

**Final Technical Addendum:
Alternative #5 Analysis**

Blair-Hunt-Morgan Connector

City of Raleigh, North Carolina



March 2010

Prepared for:

City of
Raleigh,
North Carolina



Prepared by:



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in association with

LandDesign.



Technical Addendum

To: Eric Lamb, P.E., City of Raleigh Transportation Services
From: Todd B. Delk, P.E., Kimley-Horn and Associates, Inc.
Date: Thursday, March 4, 2010
Subject: Blair-Hunt-Morgan Connector – Feasibility Study Addendum

This addendum to the Feasibility Study for the Blair-Hunt-Morgan (BHM) Connector dated March, 11, 2008 analyzes an additional alignment alternative. This new Alternative #5 provides a direct connection from Hillsborough Street at its current at-grade intersection with Park Avenue to Western Boulevard at a new at-grade intersection just west of the Motor Fuels Laboratory. The alignment, shown on Figure 1, would run south to Ashe Avenue opposite Wakefield Street and then follow the Wakefield alignment before shifting east near 905 Tryon Hill Drive and going under the rail lines. Ashe Avenue would intersect with the BHM Connector at a T-intersection, and the east-west section of Morgan Street would be extended to intersect the new facility.

The recently updated Triangle Regional Travel Demand Model was used to project the traffic volumes in the study area for the addition of the study alternative. As in the original study, the BHM Connector was modeled as a four-lane facility. Because there was concern that the new model would produce very different results from the previous model, new model runs were performed for both Alternative #4 and the new Alternative #5. Link traffic volumes from the new model were compared to results for Alternative #4 from the previous version. This comparison showed that volumes from the new model were higher on the majority of the links in the study area by anywhere from 5% to 40%. It also projected that the new connector would carry volumes beyond the capacity of a typical four-lane facility. The volumes on the connector were therefore adjusted to an average annual daily traffic (AADT) of approximately 34,000 vehicles per day, equivalent to Level of Service (LOS) E (near capacity) operations. Traffic volumes on the adjacent streets were also reduced for consistency. The model results are provided in the appendix and the adjusted link AADT volumes are shown on **Figure 2**.

Peak hour turning movement volumes were developed by examining the model AADT turning volumes and adjusting the volumes in proportion to the overall AADT reductions. The peak hour turning movement calculations are provided in the appendix of this memorandum. At-grade intersection analyses were performed using Synchro (Version 7) and SIDRA Intersection (Version 3.1) traffic capacity software. The LOS and delay at each of the study intersections for Alternatives #4 and #5 are shown on **Tables 1** and **2**, respectively. The recommended roadway laneage for each alternative is shown on **Figure 3**.

In both alternatives, the analysis indicates that the intersection of Centennial Parkway at Blair Drive will operate at LOS F in the year 2035 with the recommended roadway laneage. The poor LOS during the peak periods is



primarily due to heavy northbound left-turn movements into Centennial Campus. While the model shows these turns concentrated at Blair Drive, the volumes would likely disperse over additional campus entrances at Achievement and Main Campus Drives.

Alternative #4 and #5 also show that near-capacity traffic volumes along Western Boulevard will cause major delays for the left-turn movements from the north-south facilities. The Western Boulevard intersections operate at overall intersection LOS D or E for Alternative #4, while operations are more congested in Alternative #5, with the Western Boulevard/Hunt Drive intersection at LOS F.

Alternative #4 Evaluation

North of the rail line, all the intersections operate at acceptable LOS with the laneage shown in **Figure 3**. The high forecast volumes for 2035 show the attractiveness of the BHM Connector as a north-south connection. The increased turning movements at the roundabout at Hillsborough and Morgan Streets will require a dual-lane configuration. The northbound approach will operate well beyond capacity as a single-lane roundabout, creating long queues that will spill back on Morgan Street to the proposed connector.

