secs Phase combination order: #1 #5

Intersection Performance Summary

	Lane Mvmts	Group: Cap	Adj Sat Flow	v/c Ratio	g/C Ratio	Delay	LOS	Approach: Delay	LOS
NB	L	548	848	0.405	0.646	7.1	B	10.9	B
	TR	1078	1669	0.752	0.646	11.9	B		
SB	L	63	98	0.695	0.646	27.0	D	9.0	B
	TR	1144	1771	0.220	0.646	5.9	B		
EB	LTR	920	3008	0.747	0.306	27.4	D	27.4	D
WB	DfL	84	275	0.666	0.306	36.1	D	25.5	D
	TR	501	1638	0.276	0.306	21.2	C		

Intersection Delay = 17.1 sec/veh Intersection LOS = C

Lost Time/Cycle, L = 6.0 sec Critical v/c(x) = 0.751

HCM: SIGNALIZED INTERSECTION SUMMARY Version 2.4d 04-17-1997
Gannett Fleming Corddry And Carpenter, Inc.

Streets: (N-S) Old Concord Rd. (E-W) McLean Rd.
Analyst: RNP File Name: HCMSC2B.HC9
Area Type: Other 4-17-97 5-6 AM
Comment: LOS 1997 Volumes

	Northbound			Southbound			Eastbound			Westbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes		1	1	1	1							
Volumes		498	333	176	448					> 145		< 56
Lane W (ft)		11.0	11.0	11.0	10.5						10.0	
RTOR Vols			0			0						0
Lost Time		3.00	3.00	3.00	3.00					3.00		3.00

Signal Operations

Phase Combination	1	2	3	4	5	6	7	8
NB Left					EB Left	*		
Thru		*			Thru	*		
Right		*			Right	*		
Peds	*				Peds	*	*	
SB Left	*	*			WB Left	*	*	
Thru	*	*			Thru		*	
Right					Right	*	*	
Peds	*				Peds		*	
EB Right					NB Right	*		
WB Right					SB Right			
Green	20.0A	20.0P			Green	10.0A	23.7P	
Yellow/AR	6.7	6.7			Yellow/AR	5.6	4.0	

Cycle Length: 97 secs Phase combination order: #1 #2 #5 #6

Intersection Performance Summary

	Lane Group: Mvmts	Cap	Adj Sat Flow	v/c Ratio	g/C Ratio	Delay	LOS	Approach: Delay	LOS
NB	T	450	1837	1.164	0.245	*	*	*	*
	R	634	1561	0.553	0.406	17.5	C		
SB	L	494	1711	0.397	0.521	12.1	B	12.2	B
	T	923	1770	0.540	0.521	12.2	B		
WB	LR	529	1371	0.416	0.386	16.8	C	16.8	C

Intersection Delay = * (sec/veh) Intersection LOS = *
(g/C)*(V/c) is greater than one. Calculation of D1 is infeasable.

HCM: SIGNALIZED INTERSECTION SUMMARY Version 2.4d 04-17-1997
Gannett Fleming Corddry And Carpenter, Inc.

Streets: (N-S) Old Concord Rd. (E-W) McLean Rd.
Analyst: RNP File Name: OLDCON2.HC9
Area Type: Other 4-17-97 5-6 AM
Comment: LOS 1997 Volumes-Max Green(Old Con.)

	Northbound			Southbound			Eastbound			Westbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes		1	1	1	1						>	<
Volumes		498	333	176	448					145		56
Lane W (ft)		11.0	11.0	11.0	10.5						10.0	
RTOR Vols			0			0						0
Lost Time		3.00	3.00	3.00	3.00					3.00		3.00

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
NB	Left					EB Left	*		
	Thru		*			Thru	*		
	Right		*			Right	*		
	Peds	*				Peds	*	*	
SB	Left	*	*			WB Left	*	*	
	Thru	*	*			Thru		*	
	Right					Right	*	*	
	Peds	*				Peds		*	
EB	Right					NB Right	*		
WB	Right					SB Right			
Green		20.0A	52.0P			Green	10.0A	23.7P	
Yellow/AR		6.7	6.7			Yellow/AR	5.6	4.0	

Cycle Length: 129 secs Phase combination order: #1 #2 #5 #6

Intersection Performance Summary

	Lane Mvmts	Group: Cap	Adj Sat Flow	v/c Ratio	g/C Ratio	Delay	LOS	Approach: Delay	LOS
NB	T	795	1837	0.659	0.433	23.4	C	19.1	C
	R	865	1561	0.406	0.554	12.7	B		
SB	L	378	1711	0.519	0.640	20.2	C	12.2	B
	T	1133	1770	0.439	0.640	9.0	B		
WB	LR	397	1371	0.554	0.290	30.4	D	30.4	D

Intersection Delay = 17.8 sec/veh Intersection LOS = C
Lost Time/Cycle, L = 9.0 sec Critical v/c(x) = 0.602

HCM: SIGNALIZED INTERSECTION SUMMARY Version 2.4d 04-17-1997
Gannett Fleming Corddry And Carpenter, Inc.

