Traffic Separation Study

for the

City of Durham, North Carolina

Prepared for:
North Carolina Department of Transportation:

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Nancy Horne, P.E., Project Manager

Prepared By:
Kimley-Horn and Associates, Inc.:

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Matt West, P.E., Project Manager

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Executive Summary

The Durham Traffic Separation Study (TSS) was a joint effort between the North Carolina Department of Transportation (NCDOT) Rail Division, the City of Durham, Norfolk Southern Corporation, and Triangle Transit (TTA). The NCDOT Rail Division has developed and entered into a Traffic Separation Study Agreement with the City of Durham, Norfolk Southern, and TTA to conduct a traffic separation study of 18 public highway-rail at-grade crossings along the Norfolk Southern rail line in Durham County from Neal Road to Cornwallis Road. The study also included two existing grade-separated crossings in downtown Durham.

The crossings were divided into three "sections." In order from west to east, the following crossings were studied:

Table ES.1. Section 1 (West) Study Crossings

Crossing No.	Street Name	Milepost	Type
735 202E	Neal Road	H 50.20	At-grade
735 205A	N. Lasalle Street	H 52.04	At-grade
910 594N	Anderson Street	H 53.21	At-grade
735 223X	Swift Avenue	H 53.76	At-grade
735 225L	Buchanan Boulevard	H 54.20	At-grade

Table ES.2. Section 2 (Downtown) Study Crossings

Crossing No.	Street Name	Milepost	Type
735 227A	Duke Street	H 54.60	At-grade
735 228G	Chapel Hill Street	H 54.80	Grade-separated
735 229N	Blackwell/Corcoran Street	H 55.09	At-grade
735 231P	Mangum Street	H 55.14	At-grade
735 233D	Roxboro Street	H 55.20	Grade-separated
735 389C	Dillard Street	H 55.45	At-grade
910 605Y	Fayetteville Street	H 55.50	At-grade
630 474Y	Ramseur Street	H 55.90	At-grade
630 472K	Plum Street	H 56.40	At-grade
735 225L	Driver Street	H 56.70	At-grade
	Briggs Avenue/Guthrie Avenue	Approximate milepost H 56.93	Future grade-separated

Table ES.3. Section 3 (East) Study Crossings

Crossing No.	Street Name	Milepost	Type
735 236Y	Ellis Road (West)	H 57.57	At-grade
734 735L	Glover Road	H 58.98	At-grade
734 736T	Wrenn Road	H 59.28	At-grade
734 737A	Ellis Road (East)	H 60.27	At-grade
734 742W	Cornwallis Road	H 62.93	At-grade

The analysis of each crossing included several elements.

Crash Data

Crash data from NCDOT and the Federal Railroad Administration (FRA) was analyzed for the 20-year period from 1991 to 2011. Thirty-seven crashes involving train/vehicle or train/pedestrian collisions were reported at crossings in the study area, as summarized in Table ES.4. Of these, 15 occurred before existing warning devices were installed, or before existing traffic signal improvements had been made. Most collisions occurred when vehicles were stopped over the tracks because of a queue from an adjacent traffic signal.

Table ES.4. Crashes at Study Area Crossings (1991 to 2011)

Crossing No.	Crossing Location	Motor Vehicle Incidents			Pedestrian Incidents
		PDO*	Injury	Fatality	Fatality
910 594N	Anderson Street	3	0	0	0
735 223X	Swift Avenue	2	0	0	0
735 225L	Buchanan Boulevard	2	0	0	0
735 229N	Blackwell/Corcoran Street	0	2	0	0
735 231P	Mangum Street	1	0	0	0
735 389C	Dillard Street	1	0	0	1
630 474Y	Ramseur Street	5	0	0	0
630 472K	Plum Street	1	0	1	0
630 471D	Driver Street	4	0	1	0
735 236Y	Ellis Road (West)	5	0	2	0
734 735L	Glover Road	4	0	0	0
734 737A	Ellis Road (East)	2	0	0	0
Total		**30**	**2**	**4**	**1**

* PDO – Property Damage Only

Crossing Closure

All crossings were considered for potential closure. Four crossings are recommended as long term for closure:

- Dillard Street – includes a proposed new pedestrian grade separation
- Ramseur Street – includes a proposed new pedestrian grade separation
- Plum Street – includes a proposed new pedestrian grade separation and greenway connection at the proposed TTA station, and is contingent on studying the switching yard operations at the Driver Street crossing and making improvements to switching operations as appropriate to keep static trains off of the Driver Street crossing.
- Wrenn Road – includes a new access road to Glover Road, and is contingent on grade separating the Glover Road crossing

Capacity analyses were performed to determine the operating characteristics of the adjacent road network and the impacts of the potential closure of these crossings. All intersections studied adjacent to the four crossings currently operate at acceptable levels of service. Some adjacent intersections are projected to operate at level of service F in 2035, but the poor level of service would occur with existing geometry or with the crossing closures. Therefore, it is anticipated that the closure of Dillard Street, Ramseur Street, Plum Street, and/or Wrenn Road will have little impact on the traffic operations in the area, and no roadway improvements are needed in conjunction with these crossing closure.

Safety and Mobility Issues

Safety and mobility issues were considered at each crossing based on roadway geometry, existing warning devices, and behavior of users across the tracks. The following conditions were observed:

- Vehicles were observed queuing over the tracks and getting hit by the gates at the Anderson Street, Swift Avenue, Buchanan Boulevard, Ramseur Street, Plum Street, Driver Street, and Ellis Road (West) crossings.
- New traffic signals or modifications to existing traffic signals are recommended at the Swift Avenue, Blackwell/Corcoran Street, and Fayetteville Street crossings.
- Installation of advanced warning signs were originally identified as needed at N. Lasalle Street, Swift Avenue, and Glover Road crossings, but the City has recently installed signs in those locations. No additional pavement markings or signs are recommended.
- Existing median barriers are located at Neal Road and Ellis Road (East) crossings. Median barriers are not needed at any additional locations, although an upgrade to a concrete median is proposed at Neal Road.
- There are two disconnected tracks adjacent to the grade-separated Chapel Hill Street crossing.
- Either advance or simultaneous traffic signal preemption is currently provided at all signalized intersections within 200 feet of the at-grade crossings. The intersections of Blackwell Street/Pettigrew Street and Corcoran Street/Main Street are not interconnected across the railroad tracks.
- All crossings have flashing signals, bells, and gate arms. The following crossings also have a four-quad gate system: N. Lasalle Street, Anderson Street, Swift Avenue, Blackwell/Corcoran Street, Mangum Street, Dillard Street, Fayetteville Street, Driver Street, Ellis Road (West), and Cornwallis Road.
- An analysis indicated that all of the at-grade crossings exceeded the target vehicle-train volume threshold (called the "exposure index") based on existing train and vehicle volumes except Dillard Street, Ramseur Street, and Wrenn Road. All crossings exceeded the exposure index based on future train volumes except Wrenn Road.
- A community impact analysis identified community features near the crossings, demographics of adjacent neighborhoods, and pedestrian, bicycle, and transit usage across the tracks. These impacts were used during the alternatives development process, and will be considered by City and NCDOT staff when moving forward with specific alternatives.

In addition, a group of stakeholders met to review recommendations during the course of the study. Stakeholders included:

- NCDOT Rail Division, Division 5, and District 2
- City of Durham Planning and Transportation Departments
- City of Durham Police and Fire
- Durham County EMS, Public Schools, and Chamber of Commerce
- Durham-Chapel Hill-Carrboro Metropolitan Planning Organization (DCHC MPO)
- NC Railroad
- Norfolk Southern Corporation
- Triangle Transit
- Downtown Durham, Inc.
- Durham Area Transit Authority
- Durham Bulls
- Durham Performing Arts Center (DPAC)
- Research Triangle Park (RTP)
- American Tobacco Campus (ATC)
- Duke University
- North Carolina Central University (NCCU)
- Triangle J Council of Governments
- Interneighborhood Council of Durham

A public involvement program was established as part of this study. It consisted of:

- Project committee meetings
- Stakeholder committee meetings
- Public workshops
- City Council meeting/public hearing
- Environmental justice/limited English proficiency outreach
- Small group meetings
- Mailings/press release

Based on this evaluation and input from stakeholders and the public, 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.
- Recommend action identified at the 18 at-grade railroad crossings and two of the existing grade-separated railroad crossings.
- Include a preliminary construction cost estimate for all proposed improvements.

Table ES.5 summarizes recommended improvements for each crossing studied. For each location, multiple near and/or mid term solutions could be implemented. These near and mid term solutions could, in most cases, be made instead or in addition to one of the long term solutions. The cost estimates presented below are for construction only and do not include right of way acquisition, utility relocation, or costs associated with construction phasing where railroad construction is required. Recommendations (Alternatives) marked with an asterisk have been made by the City of Durham since the draft recommendations were first presented to stakeholders.

Table ES.5. Recommended Alternatives

Crossing	Type	Near Term (2-5 years)		Mid Term (5-7 years)		Long Term (more than 7 years)	
		Alternatives	Const. Cost	Alternatives	Const. Cost	Alternatives	Const. Cost
West Durham (Section 1)							
Neal Road Crossing #735 202E Milepost H 50.20	At-grade	N/A	$0	N/A	$0	• Grade separation	$4,000,000
						• Widen pavement and replace bollards with 4' concrete monolithic island. Set new roadway vertical wedge to remove hump	$500,000
N. Lasalle Street Crossing #735 205A Milepost H 52.04	At-grade	• Install grade-crossing warning sign on WB Pettigrew St* • Install median barrier between crossing and nearest driveways north and south	$90,000	N/A	$0	• Grade separation	$9,000,000
Anderson Street Crossing #910 594N Milepost H 53.21	At-grade	• Stripe outside edges of travel lane across railroad crossing*	$500	N/A	$0	N/A	$0
Swift Avenue Crossing #735 223X Milepost H 53.76	At-grade	• Widen asphalt shoulder and stripe outside edge of travel lane on west side of Swift Ave over railroad tracks* • Install grade-crossing warning signs on EB and WB Pettigrew St* • Install crosswalk markings on Swift Ave and Pettigrew St, and install/upgrade curb ramps	$90,000	• Signalize Swift Ave/Pettigrew St intersection	$240,000	N/A	$0
Buchanan Boulevard Crossing #735 225L Milepost H 54.20	At-grade	• Install/upgrade curb ramps	$2,000	N/A	$0	N/A	$0
Downtown Durham (Section 2)							
Duke Street Crossing #735 227A Milepost H 54.60	At-grade	• Install crosswalk markings across Duke St and Peabody St, and install/upgrade curb ramps • Install sidewalk on west side of Duke St between Pettigrew St and existing sidewalk, and pave Pettigrew St apron	$30,000	N/A	$0	N/A	$0
Chapel Hill Street Crossing #735 228G Milepost H 54.80	Grade-separated	• Add raised concrete island as pedestrian refuge, install/upgrade curb ramps, apply new crosswalk markings, and install pedestrian signal heads at the Chapel Hill St/Downtown Loop intersection. • Construct a sidewalk on the north side of Ramseur St from Queen Street to Roxboro St, including a ramp down the slope adjacent to the Ramseur St bridge over Roxboro St. • Remove existing sidewalk on the north side of Pettigrew St from Chapel Hill St to the end of the sidewalk, and reconstruct the pedestrian ramp to redirect pedestrians to the crosswalk across Pettigrew St. • Sandblast, repair, and repaint bridge structure and wingwalls. Improve landscaping on top of wingwalls. Repair sidewalks in railroad tunnel. Add pedestrian lighting in railroad tunnel*	$110,000	• Remove two disconnected railroad tracks and bridges over Chapel Hill Street	$160,000	N/A	$0

* Recommendations (Alternatives) marked with an asterisk have been made by the City of Durham since the draft recommendations were first presented to stakeholders.

Table ES.5. Recommended Alternatives (Continued)							
Crossing	Type	Near Term (2-5 years)		Mid Term (5-7 years)		Long Term (more than 7 years)	
		Alternative	Const. Cost	Alternative	Const. Cost	Alternative	Const. Cost
Downtown Durham (Section 2) (Continued)							
Blackwell/Corcoran Street Crossing #735 229N Milepost H 55.09	At-grade	• Mill pavement at both intersections and resurface with stamped asphalt. • Install/upgrade curb ramps, and construct a concrete sidewalk with curb and gutter and brick trim on both sides of Blackwell/Corcoran St (except over the railroad, which will use standard asphalt pavement for sidewalk connectivity). • Add interconnectivity between Pettigrew St and Ramseur St traffic signals. • Construct restricted access for rail maintenance vehicles on Blackwell/Corcoran St between the railroad track and Ramseur St. • Install streetscape lighting and street furniture along Blackwell/Corcoran Street as a continuation of the downtown streetscaping plan.	$250,000	• Remove crosswalk on the north side of Pettigrew St across Blackwell St (to be done after TTA track is constructed), and remove associated pedestrian ramps and pedestrian signals. • Construct a sidewalk on the south side of Pettigrew St between Blackwell St and Mangum St.	$50,000	• Grade separate Blackwell/ Corcoran St and the railroad, and grade separate Mangum St and the railroad (Grade Separation). Replace Roxboro Street bridge as part of new grade separation.	$43,000,000
Mangum Street Crossing #735 231P Milepost H 55.14	At-grade	• Mill pavement at both intersections and resurface with stamped asphalt. • Install/upgrade curb ramps, and construct a concrete sidewalk with curb and gutter and brick trim on both sides of Blackwell/Corcoran St (except over the railroad, which will use standard asphalt pavement for sidewalk connectivity). • Install streetscape lighting and street furniture along Blackwell/Corcoran St as a continuation of the downtown streetscaping plan. Upgrade bus stops on Mangum St. • Remove pedestrian path and railing in the northeast quadrant of the Mangum St/Pettigrew St intersection. • Install a decorative fence on the south side of Ramseur St from Mangum St to east of Roxboro St.	$230,000	• Remove crosswalk on the north side of Pettigrew St across Mangum St (to be done after TTA track is constructed). • Construct a sidewalk on the south side of Pettigrew St between Blackwell St and Mangum St.	$40,000		
Roxboro Street Crossing #735 233D Milepost H 55.20	Grade-separated	• Sandblast, repair, and repaint bridge structure and wingwalls. Improve landscaping on top of wingwalls. Repair the sidewalks in railroad tunnel. Add pedestrian lighting in railroad tunnel* • Install a decorative fence on the south side of Ramseur St from Mangum St to east of Roxboro St. • Remove sidewalk on the north side of Pettigrew St from Roxboro St to the end of the sidewalk. • Install/upgrade curb ramps.*	$160,000	N/A	$0		

* Recommendations (Alternatives) marked with an asterisk have been made by the City of Durham since the draft recommendations were first presented to stakeholders.

Table ES.5. Recommended Alternatives (Continued)							
Crossing	Type	Near Term (2-5 years)		Mid Term (5-7 years)		Long Term (more than 7 years)	
		Alternative	Const. Cost	Alternative	Const. Cost	Alternative	Const. Cost
Downtown Durham (Section 2) (Continued)							
Dillard Street Crossing #735 389C Milepost H 55.45	At-grade	N/A	$0	N/A	$0	• Close crossing (remove pavement, and add signs and landscaping on Dillard St, and remove railroad crossing gates, signs, and equipment) and construct pedestrian grade separation • Install decorative fence between Roxboro Rd and Fayetteville St	$6,000,000
Fayetteville Street Crossing #910 605Y Milepost H 55.50	At-grade	• Install crosswalk markings on Fayetteville Street at Jackie Robinson Dr and Pettigrew St. and install/upgrade curb ramps • Install advanced pavement marking on northbound Fayetteville St. • Stripe outside edges of travel lane across railroad tracks*	$60,000	• Install advanced signal heads on Fayetteville St for westbound traffic approaching the Fayetteville St/Pettigrew St intersection. • Cut new vehicle detection loops on Fayetteville St east of railroad tracks, at stop bar. • Replace signal heads with optically programmed signal heads (eastbound signal heads at Fayetteville St/Pettigrew St intersection, and westbound signal heads at Fayetteville St/Jackie Robinson Dr intersection).	$40,000	• Grade separation and rail realignment, and Ramseur St • Install decorative fence between Roxboro Road and Fayetteville Rd.	$15,500,000
Ramseur Street Crossing #630 474Y Milepost H 55.90	At-grade	N/A	$0	N/A	$0	• Close crossing (remove pavement, and add signs and landscaping on Plum St, and remove railroad crossing gates, signs, and equipment) and construct pedestrian grade separation	$4,000,000
Plum Street Crossing #630 472K Milepost H 56.40	At-grade	N/A	$0	N/A	$0	• Close crossing (remove pavement, and add signs and landscaping on Plum St, and remove railroad crossing gates, signs, and equipment), construct new driveway for concrete company, construct pedestrian grade separation, and construct a greenway from und to Angier Ave	$3,500,000
Driver Street Crossing #630 471D Milepost H 56.70	At-grade	N/A	$0	N/A	$0	N/A	$0
Briggs/Guthrie Avenue Future Grade-Separated Crossing, Approx. Milepost H 56.92	N/A	N/A	$0	N/A	$0	• Grade separation	$21,500,000

* Recommendations (Alternatives) marked with an asterisk have been made by the City of Durham since the draft recommendations were first presented to stakeholders.

Table ES.5. Recommended Alternatives (Continued)							
Crossing	Type	Near Term (2-5 years)		Mid Term (5-7 years)		Long Term (more than 7 years)	
		Alternative	Const. Cost	Alternative	Const. Cost	Alternative	Const. Cost
Downtown Durham (Section 3)							
Ellis Road (West) Crossing #735 236Y Milepost H 57.57	At-grade	• Close center driveway to New York Mini Mart	$500	N/A	$0	• Grade separation	$3,500,000
Glover Road Crossing #734 735L Milepost H 58.98	At-grade	• Install grade-crossing warning sign on NB and SB Angier Ave*	$500	N/A	$0	• Grade separation of Glover Road and closure of Wrenn Road, including new connector road	$37,000,000
Wrenn Road Crossing #734 736T Milepost H 59.28	At-grade	N/A	$0	N/A	$0		
Ellis Road (East) Crossing #734 737A Milepost H 60.27	At-grade	N/A	$0	N/A	$0	• Grade separation	$4,000,000
Cornwallis Road Crossing #734 742W Milepost H 62.93	At-grade	• Widen asphalt shoulder and stripe outside edge of travel lane	$40,000	N/A	$0	• Grade separation	$10,000,000

* Recommendations (Alternatives) marked with an asterisk have been made by the City of Durham since the draft recommendations were first presented to stakeholders.

A. Introduction

A.1. Preamble

Safety and mobility are top priorities for the NCDOT, City of Durham, TTA and railroad companies. Collisions between trains and highway vehicles are the second highest cause of death in the railroad industry. In 2012, there were 45 rail/highway incidents in North Carolina, resulting in 2 deaths and 42 injuries. The number and speed of freight and passenger trains is anticipated to increase through the state in the next few years, with a notable increase in train volumes through areas such as Durham with planned light rail service. As train volumes and highway volumes grow, it will become even more critical to identify and prioritize safety enhancements at rail/highway crossings.

The NCDOT Rail Division has completed traffic separation studies in both small and large communities throughout the state. These studies are part of a comprehensive evaluation of traffic patterns and road usage on a corridor- or regional-level. The purpose of the TSS is to determine the need for improvements and/or elimination of public at-grade crossings to improve safety and mobility for motorists, rail passengers, and train crews. These studies are one of the comprehensive programs to improve rail-crossing safety administered by NCDOT, the Federal Highway Administration (FHWA), and the Federal Railroad Administration (FRA).

The NCDOT Rail Division has developed and entered into a Municipal Agreement with the City of Durham, Norfolk Southern, and TTA to conduct a traffic separation study of 18 public highway-rail at-grade crossings along the Norfolk Southern rail line in Durham County from Neal Road to Cornwallis Road. Specific goals for this TSS include:

- Identify existing safety concerns
- Enhance railroad and vehicular safety
- Maintain citizen mobility

In addition to the safety and mobility goals, the City of Durham also asked the project team to provide detailed recommendations for pedestrian enhancements and connectivity along the railroad corridor in downtown Durham. Thus, the study also included two existing grade-separated crossings in downtown Durham, Chapel Hill Street and Roxboro Street.

A.2. Study Objectives

A TSS considers pedestrian and traffic conditions along an entire corridor with the goal of making recommendations to improve safety at each specific at-grade crossing while maintaining public support. The study determines the need for improvements, such as the following:

- Crossing consolidations
- Installation of new grade-separations or repair of existing grade separations
- Signage
- Pavement marking
- Illumination
- New or upgraded highway-railroad grade crossing signals, gates, and/or lights
- Improved crossing surfaces
- Traffic signal interconnection/preemption
- Sight distance or geometric improvements

In addition to the agencies that were a part of the municipal agreement, a group of stakeholders met to review recommendations during the course of the study. Stakeholders included:

- NCDOT Rail Division, Division 5, and District 2
- City of Durham Planning and Transportation Departments
- City of Durham Police and Fire
- Durham County EMS, Public Schools, and Chamber of Commerce
- Durham-Chapel Hill-Carrboro Metropolitan Planning Organization (DCHC MPO)
- NC Railroad
- Norfolk Southern Corporation
- Triangle Transit
- Downtown Durham, Inc.
- Durham Area Transit Authority
- Durham Bulls
- Durham Performing Arts Center (DPAC)
- Research Triangle Park (RTP)
- American Tobacco Campus (ATC)
- Duke University
- North Carolina Central University (NCCU)
- Triangle J Council of Governments
- Interneighborhood Council of Durham

All of the crossings studied as part of the Durham TSS are within the North Carolina Railroad right-of-way. The railroad tracks along this corridor are primarily operated on AMTRAK passenger service, and Norfolk Southern Freight rail. To help facilitate effective public outreach, the crossings were divided into three “sections.” The crossings studied, in order from west to east, are listed in Tables A.1 through A.3, and are shown on Figures 1 through 3.

Table A.1. Section 1 (West) Study Crossings			
Crossing No.	**Street Name**	**Milepost**	**Type**
735 202E	Neal Road	H 50.20	At-grade
735 205A	N. Lasalle Street	H 52.04	At-grade
910 594N	Anderson Street	H 53.21	At-grade
735 223X	Swift Avenue	H 53.76	At-grade
735 225L	Buchanan Boulevard	H 54.20	At-grade

Table A.2. Section 2 (Downtown) Study Crossings			
Crossing No.	**Street Name**	**Milepost**	**Type**
735 227A	Duke Street	H 54.60	At-grade
735 228G	Chapel Hill Street	H 54.80	Grade-separated
735 229N	Blackwell/Corcoran Street	H 55.09	At-grade
735 231P	Mangum Street	H 55.14	At-grade
735 233D	Roxboro Street	H 55.20	Grade-separated
735 389C	Dillard Street	H 55.45	At-grade
910 605Y	Fayetteville Street	H 55.50	At-grade
630 474Y	Ramseur Street	H 55.90	At-grade
630 472K	Plum Street	H 56.40	At-grade
630 471D	Driver Street	H 56.70	At-grade
	Briggs Avenue/Guthrie Avenue	H 56.93 (estimated)	Future grade separated

Table A.3. Section 3 (East) Study Crossings			
Crossing No.	**Street Name**	**Milepost**	**Type**
735 236Y	Ellis Road (West)	H 57.57	At-grade
734 735L	Glover Road	H 58.98	At-grade
734 736T	Wrenn Road	H 59.28	At-grade
734 737A	Ellis Road (East)	H 60.27	At-grade
734 742W	Cornwallis Road	H 62.93	At-grade

SECTION 1 - FIGURE 1
STUDY CROSSINGS
MARCH 2013

Neal Road (SR 1314) Crossing

Durham Freeway (NC 147) Not Studied

Neal Road Not Studied

N. Lasalle Street Crossing

Hillandale Road Grade-Separated Crossing

Swift Avenue Crossing

Campus Drive Grade-Separated Crossing

Anderson Street Crossing

Erwin Road / 9th Street (SR 1302) Grade-Separated Crossing

Buchanan Boulevard Crossing

US Highway 15-501 Not Studied

U-3804

C-5178

C-4928

LRTP 114

Triangle Day School

US Veterans Medical Center

Duke School for Children

North Carolina Specialty Hospital

Immaculata Catholic School

Orange County
Durham County
Durham
Chapel Hill
Raleigh
Cary
Wake

Legend

At-Grade Crossings

Grade-Separated Crossings

Other Crossings - Not in Project

Rail Corridor

Schools

Hospitals

Historic Places

Local Project

TIP Bike/Ped Project

TIP Roadway Project

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NS NORFOLK SOUTHERN

SECTION 2 - FIGURE 2
STUDY CROSSINGS
MARCH 2013

Gregson Street Grade-Separated Crossing

Blackwell Street / Corcoran Street Crossing

Mangum Street (US 15-501) Crossing

Downtown 2-Way Loop Study

LRTP 5

Roxboro Street Grade-Separated Crossing

Dillard Street Crossing

Alston Avenue (NC 55) Grade-Separated Crossing

U-3308

Plum Street Crossing

Duke Street (SR 1455) Crossing

Chapel Hill Street Grade-Separated Crossing

Fayetteville Street (SR 1118) Crossing

Ramseur Street / Grant Street Crossing

Driver Street Crossing

North Carolina Specialty Hospital

Immaculata Catholic School

Orange County
Durham County
Durham
Chapel Hill
Durham
Wake
Raleigh
Cary

0 0.25 0.5 1 Miles

Legend

At-Grade Crossings

Grade-Separated Crossings

Other Crossings - Not in Project

Rail Corridor

Schools

Hospitals

Historic Places

Local Project

TIP Bike/Ped Project

TIP Roadway Project

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NORFOLK SOUTHERN

SECTION 3 - FIGURE 3
STUDY CROSSINGS
MARCH 2013

Legend

- At-Grade Crossings
- Grade-Separated Crossings
- Other Crossings - Not in Project
- Rail Corridor
- Schools
- Hospitals
- Historic Places
- Local Project
- TIP Bike/Ped Project
- TIP Roadway Project

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B. Data Collection

B.1. Existing Conditions

Table B.1 lists the data collected to evaluate the traffic and safety conditions for each crossing. Photographs of each crossing are in Appendix A.

Table B.1. Data Sources

Data Item	Source
Crossing Number	NCDOT Rail
Street/Route	NCDOT Rail
Railroad Company	NCDOT Rail
Railroad Milepost	NCDOT Rail
Existing Warning Devices	Site inspection
Daily Traffic Volumes	NCDOT / City of Durham
Intersection Peak Hour Volumes	Turning Movement Counts / City of Durham
Daily Train Volumes	Norfolk Southern / NCDOT Rail
Crash History	NCDOT / FRA
Street Classification	NCDOT
Transit Routes	Durham County
School Bus Routes and Counts	Durham County Public Schools
Crossing Surface and Condition	Site Inspection
Adjacent Land Use	Site Inspection
Redundant Crossing (Yes/No)	Site Inspection
Humped Crossing	Site Inspection
Crossing Geometry	Site Inspection
Existing Issues	Site Inspection / Stakeholder Input / Citizen Input

a) Traffic Counts

AM and PM peak hour turning movement counts were performed in September 2011 at the following intersections:

- Anderson Street at Erwin Road
- Main Street at Campus Drive
- Dillard Street at Pettigrew Street
- Fayetteville Road at Pettigrew Street
- Fayetteville Road at Ramseur Street
- Ramseur Street at Peabody Street
- Ramseur Street at Pettigrew Street
- Alston Avenue at Chatham Place
- Plum Street at Pettigrew Street

Historic counts were received from the City of Durham for the following crossings:

- Alston Avenue at Angier Avenue
- Blackwell Street at Pettigrew Street
- Driver Street at Pettigrew Street
- Main Street at Buchanan Boulevard
- Mangum Street at Pettigrew Street
- Roxboro Street and Pettigrew Street

b) Redundant Crossings

If a low-volume crossing has alternate access across the tracks available within a reasonable distance, it is often considered redundant. Table B.2 lists the distance between nearby crossings along the corridor.

Table B.2. Redundant Crossings (Within 0.3 Miles)

Crossing	Parallel Crossing	Distance
Swift Avenue	Erwin Road or Campus Drive	0.2 miles
Buchanan Boulevard	Campus Drive or Gregson Street	0.3 miles
Duke Street	Gregson Street Chapel Hill Street	0.1 miles 0.3 miles
Blackwell/Corcoran Street	Chapel Hill Street Mangum Street	0.3 miles 400 feet
Mangum Street	Blackwell/Corcoran Street Roxboro Street	400 feet 0.2 miles
Dillard Street	Roxboro Street or Fayetteville Street	0.2 miles
Fayetteville Street	Dillard Street Ramseur Street	0.2 miles 0.3 miles
Ramseur Street	Fayetteville Street Alston Avenue	0.3 miles 0.2 miles
Plum Street	Driver Street	0.3 miles
Driver Street	Plum Street	0.3 miles
Glover Road	Wrenn Road	0.3 miles
Wrenn Road	Glover Road	0.3 miles

c) Crash Data

Crash data from NCDOT and the Federal Railroad Administration (FRA) was analyzed for the 20-year period from 1991 to 2011. Thirty-seven crashes involving train/vehicle or train/pedestrian collisions were reported at crossings in the study area, as summarized in Table B.3. Crashes are classified as fatalities, injury, or property damage only.

Thirty-seven crashes involving train/vehicle or train/pedestrian collisions were reported at crossings in the study area. Of these, 15 occurred before existing warning devices were installed, or before existing traffic signal improvements had been made. Most collisions occurred when vehicles were stopped over the tracks because of a queue from an adjacent traffic signal. Four fatalities were reported in vehicle/train crashes. One pedestrian fatality occurred, but was considered to be a suicide.

Table B.3. Train-Related Crashes at Study Area Crossings (1991 to 2011)					
Crossing No.	Crossing Location	Motor Vehicle Incidents			Pedestrian Incidents
		PDO*	Injury	Fatality	Fatality
910 594N	Anderson Street	3	0	0	0
735 223X	Swift Avenue	2	0	0	0
735 225L	Buchanan Boulevard	2	0	0	0
735 229N	Blackwell/Corcoran Street	0	2	0	0
735 231P	Mangum Street	1	0	0	0
735 389C	Dillard Street	1	0	0	1
630 474Y	Ramseur Street	5	0	0	0
630 472K	Plum Street	1	0	1	0
630 471D	Driver Street	4	0	1	0
735 236Y	Ellis Road (West)	5	0	2	0
734 735L	Glover Road	4	0	0	0
734 737A	Ellis Road (East)	2	0	0	0
Total		**30**	**2**	**4**	**1**

* PDO – Property Damage Only

The following information about the crash history relates to the crossing geometry and safety:

- **Anderson Street** – All three vehicles were driving north and had stopped on the tracks. Vehicles may have queued over the tracks from the Main Street intersection, which is approximately 40 feet north of the railroad tracks. Although the stop bar for the intersection is south of the railroad tracks, vehicles have been observed pulling forward across the tracks for better visibility before turning. Only one collision has occurred since the traffic signal at the Main Street/Anderson Street intersection was upgraded in June 2010.
- **Swift Avenue** – Both vehicles were driving north and had stopped on the tracks. Vehicles may have queued over the tracks from the Main Street intersection, which is approximately 90 feet north of the railroad tracks.
- **Buchanan Boulevard** – Both vehicles had stopped on the tracks. The northbound vehicle may have queued over the tracks from either the Main Street intersection (which is approximately 200 feet north of the railroad tracks) or from vehicles turning into adjacent businesses. The southbound vehicle may have queued over the tracks from vehicles turning into adjacent businesses.
- **Blackwell/Corcoran Street** – One vehicle had driven around the gate (before four-quadrant gates were installed). The other vehicle was moving over the tracks (before gates were installed).
- **Mangum Street** – The vehicle was moving over the tracks (before gates were installed).
- **Dillard Street** – The vehicle was moving over the tracks (before gates were installed). The pedestrian death was ruled a suicide.
- **Ramseur Street** – Two southbound vehicles had stopped on the tracks, and may have queued over the tracks from the Pettigrew Street intersection, which is approximately 70 feet south of the railroad tracks. One of these collisions occurred before the signal was improved in April 2010). Two of the three northbound vehicles were struck before gates were installed.
- **Plum Street** – A concrete truck driving south was stopped on the mainline, and may have queued over the tracks from the Pettigrew Street intersection, which is approximately 60 feet south of the railroad tracks. A northbound vehicle was moving over the tracks (before gates were installed).
- **Driver Street** – Two vehicles drove around the gates. A bus driving south was stopped on the mainline, and was likely queued over the tracks from the Pettigrew Street traffic signal. Two northbound vehicles were stopped on the tracks, possibly queued from vehicles turning onto Peabody Street or parking on Driver Street. All collisions occurred before the traffic signal was improved in August 2010.
- **Ellis Road (West)** – Two southbound vehicles had stopped on the tracks, and were likely queued over the tracks from the Pettigrew Street traffic signal. Three northbound vehicles had stopped on the tracks or failed to clear the gate, and were likely queued over the tracks from the Angier Avenue traffic signal. Two vehicles drove around the gates (before four-quadrant gates were installed). There have not been any vehicle-train collisions since traffic signals were installed at the Ellis Road/Pettigrew Street and Ellis Road/Angier Avenue intersections in August 2010.
- **Glover Street** – All four drivers were moving over the tracks (before gates were installed).
- **Ellis Road (East)** – One vehicle drove around the gates. The other vehicle was struck by the train after it was knocked onto the tracks by another vehicle.

B.2. Exposure Index

NCDOT uses an exposure index as one factor to determine if a grade separated crossing is warranted. The exposure index is calculated by multiplying the number of trains per day on the rail line being crossed by the number of vehicles per day at that crossing. The formula is shown below as:

$$EI = N \times ADT$$

Where:

EI = NCDOT Rail Division's Exposure Index
N = Number of Trains per Day
ADT = Average Daily Traffic at at-grade crossing

Grade separations are generally considered in rural areas where the exposure index is greater than 15,000 and in urban areas where the exposure index is greater than 30,000. The exposure index was calculated for each of the study crossings using the year 2010 ADT volumes provided by NCDOT (as reported on the Crossing Inventory Sheets) and the number of trains per day as reported by the NCDOT Rail Division, Norfolk Southern, and Triangle Transit. The exposure index is summarized in Table B.4.