The potential benefits and impacts of Alternative #4 are listed below:

Benefits

- + Improved connectivity between Downtown Raleigh, Western Boulevard corridor, and Centennial Campus
- + Minimal vertical issues on north side of rail
- + Traffic maintained in existing grid system without neighborhood intrusion
- + Issues with rail limited to bridge clearances
- + Grades for Morgan St. Extension can be lessened
- + No new relocations

Impacts

- Vertical issues on south side of rail for bridge structure
- Some traffic spillback on WB Morgan Street
- Two-lane roundabout required at Hillsborough-Morgan intersection

Alternative #5 Evaluation

Two versions of Alternative #5 were analyzed to determine future traffic conditions in the study area north of the rail corridor. The first option (A) carries Morgan Street only as far as the BHM Connector, and terminates Ashe Avenue at the connector near its current intersection with Wakefield Drive. With signalized operation, both intersections operate at acceptable LOS with only moderate queuing. The option also allows for the Morgan Street extension to maintain a four-lane cross-section. While level-of-service measures show operations at LOS C, the more indicative “degree of saturation” results show the northbound leg of the roundabout still operating beyond capacity, with long queues on Morgan Street. Thus, the Hillsborough/Morgan roundabout would still need to be expanded to incorporate a dual-lane configuration.



Table 1 Alternative #4 Level-of-Service Summary		
Intersection	AM Peak-Hour LOS (Delay)	PM Peak-Hour LOS (Delay)
Blair Dr. @ Centennial Pkwy. – Signalized	E (55.3)	F (87.0)*
Hunt Dr. @ Western Blvd. – Signalized	E (70.8)*	D (55.0)*
Connector @ Western Blvd. – Signalized	D (45.5)	D (40.5)
Western Blvd. @ Ashe Ave. – Signalized	B (13.8)	A (9.9)
Morgan St. Extension @ Morgan St./ Connector – Signalized	C (24.8) <i>WB Queue: 280'</i>	C (24.0) <i>WB Queue: 307'</i>
Morgan St. Extension @ Ashe Ave. – Unsignalized	4-way stop	C (18.1)
	Roundabout	A (5.3) <i>DoS: 0.351 (EB)</i>
Ashe Ave. @ Hillsborough St. – Unsignalized (right-only, stop-controlled)	C (21.0)	C (18.8)
Hillsborough St. @ Morgan St. – Roundabout	Single	F (240.0) <i>DoS: 2.220 (NB)**</i>
	Dual	A (6.6) <i>DoS: 0.733 (NBL)</i>

* Certain movements operate at LOS F and over capacity ($v/c > 1.0$)

** Degrees of saturation for an approach exceeds than 0.85, FHWA's publication **Roundabouts: An Informational Guide** (2000) notes roundabout operations will likely deteriorate rapidly, particularly over short periods of time, with queues forming and delays increasing exponentially.

If Morgan Street were to be extended to Ashe Avenue (Option B), operations at the extension and the BHM Connector would become more congested with the increased turning movements. In order to minimize queues on westbound Morgan Street, left turns from the connector would need to be eliminated to provide more signal time to the other movements. The minimal traffic using the southbound left onto Morgan Street would be rerouted to Hillsborough Street to continue east, and traffic traveling to Ashe Avenue from the south would need to continue on Western Boulevard to directly access Ashe Avenue at the more western intersection. The concept layout of Alternative #5, Option B, is displayed in **Figure 4**.



Conceptual horizontal and vertical alignments were developed for Alternative #5 (both A and B) to determine the impacts of the roadway slopes that would be required to construct a facility that went under the existing rail line and intersected Hillsborough Street across from Ashe Avenue. These designs assumed an underpass approximately 24 feet lower than the existing rail line with 17 feet of clearance and a 7-foot structure depth. This controlling elevation of the roadway under the railroad would require 7% grades on the Morgan Street Extension to both Ashe Avenue and Morgan Street. The segment of Morgan Street east of the connection would need to be five lanes wide to accommodate traffic operations. The Hillsborough Street intersection would require widening the eastbound approach to six lanes, as well as realigning Park Avenue on the south side of Hillsborough to a right-in, right-out only T-intersection with the new connector. The Park Avenue realignment would also require a change to the circulation pattern for the nearby YMCA parking lot. The segment of Morgan Street south of Hillsborough Street would need to remain at least three lanes wide, and the street name would likely need to be changed based on Morgan Street extending west to Ashe. It should also be noted that some portion of the Morgan Street extension will likely have to be constructed within the railway right-of-way, necessitating coordination and negotiation with the rail companies.