Streets: (N-S) Old Concord Rd. (E-W) McLean Rd.
Analyst: RNP File Name: OLDCON3.HC9
Area Type: Other 4-17-97 5-6 AM
Comment: LOS 1997 Volumes-Max Green(Old Con. & McLean)

	Northbound			Southbound			Eastbound			Westbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes		1	1	1	1						>	<
Volumes		498	333	176	448					145		56
Lane W (ft)		11.0	11.0	11.0	10.5						10.0	
RTOR Vols			0			0						0
Lost Time		3.00	3.00	3.00	3.00					3.00		3.00

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
NB	Left					EB	Left		*		
	Thru		*				Thru		*		
	Right		*				Right		*		
	Peds	*					Peds	*	*		
SB	Left	*	*			WB	Left	*	*		
	Thru	*	*				Thru		*		
	Right						Right	*	*		
	Peds	*					Peds		*		
EB	Right					NB	Right	*			
WB	Right					SB	Right				
Green		20.0A	52.0P			Green		40.0A	23.7P		
Yellow/AR		6.7	6.7			Yellow/AR		5.6	4.0		

Cycle Length: 159 secs Phase combination order: #1 #2 #5 #6

Intersection Performance Summary

	Lane Mvmts	Group: Cap	Adj Sat Flow	v/c Ratio	g/C Ratio	Delay	LOS	Approach: Delay	LOS
NB	T	645	1837	0.813	0.351	41.0	E	28.7	D
	R	996	1561	0.352	0.638	10.3	B		
SB	L	301	1711	0.651	0.519	35.1	D	24.2	C
	T	919	1770	0.542	0.519	19.9	C		
WB	LR	581	1371	0.378	0.424	24.0	C	24.0	C

Intersection Delay = 26.4 sec/veh Intersection LOS = D
Lost Time/Cycle, L = 9.0 sec Critical v/c(x) = 0.594

HCM: SIGNALIZED INTERSECTION SUMMARY Version 2.4d 04-17-1997
Gannett Fleming Corddry And Carpenter, Inc.

Streets: (N-S) Old Concord Rd. (E-W) McLean Rd.
Analyst: RNP File Name: OLDCON4.HC9
Area Type: Other 4-17-97 5-6 AM
Comment: LOS 2010 Volumes-Max Green(Old Con.)

	Northbound			Southbound			Eastbound			Westbound		
	L	T	R	L	T	R	L	T	R	L	T	R
No. Lanes		1	1	1	1							
Volumes		498	333	176	448					> 145		< 56
Lane W (ft)		11.0	11.0	11.0	10.5						10.0	
RTOR Vols			0			0						0
Lost Time		3.00	3.00	3.00	3.00					3.00		3.00

Signal Operations

Phase Combination		1	2	3	4	5	6	7	8
NB	Left					EB	Left		*
	Thru		*				Thru		*
	Right		*				Right		*
	Peds	*					Peds	*	*
SB	Left	*	*			WB	Left	*	*
	Thru	*	*				Thru		*
	Right						Right	*	*
	Peds	*					Peds		*
EB	Right					NB	Right	*	
WB	Right					SB	Right		
Green		20.0A	52.0P			Green		10.0A	23.7P
Yellow/AR		6.7	6.7			Yellow/AR		5.6	4.0

Cycle Length: 129 secs Phase combination order: #1 #2 #5 #6

Intersection Performance Summary

	Lane Mvmts	Group: Cap	Adj Sat Flow	v/c Ratio	g/C Ratio	Delay	LOS	Approach: Delay	LOS
NB	T	795	1837	0.830	0.433	29.8	D	23.4	C
	R	865	1561	0.511	0.554	14.0	B		
SB	L	371	1711	0.666	0.640	29.1	D	15.6	C
	T	1133	1770	0.553	0.640	10.3	B		
WB	LR	397	1371	0.697	0.290	33.7	D	33.7	D

Intersection Delay = 21.7 sec/veh Intersection LOS = C
Lost Time/Cycle, L = 9.0 sec Critical v/c(x) = 0.759