Table B.4. Exposure Index for At-Grade Crossings

Crossing Location	Vehicle AADT (2010)	Existing Daily Train Volume	Future Daily Train Volume*	Future Train Service*	Existing Exposure Index	Future Exposure Index**	Exposure Index Threshold ***
Neal Road	3,700	14	14	NS	**51,800**	**51,800**	15,000
N. Lasalle Street	13,000	14	14	NS	**182,000**	**182,000**	15,000
Anderson Street	8,200	14	166	NS, LR, CRT	**114,800**	**1,361,200**	30,000
Swift Avenue	12,400	14	166	NS, LR, CRT	**173,600**	**2,058,400**	30,000
Buchanan Boulevard	7,700	14	166	NS, LR, CRT	**107,800**	**1,278,200**	30,000
Duke Street	10,200	14	166	NS, LR, CRT	**142,800**	**1,693,200**	30,000
Blackwell/Corcoran Street	4,900	14	166	NS, LR, CRT	**68,600**	**813,400**	30,000
Mangum Street	8,000	14	166	NS, LR, CRT	**112,000**	**1,328,000**	30,000
Dillard Street	1,300	14	166	NS, LR, CRT	18,200	**215,800**	30,000
Fayetteville Street	12,200	14	166	NS, LR, CRT	**170,800**	**2,025,200**	30,000
Ramseur Street	1,500	14	166	NS, LR, CRT	21,000	**249,000**	30,000
Plum Street	2,300	14	42	NS, CRT	**32,200**	**96,600**	30,000
Driver Street	5,100	14	42	NS, CRT	**71,400**	**214,200**	30,000
Ellis Road (West)	5,900	14	42	NS, CRT	**82,600**	**247,800**	30,000
Glover Road	2,700	14	42	NS, CRT	**37,800**	**113,400**	15,000
Wrenn Road	200	14	42	NS, CRT	2,800	8,400	15,000
Ellis Road (East)	12,400	14	42	NS, CRT	**173,600**	**520,800**	15,000
Cornwallis Road	7,900	14	42	NS, CRT	**110,600**	**331,800**	15,000

* NS = Norfolk Southern, LR = light rail, CRT = commuter rail transit. Assumes light rail will have 62 trains per day in each direction, including 6 trains per hour during peak hours in each direction. Assumes commuter rail will have 14 trains per day in each direction.

** Assumes future train volume and existing vehicle volume.

*** A threshold of 15,000 indicates the crossing is in a rural area, and 30,000 indicates the crossing is in an urban area.

Note: **Bold** indicates that the exposure index exceeds the threshold.

According to NCDOT Crossing Inventory Form, currently six of the fourteen trains each day arrive between the hours of 6 a.m. and 6 p.m. at all of these crossings. Therefore, the resulting exposure indices may overstate the conflict between rail and automobile traffic at these locations. However, adjusting the exposure index to only use the daytime train volumes did not notably change the results of the calculation. Future vehicle traffic volumes were not calculated as part of this study.

B.3. Train Operations

a) Train & Transportation Stations

- Durham Commuter Rail Station – a new commuter rail station opened in 2009, located in the Walker Warehouse Building at 601 West Main Street. This houses Amtrak service with a platform located between Duke Street and Chapel Hill Street.
- Durham Transportation Center – the transportation center services DATA, Triangle Transit, and Greyhound buses.
- Proposed Light Rail Stations are planned along the SEHSR Corridor at the following locations:
  - Ninth Street
  - Buchanan Blvd.
  - S. Duke Street (Durham CRS)S. Dillard St.
  - Alston Ave. - West of Plum Street
- Existing and proposed Commuter Rail Stations are located at the following locations:
  - Hillandale Road (West Durham CRS)
  - S. Duke Street (Durham CRS)
  - IBM Access Road (North RTP CRS)

b) Existing Train Service

- The primary users of the NCRR Corridor through Durham, NC include Amtrak,, NC Commuter Rail, and Norfolk Southern Corporation. Intrastate passenger service is provided daily by North Carolina's Amtrak local trains. Currently there are 12 passenger trains daily serving 16 cities. Regional rail service is provided by Amtrak national thru trains. Norfolk Southern Corporation operates regularly scheduled freight train service through Durham County, sharing the tracks with commuter rail service.

There is currently no light rail service in Durham County.

c) Future Train Service

- Southeast High Speed Rail – As the SEHSR corridor continues to be upgraded with double tracking and strategic siding construction through central NC the number of commuter trains will continue to increase.
- Commuter rail – Commuter rail will continue to share the tracks with freight train operations through Durham County; however, capacity expansion is planned through the construction of a second heavy rail with will parallel the existing heavy rail line At this time, it is anticipated that there will be 14 commuter trains per day in each direction, for a total of 28 additional trains. The maximum speed will be 79 miles per hour (mph), with an average speed of 43.5 mph. A commuter train will block an at-grade crossing for approximately 35 seconds, in addition to the 20 seconds that the gates go down before the train arrives and 20 seconds that it returns to the upright position as the train passes.
- Light rail – Beginning at Ninth Street and ending at Sowell Street, a light rail system consisting of two new tracks located to the south of the shared freight/commuter tracks is proposed. The Triangle Transit plan identifies a future total of 62 trains per day in each direction, for a total of 124 additional trains. During the peak hour, there are expected to be 6 trains in each direction. The maximum speed will be 55 mph, with an average speed of 29.6 mph. A light rail train will block an at-grade crossing for 35 to 40 seconds, in addition to the 20 seconds that the gates go down before the train arrives and 20 seconds as the train leaves.

Below is a list of crossings studied by Triangle Transit for future LRT and Commuter Rail (CRT) service:

- Anderson Street: LRT (new crossing) and CRT.
- Swift Avenue: LRT and CRT
- Buchanan Boulevard: LRT and CRT
- Duke Street: LRT and CRT
- Blackwell/Corcoran Street: LRT and CRT
- Mangum Street: LRT and CRT
- Dillard Street: LRT and CRT
- Fayetteville Street: LRT and CRT
- Ramseur Street: LRT and CRT
- Plum Street: CRT and maybe a spur track to the LRT Maintenance Facility.
- Driver Street: CRT
- Ellis Road (West): CRT
- Glover Road: CRT
- Wrenn Road: CRT
- Ellis Road (East): CRT
- Cornwallis Road: CRT

B.4. Future Highway Projects

Table B.5 lists projects that are proposed in the vicinity of the at-grade study crossings. Figures 1 through 3 show their locations. Information is based on the NCDOT 2012-2020 State Transportation Improvement Program (STIP) and the Durham-Chapel Hill-Carrboro Metropolitan Planning Organization (DCHCMPO) 2035 Long Range Transportation Plan (May 13, 2009).

Two additional projects are listed in the current STIP, but have recently been completed. Project U-3804 widened Hillandale Road from I-85 to Carver Street (0.7 miles). Project U-4011 widened South Miami Boulevard from Methodist Street to north of Bethesda Avenue (0.7 miles).

Table B.5. Potential Projects in the Vicinity

Project Number	Plan	Type	Description	Length	Status
West Durham Section					
C-4928	NCDOT STIP	Bike/ Pedestrian	Morreene Road (SR 1317), Construct bike lanes and sidewalks from Neal Road to Erwin Road (SR 1320).	1.5 miles	Construction scheduled to begin in 2014
C-5178	NCDOT STIP	Bike/ Pedestrian	Construct sidewalks on Campus Walk Avenue from Morreene Road to Lasalle Street and on Lasalle Street from Kangaroo Drive to Erwin Road.	0.8 miles	Construction scheduled to begin September 2013 in STIP, but currently on hold
114	LRTP	Roadway Improvement	US 15-501 Bypass, Widen from 4 lanes to 6 lanes from Pickett Road to Morreene Road.	2.6 miles	Unscheduled
Downtown Durham Section					
U-3308	NCDOT STIP	Roadway Improvement	NC 55 (Alston Avenue), Widen to four-lane divided facility from NC 147 to US 70 Business/NC 98 (Holloway Street) and replace Norfolk Southern bridges.	1.0 mile	Construction scheduled to begin in 2015
5	LRTP	New Location Roadway	Alston Avenue, Extend facility on new location from Holloway Street to Old Oxford/Roxboro Road.	3.5 mile	Unscheduled
N/A*	N/A	Roadway Improvement	Downtown Loop 2-Way conversion study.	1.9 mile	Study completed, no funding available
East Durham Section					
U-0071	NCDOT STIP	New Location Roadway	East End Connector, Build multi-lane divided facility partially on new location from NC 147 to north of NC 98.	3.2 miles	Construction scheduled to begin in 2014
U-4720	NCDOT STIP	New Location Roadway	US 70, Extend facility from Lynn Road to the proposed Northern Durham Parkway.	7.8 miles	Scheduled for Feasibility Study
U-4721**	NCDOT STIP	New Location Roadway	Northern Durham Parkway, Build multi-lane facility on new location from I-540 to Roxboro Road.	18.8 miles	Unfunded

* City of Durham study

** Not shown in figure because outside extents

C. Crossing Analysis

C.1. Crossing Closure and Intersection Analysis

All crossings studied were considered for potential closure. Based on train and vehicle volume data, exposure index, redundant crossing locations, environmental considerations, and input from stakeholders, the following crossings are recommended to be closed:

- Dillard Street – includes a proposed new pedestrian grade separation
- Ramseur Street – includes a proposed new pedestrian grade separation
- Plum Street – includes a proposed new pedestrian grade separation and greenway connection at the proposed TTA station, and is contingent on studying the switching yard operations at the Driver Street crossing and making improvements to switching operations as appropriate to keep static trains off of the Driver Street crossing.
- Wrenn Road – includes a new access road to Glover Road, and is contingent on grade separating the Glover Road crossing

Capacity analyses were performed to determine the operating characteristics of the adjacent road network and the impacts of the potential closure of these crossings.

Intersection capacity analyses were performed for the AM and PM peak hours for the existing and projected post-closure traffic conditions for each closure location using Synchro Version 7 software. Capacity is defined as the maximum number of vehicles that can pass over a particular road segment or through a particular intersection within a set time duration. Capacity is combined with level of service (LOS) to describe the operating characteristics of a road segment or intersection. LOS is a qualitative measure that describes operational conditions and motorist perceptions within a traffic stream. Synchro Version 7 defines six levels of service, LOS A through LOS F, with A representing the shortest average delays and F representing the longest average delays. LOS D is the typically accepted standard for signalized intersections in urbanized areas.

For signalized intersections, LOS is defined for the overall intersection operation. For unsignalized intersections, only the movements that must yield right-of-way experience control delay. Therefore, LOS criteria for the overall intersection is not reported by Synchro Version 7 or computable using methodology published in the *Highway Capacity Manual*. Accordingly, minor street approach delays are reported herein for unsignalized conditions. It is typical for stop sign controlled side streets and driveways intersecting major streets to experience long delays during peak hours, while the majority of the traffic moving through the intersection on the major street experiences little or no delay. Table C.1 lists the LOS control delay thresholds published in the *Highway Capacity Manual* for signalized and unsignalized intersections.

Table C.1. Level-of-Service Control Delay Thresholds

Level-of-Service	Signalized Intersections – Control Delay Per Vehicle [sec/veh]	Unsignalized Intersections – Average Control Delay [sec/veh]
A	≤ 10	≤ 10
B	> 10 – 20	> 10 – 15
C	> 20 – 35	> 15 – 25
D	> 35 – 55	> 25 – 35
E	> 55 – 80	> 35 – 50
F	> 80	> 50

Existing traffic volumes at the study intersections were obtained from the City of Durham and turning movement counts as discussed in Chapter B. Traffic at the crossings to be closed was then diverted to adjacent intersections. Table C.2 summarizes the analysis assumptions and results for each of the potential crossing closures studied.

Table C.2. Crossing Closure Analysis Intersections

Crossing	Intersections Analyzed	Assumptions
Dillard Street	Roxboro Street/Pettigrew Street, Dillard Street/Pettigrew Street, Dillard Street/Ramseur Street, Fayetteville Street/Pettigrew Street, Fayetteville Street/Ramseur Street	Traffic on Dillard Street diverted to Roxboro Street and Fayetteville Street
Ramseur Street	Fayetteville Street/Pettigrew Street, Fayetteville Street/Ramseur Street, Ramseur Street/Pettigrew Street, Ramseur Street/Lyon Street, Alston Avenue/Gann Street, Alston Avenue/Angier Avenue	Traffic on Ramseur Street diverted to Fayetteville Street
Plum Street	Alston Avenue/Angier Avenue, Alston Avenue/Gann Street, Pettigrew Street/Driver Street	Traffic on Plum Street diverted to Alston Avenue and Driver Street
Wrenn Road	Angier Avenue/Glover Road	Traffic on Wrenn Road diverted to Glover Road, Glover Road grade separated at railroad

Table C.3 summarizes the LOS and delay (seconds per vehicle) for all of the study intersections related to the four proposed crossing closures.

All intersections analyzed for the Dillard Street and Ramseur Street closings currently operate at acceptable levels of service (LOS D or better). The Fayetteville Street/Ramseur Street intersection is projected to operate at LOS F in 2035 with existing geometry, if the Dillard Street crossing is closed, if the Ramseur Street crossing is closed, or if both Dillard Street and Ramseur Street crossings are closed. The intersections of Alston Avenue/Gann Street and Alston Avenue/Angier Avenue are projected to operate at LOS F in 2035 with existing geometry, if the Ramseur Street crossing is closed, if the Plum Street crossing is closed, or if both Ramseur Street and Plum Street crossings are closed. The intersection of Driver Street/Pettigrew Street also is projected to operate at LOS F in 2035 with existing geometry or if the

Plum Street crossing is closed. The intersection of Angier Avenue/Glover Road is projected to operate at LOS F with existing geometry or if the Wrenn Street crossing is closed.

In conclusion, it is anticipated that the closure of Dillard Street, Ramseur Street, Plum Street, and/or Wrenn Road will have little impact on the traffic operations in the area, and no roadway improvements are needed in conjunction with this crossing closure.

Table C.3. Intersection Level-of-Service Summary – Dillard Street Closure

Condition	Existing 2011		Future 2035	
	AM Peak-Hour LOS (Delay)	PM Peak-Hour LOS (Delay)	AM Peak-Hour LOS (Delay)	PM Peak-Hour LOS (Delay)
S. Roxboro Street at Pettigrew Street (Signalized)				
No Build	B (14.4)	B (15.3)	B (19.1)	B (18.7)
Build – *Dillard St Closure*	B (14.0)	B (14.8)	B (19.0)	B (18.6)
Dillard Street at Pettigrew Street (Signalized)				
No Build	B (11.5)	A (9.6)	B (15.9)	B (10.4)
Build – *Dillard St Closure*	B (12.3)	B (10.1)	B (18.3)	B (11.3)
Dillard Street at Ramseur Street (Unsignalized)				
No Build	EB – A (10.0) WB – A (9.2)	EB – B (10.3) WB – A (9.9)	EB – B (12.1) WB – B (10.2)	EB – B (13.3) WB – B (12.7)
Build – *Dillard St Closure*	EB – B (11.4) WB – A (9.6)	EB – C (16.0) WB – B (10.1)	EB – B (11.4) WB – A (9.7)	EB – B (16.0) WB – B (10.2)
Fayetteville Street at Pettigrew Street (Signalized)				
No Build	B (10.5)	B (11.9)	B (18.8)	C (34.5)
Build – *Dillard St Closure*	B (11.4)	B (11.9)	C (20.7)	D (37.9)
Build – *Dillard & Ramseur St Closures*	B (12.2)	B (12.3)	C (24.1)	C (35.3)
Fayetteville Street at Ramseur Street (Unsignalized)				
No Build	EB – B (12.8) WB – C (16.4)	EB – B (13.4) WB – B (14.3)	EB – D (25.6) WB – F (108.6)	EB – E (37.9) WB – F (62.5)
Build – *Dillard St Closure*	EB – B (12.9) WB – C (19.1)	EB – B (13.6) WB – C (16.6)	EB – D (30.3) WB – F (470.3)	EB – E (48.2) WB – F (368.6)
Build – *Dillard & Ramseur St Closures*	EB – B (12.0) WB – C (21.3)	EB – B (12.7) WB – C (18.1)	EB – C (20.7) WB – F (342.6)	EB – E (35.1) WB – F (459.8)

Table C.4. Intersection Level-of-Service Summary – Ramseur Street Closure

Condition	Existing 2011		Future 2035	
	AM Peak-Hour LOS (Delay)	PM Peak-Hour LOS (Delay)	AM Peak-Hour LOS (Delay)	PM Peak-Hour LOS (Delay)
Fayetteville Street at Pettigrew Street (Signalized)				
No Build	B (10.5)	B (11.9)	B (18.8)	C (34.5)
Build – *Ramseur St Closure*	B (11.8)	B (12.3)	C (23.1)	C (33.5)
Build – *Dillard & Ramseur St Closures*	B (12.2)	B (12.3)	C (24.1)	C (35.3)
Fayetteville Street at Ramseur Street (Unsignalized)				
No Build	EB – B (12.8) WB – C (16.4)	EB – B (13.4) WB – B (14.3)	EB – D (25.6) WB – F (108.6)	EB – E (37.9) WB – F (62.5)
Build – *Ramseur St Closure*	EB – B (11.8) WB – C (17.9)	EB – B (12.4) WB – C (16.0)	EB – C (18.8) WB – F (88.8)	EB – D (29.2) WB – F (75.9)
Build – *Dillard & Ramseur St Closures*	EB – B (12.0) WB – C (21.3)	EB – B (12.7) WB – C (18.1)	EB – C (20.7) WB – F (342.6)	EB – E (35.1) WB – F (459.8)
Ramseur Street at Pettigrew Street (Signalized)				
No Build	A (4.6)	A (4.6)	A (6.4)	A (6.2)
Build – *Ramseur St Closure*	A (3.5)	A (2.8)	A (5.7)	A (5.7)
Ramseur Street at Lyon Street (Unsignalized)				
No Build	NB – A (9.0)	NB – A (9.0)	NB – A (9.5)	NB – A (9.5)
Build – *Ramseur St Closure*	NB – B (10.6)	NB – A (8.7)	NB – A (9.1)	NB – A (9.1)
Alston Avenue at Gann Street/NC 147 Off-Ramp (Signalized)				
No Build	A (8.8)	A (9.3)	F (138.3)	F (105.3)
Build – *Ramseur St Closure*	A (9.1)	B (10.2)	F (165.7)	F (125.6)
Build – *Ramseur & Plum St Closures*	B (13.4)	B (13.2)	F (188.6)	F (146.0)
Alston Avenue at Angier Avenue (Unsignalized)				
No Build	C (32.7)	C (32.8)	F (270.3)	F (298.4)
Build – *Ramseur St Closure*	C (32.7)	C (32.8)	F (270.3)	F (298.4)
Build – *Ramseur & Plum St Closures*	D (47.0)	D (53.0)	F (329.6)	F (344.5)

Table C.5. Intersection Level-of-Service Summary – Plum Street Closure				
Condition	**Existing 2011**		**Future 2035**	
	AM Peak-Hour LOS (Delay)	**PM Peak-Hour LOS (Delay)**	**AM Peak-Hour LOS (Delay)**	**PM Peak-Hour LOS (Delay)**
Alston Avenue at Gann Street/NC 147 Off-Ramp (Signalized)				
No Build	A (8.8)	A (9.3)	F (138.3)	F (105.3)
Build – *Plum St Closure*	B (12.8)	B (12.6)	F (169.2)	F (126.1)
Build – *Ramseur & Plum St Closures*	B (13.4)	B (13.2)	F (188.6)	F (146.0)
Alston Avenue at Angier Avenue (Unsignalized)				
No Build	C (32.7)	C (32.8)	F (270.3)	F (298.4)
Build – *Plum St Closure*	D (47.1)	D (52.7)	F (329.0)	F (345.4)
Build – *Ramseur & Plum St Closures*	D (47.0)	D (53.0)	F (329.6)	F (344.5)
Driver Street at Pettigrew Street (Signalized)				
No Build	C (27.0)	B (16.8)	F (95.9)	C (25.5)
Build – *Plum St Closure*	C (32.5)	B (18.9)	F (154.8)	D (36.4)

Table C.6. Intersection Level-of-Service Summary – Wrenn Road Closure				
Condition	**Existing 2011**		**Future 2035**	
	AM Peak-Hour LOS (Delay)	**PM Peak-Hour LOS (Delay)**	**AM Peak-Hour LOS (Delay)**	**PM Peak-Hour LOS (Delay)**
Angier Avenue at Glover Road (Unsignalized)				
No Build	EB – C (15.3)	EB – B (14.5)	EB – F (198.0)	EB – F (108.0)
Build – *Wrenn St Closure*	EB – C (15.7)	EB – C (17.4)	EB – F (416.6)	EB – F (230.5)

C.2. Economic Analysis

An economic analysis was performed of the alternatives considered at each crossing. Estimated construction costs were inputted into GradeDec.Net, which provided the benefit/cost information for each alternative. GradeDec.Net is a web-based decision support tool developed by FRA that assists federal, state and local authority decision makers in evaluating the benefits and costs of highway-rail grade crossing upgrades, separations, and closures. To find the high yield crossing improvement alternatives, the analysis considers traffic flows and composition by highway and rail, growth in traffic over a specified time horizon, the physical characteristics of the crossings and price information.

Algorithms in GradeDec.NET calculate the effects of the improvements, incorporating recent research findings relating safety to crossing improvements. The analysis includes sets of tables and graphs, included in Appendix G, that rank crossing improvements and provide quick indicators for high yield investments. The impact analysis also evaluates shifts in traffic flows in a corridor due to grade separations and closures. The analysis considers the cost side as well and provides summary measures of costs and benefits. The GradeDec analysis incorporated the best available information at the time it was performed in May 2013. Table C.7 summarizes the results of the GradeDec analysis for each long term recommended alternative.

Table C.7. GradeDec Results – Recommended Long Term Alternatives			
Crossing	**Recommendation**	**Benefit-Cost Ratio**	**Safety Improvements (reduction in collisions per year)**
Neal Road	Grade separation	0.19	0.006
N. Lasalle Street	Grade separation	0.28	0.009
Blackwell/Corcoran Street & Mangum Street	Grade separation	0.31	0.075
Dillard Street	Crossing closure	-0.06	0.238
Fayetteville Street	Grade separation	0.44	0.015
Ramseur Street	Crossing closure	1.89	0.208
Plum Street	Crossing closure	1.44	0.104
Ellis Road (West)	Grade separation	0.53	0.050
Glover Road & Wrenn Road	Grade separation / crossing closure	0.39	0.041
Ellis Road (East)	Grade separation	0.34	0.016
Cornwallis Road	Grade separation	0.19	0.008

D. Safety and Mobility Issues

This section summarizes the existing warning devices at each of the at-grade crossings studied, and discusses the potential safety and mobility issues at each crossing.

D.1. Vehicles Queuing Across Railroad Tracks

Vehicles may queue over the railroad tracks when the tracks are near parallel roadways, especially when vehicles on the road across the railroad tracks are required to stop at a stop sign or traffic signal. All study crossings have "Do Not Stop On Tracks" and/or "Stop Here When Flashing" signs, as appropriate. In several locations where the railroad tracks are close to the adjacent signalized intersection, the stop bar with a "Stop Here On Red" sign is behind the railroad tracks. The intent of this design is to discourage drivers from queuing over the railroad tracks when stopped at the traffic signal. If vehicles are queued over the tracks when the train is approaching, they may become trapped by the vehicles in front of them and behind them, and become unable to exit from between the gates. Where four quadrant gate systems are installed, the gates are timed to allow vehicles to clear the crossing prior to both gates coming down; however if vehicles are queued up, this may cause a vehicle to become trapped between gates. The table below identifies the location of four-quad gate systems. Traffic signals are often coordinated with the train signals to allow all vehicles to clear the tracks before the train arrives. Table D.1 lists the study crossings that are within 75 feet of a parallel roadway.

Table D.1. At-Grade Study Crossings Within 75 Feet of Parallel Roadway

Crossing	Approximate Distance	Parallel Roadway	Adjacent Intersection Control Type	Four-Quad Gate System
N. Lasalle Street	60 ft	Pettigrew Street	Unsignalized	Yes
Anderson Street	40 ft	Main Street	Signalized	Yes
Swift Avenue	60 ft	Pettigrew Street	Unsignalized	Yes
Duke Street	45 ft 35 ft	Peabody Street Pettigrew Street	Unsignalized	No
Blackwell/Corcoran Street	55 ft 70 ft	Ramseur Street Pettigrew Street	Signalized	Yes
Mangum Street	45 ft 45 ft	Ramseur Street Pettigrew Street	Signalized	Yes
Dillard Street	75 ft	Pettigrew Street	Signalized	Yes
Fayetteville Street	70 ft	Pettigrew Street	Signalized	Yes
Ramseur Street	70 ft	Pettigrew Street	Signalized	No
Plum Street	60 ft	Pettigrew Street	Unsignalized	No
Driver Street	20 ft 40 ft	Peabody Street Pettigrew Street	Signalized	Yes
Ellis Road (West)	75 ft 35 ft	Angier Avenue Pettigrew Street	Signalized	Yes
Glover Road	35 ft	Residential road	Unsignalized	No

D.2. Humped Crossings

A "humped" crossing occurs when the elevation of the railroad crossing is significantly higher than the intersecting roadway, which results in steep grades on the approaches to the crossing. Humped crossings can cause in driver discomfort or "bottoming out" of vehicles with long wheelbases or low clearances; vehicles can be damaged or even become stuck on the crossing. A humped crossing has a combination of short crest and sag vertical curves, and is most easily identified by scrapes in the asphalt on the approaches. Routine track maintenance tends to exacerbate the problem over time, as track ballast work typically adds about 3 inches to track height per occurrence. Over a 10-year period, the railroad could rise about one foot as a result of this routine maintenance depending on frequency.

The only study crossing with "humped crossing" signs is Cornwallis Road. Observations at the Neal Road crossing indicated that there were scrapes in the asphalt.

Neal Road Crossing

Cornwallis Road Crossing

D.3. Crossing Protection Device Upgrades

Upgrading existing warning devices is one of the most cost-effective methods of improving safety at an at-grade railroad crossing. Commonly used warning devices, in order of increasing safety, include signs, crossbucks, flashers and warning bells, and gate arms. Passive devices like signs and crossbucks alert the driver to the presence of the crossing but do not prevent them from driving through the crossing when a train is present. Such devices are generally used when train volumes and vehicle crossing volumes are low, train speeds are low, and sight distance is not an issue.

Active devices such as gate arms, flashers, and bells warn the driver of a train approaching the crossing. These devices are generally used at higher volume crossings, where train speeds are higher, or when there is a history of train/vehicle collisions. The effectiveness of warning signs, pavement markings, traffic signals, and other traffic control devices is largely dependent upon proper installation and maintenance. All study crossings include both active and passive devices.

Automated gates are generally one of the best possible warning devices for use at at-grade railroad crossings. However, when not used properly, they can lead to driver frustration, which can result in motorists driving around the gate arms. Situations that can lead to this behavior include:

- Gates are lowered, but no train is visible
- Gate failure causes arms to remain in lowered position
- Gates are lowered and train is visible, but the motorist is too impatient to wait
- The crossing is adjacent to a switching station, where trains move slowly and often block the crossing for several minutes, leading to driver impatience

Switching maneuvers occur adjacent to Plum Street, Driver Street, and Ellis Road (West) crossings. Five of the reported train/vehicle crashes at the study crossings involved vehicles driving around automated gate, including two at Driver Street (before the traffic signal was improved), two at Ellis Road (West) (before four-quadrant gates were installed), and one at Ellis Road (East).

Overall, the 18 crossings have sufficient warning devices. All crossings have both active and passive devices, and none of the signs need to be replaced. New advanced pavement markings are recommended at the Fayetteville Street crossing. Grade-crossing warning signs are recommended on streets adjacent to the N. Lasalle Street, Swift Avenue, and Glover Road crossings.

D.4. Grade Crossing Condition

A poor grade crossing surface is not a safety concern, but it can result in a rough, uneven ride and require increased maintenance requirements of the track and the road itself. This wears on vehicles and can lead to increased congestion due to reduced travel speeds. None of the study crossings have a poor grade crossing surface.

There are many different types of road crossing materials that are commonly found throughout North America. However, three types of materials are typically used for at-grade crossings on public streets in North Carolina. Asphalt with timber flangeway is the most common. Concrete (cast in place and precast) is typically used at locations with medium to heavy vehicular traffic. Pre-manufactured rubber is typically used for road crossings with a heavy volume of vehicular traffic. All of the study crossings are asphalt with timber flangeway except the Mangum Street crossing which is a concrete panel crossing. No changes to crossing material type are recommended.

D.5. Traffic Signals

The *Manual on Uniform Traffic Control Devices* (MUTCD) requires that traffic signals located within 200 feet of an at-grade rail crossing be coordinated with the train detection and warning system at the adjacent crossing to preempt normal operation of the traffic signal and disallow vehicles from crossing the railroad tracks. The normal signal operation should be preempted in the event of an approaching train to allow traffic to clear off the tracks. The signal should also be designed to allow non-conflicting movements to continue while the train is crossing to minimize delay. Table D.2 lists the study crossings within 200 feet of a signalized intersection.

Table D.2. At-Grade Study Crossings Within 200 Feet of Traffic Signal

Crossing	Approximate Distance	Parallel Roadway	Adjacent Intersection Control Type	Traffic Signals Interconnected*
Anderson Street	40 ft	Main Street	Signalized	Simultaneous Preemption
Swift Avenue	95 ft	Main Street	Signalized	Simultaneous Preemption
Blackwell/Corcoran Street	55 ft 70 ft	Ramseur Street Pettigrew Street	Signalized	Simultaneous Preemption
Mangum Street	45 ft 45 ft	Ramseur Street Pettigrew Street	Signalized	Simultaneous Preemption
Dillard Street	75 ft	Pettigrew Street	Signalized	Simultaneous Preemption
Fayetteville Street	70 ft	Pettigrew Street	Signalized	Advance Preemption
Ramseur Street	70 ft	Pettigrew Street	Signalized	Simultaneous Preemption
Driver Street	20 ft 40 ft	Peabody Street Pettigrew Street	Signalized	Advance Preemption
Ellis Road (West)	75 ft 35 ft	Angier Avenue Pettigrew Street	Signalized	Advance Preemption

* Based on data provided by the City of Durham (August 2013)

As traffic volumes on the adjacent roadway network or at an intersection increase, warrants for traffic signals may be met. Advantages of traffic signals include increasing the traffic-handling capacity of intersections and reducing certain types of accidents (especially right-turn collisions). They can facilitate improved progression of traffic along a route, and they can interrupt heavy flows of traffic to allow other traffic (vehicular and pedestrian) to cross. Disadvantages include the increase in frequency of certain types of accidents (especially rear end collisions), increases in delay, and use of less adequate routes to avoid the signal. There are nine warrants for signalization, including one (Warrant 9) for intersections near a grade crossing. Minimum criteria are established for each of the warrants.

D.6. Advanced Crossing Protection Measures

Additional crossing protection measures can also be used in crossing locations with high-volume, multi-lane roadways or where drivers are consistently ignoring or driving around existing crossing protection devices. Additional protection measures include median separators, four-quadrant gates, longer gate arms, articulated gates, remote video detection, traffic signals, and roadway improvements.

a) Long Gate Arms and Articulated Gate Arms

Extra-long gate arms that extend for three-fourths of the crossing can be used to make it difficult for vehicles to drive around the lowered gate arms. Articulated gate arms—which are hinged and fold out to three-fourths of the crossing distance like long gate arms—are generally used when vertical clearances prevent the use of long gate arms. There are no existing long or articulated gate arms within the corridor.

b) Four-Quadrant Gates

Four-quadrant gate treatments involve gate arms on both the approaches and departures of the crossing roadway. This restricts vehicles from being able to drive around the approach gate arms. However, care has to be taken to prevent vehicles from becoming trapped inside the gate arms. To avoid this situation, the gates are timed for the approach arms to lower before the departure arms, 16 feet of clearance is generally provided between the gates and the tracks, and either breakaway arms are used or a gap is provided between the tips of the arms to allow a vehicle to slip out. Four-quadrant gates are located at the N. Lasalle Street, Anderson Street, Swift Avenue, Blackwell/Corcoran Street, Dillard Street, Fayetteville Street, Driver Street, Ellis Road (West), and Cornwallis Road crossings.

c) Median Separators

Median separators consist of markers mounted on raised islands along the roadway centerline to discourage motorists from driving in opposite travel lanes to avoid lowered gate arms. Where markers are not preferred, a 4-foot median can be constructed with an 8-inch curb, which allows for landscaping. Median treatments typically extend 70 feet to 100 feet back from the gates, but they may be precluded by driveways or intersection roads within the distance.

Currently, there is a median barrier at two crossings along the corridor. Flexible yellow tubes mounted directly to the roadway surface are located on Neal Road and on Ellis Road (East) on both sides of the crossings.

Median barrier on Neal Road

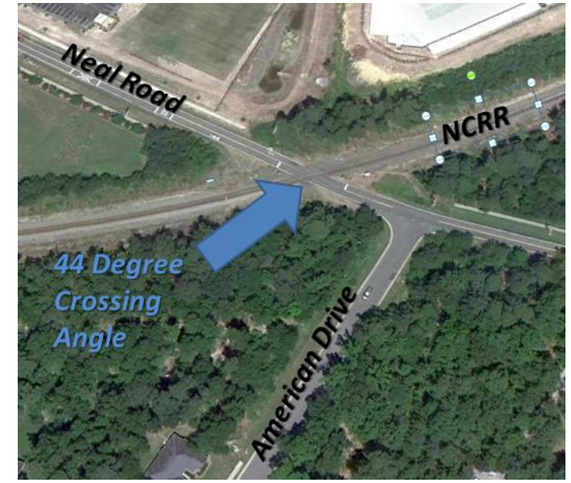
Median barrier on Ellis Road (East)

d) Remote Video Detection

The Crossing Law Enforcement and Research (CLEAR) of Violations program uses video detection to monitor crossings at select locations. This program provides information on crossing operations, crashes, and violations for research and enforcement purposes. This program was not determined to be necessary for crossings along this corridor.

e) Roadway Improvements

Roadway improvements can reduce both accident potential and traffic delay at highway/railroad crossings. Realignment and re-grading can improve skewed crossing alignments, thereby improving visibility and reducing the time required to traverse a crossing. Additional lanes significantly increase capacity, reducing the residual delay following a crossing event. New roadways can provide alternate routes, allowing crossings to occur at more desirable locations, and potentially eliminating some trips.