Alternative #5 creates several short links with the potential for queuing issues, specifically Hillsborough Street between the BHM Connector and Morgan Street, BHM Connector between Hillsborough Street and Ashe Street, and the Morgan Street Connector between BHM Connector and Morgan Street. Synchro queuing reports and SimTraffic observations indicate that queues for the westbound left-turn movement on Hillsborough Street at the connector, the northbound approach of the connector at Hillsborough Street, and the westbound left-turn movement on the Morgan Street Connector all have the potential to spill back into the adjacent intersections.

The potential benefits and impacts of Alternative #5 are listed below:

Benefits

- + Improved connectivity between Downtown Raleigh, Western Boulevard corridor, and Centennial Campus
- + More dispersed traffic by extending downtown grid one block west
- + Traffic relief and better operations at Hillsborough/Morgan roundabout
- + Minor vertical issues south of rail corridor
- + Potential to transition regional rail to Morgan Street with less traffic impact

Impacts

- Some traffic spillback on WB Morgan Street
- Moderate to considerable neighborhood intrusion on Ashe Avenue
- Residential relocations on Ashe and Park Avenues
- Traffic pattern changes for YMCA
- Issues with rail limited to bridge clearances
- Greater grades along Morgan Street extension
- Necessary approvals and coordination with rail
- Uncertainty of future rail projects
- Border-line operations at Hillsborough/ Morgan roundabout if single-lane



Table 2			
Alternative #5 Level-of-Service Summary			
Intersection	AM Peak-Hour LOS (Delay)	PM Peak-Hour LOS (Delay)	
<i>With Offset Intersections for Morgan St. Extension and Ashe Avenue</i>			
Blair Dr. @ Centennial Pkwy. – Signalized	E (61.2)	F (95.3)*	
Hunt Dr. @ Western Blvd. – Signalized	F (80.3)*	F (81.7)*	
Connector @ Western Blvd. – Signalized	D (35.5)*	C (34.8)	
Western Blvd. @ Ashe Ave. – Signalized	B (13.3)	B (16.6)	
Connector @ Morgan St. Extension – Signalized	B (13.7) <i>WB Queue: 182'</i>	B (15.9) <i>WB Queue: 239'</i>	
Morgan St. @ Morgan St. Connector – Signalized	B (19.5)	B (15.4)	
Connector @ Ashe Ave. – Signalized	C (22.8)	B (18.9)	
Connector @ Hillsborough St. – Signalized	C (21.9)	B (19.4)	
Hillsborough St. @ Morgan St. – Roundabout	Single	C (32.0) <i>DoS: 1.151 (NB)</i>	A (9.4) <i>DoS: 0.928 (WB)</i>
	Dual	A (2.6) <i>DoS: 0.437 (EB)</i>	A (2.4) <i>DoS: 0.421 (WB)</i>
<i>With Morgan St. Extended to Ashe Avenue (if affected)</i>			
Connector @ Morgan St. Extension – Signalized	C (34.2) / C (21.5) <i>WB Queue: 378'/258'</i>	D (38.0) / C (20.8) <i>WB Queue: 409'/298'</i>	
Ashe Ave. @ Morgan St. Extension – Unsignalized	4-way stop	B (12.4) / B (10.3)	B (11.3) / A (9.5)
	Roundabout	A (3.2) <i>DoS: 0.327 (NEB)</i>	A (3.1) <i>DoS: 0.274 (NB)</i>
Connector @ Ashe Ave. – Unsignalized (right-only, stop-controlled)	B (12.1) / B (12.0)	B (12.0) / B (11.9)	

* Certain movements operate at LOS F and over capacity ($v/c > 1.0$)

** Degrees of saturation for an approach exceeds than 0.85, FHWA's publication **Roundabouts: An Informational Guide** (2000) notes roundabout operations will likely deteriorate rapidly, particularly over short periods of time, with queues forming and delays increasing exponentially.