Date: 2/18/97 Time: 4:00-6:00 PM Weather: SUNNY		MANUAL TRAFFIC COUNT SUMMARY IN PASSENGER CAR EQUIVALENTS (PCE'S)		Counted by: RLC Location: McLean @ Old Concord	
Time	**Approach**	**Left-Turn**	**Through**	**Right-Turn**	**Total**
4:00-4:15	EB	N/A	N/A	N/A	N/A
4:15-4:30	EB	N/A	N/A	N/A	N/A
4:30-4:45	EB	N/A	N/A	N/A	N/A
4:45-5:00	EB	N/A	N/A	N/A	N/A
5:00-5:15	EB	N/A	N/A	N/A	N/A
5:15-5:30	EB	N/A	N/A	N/A	N/A
5:30-5:45	EB	N/A	N/A	N/A	N/A
5:45-6:00	EB	N/A	N/A	N/A	N/A
TOTAL		N/A	N/A	N/A	N/A
4:00-4:15	WB	26	N/A	14	40
4:15-4:30	WB	26	N/A	9	35
4:30-4:45	WB	29	N/A	18	47
4:45-5:00	WB	40	N/A	11	51
5:00-5:15	WB	42	N/A	10	52
5:15-5:30	WB	35	N/A	8	43
5:30-5:45	WB	28	N/A	22	50
5:45-6:00	WB	40	N/A	16	56
TOTAL		266	N/A	108	374

Date: 2/18/97 Time: 4:00-6:00PM Weather: SUNNY		MANUAL TRAFFIC COUNT SUMMARY IN PASSENGER CAR EQUIVALENTS (PCE'S)		Counted by: RLC Location: Old Concord @ McLean	
Time	**Approach**	**Left-Turn**	**Through**	**Right-Turn**	**Total**
4:00-4:15	NB	N/A	70	39	109
4:15-4:30	NB	N/A	82	53	135
4:30-4:45	NB	N/A	113	55	168
4:45-5:00	NB	N/A	107	56	163
5:00-5:15	NB	N/A	96	60	156
5:15-5:30	NB	N/A	114	85	199
5:30-5:45	NB	N/A	130	88	218
5:45-6:00	NB	N/A	158	100	258
TOTAL		N/A	870	536	1406
4:00-4:15	SB	18	84	N/A	102
4:15-4:30	SB	24	83	N/A	107
4:30-4:45	SB	27	104	N/A	131
4:45-5:00	SB	35	112	N/A	147
5:00-5:15	SB	40	113	N/A	153
5:15-5:30	SB	42	130	N/A	172
5:30-5:45	SB	48	102	N/A	150
5:45-6:00	SB	46	103	N/A	149
TOTAL		280	831	N/A	1111

Date: 4/7/97 Time: 4:00-6:00 PM Weather: SUNNY		MANUAL TRAFFIC COUNT SUMMARY IN PASSENGER CAR EQUIVALENTS (PCE'S)		Counted by: RLC Location: Davidson @ Craighead	
Time	**Approach**	**Left-Turn**	**Through**	**Right-Turn**	**Total**
4:00-4:15	EB	53	N/A	39	92
4:15-4:30	EB	63	N/A	22	85
4:30-4:45	EB	65	N/A	25	90
4:45-5:00	EB	54	N/A	40	94
5:00-5:15	EB	66	N/A	36	102
5:15-5:30	EB	75	N/A	55	130
5:30-5:45	EB	65	N/A	57	122
5:45-6:00	EB	54	N/A	65	119
TOTAL		495	N/A	339	834
4:00-4:15	NWB	29	N/A	21	50
4:15-4:30	NWB	20	N/A	15	35
4:30-4:45	NWB	27	N/A	19	46
4:45-5:00	NWB	30	N/A	22	52
5:00-5:15	NWB	24	N/A	17	41
5:15-5:30	NWB	15	N/A	20	35
5:30-5:45	NWB	19	N/A	12	31
5:45-6:00	NWB	20	N/A	8	28
TOTAL		184	N/A	134	318

Date: 4/7/97 Time: 4:00-6:00PM Weather: SUNNY-75°		MANUAL TRAFFIC COUNT SUMMARY IN PASSENGER CAR EQUIVALENTS (PCE'S)		Counted by: RLC Location: Craighead @ Davidson	
Time	**Approach**	**Left-Turn**	**Through**	**Right-Turn**	**Total**
4:00-4:15	NB	N/A	N/A	N/A	N/A
4:15-4:30	NB	N/A	N/A	N/A	N/A
4:30-4:45	NB	N/A	N/A	N/A	N/A
4:45-5:00	NB	N/A	N/A	N/A	N/A
5:00-5:15	NB	N/A	N/A	N/A	N/A
5:15-5:30	NB	N/A	N/A	N/A	N/A
5:30-5:45	NB	N/A	N/A	N/A	N/A
5:45-6:00	NB	N/A	N/A	N/A	N/A
TOTAL		N/A	N/A	N/A	N/A
4:00-4:15	SB	28	N/A	28	56
4:15-4:30	SB	28	N/A	33	61
4:30-4:45	SB	34	N/A	31	65
4:45-5:00	SB	37	N/A	27	64
5:00-5:15	SB	33	N/A	30	63
5:15-5:30	SB	46	N/A	35	81
5:30-5:45	SB	34	N/A	32	66
5:45-6:00	SB	26	N/A	25	51
TOTAL		266	N/A	241	507