Roadway crossing angles should be as near to 90 degrees as possible, but not exceed 70 degrees. Of the study crossings, Neal Road, which has a crossing angle of 44 degrees, is the only road that crosses the railroad tracks at an angle less than 70 degrees.

D.7. Crossing Consolidation/Elimination

Vehicle and train volumes, geometry, safety, and proximity to nearby crossings are factors that are considered when identifying potential crossing closures. Good candidates for closure often have one or more of the following issues:

- Alternate crossing locations located within reasonable distance
- Skewed crossings
- Limited sight distance
- History of train/vehicle crashes
- Private crossing with no identifiable owner
- Complex crossings (e.g. multiple tracks, switching operations, etc.) that cannot be safely served with warning devices

Four crossing consolidation/eliminations are recommended:

- Dillard Street – includes a pedestrian grade separation
- Ramseur Street – includes a pedestrian grade separation
- Plum Street – includes a pedestrian grade separation and greenway connection, and is contingent on improving train operations at the Driver Street crossing to minimize blockages of the crossing

- Wrenn Road – includes a new access road to Glover Road, and is contingent on grade separating the Glover Road crossing

The Dillard Street crossing had an annual average daily traffic (AADT) volume of approximately 1,300 in 2010, the second lowest traffic volume of the 18 study crossings. It is within 0.2 miles of both the Roxboro Street grade-separated crossing and the Fayetteville Street at-grade crossing and has been identified as a site for a future transit station. Due to local agency and citizen concerns about pedestrian use at this crossing, a new pedestrian grade separation is recommended if this crossing is closed to vehicles.

The Ramseur Street crossing had approximately 1,500 vehicles per day (vpd) in 2010. It is within 0.3 miles of the at-grade Fayetteville Street crossing and within 0.2 miles of the grade-separated Alston Avenue crossing. There were five train/vehicle collisions between 2001 and 2010. However, two of them occurred before gates were installed, and there have not been any incidents since the City improved the traffic signal at the Ramseur Street/Pettigrew Street intersection. Because a Boys and Girls Club is located on the south side of the railroad track and a community is on the north side of the railroad track, a new pedestrian grade separation is recommended if this crossing is closed to vehicles.

Plum Street had approximately 2,300 vpd across six railroad tracks. A train yard is located between Alston Avenue and Briggs Avenue, and is crossed by Plum Street and Driver Street. Plum Street is within 0.3 miles of the Driver Street at-grade crossing. Local agencies and citizens expressed concern that delays on Driver Street because of the switching movements would become worse if the Plum Street crossing was closed. Therefore, NCDOT will conduct an operational analysis of the switching station, and will only close Plum Street if operational improvements at the Driver Street crossing are made.

Wrenn Road had the lowest traffic volumes in 2010, with approximately 200 vpd across the railroad tracks. Glover Road, which is within 0.3 miles from Wrenn Road, had approximately 2,700 vpd across the railroad tracks. The two crossings are recommended to be consolidated into one grade-separated crossing at Glover Road. A new road is proposed to connect Wrenn Road with Glover Road, although specific design details will need to be further studied

D.8. Grade Separation

Grade-separated crossings eliminate the potential for train/vehicle collisions while maintaining vehicular and pedestrian access across the railroad tracks. However, stringent design standards and cost make changes to the railway difficult. Railroad overpasses of highways require approximately 17 feet of vertical clearance, and highway overpasses of railroad tracks require approximately 23 feet of clearance. Sight distance requirements on the overpass vertical curves generally result in long approaches, which can create adjacent property access and connectivity issues. In addition, visual and noise impacts associated with overpasses can negatively affect neighborhoods or historic areas.

All of the 18 at-grade crossings were considered for grade separation. Of these, nine grade separations are recommended for future study. Table D.3 summarizes the six primary factors included in the assessment. Additional information about each factor is given following the table.

Table D.3. Crossings Recommended for Grade Separation

Crossing	Existing Exposure Index	Number of Crashes (1991-2011)	Required Grade	Adjacent Land Uses	Construction Cost* (million)
Neal Road	51,800	0	8%	Rural - Residential	$3.2
N. Lasalle Street	182,000	0	7%	Urban - Commercial	$8.6
Blackwell/Corcoran Street	68,600	2	8%	Urban - Commercial	$42.5
Mangum Street	112,000	1	6.6%	Urban - Commercial	
Fayetteville Street	170,800	0	8%	Urban - Industrial	$15.1
Ellis Road (West)	82,600	7	To be determined	Suburban - Residential / Commercial	$3.3
Glover Road	37,800	4	7.5%	Rural - Residential / Industrial	$36.5
Ellis Road (East)	173,600	2	5%	Rural – Residential / Commercial	$3.9
Cornwallis Road	110,600	0	3.3%	Rural – Residential / Commercial	$9.9

* Estimated construction cost for roadway and rail realignment only. Does not include cost of right-of-way or utility relocation.

a) Exposure Index

NCDOT uses the exposure index as one factor to determine whether grade separation of a crossing should be considered in place of an at-grade crossing. As discussed previously in Chapter B, the exposure index is calculated by multiplying the number of trains per day by the daily traffic volume using the crossing. Table B.4 shows the exposure index at each of the study crossings. All of the crossings recommended for grade exceeded the identified threshold based on existing train and traffic volumes and based on future train volumes (using existing traffic volumes).

b) Crash History

A history of train/vehicle crashes can contribute to the need for a grade separated crossing. A review of the crash data at the study crossings shows a safety concern at two crossings. The Ellis Road (West) crossing has had seven collisions in the past 20 years, including two with fatalities. The Driver Street crossing has had four collisions in the same time period.

c) Topography

Elevations and slopes in the vicinity of an at-grade crossing have a large impact on the feasibility of a grade separation. The cost of grade separation can be significantly reduced in situations where the topography facilitates a highway overpass due to the need for relatively minimal earthwork or right-of-way requirements. With challenging site constraints, it may be necessary to adjust roadway and railroad grades to facilitate an acceptable grade separation. This is the case on Blackwell and Mangum Streets where a railroad bridge over the roadways will require raising the railroad and lowering the roadway.

d) Adjacent Land Uses

Grade separations may not be feasible in heavily developed areas such as central business or historic districts. Right-of-way costs or socio-economic impacts associated with the potential loss of businesses and jobs can result in an unfavorable cost-benefit ratio for the project. New bridges also have the potential to relocate a large number of people and/or disrupt neighborhoods. Grade separations were not recommended at the Anderson Street, Duke Street, and Swift Avenue crossings in part because of the potential impact to adjacent properties.

e) Construction Impacts

The impacts associated with the construction of new grade-separated crossings can be substantial and can include visual, noise, and access degradation and the relocation of dwellings or businesses. Environmental features like wetlands or woodlands, historical and archaeological sites, and the presence of hazardous materials can also pose considerable challenges. Construction impacts for recommended grade separations are described in Section E.4. Grade separations were not recommended at the N. LaSalle Street, Anderson Street, Duke Street, and Swift Avenue crossings in part because of potential construction impacts.

f) Costs

Grade separations are significant long term infrastructure investments. A detailed feasibility study, including a cost-benefit analysis, is required before a grade separation is implemented. A construction cost estimate has been prepared for all recommended alternatives. This cost does not include right-of-way or utility relocation, and should not used for planning purposes. However, the construction cost estimate is useful to compare alternatives with each other, and to develop a preliminary cost/benefit ratio. A more detailed cost estimate will be done as part of an alternatives analysis process that would be required if a grade separation project is selected.

The cost estimate for the grade separation of Blackwell/Corcoran Street and Mangum Street has been combined, with the assumption that one structure will be built over both crossings. This cost also includes replacing the existing Roxboro Street bridge. The cost estimate for the grade separation of Glover Road also includes closing Wrenn Road and building a new connector road.

E. Community Impact Analysis

The project study area encompasses a half-mile radius around each of the 18 at-grade crossings. Potential impacts to community resources were considered when analyzing and ranking long term alternatives.

The project study area is densely developed with a mix of residential, commercial, office, institutional, and industrial land use.

E.1. Community Features

An aerial mapping review and field visit were performed to identify community facilities such as hospitals, churches, schools, fire and rescue stations, parks, and recreation areas. The following community features were observed near the crossings, as shown on Figures 1 through 3:

- There are several athletic fields near the Neal Street crossing.
- Duke University's West Campus and Medical Center are in the western portion of the project study area, just east of US 15-501.
- There are a number of parks within the project study area.
- There are many educational facilities in the project study area.
- The project study area between Duke Street and Fayetteville Street contains several government facilities, including the Durham Police Headquarters, Wake County Sheriff's Headquarters, County Courthouse, Correction Facility, City Hall, County Health Department, and Housing & Community Development Housing.
- The American Tobacco Trail and Durham North/South Greenway run concurrently through downtown Durham across the Blackwell/Corcoran Street crossing. Central Durham is a pedestrian-dominated area, particularly in the 9th Street, Brightleaf, downtown, Chapel Hill Street, and Northeast Central Durham districts.

Known historic (either listed on or eligible for the National Register of Historic Places [NRHP] were also identified from the State Historic Preservation Office (SHPO) website:

- The West Durham National Historic District is north of the Anderson Street crossing.
- Trinity National Historic District is north of the Buchanan Boulevard crossing. Its southeast corner is one block north of the rail corridor.
- The Brightleaf National Historic District is near the Duke Street crossing and the Chapel Hill Street crossing. The district contains several local landmarks and is in the process of being restored.
- The Downtown Durham Local Historic District and the American Tobacco National Historic District are adjacent to the Blackwell/Corcoran Street and Mangum Street crossings.
- The Golden Belt National Historic District is several blocks north of the Ramseur Street crossing.
- The Driver Street National Historic District is located north of the Plum Street and Driver Street crossings.

E.2. Demographic Characteristics

Demographic data was gathered from the U.S. Census (2010). Race and ethnicity data is provided at the block level, aggregated by segment. Age, income, and limited English proficiency data is provided at the block group level, aggregated by segment. Detailed data is in Appendix B.

The City of Durham had 57.5% minority and 14.2% Hispanic in 2010. The median household income for the city was $45,500. Durham County had 53.6% minority and 13.5% Hispanic, with a median household income of $47,400. The following section lists the areas adjacent to the at-grade study crossings where area has minority and Hispanic populations that are at least 10% greater than the county's average or at least 50% total, or have a median income at least 10% less than the county's average.

West Section (Section 1)

Nine of the 15 block groups along the West Durham section have a median household income at least 10% below the county's average. The lowest income in this section is in Census Tract 5 Block Group 1, with a median household income of $5,900. This block group is located on the south side of the railroad tracks between Anderson Street and Campus Drive.

The Crest Street community is between the Lasalle Street and Anderson Street crossings. Crest Street is a small, predominately African-American residential area. The neighborhood has been the focus of a community revitalization program, and as a result many of the homes are new and are owner-occupied. The neighborhood has a community council that owns and manages the neighborhood's one apartment building and two retirement centers, and manages an after-school tutoring service. The Census block group that contains the Crest Street neighborhood (Census Tract 15.02 Block Group 1) contains a 77.1% minority population, 47.5% Hispanic population, and a median household income that is only slightly more than half of Durham County.

Downtown Durham (Section 2)

Downtown Durham and Northeast Central Durham are characterized by high percentages of racially and ethnically minority and low income populations. The seven block groups from Blackwell Street to Driver Street have a minority percent greater than 10% above the county average (85.4% to 94.4%), and all nine of the block groups in the East Durham section have a median household income under $36,000. The block groups north and south of the segment between Dillard Street and Ramseur Street also have a Hispanic population more than 10% above the county average.

East Durham (Section 3)

East Durham is less populated than the other areas along the corridor, with fewer minority and Hispanic residents and a higher median income. However, although the block group averages are similar to the county average, there are pockets of homes adjacent to the railroad corridor with higher percentages of minority residents near the Glover Road, Wrenn Road, and Ellis Road (East) crossings.

E.3. Land Use and Transportation Plans

The following local transportation and land use plans were referenced during development of the long term alternatives:

- Capital Area Metropolitan Planning Organization and Durham-Chapel Hill-Carrboro Metropolitan Planning Organization 2035 Long Range Transportation Plan (2009)
- Downtown City Center District (2010)
- Durham Area Transit Authority Route Maps (2012)
- Durham Bike & Hike Map (2010)
- Durham Comprehensive Bicycle Transportation Plan (2006)
- Durham Comprehensive Plan (2012)
- Durham Design Manual (2010)
- Durham Trails and Greenways Master Plan (2001)
- DurhamWalks! Pedestrian Plan (2006)
- NCDOT State Transportation Improvement Program (2012)
- Triangle Transit Regional Rail Plan (2013)

Existing and proposed bicycle and pedestrian facilities at each crossing are described in Section H.

E.4. Community Impact Analysis

None of the short or mid term alternatives are anticipated to have negative community impacts. Several, such improved pedestrian accommodations, will have a positive impact. Long term impacts are anticipated from the crossing closures and grade separations, as discussed in the following sections.

a) Crossing Closures/Consolidations

Closing existing at-grade crossings to vehicles will change travel patterns and may increase EMS response time. As discussed in Section C.1, none of the closures are anticipated to result in an unacceptable level of service at adjacent intersections. Other potential impacts are described below:

Dillard Street

- If the Dillard Street crossing is closed, drivers are expected to use the grade separated Roxboro Street and at-grade Fayetteville Street crossings instead, both of which are approximately 0.2 miles from Dillard Street.
- Comments received at the public meetings opposed to the closure note that Dillard Street provides access to businesses, and allows drivers to avoid the busier streets in downtown Durham.
- A new pedestrian grade separation will be built before the crossing is closed, which was included to address concerns of the County about employees walking across the tracks during the work day, and concerns regarding pedestrian access to several buildings providing county services.
- The crossing closure and pedestrian grade separation will have very few physical impacts, and will not have any direct impacts to community features or neighborhoods.

Ramseur Street

- If the Ramseur Street crossing is closed, drivers are expected to use at-grade Fayetteville Street (0.3 miles) and grade separated Alston Avenue (0.2 miles) crossings instead.
- Comments received at the public meetings opposed to the closure note that this is a local street that provides access for residents and businesses. A local business owner requested that the Ramseur Street and/or Plum Street crossings remain open until after the Alston Avenue improvement project is completed (the Alston Avenue project is proposed to widen Alston Avenue and raise the Pettigrew Street bridge over Alston Avenue to a height exceeding 13'-6".)
- A new pedestrian grade separation will be built before the crossing is closed, which was included to address concern of several citizens about accessing the Boys & Girls Club.
- The crossing closure and pedestrian grade separation will have very few physical impacts, and will not have any direct impacts to community features or neighborhoods.

Plum Street

- If the Plum Street crossing is closed, drivers are expected to use the at-grade Driver Street crossing instead, which is approximately 0.3 miles from Plum Street.
- Approximately 25 comments were received at the 2013 public workshop that opposed closing the Plum Street, Ramseur Street, and Driver Street crossings. The primary reasons given were that Plum Street is used by local residents and businesses, that it provides a connection to the Green Flea Market, and that there are not sufficient alternate routes. The Driver Street crossing experiences delays due to the location of the railroad switching yard, and the next nearest crossing (grade separated Alston Avenue) is approximately 0.5 miles from Plum Street. NCDOT will complete an operations analysis of the switching movements in the railyard, and will only close the Plum Street crossing if improvements to the railyard are made that would reduce vehicle delays at the Driver Street crossing.
- The Plum Street/Driver Street area is primarily minority and low income, and this crossing is used actively by pedestrians. A new pedestrian grade separation at the railroad in the vicinity of Sowell Street and a new greenway connection between the underpass and Angier Avenue are included to address concerns about pedestrian access across the railroad tracks. The proposed location meets with a recently built multiuse path over NC 147.
- The crossing closure will have no physical impacts. The new pedestrian grade separation and greenway will require some new right of way, but will not relocate any homes or businesses, or have direct impacts to community features or neighborhoods.

Wrenn Road

- If the Wrenn Road crossing is closed, a new access road would be built to connect drivers from Wrenn Road to an adjacent crossing. The design shown in this TSS includes a connector road to Glover Road, approximately 0.3 miles from Wrenn Road. Wrenn Road would not be closed until the connector road is built and the adjacent crossing is grade separated. (If this alternative is selected, a feasibility study would consider a range of locations for the connector road.)
- The new connector road would require new right of way, but is not anticipated to relocate any homes or businesses. It may be located between existing residential properties, but will not disrupt cohesive neighborhoods. It will not impact any community features.
- Currently, Waste Industries uses the Wrenn Road crossing. With this alternative, they would be routed to a new grade separated crossing via the connector road. Although the route would be longer if their destination is south of the facility, this impact may be offset by the benefit of using a grade separated crossing rather than an at-grade crossing.

b) Grade Separations

Grade separating existing at-grade crossings will improve vehicular travel time and will typically decrease EMS response time. The impacts described in this section are based on the designs shown in Section H. However, other alternatives were considered as part of the TSS process. The eliminated alternatives are included in Appendix C. If a crossing is selected to be studied further for grade separation, a more in-depth alternatives analysis will be performed, including consideration of other designs. This TSS is intended to explore the feasibility of a range of alternatives at each crossing using high-level conceptual designs. Although the TSS may have investigated a bridge over or under the railroad, subsequent environmental documentation may examine additional alternatives. Therefore, recommendations as part of this study are for a grade separation and not a particular alternative. Based on these conceptual designs, the following impacts are anticipated:

Neal Road

- The proposed grade separation alternative at Neal Road could construct a bridge over the railroad, and thereby shift the intersection of Neal Road and American Drive approximately 200 feet to the east. The realignment of American Drive would require new right of way, but no relocations are anticipated. It will move American Drive closer to existing residences, but will not disrupt cohesive neighborhoods. It will not impact any community features.
- Several residents in the neighborhood south of the crossing have complained about the noise of the train horn at this crossing. Grade separating this location may reduce the level of noise to those properties.

N. Lasalle Street

- The proposed grade separation at N. Lasalle Street could construct an underpass for Lasalle Street under the railroad and Pettigrew Street. This would include a new connector road from Lasalle Street to Pettigrew Street.
- An underpass would require retaining walls along Lasalle Street, which would require closing existing business driveways in all four quadrants. However, the conceptual design indicates all properties would be accessible from other driveways, and no business relocations are anticipated. Some new right of way would be required, and access to the local businesses will change. It will not impact any community features or neighborhoods.
- This is an active route for pedestrians and is used by DATA and Duke University buses. A grade separation would provide a route across the railroad corridor for pedestrians and bicyclists that does not require crossing the tracks. It would likely reduce delays for buses.

Blackwell/Corcoran Street & Mangum Street

- The proposed alternative could construct a bridge for the railroad over Blackwell/Corcoran Street and Mangum Street. To achieve the necessary separation between the road and rail, it is likely that this would include a combination of lowering the roads and raising the railroad tracks. The Roxboro Street bridge would also have to be replaced with a higher bridge to tie into the raised railroad bridge at Mangum Street.
- There were no comments received from the public about this alternative. The primary concern by stakeholders is the change to the viewshed between the downtown business district and the Durham Performing Arts Center/American Tobacco Campus area. If this location is selected, the next phase will likely study both a single bridge over both streets—allowing the space between them to be used as a park or other public space—or as two separate bridges.
- No business or residential relocations are anticipated. However, because of the change in elevation of Blackwell/Corcoran Street and Mangum Street, it is possible that businesses adjacent to the crossing may be affected because of loss of access to the building or parking area. It will not impact any community features or neighborhoods.
- This is an active route for pedestrians and is used by DATA and the Bull City Connector. A grade separation would provide a route across the railroad corridor for pedestrians and bicyclists that does not require crossing the tracks. It would likely reduce delays for buses.

Fayetteville Street

- The proposed grade separation at Fayetteville Street would construct a bridge over the railroad and Ramseur Street, and would realign the railroad tracks to flatten the curve between Dillard Street and Ramseur Street. It also includes improving existing Walker Street and Hood Street to provide a connection from Fayetteville Street to Ramseur Street.
- This alternative would impact all businesses and several residences in the project area between Ramseur Street and Pettigrew Street to accommodate the rail and rail spur realignment. It would maintain existing access for businesses north of Ramseur Street. Retaining walls at the Fayetteville Street/Ramseur Street intersection would restrict driveway access, but all properties have secondary access on other roads. It will not impact any community features, and is not expected to disrupt a cohesive neighborhood.

Ellis Road (West)

- The proposed grade separation could construct a bridge over the railroad. In 2007, NCDOT Rail Division had developed four potential alternatives for a bridge over the railroad. A fifth alternative was developed as part of this TSS, and is included in Appendix C (Eliminated Alternatives). Each of the alternatives considered would change the connection between Ellis Road, Angier Avenue, Pettigrew Street, and East End Avenue.
- Delays at this crossing are frequent due to the location of the railroad switching station next to Ellis Road. Providing a grade separation would reduce delays and improve travel time consistency for drivers, which would also reduce EMS response time.
- All alternatives that have been considered to date would impact properties on both sides of the railroad corridor, resulting in residential and business relocations. This project may disrupt an existing neighborhood along East End Avenue. Orange Grove Missionary Baptist Church, located north of the crossing, may be impacted.

Glover Road

- The Glover Road grade separation could involve a bridge over the railroad, including realignment of the railroad from Ellis Road (East) to Glover Road. It would also include a new connector road from Glover Road to Angier Avenue in the southeast quadrant, and a new connector road from Glover Road to Wrenn Road in the southwest quadrant. It also includes an extension of Pettigrew Street from Ellis Road (West) to Glover Road and a new interchange at NC 147 and Glover Road.
- The proposed project, including the new connector roads, interchange at NC 147, and rail realignment, would require residential and business relocations and may disrupt existing cohesive neighborhoods. No impacts to community features are anticipated.

Ellis Road (East)

- The proposed grade separation at Ellis Road (East) would construct a bridge over the railroad, including realigning Ellis Road to the west to flatten the curve. Some new right of way will be required, and a small number of residential and business relocations are possible. It will not impact any community features.

Cornwallis Road

- The proposed grade separation would construct an underpass for Cornwallis Road under the railroad. It would tie to Miami Boulevard on existing location, requiring the grades at the intersection to be modified to tie into the new underpass. Some new right of way will be required, but no residential or business relocations are anticipated. It will not impact any community features.

F. Public Involvement

A public involvement program was established as part of this study. It consisted of:

- Project committee meetings
- Stakeholder committee meetings
- Public workshops
- City Council meeting/public hearing
- Environmental justice/limited English proficiency outreach
- Small group meetings
- Mailings/press release

F.1. Project Committee Meetings

The project committee included NCDOT Rail Division, City of Durham, Triangle Transit, North Carolina Railroad Company, and Norfolk Southern Corporation. The project committee met in September 2011, November 2011, January 2012, March 2012, April 2012, October 2012, May 2013, and June 2013.

F.2. Stakeholder Committee Meetings

A stakeholder committee was established to provide an opportunity for key agencies and organization to participate in the recommendation process. The members of the stakeholder committee are listed in Section A.2. The stakeholders met in November 2011, April 2012, January 2013, and May 2013. At each meeting, stakeholders were provided a project update and asked to provide feedback on the alternatives under consideration at that time.

F.3. Public Workshops

a) November-December 2011

The first set of public workshops was held in 2011 at the locations listed in Table F.1. Maps showing each crossing were displayed, and project team members spoke with citizens individually about their concerns and ideas for the crossings. The workshops did not include a formal presentation. A total of 57 people signed in at the three workshops.

Table F.1. First Public Workshops

Date	Section	Location	Attendees
November 28, 2011	Downtown (Duke Street to Driver Street	Durham Armory	34
November 29, 2011	West (Neal Road to Buchanan Boulevard)	Hilton Durham	17
December 1, 2011	East (Ellis Road to Cornwallis Road)	N.C. Biotechnology Center	6

Nineteen written comments were received at or following the workshops, and citizens were also asked to use sticky pads to note specific areas of concern at the individual crossings. A comment summary is in Appendix D. Generally, citizens providing comments were opposed to closing crossings, but have observed vehicles stopping on the tracks at several crossings. Comments identified several locations with need for improved traffic operations, enhanced safety devices, and pedestrian/bicycle facilities across the railroad tracks.

a) March 2013

The second set of workshops was held in 2013 at the locations listed in Table F.2. Long term alternatives were shown on maps, and short and mid term alternatives were described. The workshops did not include a formal presentation. A total of 41 people signed in at the three workshops.

Table F.2. Second Public Workshops

Date	Section	Location	Attendees
March 18, 2013	Downtown (Duke Street to Driver Street	Durham Armory	17
March 19, 2013	West (Neal Road to Buchanan Boulevard)	Hilton Durham	12
March 21, 2013	East (Ellis Road to Cornwallis Road)	Holton Resource Center	12

Forty-two written comments were received at or following the workshops, and are included in the comment summary in Appendix D. Comments specific to each crossing are below. No comments were received about the remaining crossings.

- **Neal Road** – Desire a quiet zone. Support a grade separation.
- **Swift Avenue** – Support a grade separation. Need sidewalks on both sides.
- **Chapel Hill Street** – Ensure clearance over street is a minimum of 13'-6". Remove disconnected tracks.
- **Roxboro Street** – Ensure clearance over street is a minimum of 13'-6". Need crosswalk in southeast quadrant.
- **Dillard Street** – Oppose crossing closure.
- **Fayetteville Street** – Need crosswalks across Fayetteville Street.
- **Ramseur Street** – Oppose crossing closure.
- **Plum Street** – Oppose crossing closure.
- **Driver Street** – Crossing is often blocked due to switching station.
- **Ellis Road** (West) – Ensure clearance over street is a minimum of 13'-6". If grade separate, support aligning Ellis Road with East End Avenue. Traffic signal needs additional improvement.

F.4. City Council Meetings/Public Hearing

A presentation was made to the Durham City Council at work sessions on November 22, 2011 and December 10, 2012. The recommendations will be presented to the Durham City Council at a work session on October 10, 2013. A Public Hearing will be advertised for two weeks before the final report is presented at a City Council meeting.

F.5. Environmental Justice/Limited English Proficiency Outreach

Several focused outreach activities have been carried as part of the public involvement program to reach low income, minority, and limited English proficiency (LEP) populations in the area. The purpose of the outreach has been to inform area stakeholders of the study and obtain input on overall issues and feedback on alternatives. The project team employed a targeted approach by contacting a variety of individuals and groups within Durham who work directly with communities that are traditionally underrepresented in planning efforts. Interviews were conducted with the following organizations:

- Uplift East Durham
- El Centro Hispano
- Immaculate Conception Church
- First Presbyterian Church
- Durham Congregations Associations and Neighborhoods
- Northeast Central Durham
- Northeast Central Durham Livability Initiative
- Northeast Central Durham City Neighborhood Improvement Services

The project team also briefed organizations that work with low income, minority, and/or LEP populations. Community groups included:

- Partners Against Crime (PAC) District 5 (Downtown)
- PAC District 1 (East Durham)
- El Centro Hispano
- Durham InterNeighborhood Council
- Immaculate Conception Church Hispanic membership

Key issues identified through the interviews and briefing sessions are listed below:

- **Neal Road** – Very little pedestrian activity at this crossing.
- **N. Lasalle Street** – Active crossing for pedestrians and buses. Oppose crossing closure, but support grade separation.
- **Anderson Street** – Support crossing closure. The neighborhood along Anderson Street was divided when the Durham Freeway was constructed, and now Anderson Street is their primary connection.
- **Swift Avenue** – Need improvement of traffic signal timing to help clear vehicles from between gates, and more signage/pavement markings to notify drivers of the correct location to stop.
- **Buchanan Boulevard** – Oppose crossing closure.
- **Duke Street** – Active crossing for pedestrians. Oppose crossing closure, but support grade separation.
- **Blackwell/Corcoran Street** – Active crossing for pedestrians. Important for connectivity and economic activity. Both opposition and support for crossing closure.
- **Mangum Street** – Active crossing for pedestrians. Important for connectivity and economic activity. Support for grade separation.
- **Dillard Street** – Active crossing for pedestrians.
- **Fayetteville Street** – Active crossing for pedestrians. Safety concerns at this crossing.
- **Ramseur Street** – Safety concerns because of skew of road. Safety concern at Ramseur Street/Pettigrew Street because of congestion. Support crossing closure.
- **Plum Street** – Active crossing for pedestrians, especially on weekends because of Green Flea Market. Serves as multi-use crossing, connecting to local greenways. Traffic backs up at crossing.
- **Driver Street** – Traffic backs up at crossing. Oppose crossing closure.
- **Ellis Road (West)** – Safety concerns. Traffic backs up at crossing. Need for more signals to increase awareness when the train is arriving.
- **Glover Road** – Key route for locals.
- **Wrenn Road** – No comments.
- **Ellis Road (East)** – No comments.
- **Cornwallis Road** – No comments.

In addition to the interviews and briefing sessions, Spanish-language handouts and interpreters were available at the public workshops. The workshop notifications were published in Spanish in La Conexion and Qué Pasa, and the 2011 workshop was advertised through Spanish flyers posted near the crossings with high percentages of minority residents.

F.6. Mailings/Press Release

A press release was sent to local papers announcing the November 28-December 1, 2011 public workshops and the March 18-21, 2013 public workshops. Postcards announcing the workshops were mailed to property owners within ½ mile of each of the 18 at-grade crossings and within ¼ mile of the railway corridor between crossings.

A press release will be used to advertise the Public Hearing. A final postcard will be mailed to property owners announcing the approved recommendations following approval by City Council.

G. Alternatives Considered and Eliminated

Through the course of the TSS, many alternatives were considered. Based on input from citizens and stakeholders, several alternatives have been eliminated. These are included in Appendix C. When a crossing is selected for grade separation in the future, an additional study will be done to look at a range of alternatives, potentially including the eliminated options.

During this process, the grade separation alternatives were numbered at crossings with more than one type of grade separation. As some were eliminated, the remaining alternatives were renumbered to always use the lowest available numbers. The numbers have been removed from the final recommendations, which are now described by the crossing name and type of bridge.

In September 2012, six alternatives were eliminated based on input from the project team:

- **Anderson Street, Grade Separation (Loop)** – Eliminated because it rerouted Anderson Street to a t-intersection with Main Street rather than intersecting with Hillsborough Street.
- **Swift Avenue, Grade Separation** (Proposed by Triangle Transit) – Eliminated because the vertical geometry would not allow for an underpass without major impacts to the existing NC 147 interchange and adjacent land use.
- **Plum Street, Grade Separation** – Eliminated because of property impacts associated with the realigned Pettigrew Street.
- **Ellis Road (West), Grade Separation (Loop)** – Eliminated because it rerouted Ellis Road to a t-intersection with Angier Avenue rather than retaining it as the primary through movement. Also, E. Pettigrew Street would lose access to Ellis Road.
- **Ellis Road (West), Grade Separation** (Proposed by Triangle Transit) – Eliminated because of the constrained grades and cost of an underpass under the railroad track.

In December 2012, Triangle Transit developed an additional three conceptual designs for grade separation projects. These were not developed further at this time, but will be included in Appendix C for future reference. They included:

- Anderson Street, Grade Separation
- Anderson Street Grade Separation with Roundabout
- Duke Street Grade Separation (2 options)

In May 2013, the remaining alternatives were ranked based on the following data and environmental factors:

- **Exposure index** – accounts for the number of vehicles and number of trains
- **Cost/benefit ratio** – output from GradeDec, accounts for construction cost and benefits in dollars
- **Safety benefit** – output from GradeDec, accounts for predicted reduction in collisions per year
- **Number of crashes** – based on 20-year collision data
- **Reduction in auto delay** – output from GradeDec
- **Reduction in CO emissions** – output from GradeDec
- **Potential impact to neighborhoods** – addresses neighborhood cohesion and connectivity
- **Potential impact to properties** – addresses property impacts and relocations
- **Potential impact to businesses** – addresses impact to commercial nodes and business operations
- **Potential impact to pedestrian and bicycle mobility** – accounts to difficulty for pedestrians and bicyclists to cross through the area with the proposed changes
- **Impact to EMS access** – accounts for change in EMS access with the proposed changes

The rankings were presented to stakeholders in May 2013, as shown in Table G.1. For discussion purposes, the alternatives were grouped into three priority tiers named High Level, Mid-Level, and Low Level. These rankings were used as a tool help stakeholders vote on whether or not a particular ranking was appropriate located and gave stakeholders to ability to move projects form tier to tier.

Following that meeting, the rankings were revised to incorporate stakeholder feedback. In August 2013, based on input received from citizens following the March 2013 workshop and from stakeholders at the May 2013 meeting, six additional alternatives were eliminated from consideration:

- **N. Lasalle Street, Grade Separation** – This alternative ranked below the Bridge Over Road grade separation alternative. The estimated construction cost is also notably more expensive than the Bridge Over Road alternative ($13.6 million vs. $8.6 million). Since the train volume through this crossing is relatively low, only the Bridge Over Road grade separation alternative (which is less expensive and has fewer anticipated impacts) will be carried forward.
- **Anderson Street, Grade Separation & Realigned Anderson Street Grad Separation** – A large percentage of the stakeholders did not support either grade separation alternative at Anderson Street. Key reasons were that the relatively low train volume results in fewer benefits (compared with grade separating other crossings) and the impacts to properties, neighborhoods, and the existing NC 147 interchange. Although the land traversed by the Realigned Anderson Street Grade Separation is currently vacant, there is an approved plan for development on that property. There is also a concern about tying Anderson Street to Rosehill Avenue because this alternative is likely to result in increased traffic through the Rosehill neighborhood.
- **Swift Avenue, Grade Separation**– A large percentage of the stakeholders did not support a grade separation of Swift Avenue, primarily because of the potential property and loss of access to Pettigrew Street and adjacent businesses.
- **Duke Street, Grade Separation** – Over half of the stakeholders did not support this alternative. Key reasons are because of the extent of impacts to existing street grades and resulting impacts to business access, as well as the high cost of construction.
- **Fayetteville Street, Grade Separation** – The two alternatives that were considered at this crossing are similar, except the alternative that was retained (Grade Separation and Ramseur) includes a longer bridge to span Ramseur Street as well as the railroad. This alternative also includes associated improvements to Walker Street and Hood Street. This alternative was selected to be eliminated based primarily on construction cost and the ranking of the two grade separation alternatives, as well as because of potential impacts of this alternative on NCCU and historic structures.

Table G.1. Ranking Matrix Presented to Stakeholders May 2013				
Crossing Name	Section	Alternatives	Summary and Ranking	
			Final Rank	Priority Tier
Blackwell, Mangum, and Roxboro Streets	Downtown	Grade Separation	1	Tier 1
Ellis Road East	East	Grade Separation	7	
Neal Road	West	Grade Separation	15	
Cornwallis Road	East	Grade Separation	5	
N. LaSalle Street (Alt 2)	West	Grade Separation	11	
Fayetteville Street (Alt 1)	Downtown	Alternative 1 - Grade Separation	16	
S. Dillard Street	Downtown	Close Crossing (Construct Pedestrian Grade Separation)	3	Tier 2
N. LaSalle Street (Alt 1)	West	Grade Separation	13	
S. Duke Street	Downtown	Grade Separation	14	
Anderson Street (Alt 1)	West	Grade Separation	17	
Briggs Avenue	Downtown	Grade Separation	6	
Fayetteville Street (Alt 2)	Downtown	Grade Separation – and Ramseur	10	
Swift Avenue	West	Grade Separation	9	Tier 3
Anderson Street (Alt 2)	West	Grade Separation – Realigned Anderson Street	18	
Ramseur Street	Downtown	Close Crossing (Construct Pedestrian Grade Separation)	4	
Ellis Road West	East	Grade Separation	2	
Glover and Wrenn Roads	East	Grade Separation –at Glover Road/Close Wrenn Road	12	
Plum Street	Downtown	Close Crossing (Construct Pedestrian Grade Separation)	8	

Table G.2 summarizes the alternatives development process. Table G.3 lists the ranking of remaining alternatives, which are recommended for implementation. The recommended alternatives are described in more detail in Section H.

Table G.2. Long Term Alternatives Considered		
Crossing	**Alternative**	**Status**
West Durham (Section 1)		
Neal Road	Concrete Median	Recommended
	Grade Separation	Recommended
N. Lasalle Street	Grade Separation	Eliminated August 2013
	Grade Separation	Recommended
Anderson Street	Grade Separation (Loop)	Eliminated September 2012
	Grade Separation	Eliminated December 2012
	Grade Separation	Eliminated August 2013
	Realigned Anderson Street Road Bridge	Eliminated August 2013
Swift Avenue	Grade Separation	Eliminated September 2012
	Grade Separation	Eliminated August 2013
Downtown Durham (Section 2)		
Duke Street	Grade Separation (2 options)	Eliminated December 2012
	Grade Separation	Eliminated August 2013
Blackwell/Corcoran Street & Mangum Street	Grade Separation	Recommended
Dillard Street	Close Crossing	Recommended
Fayetteville Street	Grade Separation	Eliminated August 2013
	Grade Separation and Ramseur	Recommended
Ramseur Street	Close Crossing	Recommended
Plum Street	Grade Separation	Eliminated September 2012
	Close Crossing	Recommended
Briggs Avenue/Guthrie Avenue	Grade Separation	Recommended
East Durham (Section 3)		
Ellis Road (West)	Grade Separation (Loop)	Eliminated September 2012
	Grade Separation	Eliminated September 2012
	Grade Separation (4 alternatives)	Recommended
Glover Road & Wrenn Road	Grade Separation at Glover Road, Close Wrenn Road Crossing	Recommended
Ellis Road (East)	Grade Separation	Recommended
Cornwallis Road	Grade Separation	Recommended

Table G.3. Final Ranking Matrix			
Crossing Name	**Section**	**Alternatives**	**Final Rank**
Blackwell, Mangum, and Roxboro Streets	Downtown	Grade Separation	1
Ellis Road West	East	Grade Separation	2
S. Dillard Street	Downtown	Close Crossing (Construct Pedestrian Grade Separation)	3
Ramseur Street	Downtown	Close Crossing (Construct Pedestrian Grade Separation)	4
Cornwallis Road	East	Grade Separation	5
Briggs Avenue	Downtown	Grade Separation	6
Ellis Road East	East	Grade Separation	7
Plum Street	Downtown	Close Crossing (Construct Pedestrian Grade Separation)	8
N. LaSalle Street	West	Grade Separation	9
Fayetteville Street	Downtown	Grade Separation and Ramseur	10
Glover and Wrenn Roads	East	Grade Separation at Glover Road/Close Wrenn Road	11
Neal Road	West	Grade Separation	12

H. Recommended Alternatives

The table below summarizes the recommended alternatives. For each location, multiple near and/or mid term solutions could be implemented. These near and mid term solutions could, in most cases, be made instead or in addition to one of the long term solutions. The cost estimates presented below are for construction only and do not include right of way acquisition, utility relocation, or costs associated with construction phasing where railroad construction is required. Recommendations (Alternatives) marked with an asterisk have been made by the City of Durham since the draft recommendations were first presented to stakeholders.

In addition to the recommendations below, The City and NCDOT have recently embarked upon a program to inspect the signalized intersections with railroad preemption throughout the county. While random inspections have taken place in the past, this new program will be more comprehensive, more frequent, and more deliberate. The first rounds of inspections are underway in 2013.

Table H.1. Recommended Alternatives

Crossing	Type	Near Term (2-5 years)		Mid Term (5-7 years)		Long Term (more than 7 years)	
		Alternatives	Const. Cost	Alternatives	Const. Cost	Alternatives	Const. Cost
West Durham (Section 1)							
Neal Road Crossing #735 202E Milepost H 50.20	At-grade	N/A	$0	N/A	$0	• Grade separation • Widen pavement and replace bollards with 4' concrete monolithic island. Set new roadway vertical wedge to remove hump	$4,000,000 $500,000
N. Lasalle Street Crossing #735 205A Milepost H 52.04	At-grade	• Install grade-crossing warning sign on WB Pettigrew St* • Install median barrier between crossing and nearest driveways north and south	$90,000	N/A	$0	• Grade separation	$9,000,000
Anderson Street Crossing #910 594N Milepost H 53.21	At-grade	• Stripe outside edges of travel lane across railroad crossing*	$500	N/A	$0	N/A	$0
Swift Avenue Crossing #735 223X Milepost H 53.76	At-grade	• Widen asphalt shoulder and stripe outside edge of travel lane on west side of Swift Ave over railroad tracks* • Install grade-crossing warning signs on EB and WB Pettigrew St* • Install crosswalk markings on Swift Ave and Pettigrew St, and install/upgrade curb ramps	$90,000	• Signalize Swift Ave/Pettigrew St intersection	$240,000	N/A	$0
Buchanan Boulevard Crossing #735 225L Milepost H 54.20	At-grade	• Install/upgrade curb ramps	$2,000	N/A	$0	N/A	$0
Downtown Durham (Section 2)							
Duke Street Crossing #735 227A Milepost H 54.60	At-grade	• Install crosswalk markings across Duke St and Peabody St, and install/upgrade curb ramps • Install sidewalk on west side of Duke St between Pettigrew St and existing sidewalk, and pave Pettigrew St apron	$30,000	N/A	$0	N/A	$0
Chapel Hill Street Crossing #735 228G Milepost H 54.80	Grade-separated	• Add raised concrete island as pedestrian refuge, install/upgrade curb ramps, apply new crosswalk markings, and install pedestrian signal heads at the Chapel Hill St/Downtown Loop intersection. • Construct a sidewalk on the north side of Ramseur St from Queen Street to Roxboro St, including a ramp down the slope adjacent to the Ramseur St bridge over Roxboro St. • Remove existing sidewalk on the north side of Pettigrew St from Chapel Hill St to the end of the sidewalk, and reconstruct the pedestrian ramp to redirect pedestrians to the crosswalk across Pettigrew St. • Sandblast, repair, and repaint bridge structure and wingwalls. Improve landscaping on top of wingwalls. Repair sidewalks in railroad tunnel. Add pedestrian lighting in railroad tunnel*	$110,000	• Remove two disconnected railroad tracks and bridges over Chapel Hill Street	$160,000	N/A	$0

* Recommendations (Alternatives) marked with an asterisk have been made by the City of Durham since the draft recommendations were first presented to stakeholders.

Table H.1. Recommended Alternatives (Continued)							
Crossing	Type	Near Term (2-5 years)		Mid Term (5-7 years)		Long Term (more than 7 years)	
		Alternative	Const. Cost	Alternative	Const. Cost	Alternative	Const. Cost
Downtown Durham (Section 2) (Continued)							
Blackwell/Corcoran Street Crossing #735 229N Milepost H 55.09	At-grade	• Mill pavement at both intersections and resurface with stamped asphalt. • Install/upgrade curb ramps, and construct a concrete sidewalk with curb and gutter and brick trim on both sides of Blackwell/Corcoran St (except over the railroad, which will use standard asphalt pavement for sidewalk connectivity). • Add interconnectivity between Pettigrew St and Ramseur St traffic signals. • Construct restricted access for rail maintenance vehicles on Blackwell/Corcoran St between the railroad track and Ramseur St. • Install streetscape lighting and street furniture along Blackwell/Corcoran Street as a continuation of the downtown streetscaping plan.	$250,000	• Remove crosswalk on the north side of Pettigrew St across Blackwell St (to be done after TTA track is constructed), and remove associated pedestrian ramps and pedestrian signals. • Construct a sidewalk on the south side of Pettigrew St between Blackwell St and Mangum St.	$50,000	• Grade separate Blackwell/ Corcoran St and the railroad, and grade separate Mangum St and the railroad. Replace Roxboro Street bridge as part of new grade separation.	$43,000,000
Mangum Street Crossing #735 231P Milepost H 55.14	At-grade	• Mill pavement at both intersections and resurface with stamped asphalt. • Install/upgrade curb ramps, and construct a concrete sidewalk with curb and gutter and brick trim on both sides of Blackwell/Corcoran St (except over the railroad, which will use standard asphalt pavement for sidewalk connectivity). • Install streetscape lighting and street furniture along Blackwell/Corcoran St as a continuation of the downtown streetscaping plan. Upgrade bus stops on Mangum St. • Remove pedestrian path and railing in the northeast quadrant of the Mangum St/Pettigrew St intersection. • Install a decorative fence on the south side of Ramseur St from Mangum St to east of Roxboro St.	$230,000	• Remove crosswalk on the north side of Pettigrew St across Mangum St (to be done after TTA track is constructed). • Construct a sidewalk on the south side of Pettigrew St between Blackwell St and Mangum St.	$40,000		
Roxboro Street Crossing #735 233D Milepost H 55.20	Grade-separated	• Sandblast, repair, and repaint bridge structure and wingwalls. Improve landscaping on top of wingwalls. Repair the sidewalks in railroad tunnel. Add pedestrian lighting in railroad tunnel* • Install a decorative fence on the south side of Ramseur St from Mangum St to east of Roxboro St. • Remove sidewalk on the north side of Pettigrew St from Roxboro St to the end of the sidewalk. • Install/upgrade curb ramps.*	$160,000	N/A	$0		

* Recommendations (Alternatives) marked with an asterisk have been made by the City of Durham since the draft recommendations were first presented to stakeholders.

Table H.1. Recommended Alternatives (Continued)							
Crossing	Type	Near Term (2-5 years)		Mid Term (5-7 years)		Long Term (more than 7 years)	
		Alternative	Const. Cost	Alternative	Const. Cost	Alternative	Const. Cost
Downtown Durham (Section 2) (Continued)							
Dillard Street Crossing #735 389C Milepost H 55.45	At-grade	N/A	$0	N/A	$0	• Close crossing (remove pavement, and add signs and landscaping on Dillard St, and remove railroad crossing gates, signs, and equipment) and construct pedestrian grade separation • Install decorative fence between Roxboro Rd and Fayetteville St	$6,000,000
Fayetteville Street Crossing #910 605Y Milepost H 55.50	At-grade	• Install crosswalk markings on Fayetteville Street at Jackie Robinson Dr and Pettigrew St. and install/upgrade curb ramps • Install advanced pavement marking on northbound Fayetteville St. • Stripe outside edges of travel lane across railroad tracks*	$60,000	• Install advanced signal heads on Fayetteville St for westbound traffic approaching the Fayetteville St/Pettigrew St intersection. • Cut new vehicle detection loops on Fayetteville St east of railroad tracks, at stop bar. • Replace signal heads with optically programmed signal heads (eastbound signal heads at Fayetteville St/Pettigrew St intersection, and westbound signal heads at Fayetteville St/Jackie Robinson Dr intersection).	$40,000	• Grade separation and rail realignment, and Ramseur St • Install decorative fence between Roxboro Road and Fayetteville Rd.	$15,500,000
Ramseur Street Crossing #630 474Y Milepost H 55.90	At-grade	N/A	$0	N/A	$0	• Close crossing (remove pavement, and add signs and landscaping on Plum St, and remove railroad crossing gates, signs, and equipment) and construct pedestrian grade separation	$4,000,000
Plum Street Crossing #630 472K Milepost H 56.40	At-grade	N/A	$0	N/A	$0	• Close crossing (remove pavement, and add signs and landscaping on Plum St, and remove railroad crossing gates, signs, and equipment), construct new driveway for concrete company, construct pedestrian grade separation, and construct a greenway from underpass to Angier Ave	$3,500,000
Driver Street Crossing #630 471D Milepost H 56.70	At-grade	N/A	$0	N/A	$0	N/A	$0
Briggs/Guthrie Avenue Future Grade-Separated Crossing, Approx. Milepost H 56.92	N/A	N/A	$0	N/A	$0	• Grade separation	$21,500,000

* Recommendations (Alternatives) marked with an asterisk have been made by the City of Durham since the draft recommendations were first presented to stakeholders.

Table H.1. Recommended Alternatives (Continued)							
Crossing	Type	Near Term (2-5 years)		Mid Term (5-7 years)		Long Term (more than 7 years)	
		Alternative	Const. Cost	Alternative	Const. Cost	Alternative	Const. Cost
Downtown Durham (Section 3)							
Ellis Road (West) Crossing #735 236Y Milepost H 57.57	At-grade	• Close center driveway to New York Mini Mart	$500	N/A	$0	• Grade separation	$3,500,000
Glover Road Crossing #734 735L Milepost H 58.98	At-grade	• Install grade-crossing warning sign on NB and SB Angier Ave*	$500	N/A	$0	• Grade separation of Glover Road and closure of Wrenn Road, including new connector road	$37,000,000
Wrenn Road Crossing #734 736T Milepost H 59.28	At-grade	N/A	$0	N/A	$0		
Ellis Road (East) Crossing #734 737A Milepost H 60.27	At-grade	N/A	$0	N/A	$0	• Grade separation	$4,000,000
Cornwallis Road Crossing #734 742W Milepost H 62.93	At-grade	• Widen asphalt shoulder and stripe outside edge of travel lane	$40,000	N/A	$0	• Grade separation	$10,000,000

* Recommendations (Alternatives) marked with an asterisk have been made by the City of Durham since the draft recommendations were first presented to stakeholders.

H.1. Neal Road (Crossing No. 735 202E, Milepost H 50.20)

Existing Conditions

Neal Road has approximately 3,700 vehicles per day (vpd) with 1% trucks across the railroad track. It is a collector road and is not expected to have notably more traffic in the future. A slight rise in the curve of the road over the track results in some gouging of the pavement by trailers and low vehicles, but there is not enough of a curve to be considered a "humped" crossing. There is a median barrier comprised of yellow flexible bollards on both sides of the track, which citizens noted had to be frequently replaced. The nearest major intersection is an unsignalized T-intersection with Hillsborough Road (US 70), which is about 0.4 miles west.

Citizens noted that pedestrians cross the tracks, although the sidewalk ends west of the tracks and the paved shoulders narrow across the tracks. The Durham bike map identifies that Neal Road, between Bennett Memorial Drive (slightly north of the railroad tracks) and the railroad tracks, is often used by experienced cyclists, but is not a designated route. American Drive is a shared bike roadway between Neal Road and Morreene Drive. The Durham Long Range Bicycle Plan proposes bike lanes on Neal Road across the railroad tracks, between Hillsborough Road and Duke University Road. Durham County school buses use this crossing nine times each day.

Citizen and stakeholder recommendations included grade separation and flattening the crossing.

The Triangle Day School is located in the northwest quadrant. The other three quadrants are forested. A new subdivision is under development further south of the crossing, adjacent with an existing residential neighborhood. Duke Forest and a nearby historic site will likely limit additional future development. Several athletic fields are located near the crossing.

Alternatives

Two long term alternatives have been proposed. For this crossing, only one of the long term alternatives would be selected.

Near Term Alternative – None

Mid Term Alternative – None

Long Term Alternatives (Figure 4 and 5)

- Grade separation – OR
- Concrete median – Widen pavement and replace bollards with 4' concrete monolithic island. Reinstall bollards on top of island to reduce likelihood of vehicular impact. Set new roadway vertical alignment on roadway approaches to remove hump.

Table H.2. Design Considerations – Neal Road

Design Considerations	Grade Separation	Median Replacement and Widening*
Alignment	Retain existing roadway location for Neal Rd. Realign American Ave to tie to Neal Rd approximately 300' east of proposed bridge	Installing median will require widening on Neal Road by approximately 3' on each side and relocation of signal equipment for wider section. Minimum offset from edge of pavement to center of signal mast is 8'3" (10' preferred) therefore existing signal masts must be relocated approximately 5' for eastbound Neal Rd and 7' for westbound Neal Rd. Existing gate arms must be replaced if not at least 32' in length to meet length requirements.
Rail Crossing	Grade separate. Approximate location of proposed high-speed rail taken into consideration	N/A
Business Impacts	None	None
Residential Impacts	One residential relocation possible	None
Local Road Impacts	Revised access to Neal Rd from American Ave	None
Retaining Walls	None	None

* If City has long-range plans to improve this road, the new median could be accommodated at that time.

Note: Design data is in Appendix E.

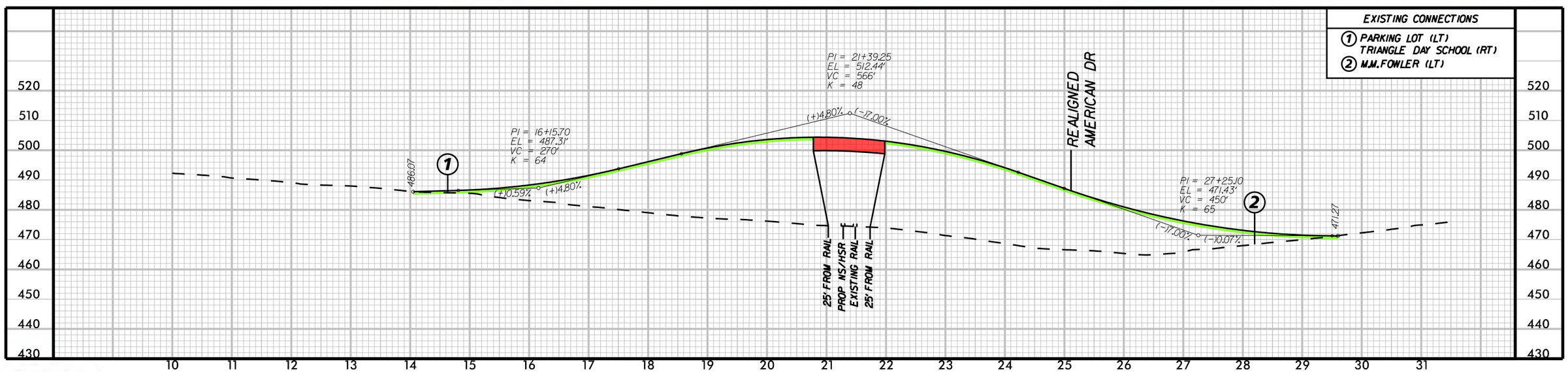
SECTION 1 - FIGURE 4

NEAL ROAD CROSSING

LONG-TERM ALTERNATIVE

GRADE SEPARATION BRIDGE OVER RAIL

MARCH 2013



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DURHAM 1869 CITY OF MEDICINE

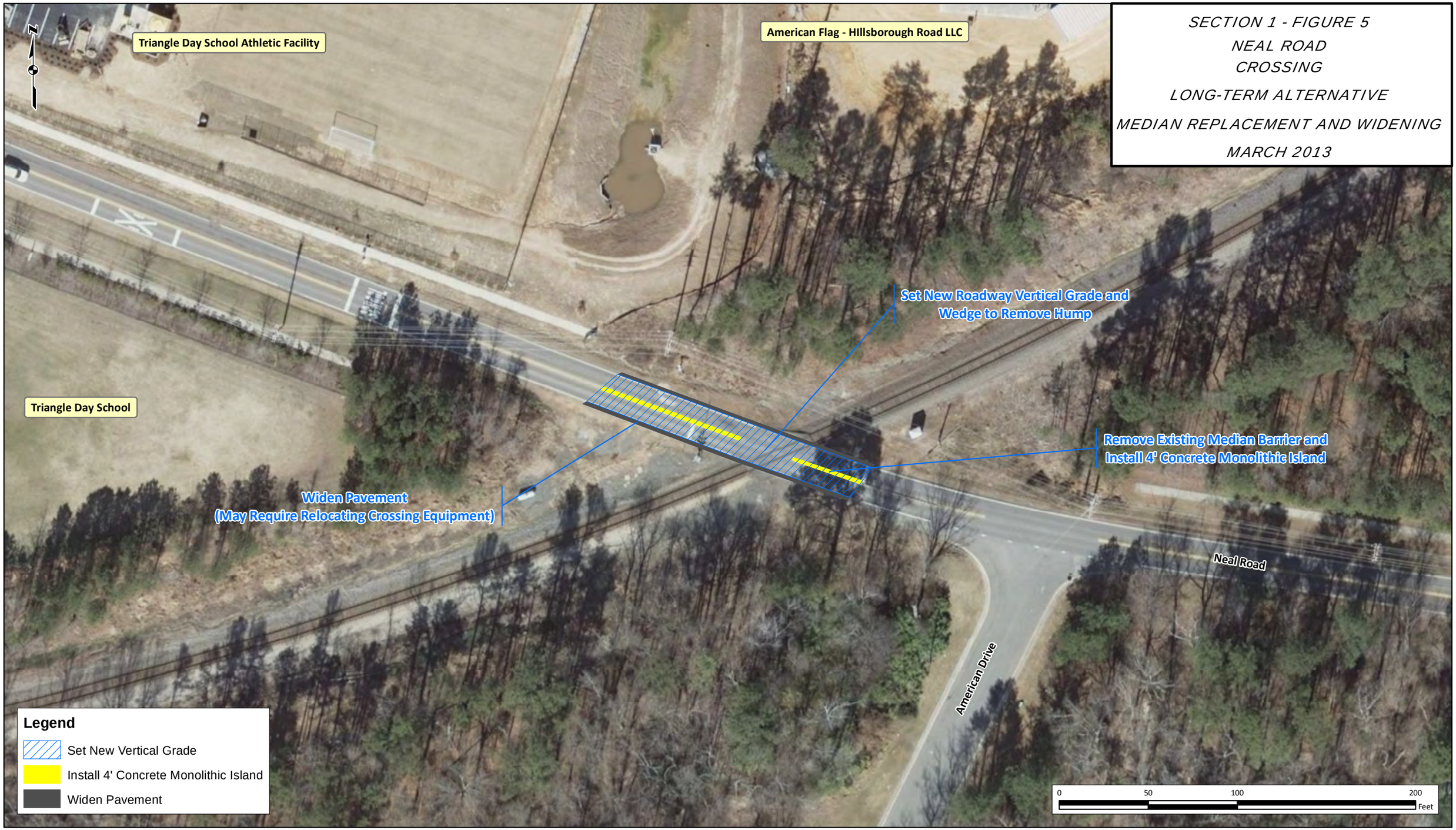
triangletransit

NS NORFOLK SOUTHERN

Near-Term Recommendations
None

Mid-Term Recommendations
None

Alternative Long-Term Recommendations (At-Grade Crossing)
Remove existing median barrier and install 4' concrete monolithic island
Widen pavement (may require relocating crossing equipment)
Set new roadway vertical grade and wedge to remove hump



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Near-Term Recommendations
None

Mid-Term Recommendations
None

Alternate Long-Term Recommendations
Grade Separation - Bridge Over Rail

H.2. N. Lasalle Street (Crossing No. 735 205A, Milepost H 52.04)

Existing Conditions

There are approximately 13,000 vpd on N. Lasalle Street across the railroad track, which has a four-quadrant gate. The FRA data form stated that there were 0% trucks at this crossing; although it is unlikely that there are no trucks, Lasalle Street does not have an interchange with NC 147 and land uses are university and residential south of NC 147, with few destinations for large trucks. The nearest major intersection is a signalized intersection at Hillsborough Road (US 70), about 500 feet north. To the south, N. Lasalle Street crosses over NC 147 before continuing south and eventually connecting with Erwin Road.

Sidewalks are in all four quadrants but do not cross the tracks. Pedestrians were observed, and citizens observed that this area is heavily used by pedestrians to go to work and during lunchtime. The Durham bike map identifies that Lasalle Street between Sprunt Avenue and Circuit Drive is often used by experienced cyclists, but is not a designated route. The Durham Long Range Bicycle Plan proposes a bike lane on Lasalle Street across the railroad tracks, between Sprunt Avenue and Circuit Drive. NCDOT Project C-5178 proposes sidewalks on Campus Walk Avenue along Lasalle Street between Kangaroo Drive and Erwin Road. Construction is scheduled to begin in fiscal year 2013. One DATA route (#11) uses Lasalle Street across the railroad tracks. A Triangle Transit station is proposed at Erwin and Lasalle Roads. Duke University bus route H-6 uses this crossing. Durham County school buses use this crossing 44 times each day.

Citizens and stakeholders commented that N. Lasalle Street is a busy shopping area used by vehicles, pedestrians, and buses. A concern was noted that vehicles pass buses when the buses are stopped at the crossing. Suggestions included improved signage, improving bicycle and pedestrian accommodations, and grade separating the crossing.

The near-term recommendation at this location is a median barrier. The City has also considered an alternative to restripe the lanes to provide wider shoulders for pedestrians to use, in lieu of a median, which would not require widening of the existing pavement.

Businesses and light industries are located in all four quadrants. The Hillandale Golf Course is north of the crossing.

Alternatives

Near term solutions have been developed, although a long term solution to grade separate is also proposed. These near term solutions could be implemented instead of, or in addition to, the long term solution.

The proposed median barrier is intended to restrict vehicles from passing buses who are stopped at the crossing. It would extend between the crossing and the nearest driveways to the north and south.

Near Term Alternative (Figure F.1 in Appendix F)

- Install grade-crossing warning sign on westbound Pettigrew Street [the City has made this improvement since draft recommendations were made to stakeholders]
- Install median barrier between crossing and nearest driveways to the north and south

Mid Term Alternative – None

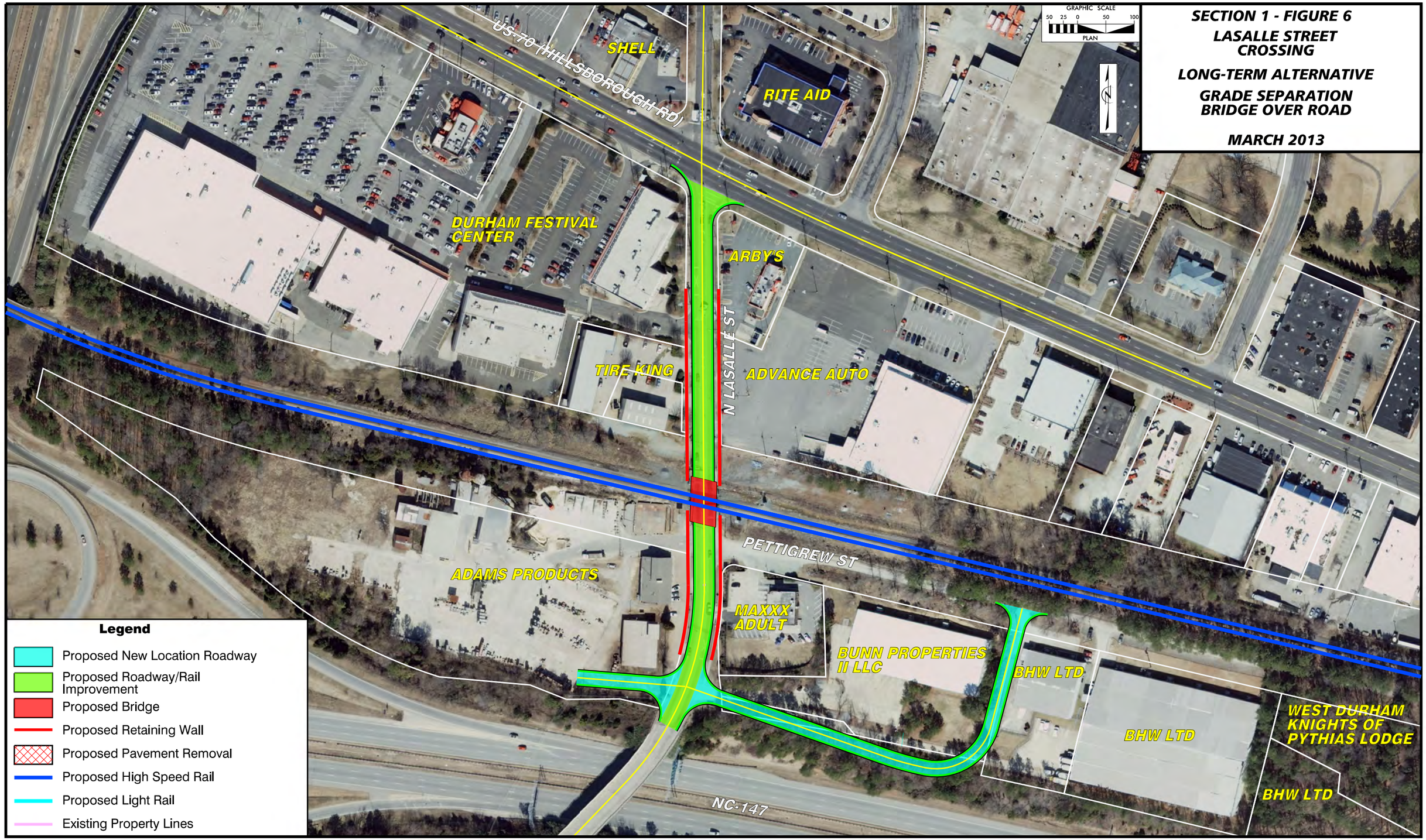
Long Term Alternative (Figures 6 and 7)

- Grade separation

Table H.3. Design Considerations – N. Lasalle Street

Design Considerations	Grade Separation
Alignment	Retain existing roadway location
Rail Crossing	Grade separate. Approximate location of proposed high-speed rail taken into consideration
Business Impacts	Revised access to all businesses between the railroad and NC 147. Access can be maintained east of Lasalle St by constructing new frontage road, access west of Lasalle St is maintained by relocating the main driveway to the south, access from Lasalle St. to Advance Auto and Shopping center is restricted and existing access points from Hillsborough Rd must be used instead
Residential Impacts	None
Local Road Impacts	Requires construction of frontage road to access Pettigrew St
Retaining Walls	Retaining walls required – Height 5' to 20'

Note: Design data is in Appendix E.



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Near-Term Recommendations
Install grade-crossing warning sign on westbound Pettigrew Street
Install median barrier between crossing and nearest driveways to the north and south

Mid-Term Recommendations
None

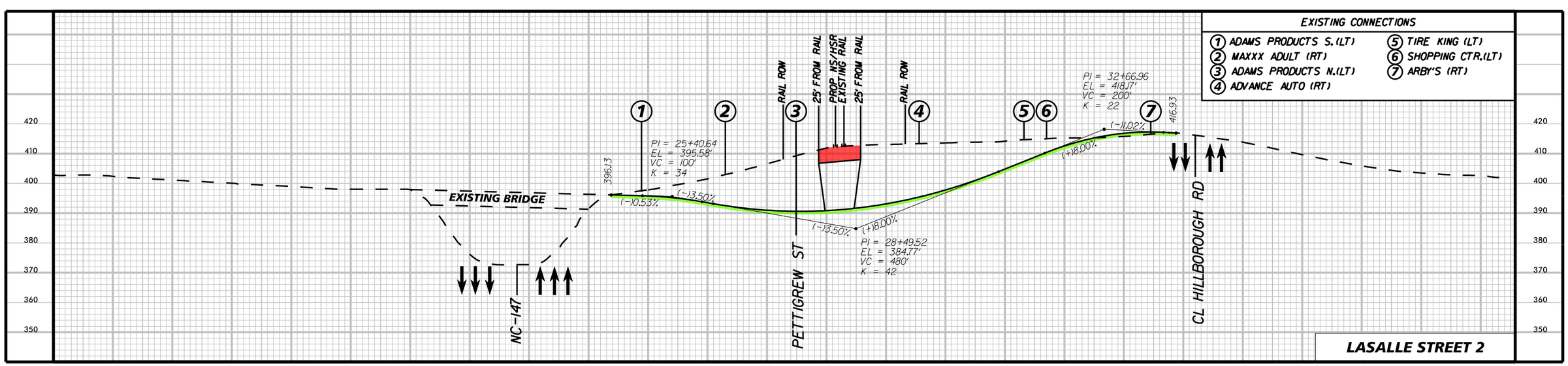
SECTION 1 - FIGURE 7

LASALLE STREET CROSSING

LONG-TERM ALTERNATIVE

GRADE SEPARATION BRIDGE OVER ROAD

MARCH 2013



H.3. Anderson Street (Crossing No. 910 594N, Milepost H 53.21)

Existing Conditions

Anderson Street carries approximately 8,200 vpd with 5% trucks across the railroad track. Anderson Street intersects with Main Street with a traffic signal about 75 feet north of the tracks, with a set of signal heads in advance of the crossing for northbound traffic. This traffic signal was upgraded in June 2010. Anderson Street is named 15th Street north of Main Street, and tees into Hillsborough Road about 1,000 north of the tracks. To the south, it bridges over NC 147 before intersecting with Erwin Road at another traffic signal about 500 feet south of the tracks. It then continues south past Duke University until it tees into Chapel Hill Road. A four-quad gate is on Anderson Street at the track.

Sidewalks are on Anderson Street north of Main Street and south of Erwin Road, and a bicycle lane on Anderson Road ends south of Erwin Road. Some pedestrians and a high number of bicyclists were observed, likely traveling between the schools to the south and the neighborhoods to the north. Sidewalks are in all four quadrants, including a paved, unmarked shoulder across the tracks on both sides. The Durham bike map identifies that Anderson Avenue between Hillsborough Road and Duke University Drive is often used by experienced cyclists, but is not a designated route. The Durham Long Range Transportation Plan proposes a bike lane on Anderson Street across the railroad tracks, between Markham Avenue and Chapel Hill Road. Duke University bus routes H-3 and H-5 use this crossing.

Duke University is considering a pedestrian connection across NC 147 and the railroad tracks, in part using the disconnected railroad bridge west of Anderson Street. Triangle Transit proposes a light rail station between Hillandale Road and Trent Street, and TTA's *Durham-Wake County CRT Corridor Alternatives Analysis* assumes the disconnected railroad bridge will be used for pedestrian access between the new station and Duke University. No funding is available for the pedestrian connection, and Duke University (who owns the disconnected railroad bridge) has not begun coordination with Norfolk Southern or NCRR.

Anderson Street is one of the few remaining at-grade connectors across NC 147, and historically was left open as part of reducing the level of impact of NC 147 to adjacent neighborhoods. Citizens and stakeholders suggested adding turn lanes to keep traffic flowing when train crossing arms are down, improving bicycle and pedestrian accommodations, and improving signage for northbound traffic.

Land uses are forest immediately adjacent to the tracks; residential and business to the north (where Anderson Street turns into Fifteenth Street); and residential and school to the south. The next crossing to the west is Hillandale Road/Fulton Street (grade separated). Hillandale Road/Fulton Street is a congested road, but widening across the railroad would be difficult because of physical constraints. The next crossing to the east is Erwin Road/9th Street (grade separated), which has a height restriction of 11'-8". The West Durham Historic District is northeast of the crossing, bound by Main Street on the south and between 15th Street and Rutherford Street on the west.

Alternatives

Near Term Alternative (Figure F.2 in Appendix F)

- Stripe outside edges of travel lane across railroad crossing [the City has made this improvement since draft recommendations were made to stakeholders]

Mid Term Alternative – None

Long Term Alternative – None

H.4. Swift Avenue (Crossing No. 735 223X, Milepost H 53.76)

Existing Conditions

There are approximately 12,400 vpd with 2% trucks on Swift Avenue across the railroad track (Swift Avenue becomes Broad Street to the north). Main and Pettigrew Streets parallel the tracks, each within about 100 feet of the tracks; the intersection of Swift Avenue and Main Street to the north is signalized, and the intersection of Swift Avenue and Pettigrew Street to the south has a stop on Pettigrew Street. Swift Avenue is named Broad Street north of Main Street, and passes Duke University East Campus before continuing north past I-85. To the south, Swift Avenue also passes by Duke University before teeing into Duke University Road. There is a four-quadrant gate at the tracks.

There are sidewalks on both sides of Swift Avenue except over the tracks. This area is heavily used by pedestrians and bicyclists. The Durham bike map identifies that Swift Avenue between Main Street and Duke University Road is often used by experienced cyclists, but is not a designated route. Swift Avenue north of Main Street is a shared bike roadway. The City recently restriped Swift Avenue to provide wide outside lanes, although striping does not currently extend over the railroad tracks, which will require NCRR approval. The Durham Long Range Bicycle Plan proposes a bike lane on Swift Avenue across the railroad tracks, between Guess Avenue and Duke University Road. Duke University bus route C-2 uses this crossing. Triangle Transit proposes a future light rail transit rail line south of the Norfolk Southern rail line (preliminary designs from Triangle Transit are shown on Figure 1.4b, and are not intended to be exactly parallel with the existing rail line).

Citizens and stakeholders commented that this is an important connection, but that Swift Avenue frequently backs up, in part because of the confusing travel patterns. There are many access points and it is close to NC 147 and Main Street. Northbound traffic from NC 147 does not always obey signage and often gets "caught" between gates as train approach. Citizens also noted that drivers frequently stop under the crossing arms and on the tracks. Suggestions included retiming the Swift Avenue/Main Street intersection, reducing access points to side streets and/or driveways, and adding signage and pavement markings. Several citizens also suggested improving bicycle and pedestrian accommodations.

Several businesses are in the northwest quadrant, Duke University campus is in the northeast quadrant (although there are no building immediately adjacent to the tracks), and medical facilities associated with Duke are in the south quadrants. Pettigrew Street terminates on the west side into the business parking lot, and tees into Erwin Street on the east side. The Duke School for Children is south of NC 147. The Powe House in the southwest quadrant of Pettigrew Street and Swift Avenue is listed on the NRHP.

Alternatives

Several near term and mid term solutions have been developed. These near term and mid term alternatives should be implemented. Due to the close proximity of the unsignalized intersection of Swift Avenue/Pettigrew Street to the intersection of Swift Avenue/Main Street and the railroad, consideration should be given for signalization of the intersection.

Near Term Alternative (Figure F.3 in Appendix F)

- Widen asphalt shoulder and stripe outside edge of travel lane on west side of Swift Avenue over railroad tracks [the City has striped the edge of the travel lane since draft recommendations were made to stakeholders]
- Install grade-crossing warning signs on eastbound and westbound Pettigrew Street [the City has made this improvement since draft recommendations were made to stakeholders]
- Install crosswalk markings on Swift Avenue and Pettigrew Street, and install/upgrade curb ramps

Mid Term Alternative (Figure F.4 in Appendix F)

- Signalize Swift Avenue/Pettigrew Street intersection

Long Term Alternative – None

H.5. Buchanan Boulevard (Crossing No. 735 225L, Milepost H 54.20)

Existing Conditions

Buchanan Boulevard carries approximately 7,700 vpd with 1% trucks across the railroad track. Main Street is parallel with the track approximately 250 feet to the north, and the intersection of Buchanan Boulevard and Main Street is signalized. Buchanan Boulevard continues north past Duke University East Campus, and tees into Club Boulevard near I-85. To the south, Buchanan Boulevard is a residential street that ends just south of Chapel Hill Street.

Sidewalks are located on both sides of Buchanan Boulevard near the crossing, with a continuous, marked asphalt crossing on the west side and a channelized crossing on the east side across the track. Some pedestrians and a higher number of bicyclists were observed across the track. The Durham bike map identifies that Buchanan Boulevard between Markham Avenue and Chapel Hill Street is often used by experienced cyclists, but is not a designated route. The Durham Long Range Bicycle Plan proposes a bike lane on Buchanan Boulevard across the railroad tracks, between Club Boulevard and Chapel Hill Street. Triangle Transit proposes a future light rail transit rail line south of the Norfolk Southern rail line. Durham County school buses use this crossing 17 times each day.

Citizens and stakeholders commented that this is an important connection for Duke and other businesses, but they do not feel it has safety concerns. Several requested improved bike and pedestrian accommodations across the track.

Businesses and industrial warehouses are located in all four quadrants, including an old Coca-Cola office that has been converted to Duke offices in the northeast quadrant. The Smith Warehouses on the south are listed in the NRHP. The Brightleaf District is just east of the crossing.

Alternatives

Widening or grade separating this crossing was considered but dismissed because of the proximity of historic buildings in the southeast and southwest quadrants. An alternative to close this crossing was not included because of its importance to Duke University.

Near Term Alternative (Figure F.5 in Appendix F)

- Install/upgrade curb ramps

Mid Term Alternative – None

Long Term Alternative – None

H.6. Duke Street (Crossing No. 735 227A, Milepost H 54.60)

Existing Conditions

Duke Street carries approximately 10,200 vpd with 2% trucks one-way (northbound) across the railroad track. Peabody Street is parallel with the track on the north, and Pettigrew Street is parallel with the track on the south; both end at Duke Street and do not continue to the east. Both adjacent intersections are unsignalized. Duke Street is a major north-south connector, and has interchanges with NC 147 to the south. To the north, it continues to I-85, also accessing Durham School of the Arts, Durham Regional Hospital, Durham County Stadium, and downtown Durham.

Pedestrians and bicyclists were observed crossing the track. Sidewalks on Duke Street extend across the tracks on the east side and end on the south side at Pettigrew Street on the west side. The Durham Long Range Bicycle Plan proposes a bike lane on Duke Street across the railroad tracks, between Roxboro Street and University Drive. Two DATA routes (#1 & #11) use Duke Street across the railroad tracks. Triangle Transit proposes a future light rail transit rail line south of the Norfolk Southern rail line (preliminary designs from Triangle Transit are shown on Figure 2.1d, and are not intended to be exactly parallel with the existing rail line). Durham County school buses use this crossing eight times each day.

Citizens and stakeholders noted that this is a heavily used pedestrian crossing, and recommended bicycle and pedestrian improvements to separate this traffic from motor vehicles. Several people emphasized the importance of this crossing, and suggested enhanced signal equipment such as additional warning lights further south on Duke Street to warn approaching traffic of oncoming trains.

The Amtrak station is in the northeast quadrant. Businesses are located in all four quadrants, and Duke Memorial United Methodist Church is one block south of the crossing. The Duke Memorial United Methodist Church in the northwest corner of Chapel Hill Street and Duke Street is on the NRHP. The Brightleaf Historic District is northeast of the crossing, bound by the railroad right of way on the south and Duke Street on the west.

Alternatives

Several near term solutions have been developed.

Near Term Alternative (Figure F.6 in Appendix F)

- Install crosswalk markings across Duke Street and Peabody Street, and install/upgrade curb ramps
- Install sidewalk on west side of Duke Street between Pettigrew Street and existing sidewalk, and pave Pettigrew Street apron

Mid Term Alternative – None

Long Term Alternative – None

H.7. Chapel Hill Street (Crossing No. 735 228G, Milepost 54.80)

Existing Conditions

Chapel Hill Street is a grade-separated crossing with approximately 13,000 vpd (NCDOT 2011 AADT maps) traveling under three railroad bridges, which have a clearance of 12'-0". The City recently installed new lighting under the railroad bridge on Chapel Hill Street. One bridge carries an active Norfolk Southern track and a disconnected track, and two disconnected tracks are each on bridges east of the active track. Chapel Hill Street intersects with the Downtown Loop to the east and Pettigrew Street to the west, both with traffic signals. Chapel Hill Street has an interchange with NC 147 to the west, continuing to Duke University. To the east, Chapel Hill Street tees into Morgan Street in downtown Durham.

A high number of pedestrians were observed walking on the Chapel Hill sidewalks under the railroad bridge. Stakeholders requested improved landscaping in this corridor. Chapel Hill Street between Ramseur Street and Mangum Street is a shared bike roadway. West of Ramseur Street, the Durham bike map identifies that Chapel Hill Street as an area often used by experienced cyclists, but it is not a designated route. The Durham Long Range Transportation Plan proposes a bike lane on Chapel Hill Street under the railroad bridge, between Broad Street and Main Street. Several DATA routes and the Bull City Connector use Chapel Hill Street under the railroad tracks frequently. Triangle Transit proposes a future light rail transit rail line south of the Norfolk Southern rail line (preliminary designs from Triangle Transit are shown on Figure 2.2b, and are not intended to be exactly parallel with the existing rail line).

The Amtrak station is in the northwest quadrant, the Durham Station Transportation Center is in the southwest quadrant, and businesses are on the east. The Brightleaf Historic District is on the north side of the crossing, bound by the railroad right of way on the south and east. The Downtown Durham Historic District is on the east side of the crossing, bound by the Downtown Loop/Ramseur Street.

Alternatives

Although this is a grade-separated crossing, several improvements are proposed as part of the overall downtown Durham study. This crossing was included as part of an early submittal focused on the downtown; the full downtown submittal is included in Appendix H.

Near Term Alternative (Figure F.7 in Appendix F)

- Add raised concrete island as pedestrian refuge, install/upgrade curb ramps, apply new crosswalk markings, and install pedestrian signal heads at the Chapel Hill Street/Downtown Loop intersection
- Construct a sidewalk on the north side of Ramseur Street from Queen Street to Roxboro Street, including a ramp down the slope adjacent to the Ramseur Street bridge over Roxboro Street
- Remove existing sidewalk on the north side of Pettigrew Street from Chapel Hill Street to the end of the sidewalk, and reconstruct the pedestrian ramp to redirect pedestrians to the crosswalk across Pettigrew Street
- Sandblast, repair, and repaint bridge structure and wingwalls. Improve landscaping on top of wingwalls. Repair the sidewalks in the railroad tunnel. Add pedestrian lighting in railroad tunnel [the City has made this improvement since draft recommendations were made to stakeholders]

Mid Term Alternative (Figure F.8 in Appendix F)

- Remove two disconnected railroad tracks and bridges over Chapel Hill Street

Long Term Alternative – None

H.8. Blackwell/Corcoran Street (Crossing No. 735 229N, Milepost 55.09)

Existing Conditions

There are approximately 4,900 vpd with 1% trucks on Blackwell/Corcoran Street across the railroad track. Blackwell/Corcoran Street intersects with Ramseur Street to the northeast and Pettigrew Street to the southwest, both with traffic signals. Southbound vehicles stopped at Pettigrew Street frequently queue over the railroad tracks. Blackwell Street transitions to residential after crossing under NC 147 to the south. To the north, Corcoran Street terminates in downtown Durham, accessing the Durham Farmers' Market and Durham Athletic Park. Ramseur Street/Downtown Loop, which connects with Corcoran Street east of the railroad tracks, is proposed to be converted from one-way operation to two-way operation, although the project is not funded. Four-quad gates are at this crossing.

A large number of pedestrians and some bicyclists were observed along this corridor. Sidewalks are on both sides of Blackwell/Corcoran Street except over the railroad track, where a variable-width asphalt path provides some continuity. Blackwell/Corcoran Street is the Downtown Bicycle Trail connecting the American Tobacco Trail and the N-S Greenway. It is signed as a shared bike roadway between Geer Street and NC 147, and a multiuse path begins south of NC 147. The Durham Long Range Bicycle Plan proposes a bike lane on Blackwell/Corcoran Street across the railroad tracks, between Main Street and University Drive, and proposes a shared road/signed route between Main Street and Chapel Hill Street. The Bull City Connector and several DATA routes use this crossing frequently. Triangle Transit proposes a future light rail transit rail line south of the Norfolk Southern rail line (preliminary designs from Triangle Transit are shown on Figure 2.3b, and are not intended to be exactly parallel with the existing rail line). Durham County school buses use this crossing four times each day.

Two disconnected railroad tracks are parallel with the active Norfolk Southern track to the north, one is on both sides of Blackwell/Corcoran Street and one that is only on the west side. Citizens and stakeholders commented that the traffic signals at the Blackwell Street/Pettigrew Street and Corcoran Street/Ramseur Street were not interconnected, which seemed to increase delay for vehicles traveling through those intersections. Ramseur Street is one-way eastbound, although the City plans to convert the Downtown Loop/Ramseur Street to two-way once funding becomes available.

Comments were received both supporting closure of this crossing and stating that Blackwell/Corcoran Street is an essential connector in downtown. Many suggested improving bicycle and pedestrian accommodations, such as providing a smoother path or constructing a grade separated pedestrian crossing. Several citizens and stakeholders also requested improved landscaping in this corridor. The Downtown Durham Historic District is on the north side of the crossing, bound by the Downtown Loop/Ramseur Street. The W.T. Blackwell and Co. (Bull Durham) Tobacco Factory on the southwest corner of Blackwell Street and Pettigrew Street is listed on the NRHP. The Durham Performing Arts Center (DPAC) is in the southeast quadrant, with businesses and office buildings in the other three quadrants. The American Tobacco District and Durham Bulls Field are on south of the crossing.

Alternatives

Several alternatives have been made in the near term, although this crossing is proposed to be grade-separated long term. The near term improvements proposed are relatively low cost and/or were determined to be important to the safety of vehicles, pedestrians, and trains at the crossing. For example, streetscape lighting and street furniture is proposed in the near team to bring consistency with the downtown streetscaping design, although some of the streetscape elements would likely be removed or changed when the TTA rail line is constructed. This crossing was included as part of an early submittal focused on the downtown; the full downtown submittal is in Appendix H.

Near Term Alternative (Figure F.9 in Appendix F)

- Mill pavement at both intersections and resurface with stamped asphalt
- Install/upgrade curb ramps, and construct a concrete sidewalk with curb and gutter and brick trim on both sides of Blackwell/Corcoran Street (except over the railroad, which will use standard asphalt pavement for sidewalk connectivity) [the City has restriped the asphalt over the railroad tracks since draft recommendations were made to stakeholders]
- Add interconnectivity between Pettigrew Street and Ramseur Street traffic signals
- Construct restricted access for rail maintenance vehicles on Blackwell/Corcoran Street between the railroad track and Ramseur Street
- Install streetscape lighting and street furniture along Blackwell/Corcoran Street as a continuation of the downtown streetscaping plan

Mid Term Alternative (Figure F.10 in Appendix F)

- Remove crosswalk on the north side of Pettigrew Street across Blackwell Street (to be done after TTA track is constructed), and remove associated pedestrian ramps and pedestrian signals
- Construct a sidewalk on the south side of Pettigrew Street between Blackwell Street and Mangum Street

Long Term Alternative (Figures 8 and 9)

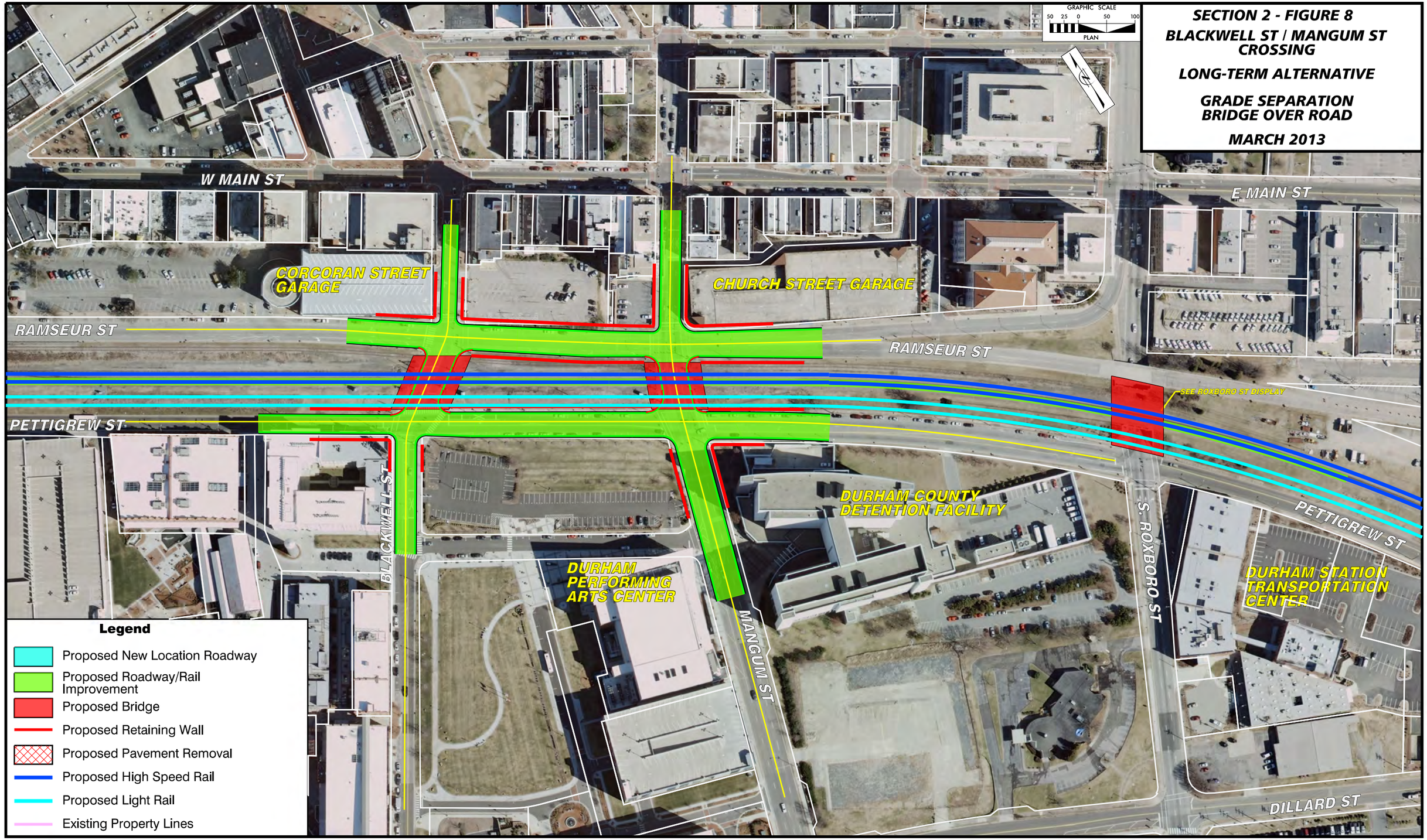
- Grade separation –The estimated construction cost assumes individual bridges over Blackwell/Corcoran Street and over Mangum Street. If this alternative is selected, an extended bridge spanning both roads may also be considered.

Table H.4. Design Considerations – Blackwell/Corcoran Street and Mangum Street

Design Considerations	Grade Separation
Alignment	Retain existing road locations
Rail Crossing	Grade separate Blackwell St and Mangum St under NS rail and proposed TTA light rail, approximate location of proposed high-speed rail taken into consideration
Business Impacts	None
Residential Impacts	None
Local Road Impacts	None
Retaining Walls	Retaining walls required – Height: 5' to 15'

Note: Design data is in Appendix E.

SECTION 2 - FIGURE 8
BLACKWELL ST / MANGUM ST CROSSING
LONG-TERM ALTERNATIVE
GRADE SEPARATION BRIDGE OVER ROAD
MARCH 2013



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Near-Term Recommendations
Mill pavement at four intersections and resurface with stamped asphalt
Construct or improve pedestrian ramps where needed at four intersections, and construct a concrete sidewalk with curb and gutter and brick trim on both sides of Blackwell/Corcoran Street and Mangum Street (except over the railroad, which will use standard asphalt pavement for sidewalk connectivity).
Add interconnectivity between Pettigrew Street and Ramseur Street traffic signals.
Construct restricted access for rail maintenance vehicles on Blackwell/Corcoran Street between the railroad track and Ramseur Street.
Install streetscape lighting and street furniture along Blackwell/Corcoran Street as a continuation of the downtown streetscaping plan.

Near-Term Recommendations (Continued)
Remove pedestrian path and railing in the northeast quadrant of the Mangum Street/Pettigrew Street intersection.
Install a decorative fence on the south side of Ramseur Street from Mangum Street to east of Roxboro Street.

Mid-Term Recommendations
Remove crosswalk on the north side of Pettigrew Street across Blackwell Street and Mangum Street (to be done after TTA track is constructed), and remove associated pedestrian ramps and pedestrian signals.
Construct a sidewalk on the south side of Pettigrew Street between Blackwell Street and Mangum Street.

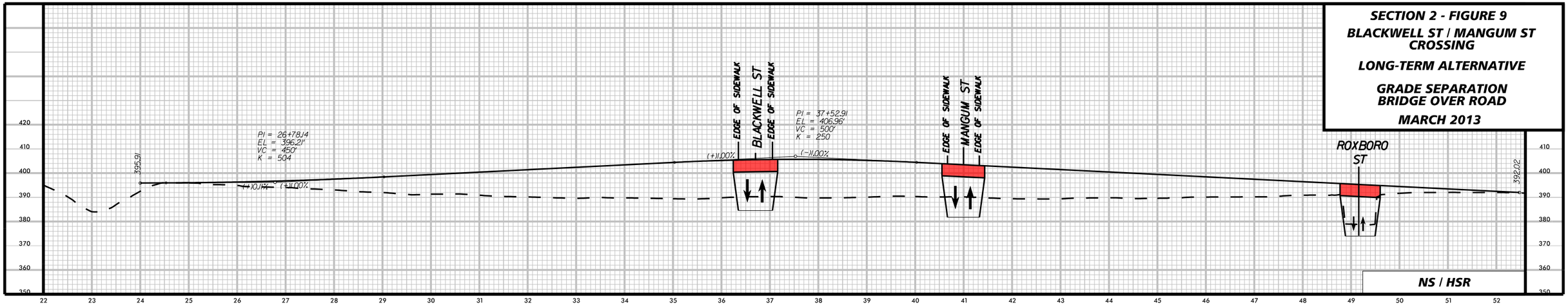
SECTION 2 - FIGURE 9

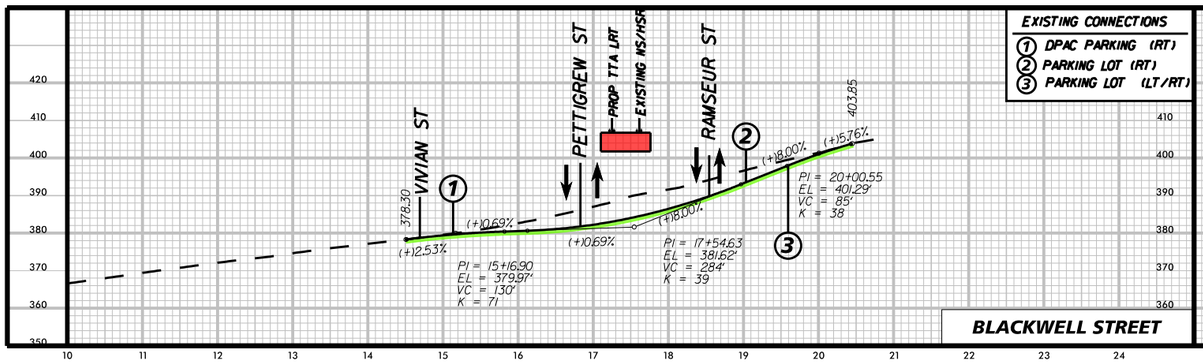
BLACKWELL ST / MANGUM ST CROSSING

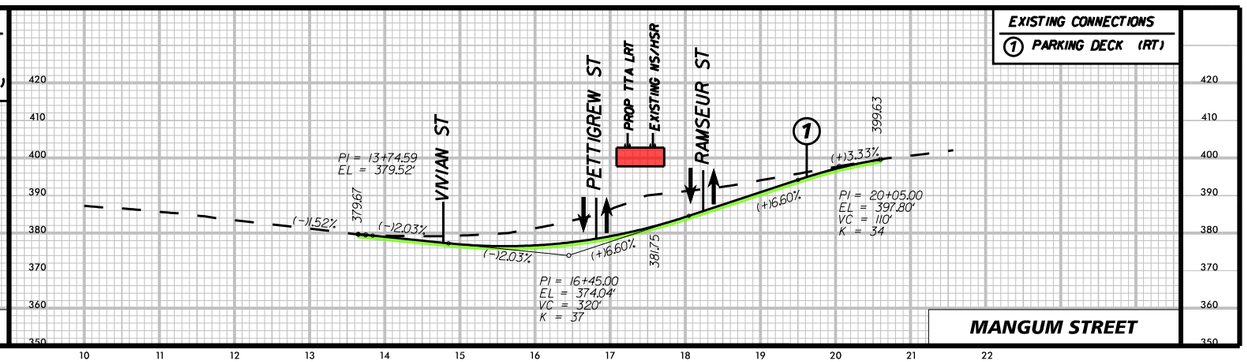
LONG-TERM ALTERNATIVE

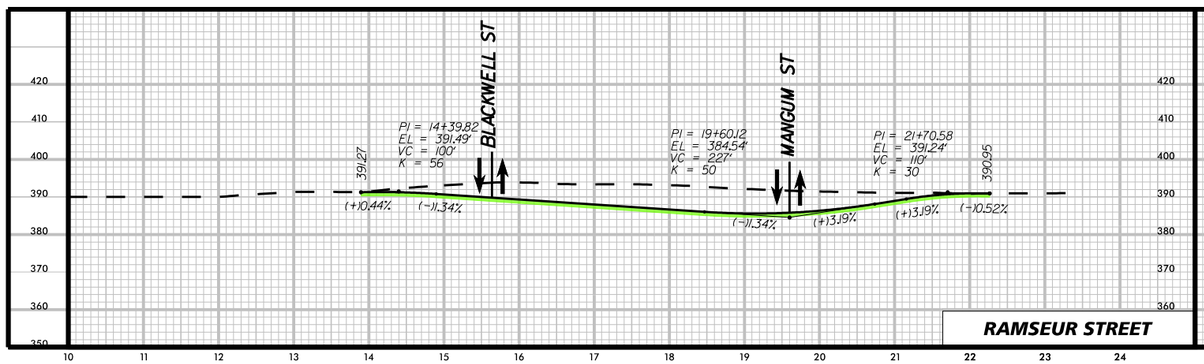
GRADE SEPARATION BRIDGE OVER ROAD

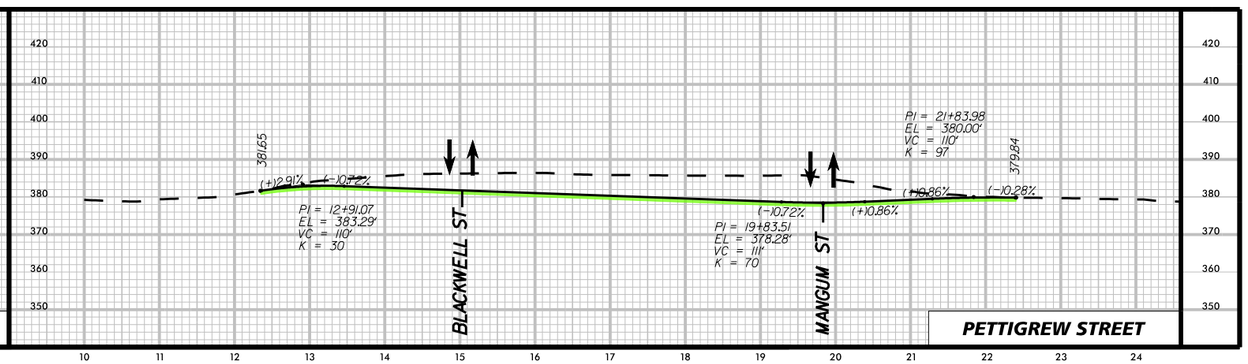
MARCH 2013











H.9. Mangum Street (Crossing No. 735 231P, Milepost H 55.14)

Existing Conditions

Mangum Street (US 15/501) carries approximately 8,000 vpd with 2% trucks traveling one-way (southbound) across the railroad track. Mangum Street intersects with Ramseur Street to the northeast and Pettigrew Street to the southwest, both with traffic signals. Southbound vehicles stopped at Pettigrew Street frequently queue over the railroad tracks. South of the crossing, the Mangum Street/Roxboro Street one-way pair has an interchange with NC 147, and north of downtown the two streets join together before an interchange with I-85. Ramseur Street/Downtown Loop, which connects with Mangum Street east of the railroad tracks, is proposed to be converted from one-way operation to two-way operation, although the project is not funded.

A large number of pedestrians and some bicyclists were observed along this corridor. Sidewalks are on both sides of Mangum Street except over the railroad track, where a striped asphalt path provides continuity. The Durham Long Range Bicycle Plan proposes a bike lane on Mangum Street across the railroad tracks, between Markham Avenue and University Drive. Durham County school buses use this crossing 32 times each day, and noted existing issues with clearing the railroad tracks because of the proximity of the Mangum Street/Pettigrew Street intersection.

Several DATA routes use this crossing frequently. Triangle Transit proposes a future light rail transit rail line south of the Norfolk Southern rail line (preliminary designs from Triangle Transit are shown on Figure 2.4b, and are not intended to be exactly parallel with the existing rail line).

Ramseur Street is one-way eastbound, although the City plans to convert the Downtown Loop/Ramseur Street to two-way once funding becomes available. A disconnected railroad track is parallel with the active Norfolk Southern track to the north.

Citizens noted that this is an essential crossing, and should either remain open or should be grade separated. Several citizens and stakeholders also requested improved landscaping in this corridor. The American Tobacco District and Durham Bulls Field are on south of the crossing. The Downtown Durham Historic District is on the north side of the crossing, bound by the Downtown Loop/Ramseur Street.

Alternatives

Several alternatives have been made in the near term, although this crossing is proposed to be grade-separated long term. The near term improvements proposed are relatively low cost and/or were determined to be important to the safety of vehicles, pedestrians, and trains at the crossing For example, streetscape lighting and street furniture is proposed in the near team to bring consistency with the downtown streetscaping design, although some of the streetscape elements would likely be removed or changed when the TTA rail line is constructed.

This crossing was included as part of an early submittal focused on the downtown; the full downtown submittal is included in Appendix H.

Near Term Alternative (Figure F.11 in Appendix F)

- Mill pavement at both intersections and resurface with stamped asphalt
- Install/upgrade curb ramps, and construct a concrete sidewalk with curb and gutter and brick trim on both sides of Blackwell/Corcoran Street (except over the railroad, which will use standard asphalt pavement for sidewalk connectivity)
- Install streetscape lighting and street furniture along Blackwell/Corcoran Street as a continuation of the downtown streetscaping plan. Upgrade bus stops on Mangum Street
- Remove pedestrian path and railing in the northeast quadrant of the Mangum Street/Pettigrew Street intersection
- Install a decorative fence on the south side of Ramseur Street from Mangum Street to east of Roxboro Street

Mid Term Alternative (Figure F.12 in Appendix F)

- Remove crosswalk on the north side of Pettigrew Street across Mangum Street (to be done after TTA track is constructed)
- Construct a sidewalk on the south side of Pettigrew Street between Blackwell Street and Mangum Street

Long Term Alternative (Figures 8 and 9)

- Grade separation – either individually or with an extended bridge also spanning Blackwell/Corcoran Street (design considerations are listed in Section H.8)

H.10. Roxboro Street (Crossing No. 735 233D, Milepost H 55.20)

Existing Conditions

Roxboro Street is a grade-separated crossing with approximately 9,000 vpd (NCDOT 2011 AADT maps) traveling one way (northbound) under the railroad bridges, which has a clearance of 11'-4". The City recently installed new lighting under the railroad bridge on Chapel Hill Street. A disconnected railroad track is parallel with the active Norfolk Southern track to the north, and splits into two tracks on the east side of Roxboro Street. South of the crossing, the Mangum Street/Roxboro Street one-way pair has an interchange with NC 147, and north of downtown the two streets join together before an interchange with I-85. Roxboro Street is a major north-south connector, continuing to the north past Durham Regional Hospital to near the Durham County border and south to Martin Luther King Jr. Parkway.

Many trucks have gotten stuck under the Roxboro Street railroad bridge. The City of Durham is working with NCDOT to conduct a low-clearance study of the bridge. Potential alternatives include installing an advance truck detection system, increasing the clearance by lowering the road, or replacing the bridge.

Some pedestrians were observed using the Roxboro Street sidewalks under the railroad bridge and crossing Roxboro Street just north of the bridge. Stakeholders requested improved landscaping in this corridor. The Durham Long Range Bicycle Plan proposes a bike lane on Roxboro Street under the railroad bridge, between Duke Street and University Drive. Several DATA routes use Roxboro Street under the railroad tracks frequently. Triangle Transit proposes a future light rail transit rail line south of the Norfolk Southern rail line. Durham County school buses use this crossing 18 times each day.

Several businesses are located in the southeast quadrant and Durham County buildings, including the detention facility, are in the other three quadrants. The Downtown Durham Historic District is on the north side of the crossing, bound by the Downtown Loop/Ramseur Street. The Venable Tobacco Company Warehouse in the southeast corner of Roxboro Street and Pettigrew Street is listed on the NRHP.

Alternatives

Although this is a grade-separated crossing, several improvements are proposed as part of the overall downtown Durham study. For example, landscaping is proposed in the near team to bring consistency with the downtown streetscaping design, although the landscaping would likely be removed or changed if Blackwell and Mangum Streets are grade separated in the long term.

This crossing was included as part of an early submittal focused on the downtown; the full downtown submittal is included in Appendix H.

Near Term Alternative (Figure F.13 in Appendix F)

- Sandblast, repair, and repaint bridge structure and wingwalls. Improve landscaping on top of wingwalls. Repair the sidewalks in the railroad tunnel. Add pedestrian lighting in railroad tunnel [the City has made this improvement since draft recommendations were made to stakeholders]
- Install a decorative fence on the south side of Ramseur Street from Mangum Street to east of Roxboro Street.
- Remove sidewalk on the north side of Pettigrew Street from Roxboro Street to the end of the sidewalk
- Install/upgrade curb ramps [the City has constructed curb ramps in the northeast and southwest quadrants since draft recommendations were made to stakeholders]

Mid Term Alternative – None

Long Term Alternative (Figures 8 and 9)

- Replace bridge as part of the Blackwell/Mangum Street Grade Separation (design considerations are listed in Section H.8)

H.11. Dillard Street (Crossing No. 735 389C, Milepost H 55.45)

Existing Conditions

Dillard Street carries approximately 1,300 vpd with 1% trucks across the railroad track. Dillard Street is a looping road that connects Mangum Street and Roxboro Street on the south with Ramseur Street and Main Street on the north. A section of Dillard Street from Ramseur Street to Main Street is closed for construction, although pedestrians were observed using that route. The road crosses the track in a horizontal curve. Ramseur Street/Downtown Loop, which connects with Dillard Street east of the railroad tracks, is proposed to be converted from one-way operation to two-way operation, although the project is not funded. Four-quad gates are at this crossing.

Some pedestrians and bicyclists were observed crossing the railroad tracks on Dillard Street. Sidewalks are on both sides of Dillard Street west of Pettigrew Street. A paved shoulder on the north side of Dillard Street crosses the railroad tracks, and there is a paved, striped shoulder on both sides of Dillard Street east of the crossing. Dillard Street between Mangum Street and Holloway Street is a shared bike roadway. The Durham Long Range Transportation Plan proposes a shared road/signed route on Dillard Street across the railroad tracks, between Mangum Street and Holloway Street.

Three DATA routes (#3, #16, #16B) use Dillard Street, with additional routes proposed. Triangle Transit proposes a future light rail transit rail line south of the Norfolk Southern rail line (preliminary designs from Triangle Transit are shown on Figure 2.6b, and are not intended to be exactly parallel with the existing rail line). A Triangle Transit light rail station is proposed between Dillard and Fayetteville Streets. Durham County school buses use this crossing five times each day.

Citizens commented that Dillard Street is an important connection, especially for bicyclist and pedestrians, and will be essential for future growth in this area.

Durham County buildings, including social services, are on both sides of the crossing. Several businesses are also in the vicinity.

Alternatives

A long term alternative is to close this crossing. However, due to potential concerns about pedestrian movement across the tracks, a pedestrian grade separation has been proposed at the existing Dillard Street crossing.

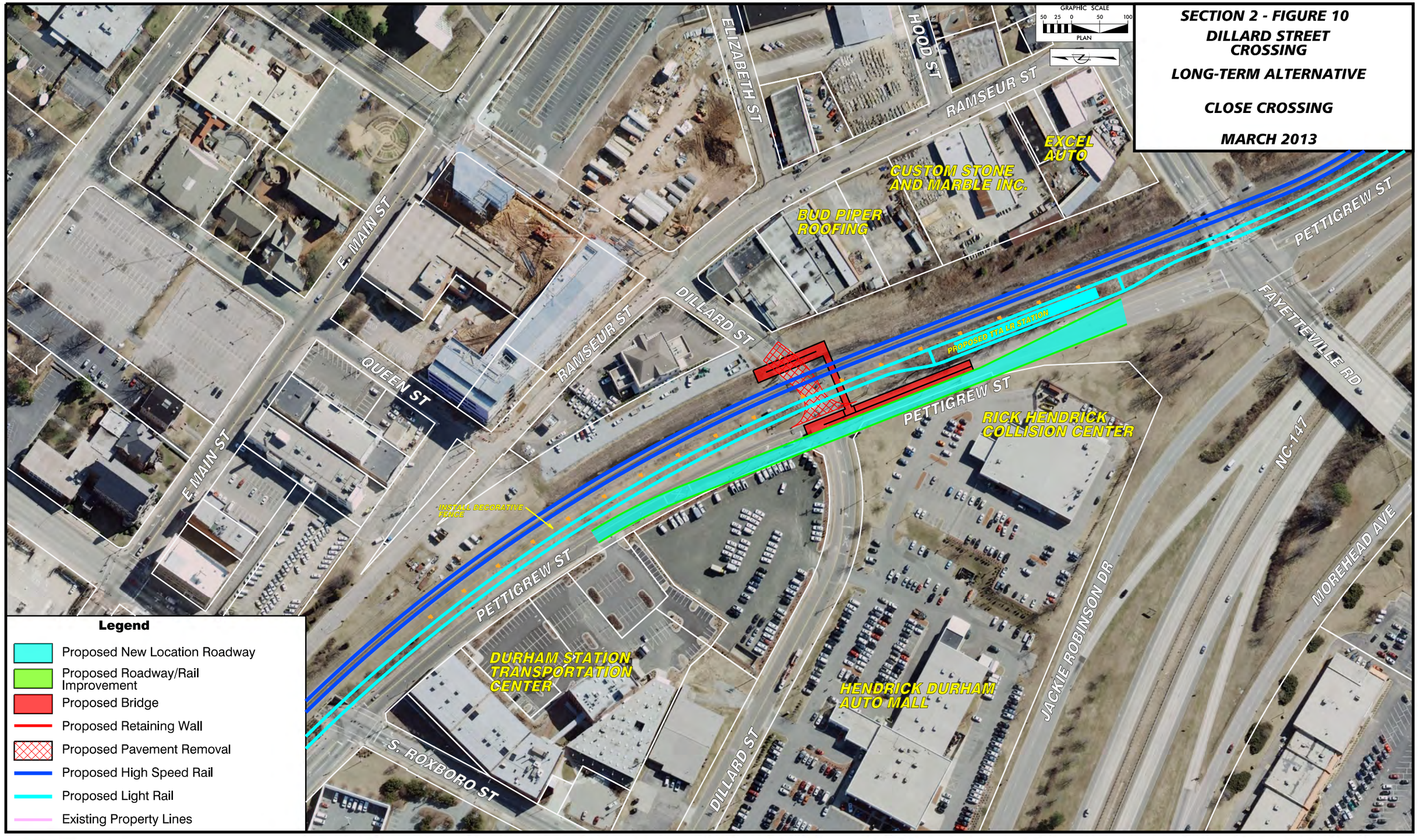
Near Term Alternative – None

Mid Term Alternative – None

Long Term Alternative (Figure 10)

- Close crossing (remove pavement, add signs and landscaping on Dillard Street, and remove railroad crossing gates, signs, and equipment) and construct pedestrian grade separation
- Install decorative fence between Roxboro Road and Fayetteville Road

SECTION 2 - FIGURE 10
DILLARD STREET CROSSING
LONG-TERM ALTERNATIVE
CLOSE CROSSING
MARCH 2013



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Near-Term Recommendations
Widen asphalt shoulders and stripe outside edges of travel lanes

Mid-Term Recommendations
None

H.12. Fayetteville Street (Crossing No. 910 605Y, Milepost H 55.50)

Existing Conditions

There are approximately 12,200 vpd with 1% trucks on Fayetteville Street across the railroad tracks. Pettigrew Street and NC 147 cross Fayetteville Street parallel with the railroad to the south, with Pettigrew Street less than 100 feet from the railroad track and the westbound on/off ramps approximately 100 feet from Pettigrew Street, both signalized intersections. Although there are four-quadrant gates are at this location, it is possible for westbound vehicles to queue across the railroad tracks while waiting at the Fayetteville Road/Pettigrew Street traffic signal. Fayetteville Street is named Elizabeth Street north of Main Street, and extends from downtown Durham through North Carolina Central University to south of the Durham County border. Four-quad gates are at this crossing.

Pedestrians and bicyclists were observed across the tracks. Sidewalks are on both sides of Fayetteville Street with unmarked paved shoulders across the tracks. The Durham bike map identifies that Fayetteville Street between Main Street and Pettigrew Street is often used by experienced cyclists, but is not a designated route. Fayetteville Avenue north of Main Street has a bike lane. The Durham Long Range Transportation Plan proposes a bike lane on Fayetteville Street across the railroad tracks, between Holloway Street and Cornwallis Road. Triangle Transit proposes a future light rail transit rail line south of the Norfolk Southern rail line (preliminary designs from Triangle Transit are shown on Figure 2.7g, and are not intended to be exactly parallel with the existing rail line). A Triangle Transit light rail station is proposed between Dillard and Fayetteville Streets. Durham County school buses use this crossing 11 times each day.

Citizens commented that the two traffic signals present confusion to some drivers. Suggestions included addressing signal issues and enhancements for bicyclists and pedestrians. Several noted that this is an important pedestrian and vehicle link between communities.

Ramseur Street is an unsignalized intersection one block to the north. Businesses are in all four quadrants. DATA buses use this crossing once an hour.

Alternatives

Several near term solutions have been developed, although a long term solution to grade separate is also proposed. These near term alternatives could be implemented instead of, or in addition to, the long term alternative. The alternatives shown on Figures 2.7b through 2.7e and described in the following tables were designed as part of this study. In addition, Triangle Transit has studied grade separating this crossing, shown in Figure 2.7g.

Near Term Alternative (Figure F.14 in Appendix F)

- Install crosswalk markings on Fayetteville Street at Jackie Robinson Drive and Pettigrew Street, and install/upgrade curb ramps
- Install advanced pavement marking on northbound Fayetteville Street
- Stripe outside edges of travel lane across railroad tracks [the City has made this improvement since draft recommendations were made to stakeholders]

Mid Term Alternative (Figure F.15 in Appendix F)

- Install advanced signal heads on Fayetteville Street for westbound traffic approaching the Fayetteville Street/Pettigrew Street intersection, and cut new vehicle detection loops at stop bar on Fayetteville Street east of railroad tracks
- Replace signal heads with optically programmed signal heads (eastbound signal heads at Fayetteville Street/Pettigrew Street intersection, and westbound signal heads at Fayetteville Street/Jackie Robinson Drive intersection)

Long Term Alternative (Figures 11 and 12)

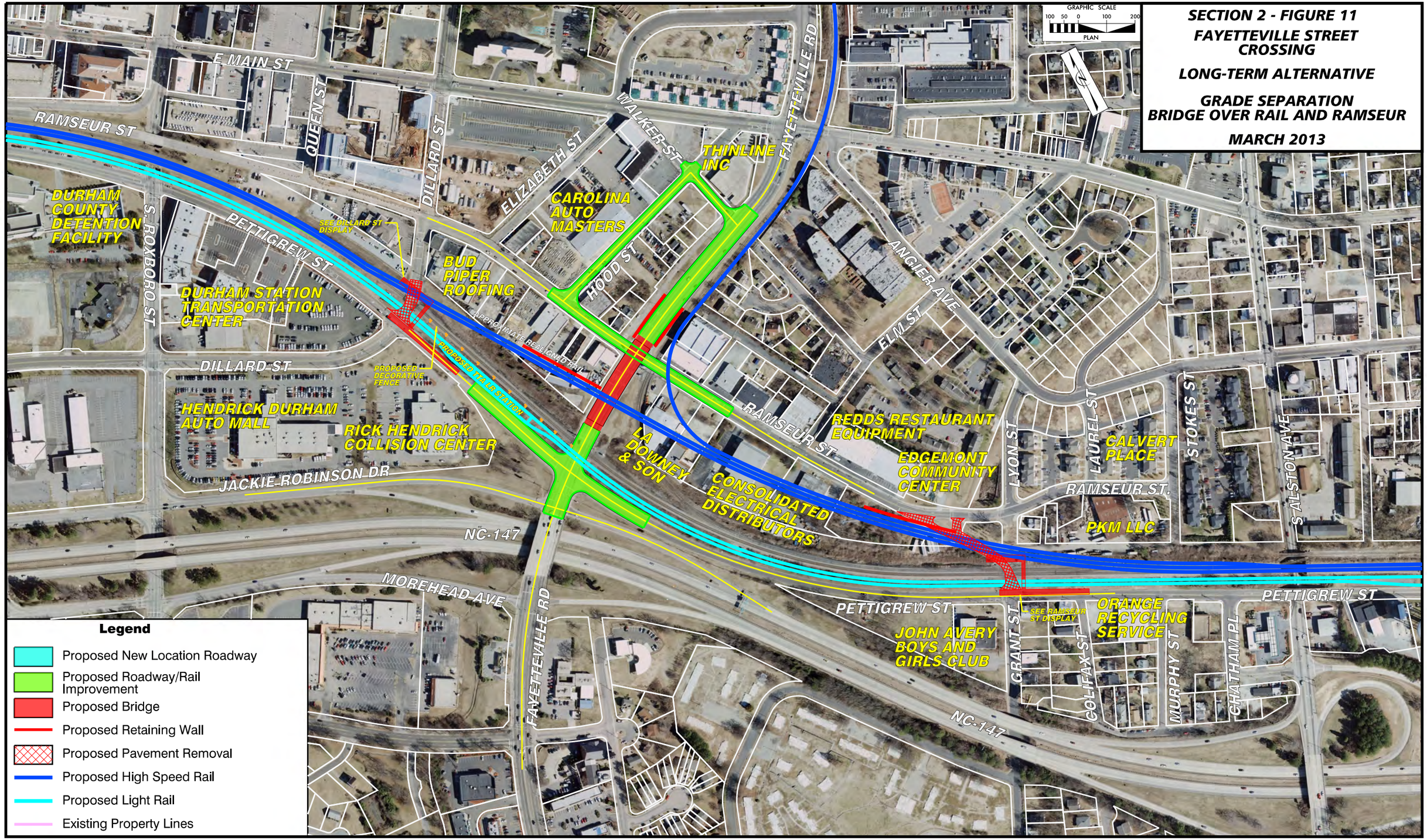
- Grade separation –and Ramseur Street, with rail realignment
- Install decorative fence between Roxboro Road and Fayetteville Road

Table H.5. Design Considerations – Fayetteville Street

Design Considerations	Grade Separation
Alignment	Retain existing roadway locations
Rail Crossing	Grade separate over rail. Approximate location of proposed high-speed rail taken into consideration
Business Impacts	Impacts all businesses in the project area between Ramseur St and Pettigrew St due to rail and rail spur realignment, maintains existing access for businesses north of Ramseur St.
Residential Impacts	May impact three residences east of Fayetteville Rd due to rail spur realignment
Local Road Impacts	Assumes closure of Ramseur St rail crossing, Ramseur St and Fayetteville St intersection is grade separated and access is maintained by utilizing Hood St and Water St as square loop.
Retaining Walls	Retaining walls required – Height 5’ to 20’

Note: Design data is in Appendix E.

SECTION 2 - FIGURE 11
FAYETTEVILLE STREET CROSSING
LONG-TERM ALTERNATIVE
GRADE SEPARATION BRIDGE OVER RAIL AND RAMSEUR
MARCH 2013



Kimley-Horn and Associates, Inc.

Near-Term Recommendations
Install crosswalk markings and ADA curb ramps on Fayetteville Street at Jackie Robinson Drive and Pettigrew Street
Install advanced pavement marking on northbound Fayetteville Street
Stripe outside edges of travel lane across railroad tracks

Mid-Term Recommendations
Install advanced signal heads on Fayetteville Street for westbound traffic approaching the Fayetteville Street/Pettigrew Street intersection, and cut new vehicle detection loops at stop bar on Fayetteville Street east of railroad tracks
Replace signal heads with optically programmed signal heads (eastbound signal heads at Fayetteville Street/Pettigrew Street intersection, and westbound signal heads at Fayetteville Street/Jackie Robinson Drive intersection)

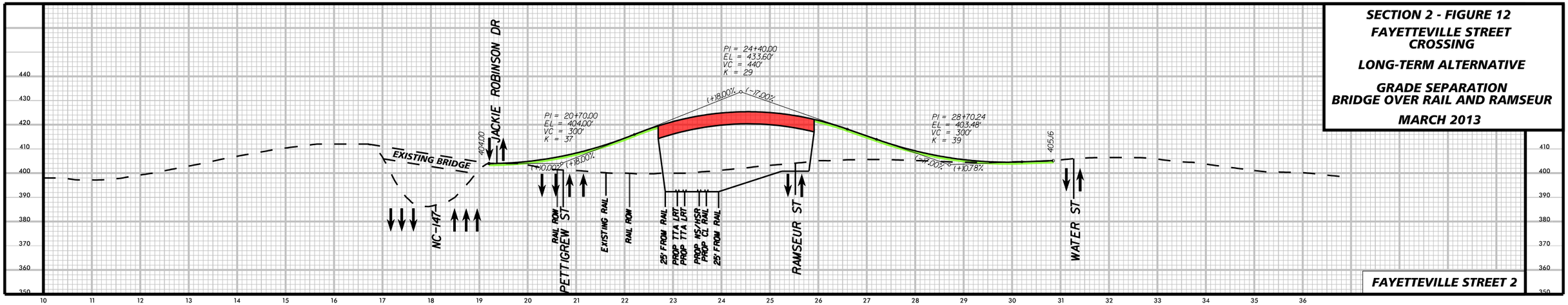
SECTION 2 - FIGURE 12

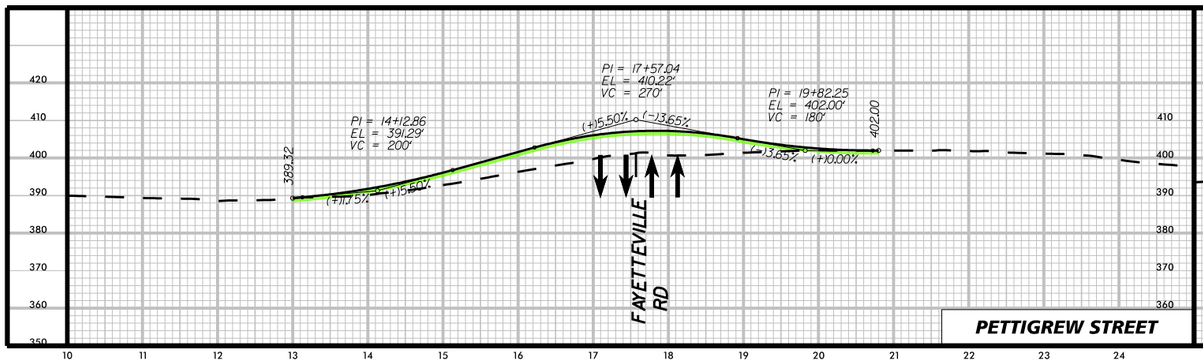
FAYETTEVILLE STREET CROSSING

LONG-TERM ALTERNATIVE

GRADE SEPARATION BRIDGE OVER RAIL AND RAMSEUR

MARCH 2013





H.13. Ramseur Street (Crossing No. 630 474Y, Milepost 55.90)

Existing Conditions

Ramseur Street carries approximately 1,500 vpd with 1% trucks across two railroad tracks. Ramseur Street crosses the tracks perpendicularly, but has a 45 degree curve immediately north of the crossing. Pettigrew Street is parallel with the tracks to the south, and intersects with Ramseur Street/Grant Street with a traffic signal. The traffic signal has advanced signal heads 300 feet north of the intersection, which keeps vehicles from queuing over the tracks. The City upgraded the traffic signal at Ramseur Street/Pettigrew Street in April 2010. Ramseur Street continues northwest, becoming the Downtown Loop. To the southeast, it is named Grant Street, and tees into a residential area south of NC 147.

NCDOT Project U-3308 would widen Alston Avenue from the bridge over NC 147 to US 70 Business/NC 98, including replacing the Norfolk Southern bridges. Alston Avenue is a grade-separated crossing over the railroad approximately 1,000 feet east of Ramseur Street. Triangle Transit proposes a future light rail transit rail line south of the Norfolk Southern rail line (preliminary designs from Triangle Transit are shown on Figure 2.8a, and are not intended to be exactly parallel with the existing rail line). Durham County school buses use this crossing 12 times each day, and noted existing issues with clearing the railroad tracks because of the proximity of the Ramseur Street/Pettigrew Street intersection.

Pedestrians were observed using a dirt path from Laurel Street to Pettigrew Street across the tracks, and bicyclists were observed crossing on Ramseur Street. Citizens have noted that the Boys & Girls Club in the southwest quadrant attracts a high number of pedestrians and bicyclists. There are no sidewalks on Ramseur Street between Laurel Street and Pettigrew Street. Citizens suggested that the Ramseur Street crossing be closed, other than providing pedestrian access.

Land uses are primarily residential except for a trailer storage company located in the northeast quadrant. Additional neighborhoods are under development on the north. Neighborhoods are denser than near Plum Street, and include a high percentage of minority and low-income residents.

Alternatives

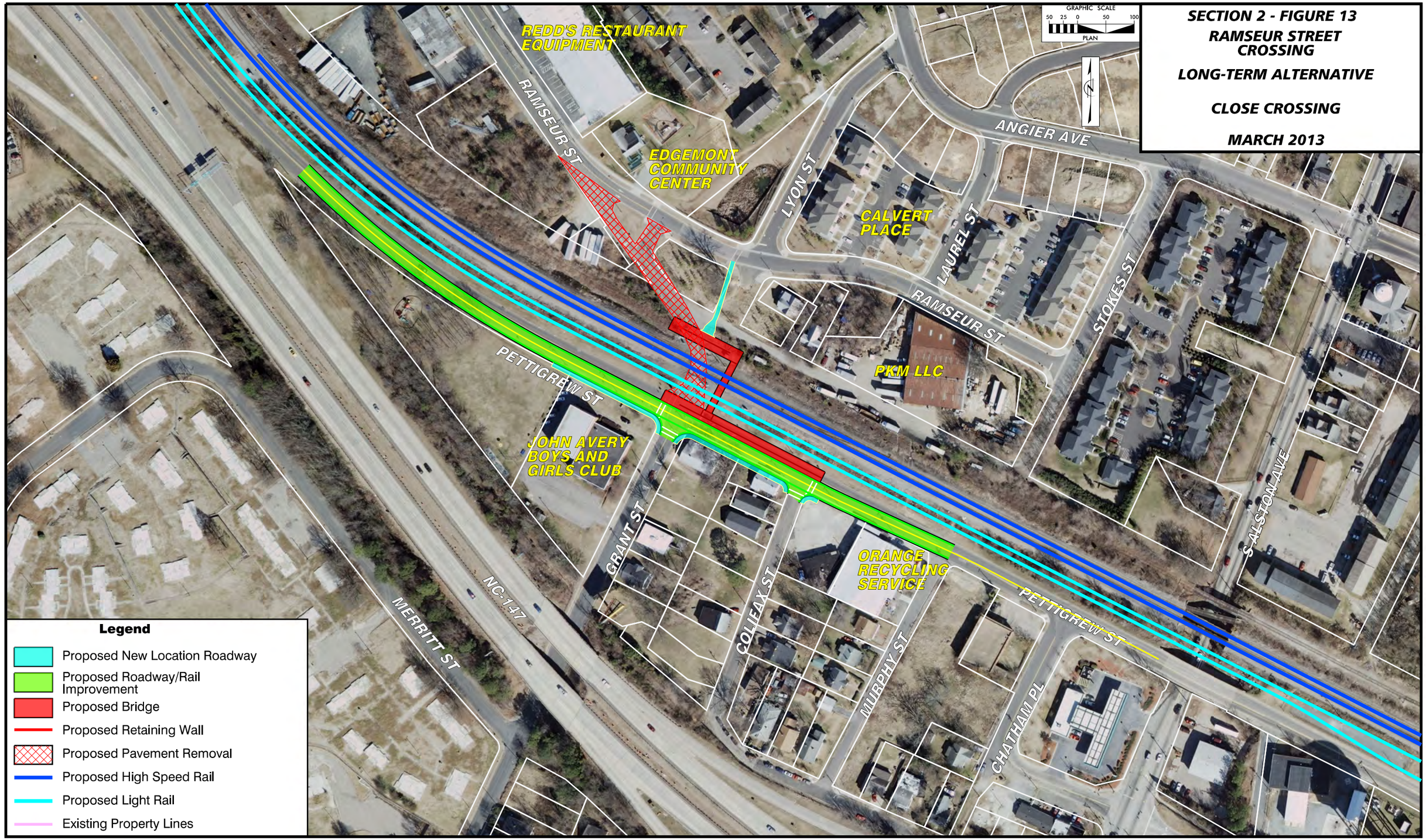
This crossing was proposed to be closed. However, due to the residential nature of the adjacent neighborhoods north of the railroad tracks and the pedestrian-focused draw of the Boys & Girls Club south of the tracks, a pedestrian grade separation is also proposed. This will improve sidewalk connectivity on the south side of Pettigrew Street, and creates connectivity between Peabody Street and Pettigrew Street via the new sidewalk and pedestrian grade separation. The grade separation shown is long enough to cross the existing rail lines, the proposed high speed rail lines, and the proposed Triangle Transit light rail line.

Near Term Alternative – None

Mid Term Alternative – None

Long Term Alternative (Figure 13)

- Close crossing (remove pavement, add signs and landscaping on Ramseur Street, and remove railroad crossing gates, signs, and equipment) and construct pedestrian grade separation



SECTION 2 - FIGURE 13

RAMSEUR STREET CROSSING

LONG-TERM ALTERNATIVE

CLOSE CROSSING

MARCH 2013

Kimley-Horn and Associates, Inc.

DURHAM 1869

triangletransit

NS NORFOLK SOUTHERN

Near-Term Recommendations
None

Mid-Term Recommendations
None

H.14. Plum Street (Crossing No. 630 472K, Milepost H 56.40)

Existing Conditions

Plum Street has approximately 2,300 vpd with 1% trucks across six railroad tracks. This is one of Norfolk Southern's switching stations, and trains move back and forth across Plum Street and Driver Street slowly and frequently. Citizens and stakeholders are concerned that if the Plum Street crossing is closed, the Driver Street crossing will have notably more delays because of the additional vehicle traffic and the switching station. If Plum Street is selected for closure, NCDOT will conduct an operational analysis of the switching station and the Driver Street crossing, and will only proceed with closing Plum Street if improvements are made at Driver Street.

Pettigrew Street is parallel with the tracks to the south and intersects with Plum Street at a two-way stop. It is likely that vehicles stop on the tracks because of the short distance between the southbound stop sign and the six tracks. Plum Street extends about 0.4 miles north of the tracks and 200 feet south of the tracks before terminating in residential areas.

Pedestrians and bicyclists were observed crossing the railroad tracks on Plum Street. There are no sidewalks across the tracks. A future greenway is planned on Plum Street as part of a greenway network connecting over NC 147. Plum Street north of Pettigrew Street is a shared bike roadway. The Durham Long Range Transportation Plan proposes a bike lane on Plum Street across the railroad tracks, between Angier Avenue and Pettigrew Street, and a shared road/signed route north of Angier Avenue.

Citizens commented that this crossing is most frequently used by pedestrians on the weekends, when the Durham Green Flea Market is open. Several people also noted that this crossing is wider and is blocked less frequently than the Driver Street crossing. One citizen also noted that there are drainage issues on Pettigrew Street near this crossing, although City and NCDOT County maintenance personnel did not identify any problems at this location.

The Durham Green Flea Market is in the southwest quadrant, which local residents say is an important business in the neighborhood. A concrete company is in the northwest quadrant, an auto repair company is in the northeast quadrant, and residences surround the area. Stakeholders noted that concrete trucks currently have difficulty turning onto Pettigrew Street from the plant. Minority and low-income neighborhoods are located further north and south of the tracks. The East Durham Historic District is northeast of the crossing, bound by Vale Street on the south and Plum Street on the west.

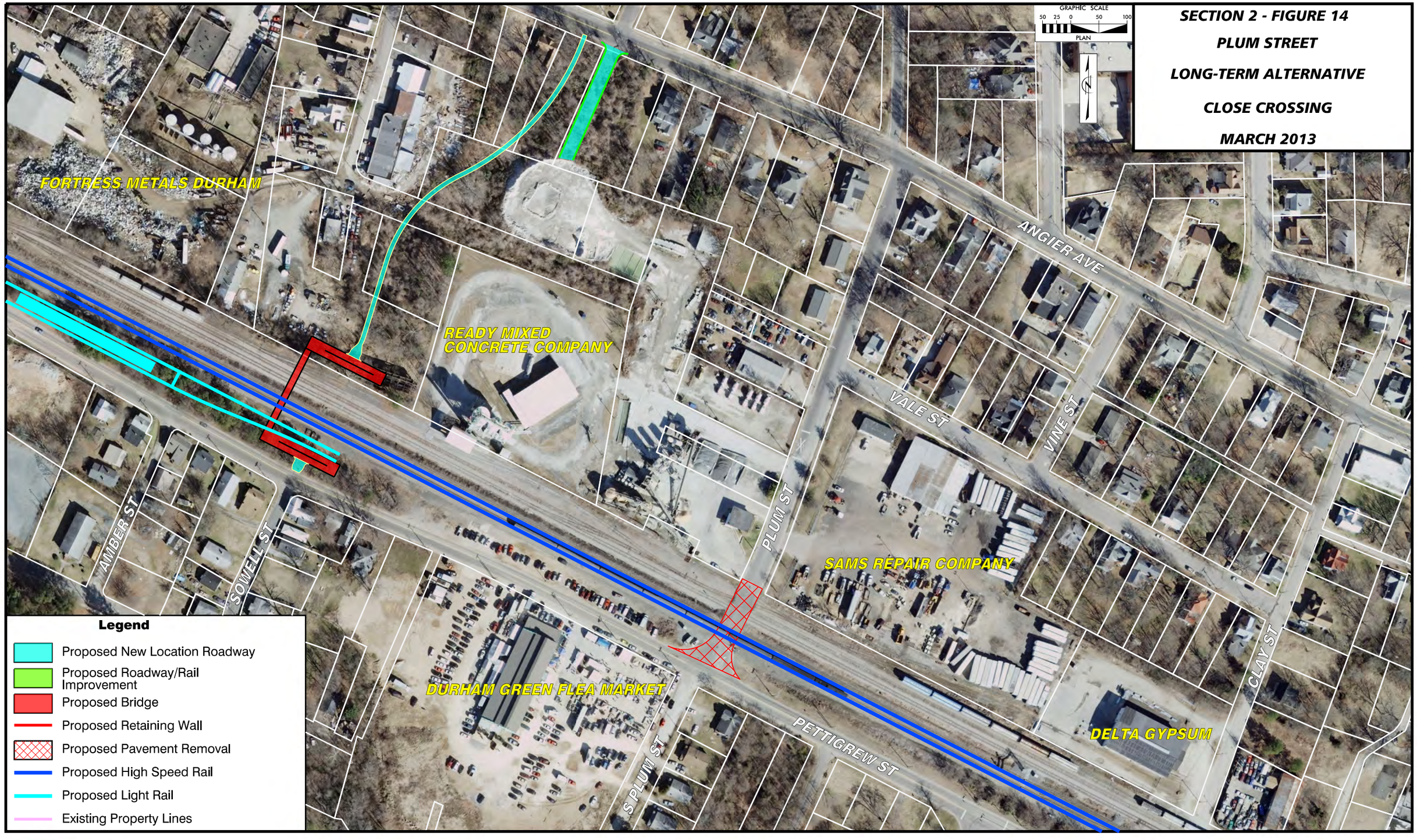
Alternatives

Near Term Alternative – None

Mid Term Alternative – None

Long Term Alternative (Figure 14)

- Close crossing (remove pavement, add signs and landscaping on Plum Street, and remove railroad crossing gates, signs, and equipment), construct a new driveway from the concrete plant to Angier Street, construct pedestrian grade separation, and construct a greenway from grade separation to Angier Avenue. Closure of this crossing is contingent on making operational improvements at the existing railyard which would reduce blockages due to train switching movements at the Driver Street crossing.



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Near-Term Recommendations
None

Mid-Term Recommendations
None

H.15. Driver Street (Crossing No. 630 471D, Milepost H 56.70)

Existing Conditions

Driver Street has approximately 5,100 vpd with 5% trucks across four railroad tracks. This is one of Norfolk Southern's switching stations, and trains move back and forth across Driver Street slowly and frequently. Peabody Street is parallel with the tracks to the north, and Pettigrew Street is parallel with the tracks to the south. Both streets intersect with Driver Street with traffic signals. Driver Street crosses through a small commercial area north of the tracks before transitioning to primarily residential. South of the tracks, Driver Street tees into Pettigrew Street.

It is likely that vehicles stop on the tracks because of the short distance between the southbound stop sign and the four tracks. Pedestrians and bicyclists were observed at this location; sidewalks are on both sides of Driver Street north of Peabody Street. Driver Street is a shared bike roadway. The Durham Long Range Transportation Plan proposes a bike lane on Driver Street across the railroad tracks, between Angier Avenue and Pettigrew, and a shared road/signed route north of Angier Avenue. Durham County school buses use this crossing 16 times each day, and noted existing issues with clearing the railroad tracks because of the proximity of the Driver Street/Pettigrew Street intersection.

Citizens pointed out problems with the traffic signal at this crossing, including vehicles getting trapped over the railroad tracks. However, NCDOT recently installed new signal equipment, which appears to be functioning correctly and seems to have helped mitigate the problems. Several people asked for this crossing to remain open, especially if the Plum Street crossing is closed, to provide access to commercial areas in Northeast Central Durham.

Land uses adjacent to the crossing are primarily commercial and light industrial, with residential in the surrounding neighborhoods. A streetscape plan is underway along Angier Avenue through the City's economic development department that is expected to increase traffic in this area.

Alternatives

There were no alternatives at Driver Street. NCDOT upgraded the traffic signal equipment at this crossing in August 2009, and no issues have been reported since it was operational.

Near Term Alternative – None

Mid Term Alternative – None

Long Term Alternative – None

H.16. Briggs Avenue/Guthrie Avenue (Future Grade-Separated Crossing, Approximately Milepost H 56.92)

Existing Conditions

A project to extend Briggs Avenue north across NC 147 to Guthrie Avenue was included on the prior Durham Thoroughfare Plan, although it is not on the current LRTP. If Briggs Avenue would be extended, it would likely be grade separated over Pettigrew Street due to the proximity of Pettigrew Street to the railroad. Therefore, this potential project is not expected to influence selection of an alternative at the Driver Street crossing. The East Durham Historic District is north of the crossing, bound by Peabody Street on the south and Salem Street on the east.

Alternatives

A conceptual design has been completed for the Briggs Avenue extension project, which was originally proposed in the Durham Thoroughfare Plan.

Near Term Alternative – None

Mid Term Alternative – None

Long Term Alternative (Figures 15 and 16)

- Grade separate Briggs Avenue/Guthrie Avenue

Briggs Avenue Grade Separation

Table H.6. Design Considerations – Briggs Avenue

Design Considerations	Grade Separation
Alignment	Extend Briggs Ave north to connect to existing Guthrie Ave
Rail Crossing	Grade separation over rail and Pettigrew St, approximate location of proposed high-speed rail, regional rail, and yard leads taken into consideration
Business Impacts	May impact three industrial businesses due to Briggs Ave extension
Residential Impacts	May impact one residence
Local Road Impacts	Access to Always Buying Scrap is eliminated, may be mitigated with access road construction parallel to Briggs Ave extension.
Retaining Walls	None

Note: Design data is in Appendix E.

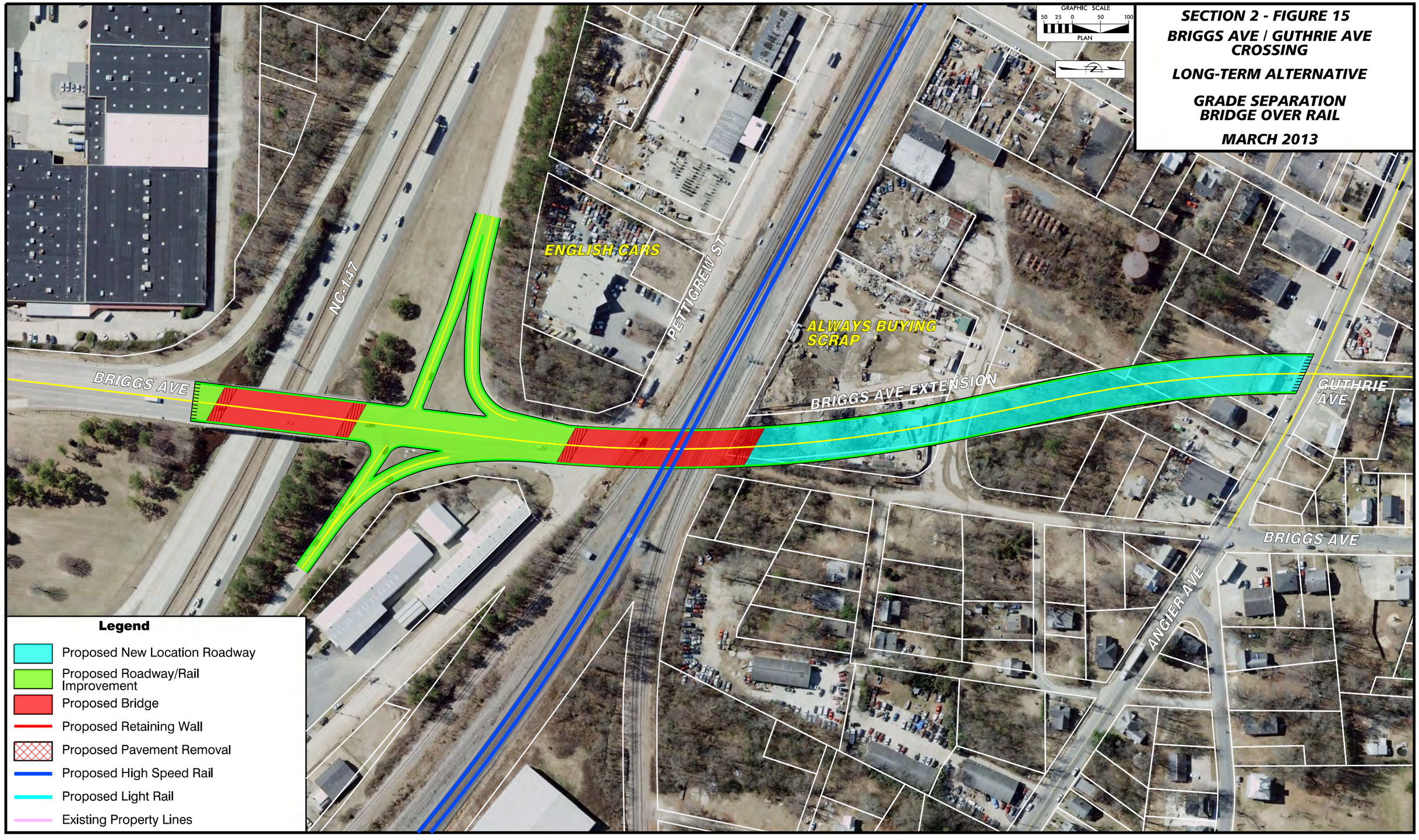
SECTION 2 - FIGURE 15

BRIGGS AVE / GUTHRIE AVE CROSSING

LONG-TERM ALTERNATIVE

GRADE SEPARATION BRIDGE OVER RAIL

MARCH 2013



Kimley-Horn and Associates, Inc.

Near-Term Recommendations
None

Mid-Term Recommendations
None

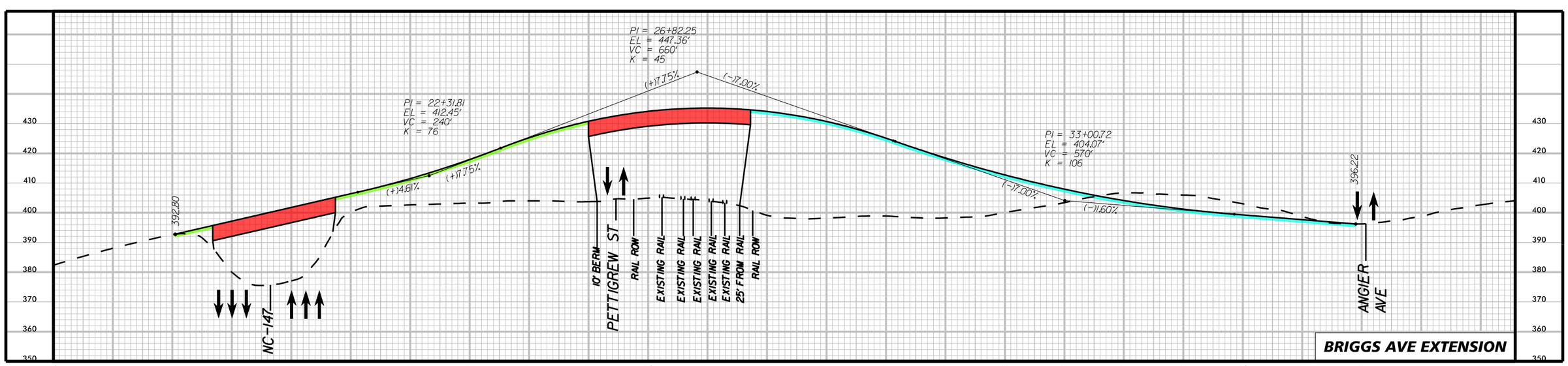
SECTION 2 - FIGURE 16

BRIGGS AVE / GUTHRIE AVE CROSSING

LONG-TERM ALTERNATIVE

GRADE SEPARATION BRIDGE OVER RAIL

MARCH 2013



H.17. Ellis Road (West) (Crossing No. 735 236Y, Milepost H 57.57)

Existing Conditions

Ellis Road (West) carries approximately 5,900 vpd with 4% trucks across three railroad tracks (one of which is associated with an adjacent crossing, #734-737H). Gates are on all four quadrants. This crossing is adjacent to one of Norfolk Southern's storage yards and switching stations, which results in trains slowly and frequently crossing Ellis Road. Angier Avenue is parallel with the tracks to the north, and Pettigrew Street is parallel to the south, both approximately 100 feet from the tracks. Both intersect Ellis Road with a traffic signal which was installed in August 2010. Ellis Road tees into Angier Avenue on the north. On the south, it crosses under NC 147, parallels NC 147 before crossing NC 147 with an interchange further south, crosses the railroad again, and then tees into Miami Boulevard.

A bicyclist and pedestrians were observed at this crossing, although no sidewalks or bike lanes are available. A DATA bus stop is on Angier Avenue adjacent to the crossing. The Durham bike map identifies that Ellis Road between Angier Avenue and Miami Boulevard is often used by experienced cyclists, but is not a designated route. The Durham Long Range Transportation Plan proposes a bike lane on Ellis Road across the railroad tracks, between Angier Avenue and Glover Road. The DCHC MPO is currently evaluating a portion of that project, which would add wide outside lanes and paved shoulders from Angier Avenue to NC 147. Durham County school buses use this crossing 54 times each day, and noted existing issues with clearing the railroad tracks because of the proximity of the Ellis Road/Angier Road intersection.

The East End Connector is an NCDOT project (Project U-0071) to connect NC 147 across the railroad tracks to Miami Boulevard, and will improve mobility through the region. Right of way acquisition for the East End Connector is scheduled to begin this year, and construction is scheduled to begin in fiscal year 2014. As part of the East End Connector project, the bridge over the railroad will be wide enough for a connector road to be built on the south side. When built, this may provide the connectivity necessary to close Ellis Road (West) in the future.

Citizens and stakeholders commented that there are backups on Ellis Road because of the rail yard, and so EMS vehicles and many drivers avoid this crossing. Several suggested improving or grade separating the crossing.

Land uses on the south are commercial or related to the railroad, and land uses on the north are a combination of residential, church, and small businesses. The Creek Woods Park is east of the crossing.

Alternatives

One near term alternative has been developed, although a long term solution to grade separate is also proposed. This near term alternative could be implemented instead of, or in addition to, the long term alternative. The grade separation alternatives shown on Figures 3.1b through 3.1e were developed by NCDOT.

Near Term Alternative (Figure F.16 in Appendix F)

- Close center driveway to New York Mini Mart

Mid Term Alternative – None

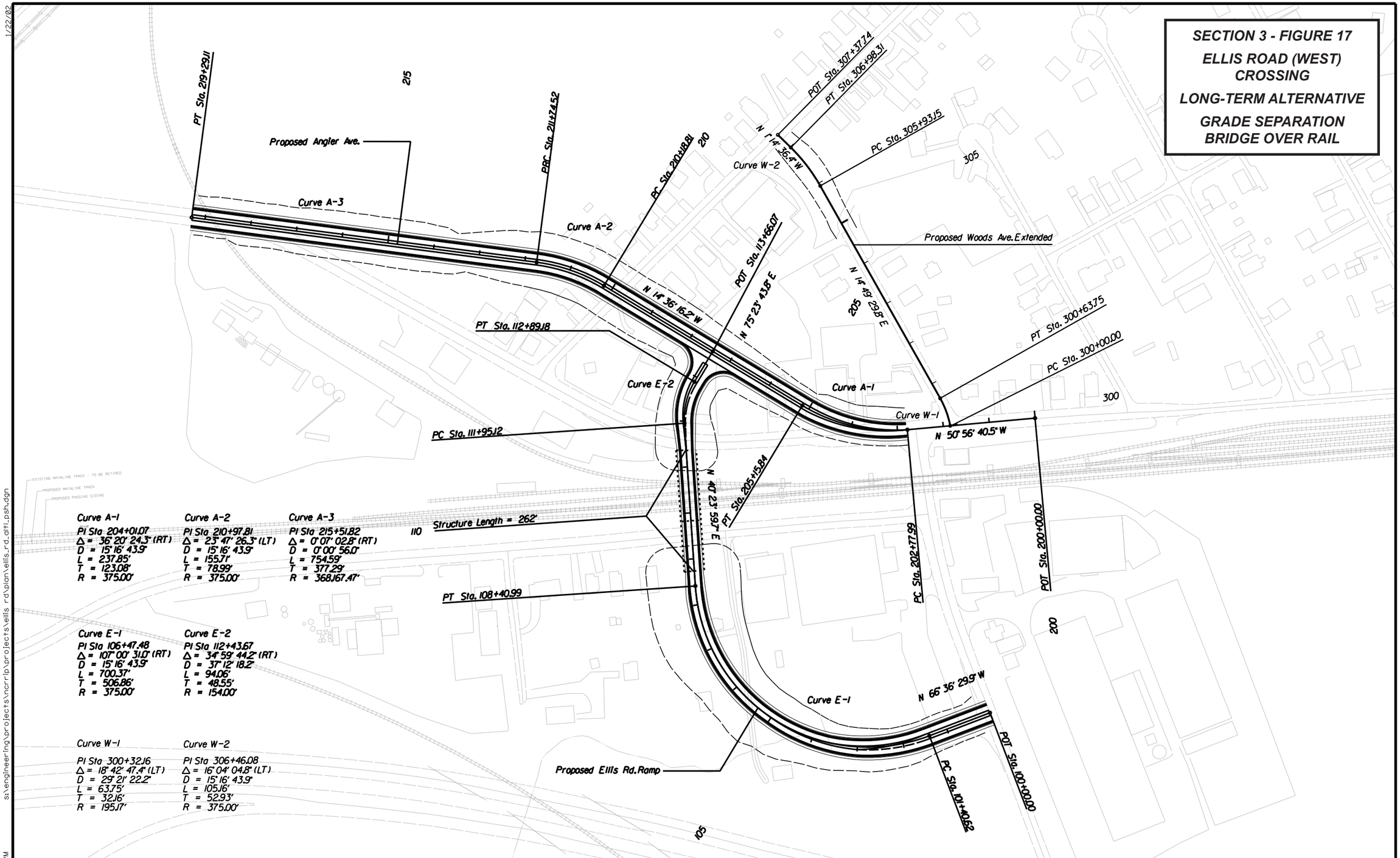
Long Term Alternative (Figures 17 through 20)

- Grade separation

Table H.7. Design Considerations – Ellis Road (West)

Design Considerations	Grade Separation
Alignment	Realign multiple roads including Angier Ave and Ellis Road (depending on alternative)
Rail Crossing	Grade separate over rail and Pettigrew Street. Approximate location of proposed high-speed rail taken into consideration
Business Impacts	Variable (depending on alternative)
Residential Impacts	Variable (depending on alternative)
Local Road Impacts	Variable (depending on alternative)
Retaining Walls	None

Note: Conceptual designs were provided by NCDOT. Design considerations and impacts were estimated based on the plans provided. No additional design data is available.



Curve A-1
PI Sta 204+01.07
Δ = 36° 20' 24.3" (RT)
D = 15° 16' 43.9"
L = 237.85'
T = 123.08'
R = 375.00'

Curve A-2
PI Sta 210+97.81
Δ = 23° 47' 26.3" (LT)
D = 15° 16' 43.9"
L = 155.71'
T = 78.99'
R = 375.00'

Curve A-3
PI Sta 215+51.82
Δ = 0° 07' 02.8" (RT)
D = 0° 00' 56.0"
L = 754.59'
T = 377.29'
R = 368,167.47'

Curve E-1
PI Sta 106+47.48
Δ = 107° 00' 31.0" (RT)
D = 15° 16' 43.9"
L = 700.37'
T = 506.86'
R = 375.00'

Curve E-2
PI Sta 112+43.67
Δ = 34° 59' 44.2" (RT)
D = 37° 12' 18.2"
L = 94.06'
T = 48.55'
R = 154.00'

Curve W-1
PI Sta 300+32.16
Δ = 18° 42' 47.4" (LT)
D = 29° 21' 22.2"
L = 63.75'
T = 32.16'
R = 195.17'

Curve W-2
PI Sta 306+46.08
Δ = 16° 04' 04.8" (LT)
D = 15° 16' 43.9"
L = 105.16'
T = 52.93'
R = 375.00'

NO.	BY	DATE	REVISION

INCOMPLETE PLANS
DO NOT USE FOR R/W ACQUISITION
PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
RAIL DIVISION

PREPARED BY:
ENGINEERING & SAFETY BRANCH
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DELIVERY: 860 CAPITAL BOULEVARD RALEIGH, NC 27603
PHONE: (919) 715-8803
FAX: (919) 715-8804

PROJECT: NORTH CAROLINA RAILROAD IMPROVEMENT PROJECT
TITLE: PROPOSED ELLIS ROAD GRADE SEPARATION CONCEPT ALTERNATE 1
LOCATION: CITY OF DURHAM, DURHAM COUNTY, NC – NORFOLK SOUTHERN PIEDMONT DIVISION

DGN BY	MBS	RAILROAD	NCRR / NS MAINLINE		MILE POST H-57.5
DWN BY	CET	VAL SEC	V24-S.14d		SHEET 1 OF 6
CHK BY	JTO	DATE	10-10-2007	SCALE 1" = 100'	

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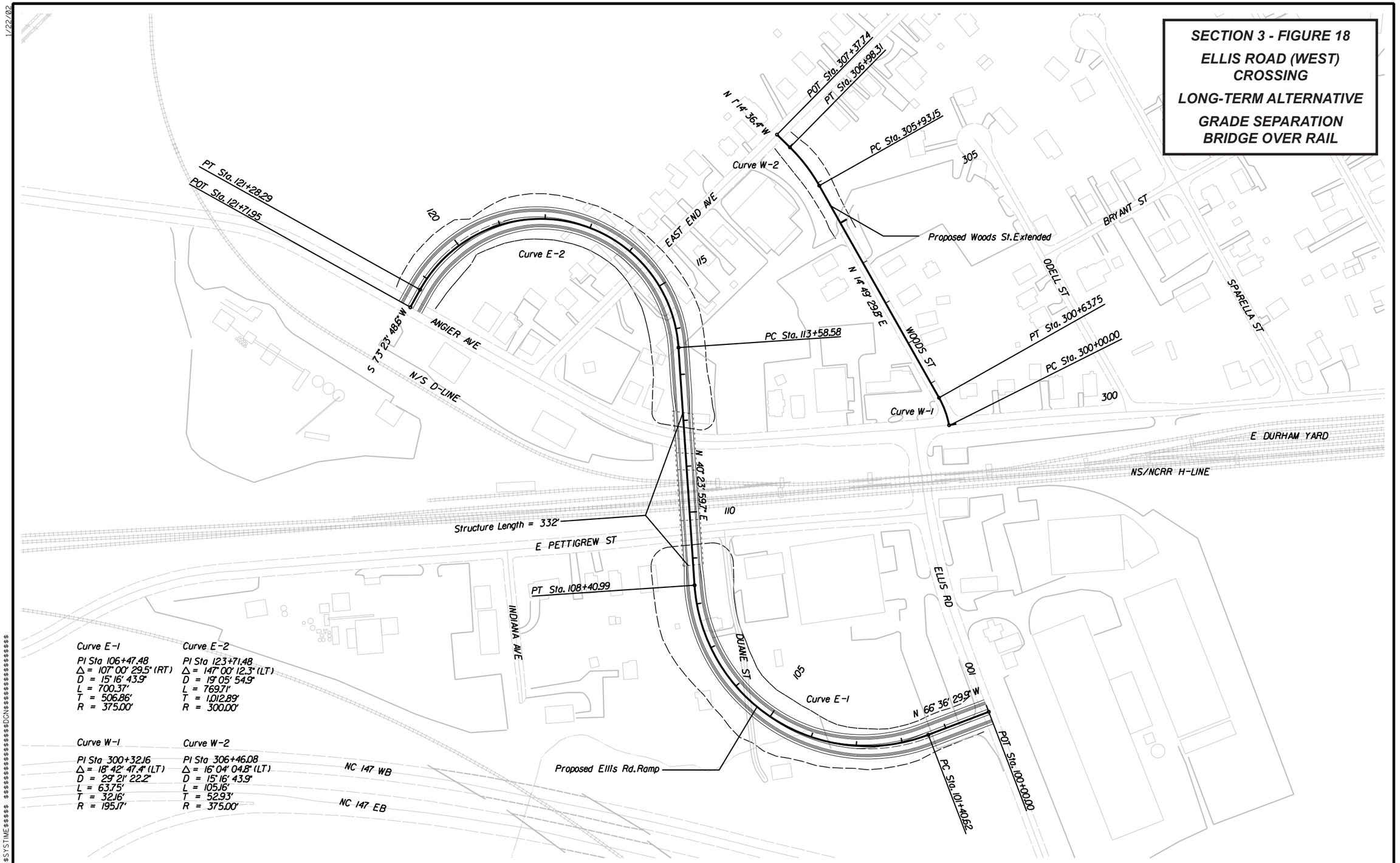
SECTION 3 - FIGURE 18

ELLIS ROAD (WEST) CROSSING

LONG-TERM ALTERNATIVE

GRADE SEPARATION BRIDGE OVER RAIL



Curve E-1

PI Sta 106+47.48
Δ = 107° 00' 29.5" (RT)
D = 15° 16' 43.9"
L = 700.37'
T = 506.86'
R = 375.00'

Curve E-2

PI Sta 123+71.48
Δ = 147° 00' 12.3" (LT)
D = 19° 05' 54.9"
L = 769.71'
T = 1,012.89'
R = 300.00'

Curve W-1

PI Sta 300+32.16
Δ = 18° 42' 47.4" (LT)
D = 29° 21' 22.2"
L = 63.75'
T = 32.16'
R = 195.17'

Curve W-2

PI Sta 306+46.08
Δ = 16° 04' 04.8" (LT)
D = 15° 16' 43.9"
L = 105.16'
T = 52.93'
R = 375.00'

NO.	BY	DATE	REVISION

INCOMPLETE PLANS
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DO NOT USE FOR CONSTRUCTION

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RAIL DIVISION

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DELIVERY: 860 CAPITAL BOULEVARD RALEIGH, NC 27603
PHONE: (919) 715-8803
FAX: (919) 715-8804

PROJECT: NORTH CAROLINA RAILROAD IMPROVEMENT PROJECT

TITLE: PROPOSED ELLIS ROAD GRADE SEPERATION CONCEPT ALTERNATE 2

LOCATION: CITY OF DURHAM, DURHAM COUNTY, NC – NORFOLK SOUTHERN PIEDMONT DIVISION

DGN BY	MBS	RAILROAD	NCRR / NS MAINLINE		MILE POST H-57.5
DWN BY	CET	VAL SEC	V24-14d		SHEET 3 OF 6
CHK BY	JTO	DATE	10-10-2007	SCALE 1" = 100'	

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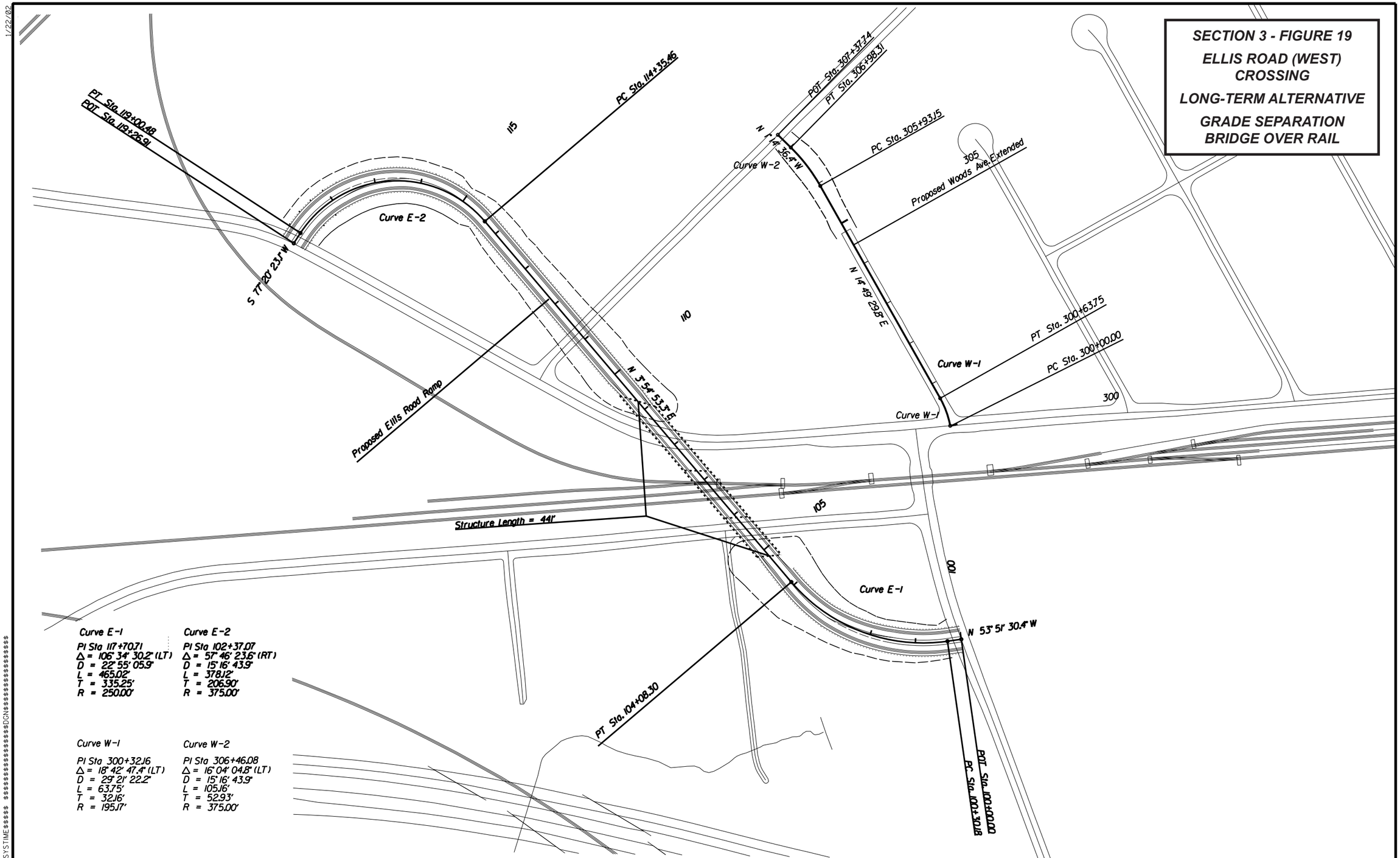
1/22/02



NO.	BY	DATE	REVISION
1	MBS	06/20/2007	ADDED PIPE EXTENSION, RIPRAP DITCH AND RIPRAP DITCH DETAIL. MODIFIED SLOPE STAKING LINE.

INCOMPLETE PLANS
DO NOT USE FOR R/W ACQUISITION
PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
RAIL DIVISION

PREPARED BY:
ENGINEERING & SAFETY BRANCH

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DELIVERY: 860 CAPITAL BOULEVARD RALEIGH, NC 27603
PHONE: (919) 715-8803
FAX: (919) 715-8804

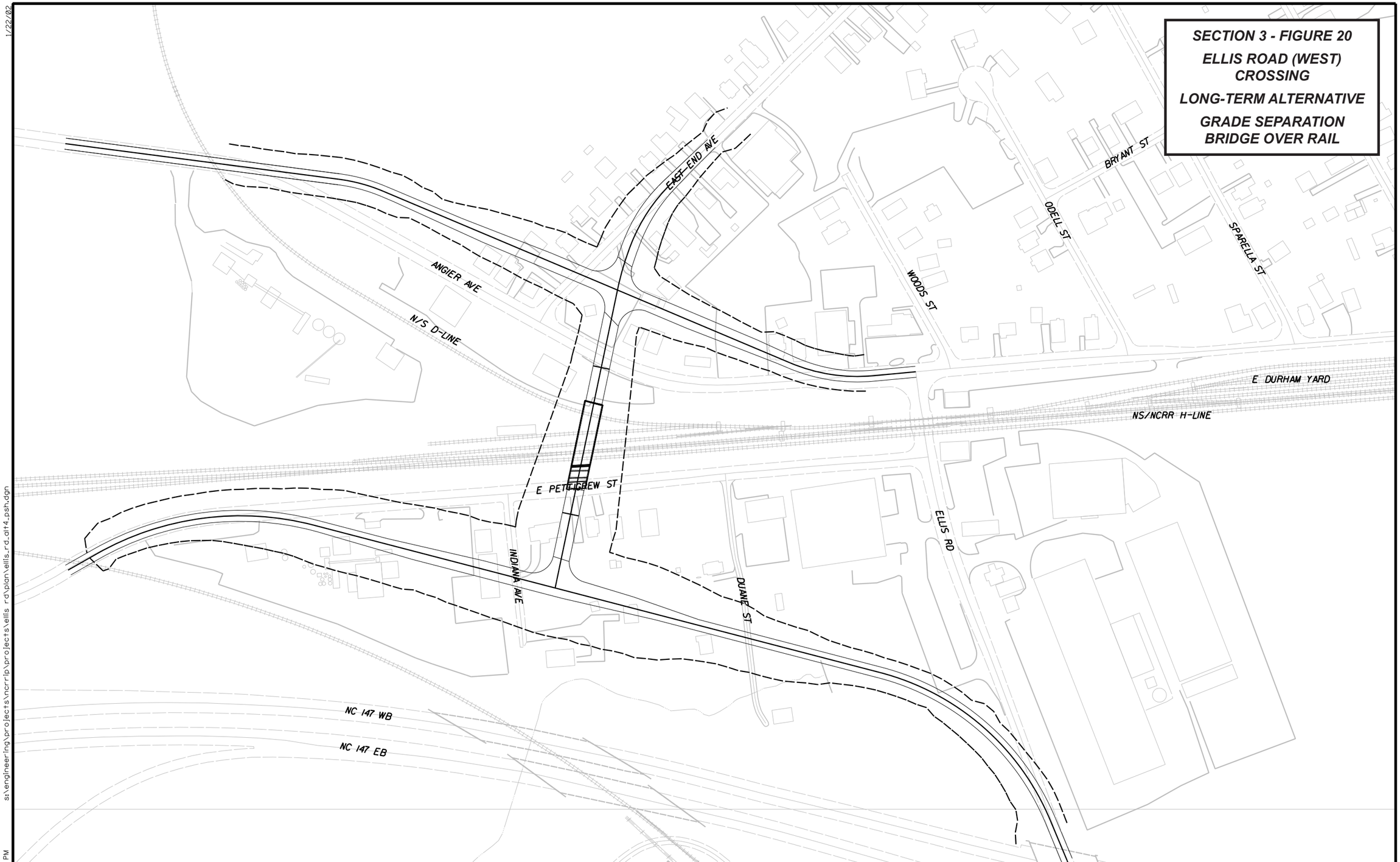
PROJECT: NORTH CAROLINA RAILROAD IMPROVEMENT PROJECT

TITLE: PROPOSED ELLIS ROAD GRADE SEPARATION CONCEPT ALTERNATE 3

LOCATION: CITY OF DURHAM, DURHAM COUNTY, NC – NORFOLK SOUTHERN PIEDMONT DIVISION

DGN BY	MBS	RAILROAD	NCRR / NS MAINLINE		MILE POST H-57.5
DWN BY	CET	VAL SEC	V24-14d		SHEET 5 OF 6
CHK BY	JTO	DATE	10-10-2007	SCALE 1" = 100'	

$$USERNAME$$ $$SYSTIME$$ $$DGN$$



NO.	BY	DATE	REVISION

INCOMPLETE PLANS
DO NOT USE FOR R/W ACQUISITION
PRELIMINARY PLANS
DO NOT USE FOR CONSTRUCTION

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
RAIL DIVISION

PREPARED BY:
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DELIVERY: 860 CAPITAL BOULEVARD RALEIGH, NC 27603
PHONE: (919) 715-8803
FAX: (919) 715-8804

PROJECT	NORTH CAROLINA RAILROAD IMPROVEMENT PROJECT
TITLE	PROPOSED ELLIS ROAD GRADE SEPARATION CONCEPT ALTERNATE 4
LOCATION	CITY OF DURHAM, DURHAM COUNTY, NC – NORFOLK SOUTHERN PIEDMONT DIVISION
DGN BY	MBS
RAILROAD	NCRR / NS MAINLINE
MILE POST	H-57.5
DWN BY	CET
VAL SEC	V24-5.14d
CHK BY	JTO
DATE	04-28-2008
SCALE	1" = 100'
	SHEET 1 OF 1

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H.18. Glover Road (Crossing No. 734 735L, Milepost H 58.98) & Wrenn Road (Crossing No. 734 736T, Milepost H 59.28)

Existing Conditions – Glover Road

There are approximately 2,700 vpd with 1% trucks on Glover Road across two railroad tracks. Angier Avenue is parallel with the tracks to the east, and a 0.7-mile long residential access road is parallel to the west. Both intersections with Glover Road are unsignalized. East of Angier Avenue, Glover Road ends at a gravel driveway. To the west, after crossing under NC 147, Glover Road tees into Ellis Road. There are no sidewalks or bike lanes, and no pedestrians or bicyclists were observed. The Durham Long Range Bicycle Plan proposes a bike lane on Glover Road across the railroad tracks between Ellis Road and Angier Avenue. However, the DCHC MPO Bicycle and Pedestrian Advisory Committee (BPAC) recently evaluated this project, and determined Glover Road is too narrow to add bicycle lanes without widening the pavement. Durham County school buses use this crossing 18 times each day.

A project to extend Glover Road west to Riddle Road and east to Angier Avenue and past Miami Boulevard has been considered previously by the City of Durham and was included on the prior Durham Thoroughfare Plan, but is not on the current LRTP. This design is shown on Figure 3.2b, along with an alternate alignment east of Miami Boulevard which would avoid development that has been built since the Thoroughfare Plan was approved. An interchange on Glover Road and NC 147 would also improve connectivity. Citizens and stakeholders did not have any comments about this crossing, other than to note that it is not a primary route for EMS vehicles. Land immediately adjacent to the crossing is a mix of low-density residential and business, surrounded by undeveloped forest. Glover Road continues west past NC 147 to a larger residential neighborhood, eventually ending at Ellis Road.

Existing Conditions – Wrenn Road

Approximately 200 vpd with 2% trucks were recorded on Wrenn Road across the railroad track. However, this volume appears to be low, and may have been taken on Wrenn Road south of Stone Park Court, which would not have accounted for the vehicles access Waste Industries on Stone Park Court. Angier Avenue is parallel with the tracks to the northeast, where Wrenn Road ends at a stop sign. Southwest of the tracks, Wrenn Road serves low-density residences, and ends about 0.6 miles south of the tracks. There are no sidewalks or bike lanes, and no pedestrians or bicyclists were observed. Durham County school buses use this crossing 6 times each day.

One citizen suggested combining Glover Road and Wrenn Road into one grade-separated crossing over the railroad, perhaps connecting to Ruritan Road on the east. Stakeholder noted that this crossing is used infrequently by police and EMS. Land adjacent to the crossing is primarily forested, with a few scattered homes and businesses. Within 0.25 miles are Waste Industries, an auto repair shop, and several other small businesses. Wrenn Road dead-ends less than a mile to the south, and does not have another outlet other than across the railroad track.

Alternatives

One near term alternative at Glover Road has been developed, although a long term alternative to grade separate is also proposed. This near term alternative could be implemented instead of, or in addition to, the long term alternative. The crossings of Glover Road and Wrenn Road were considered together due to their proximity to each other and the low volumes of traffic on each. The Wrenn Road crossing was determined to be less vital to the larger Durham connection than the Glover Road crossing. Therefore, this report includes an alternative to close the existing Wrenn Road as part of a joint grade-separation project with Glover Road. A new location road would be built to connect Wrenn Road and Glover Road. Part of the consideration for alternatives at Glover Road and Wrenn Road is a potential rail realignment project considered by Norfolk Southern.

Near Term Alternative (Figure F.17 in Appendix F)

- Install grade-crossing warning signs on northbound and southbound Angier Avenue adjacent to the Glover Road at-grade crossing [the City has made this improvement since draft recommendations were made to stakeholders]

Mid Term Alternative – None

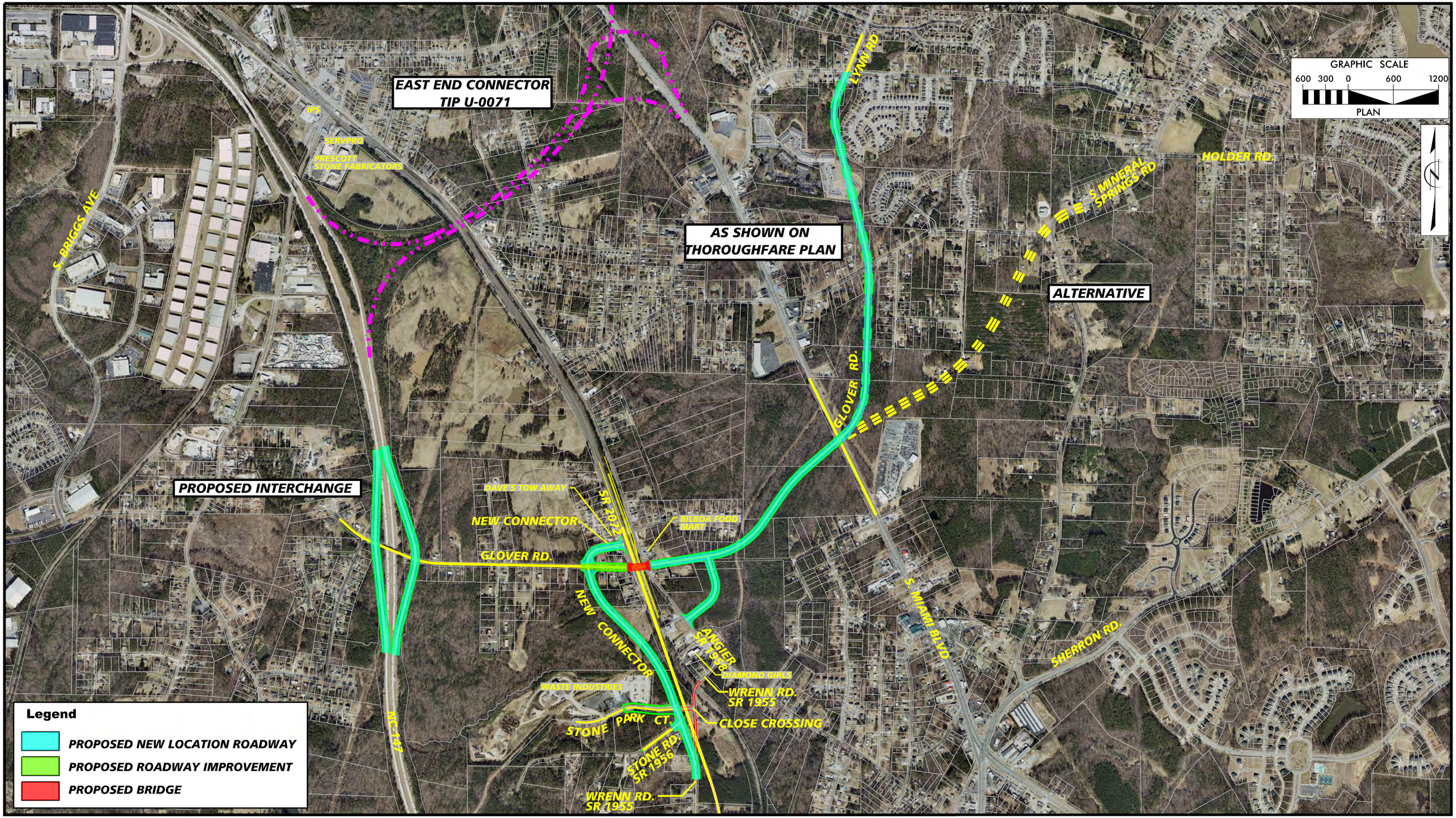
Long Term Alternative (Figures 21 through 24)

- Grade separation of Glover Road and closure of Wrenn Road, including a new connector road from Glover Road to Angier Avenue, a new connector road from Glover Road to Wrenn Road, an extension of Pettigrew Street from Ellis Road (West) to Glover Road, a new interchange at NC 147 and Glover Road, and rail realignment between Ellis Road (East) and Glover Road

Table H.8. Design Considerations – Glover Road

Design Considerations	Grade Separation
Alignment	Extends Glover Rd northeast to connect with Lynn Rd (LRTP plan) or S Mineral Springs Rd (KHA alternative), creates new connector from Angier to Wrenn Rd, creates diamond interchange at NC-147 and Glover Rd, extends Pettigrew St from Ellis Rd to Glover Rd
Rail Crossing	Grade separate over rail and Angier Ave. Approximate location of proposed high-speed rail taken into consideration
Business Impacts	Revises access to Waste Industries, may impacts Dave's Tow Away due to new connector location, proposed location of regional rail lines may impact Diamond Girls.
Residential Impacts	May impact 29 residences due to new roadways, proposed rail lines, and grade separation
Local Road Impacts	Wrenn Rd rail crossing closure revises access to Stone Park Ct and Stone Rd, new connector revises current traffic pattern at Glover Rd and Angier Ave, Glover Rd extension creates new access to undeveloped land northeast of grade separation
Retaining Walls	Retaining walls required – Height: 5' to 30'

Note: Design data is in Appendix E.



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Kimley-Horn and Associates, Inc.

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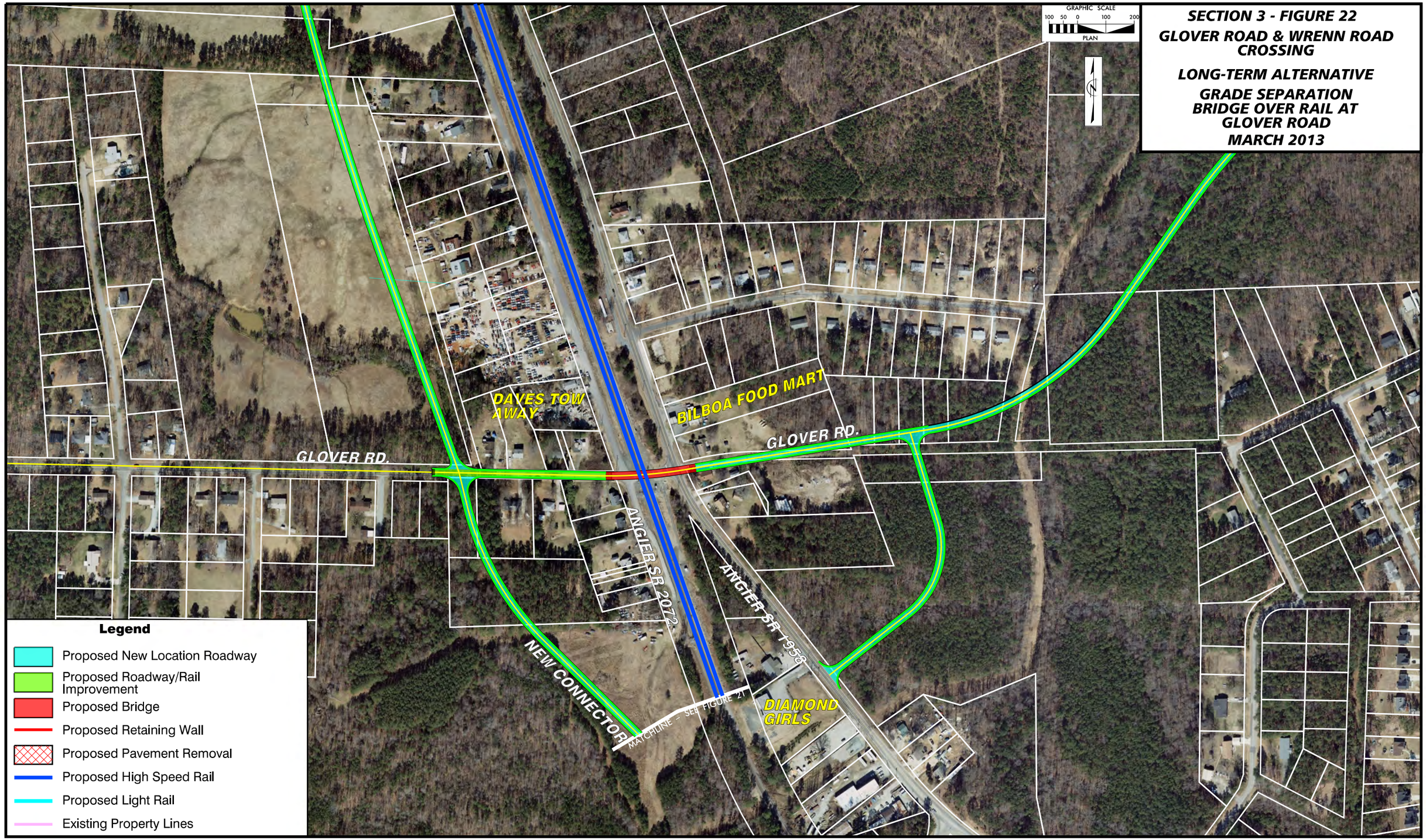
SECTION 3- FIGURE 21
GLOVER ROAD & WRENN ROAD CROSSING
LONG-TERM ALTERNATIVE
GRADE SEPARATION
BRIDGE OVER RAIL AT GLOVER ROAD/CLOSE WRENN ROAD

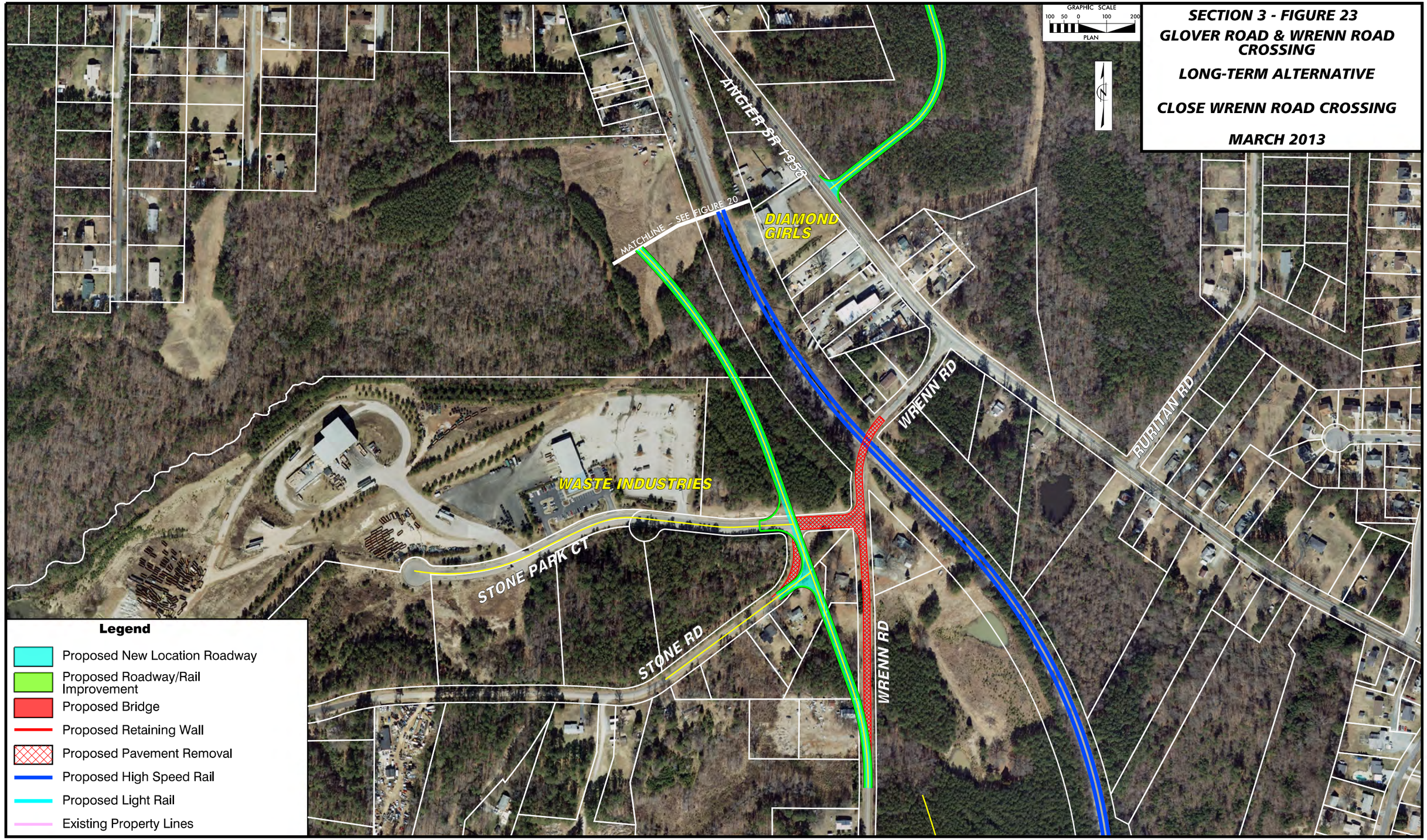


Kimley-Horn and Associates, Inc.

Near-Term Recommendations
Install grade-crossing warning signs on northbound and southbound Angier Avenue

Mid-Term Recommendations
None

SECTION 3 - FIGURE 23
GLOVER ROAD & WRENN ROAD CROSSING
LONG-TERM ALTERNATIVE
CLOSE WRENN ROAD CROSSING
MARCH 2013



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Near-Term Recommendations
None

Mid-Term Recommendations
None

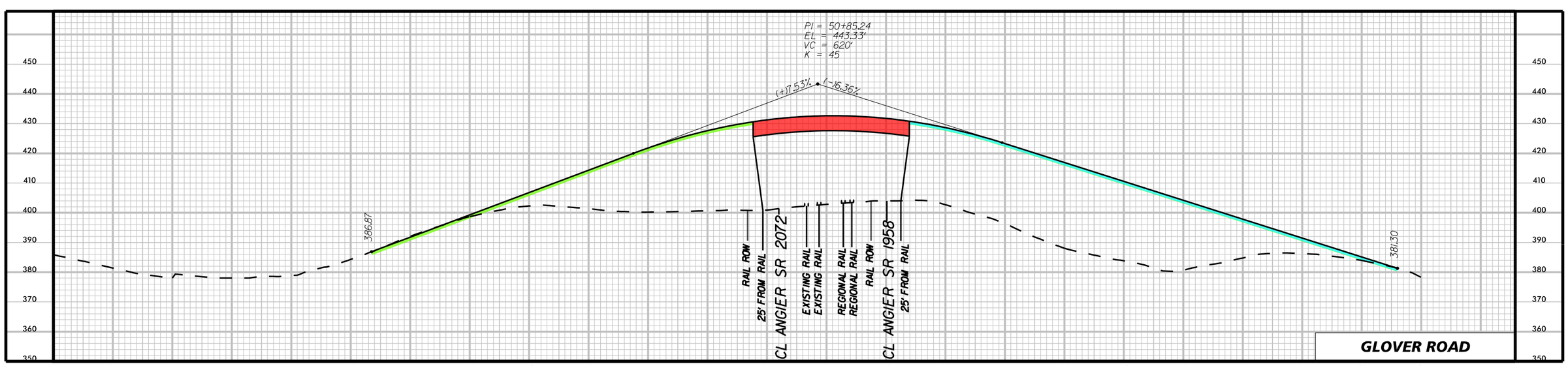
SECTION 3 - FIGURE 24

GLOVER ROAD & WRENN ROAD CROSSING

LONG-TERM ALTERNATIVE

GRADE SEPARATION BRIDGE OVER RAIL AT GLOVER ROAD

MARCH 2013



H.19. Ellis Road (East) (Crossing No. 734 737A, Milepost H 60.27)

Existing Conditions

Ellis Road (East) carries approximately 12,400 vpd with 1% trucks across the railroad track. Ellis Avenue tees into Miami Boulevard approximately 0.7 miles to the east. To the west, it crosses NC 147 with an interchange, parallels NC 147 before crossing under NC 147 further north, crosses the railroad again, then tees into Angier Avenue. NCDOT Project U-4011, currently under construction, widens Miami Boulevard from just west of Ellis Road to SR 1960 (Bethesda Avenue) to add a center turn lane. There is a median barrier comprised of yellow flexible bollards on both sides of the track.

Pedestrians and bicyclists were observed at this location, though there are no sidewalks or bike lanes. The Durham bike map identifies that Ellis Road between Angier Avenue and Miami Boulevard is often used by experienced cyclists, but is not a designated route.

Stakeholders noted that this crossing is used infrequently by EMS, especially by fire trucks because of the narrow travel lanes.

Land uses adjacent to the crossing are forest and farmland except for the Research Triangle Charter Academy in the southwest quadrant. Triangle Transit owns property in the southeast quadrant. Several large office complexes and high-density neighborhoods are within 0.25 miles of the crossing. Ellis Road tees into Miami Boulevard to the east and has an interchange with NC 147 to the west. Traffic volumes are expected to increase on Ellis Road as the connecting routes are improved and development continues.

A proposed development plan called "Joven – Northeast Creek" has been submitted for an apartment complex in the northwest quadrant. This plan also includes a new connection from Ellis Road to Wrenn Road.

Alternatives

Near Term Alternative – None

Mid Term Alternative – None

Long Term Alternative (Figures 25 and 26)

- Grade separation

Table H.9. Design Considerations – Ellis Road (East)

Design Considerations	Grade Separation
Alignment	Realigns Ellis Rd north of existing alignment to maintain traffic during construction
Rail Crossing	Grade separation over rail. Approximate location of proposed high-speed rail, regional rail, and yard leads taken into consideration
Business Impacts	Revises access to Research Triangle Academy while maintaining current turning movements for two driveways
Residential Impacts	May impact one residence
Local Road Impacts	None
Retaining Walls	Retaining walls required – Height: 5' to 29'

Note: Design data is in Appendix E.

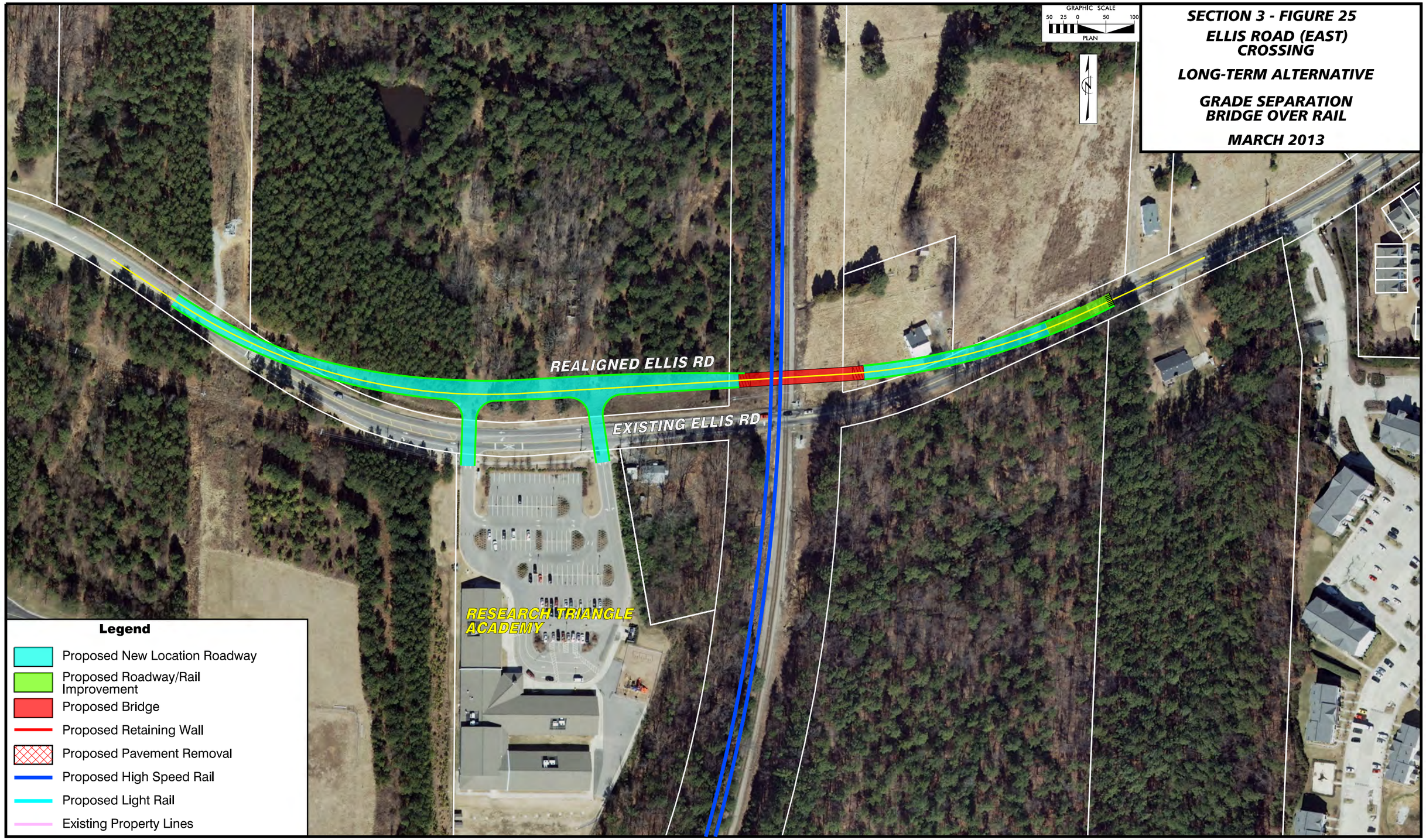
SECTION 3 - FIGURE 25

ELLIS ROAD (EAST) CROSSING

LONG-TERM ALTERNATIVE

GRADE SEPARATION BRIDGE OVER RAIL

MARCH 2013



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Near-Term Recommendations
None

Mid-Term Recommendations
None

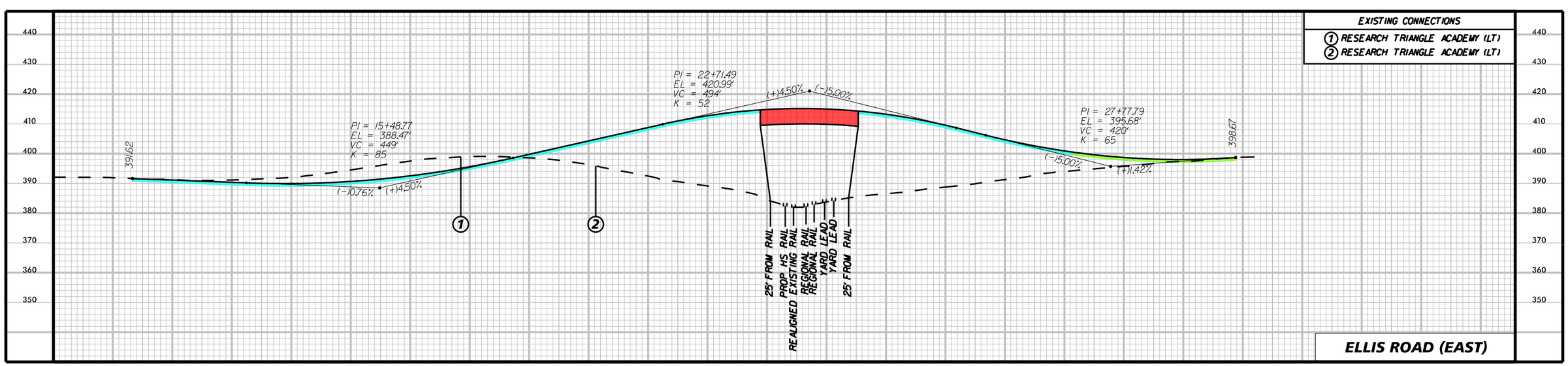
SECTION 3 - FIGURE 26

ELLIS ROAD (EAST) CROSSING

LONG-TERM ALTERNATIVE

GRADE SEPARATION BRIDGE OVER RAIL

MARCH 2013



H.20. Cornwallis Road (Crossing No. 734 742W, Milepost H 62.93)

Existing Conditions

There are approximately 7,900 vpd with 1% trucks on Cornwallis Road across the railroad track which has a four-quadrant gate. Cornwallis crosses the track at about a 65 degree skew. Miami Boulevard is parallel with the track to the east, and intersects with Cornwallis Road with a traffic signal about 0.25 miles east of the tracks. Cornwallis Road continues west, with an interchange with NC 147 and an intersection with T.W. Alexander Drive and Apex Highway (NC 55) before teeing into Fayetteville Road. NCDOT Project U-3309, under construction, widens T.W. Alexander Drive from Cornwallis Road to Miami Boulevard to a four-lane road.

This crossing is labeled as a humped crossing (signs on Miami Boulevard), and several citizens noted that this crossing's vertical grade results in vehicles, especially trailers, scraping the pavement on the west side of the crossing. The grade, however, is not severe enough to be considered a safety problem.

Bicyclists were observed at this location using marked bike lanes on both sides of Cornwallis Road from Fayetteville Street to Miami Boulevard that narrow to about one foot wide across the track. Citizens and stakeholders commented that Research Triangle Foundation plans to extend a jogging trail along this section of Cornwallis Road, and the City of Durham may extend the proposed trail further into their greenway system. No timeline or funding has been set for these projects, but the DCHC MPO staff noted that this route is one of the top priority projects in the Durham Bicycle Plan. Although pedestrian safety is not seen as a problem now, it may become one in the future as traffic on Cornwallis Road continues to increase. An RTP shuttle provided by Triangle Transit uses this crossing. Durham County school buses use this crossing 55 times each day.

Although the land immediately adjacent to the crossing is forested, large office complexes are within 0.25 miles in all four quadrants. Traffic volumes are expected to increase on Cornwallis Road as the connecting routes are improved and development continues.

Alternatives

One near term solution has been developed, although a long term solution to grade separate is also proposed. This near term alternative could be made instead of, or in addition to, the long term alternative.

Near Term Alternative (Figure F.18 in Appendix F)

- Widen asphalt shoulder and stripe outside edges of travel lane

Mid Term Alternative – None

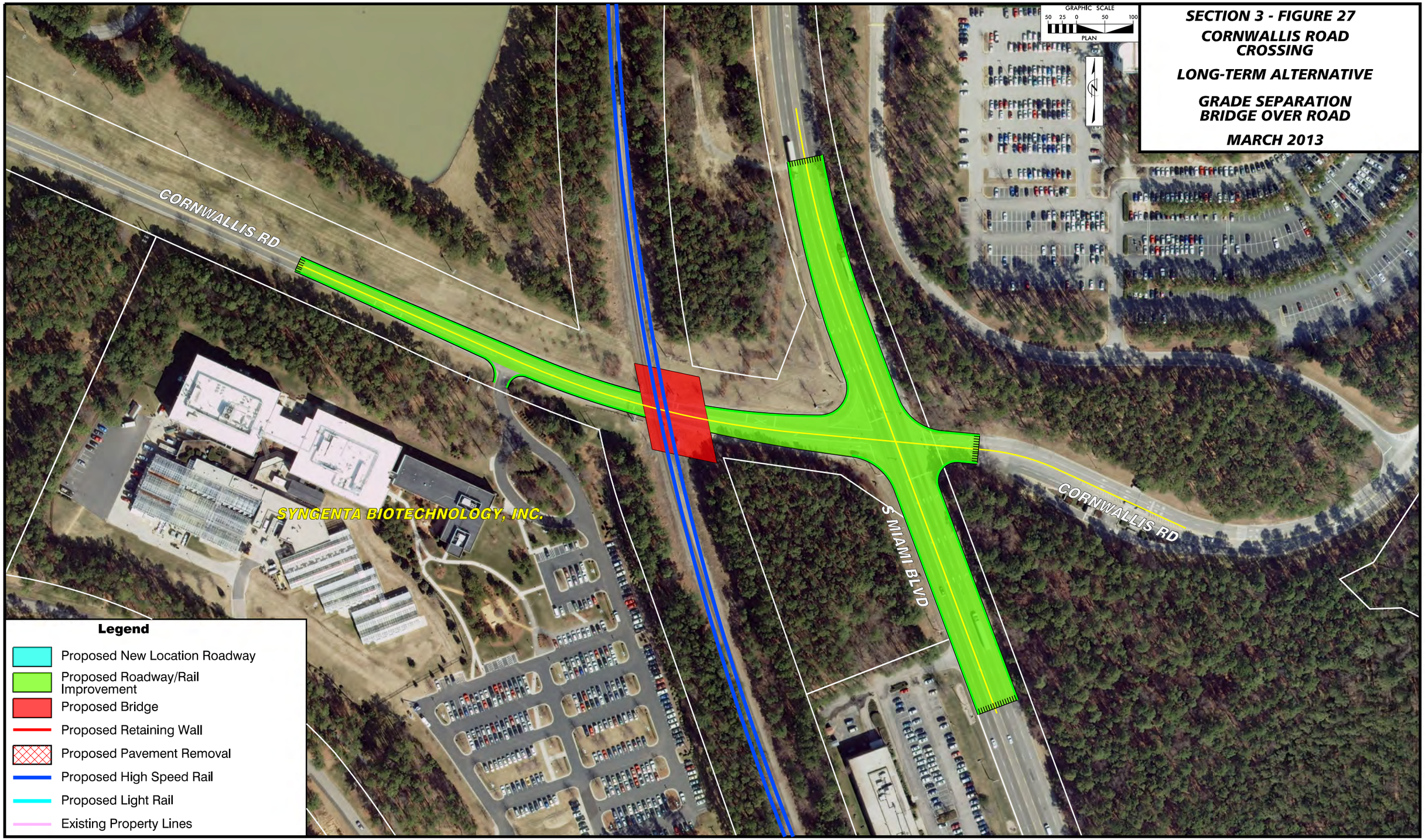
Long Term Alternative (Figures 27 and 28)

- Grade separation

Table H.10. Design Considerations – Cornwallis Road

Design Considerations	Grade Separation
Alignment	Retain existing roadway location south of grade separation, construct loop to tie to Odell St north of grade separation
Rail Crossing	Grade separate under rail and Angier Ave. Approximate location of proposed high-speed rail taken into consideration
Business Impacts	Access to Syngenta must be lowered approximately 15' to tie to lowered Cornwallis Rd
Residential Impacts	May impact five residences
Local Road Impacts	S Miami Blvd must be lowered approximately 6' to tie to lowered Cornwallis Rd
Retaining Walls	Retaining walls required – Height: 5' to 21'

Note: Design data is in Appendix E.



SECTION 3 - FIGURE 27

CORNWALLIS ROAD CROSSING

LONG-TERM ALTERNATIVE

GRADE SEPARATION BRIDGE OVER ROAD

MARCH 2013

Kimley-Horn and Associates, Inc.

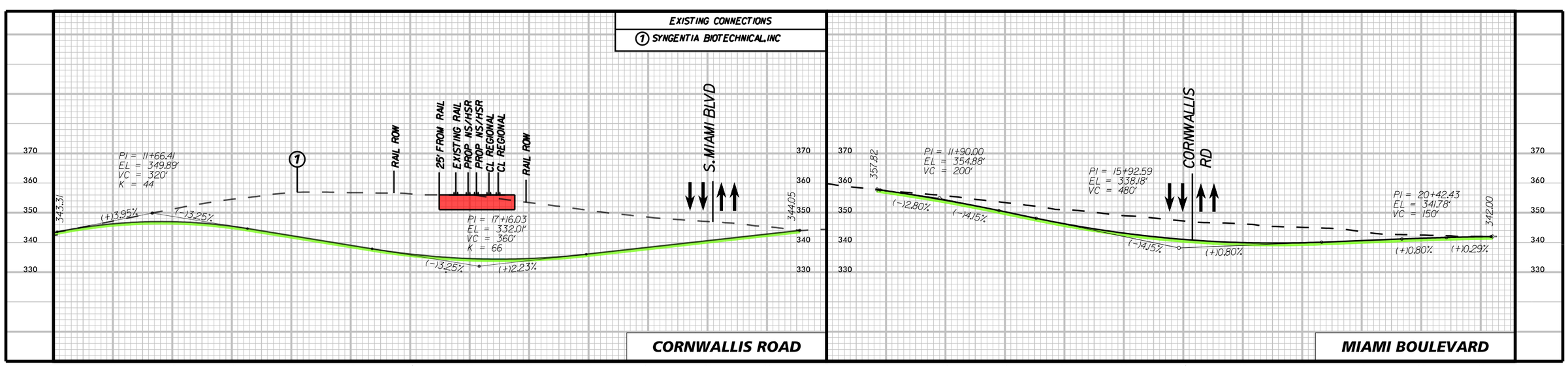
Near-Term Recommendations
Widen asphalt shoulder and stripe outside edges of travel lane

Mid-Term Recommendations
None

SECTION 3 - FIGURE 28

CORNWALLIS ROAD CROSSING

LONG-TERM ALTERNATIVE

GRADE SEPARATION BRIDGE OVER ROAD

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