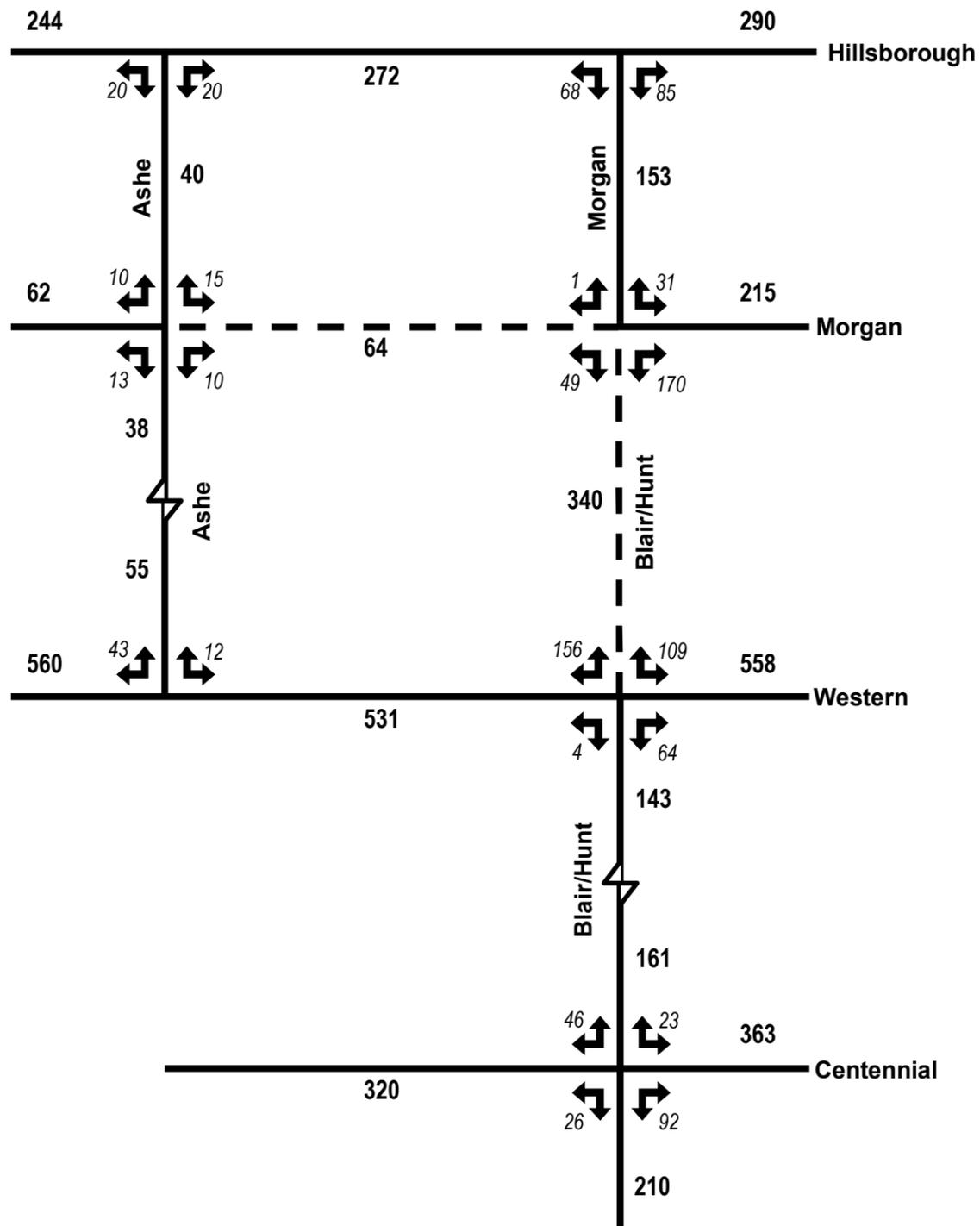


Summary of Findings / Conclusions

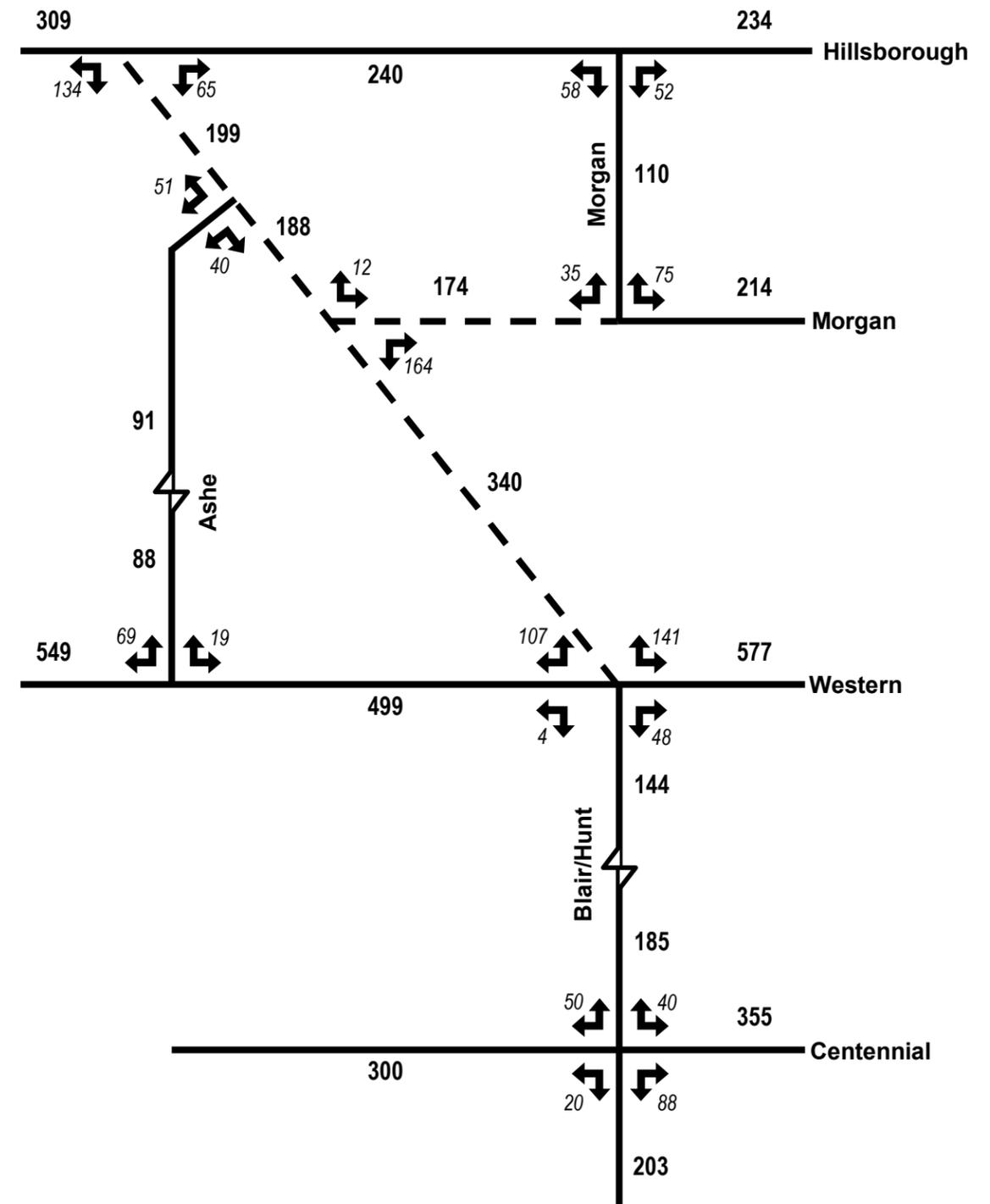
Based on the revised traffic forecasts developed with the updated Triangle Regional Model, the Blair Hunt Morgan Connector will attract average daily traffic volumes of 34,000 (near capacity) for its proposed four-lane cross-section. There is a high travel demand to use the link, one that represents a missing north-south connection west of Downtown Raleigh from the Hillsborough and Morgan corridors to Western Boulevard and Centennial Campus. With both alternatives, the intersections north of Western Boulevard can be designed to operate at acceptable levels-of-service, assuming the Hillsborough/Morgan roundabout intersection can be converted to a dual-lane roundabout. Queuing on short links of westbound Morgan Street and eastbound Hillsborough Street though will cause delays and at times spill into upstream intersections. Of note, the increased traffic will likely impact the community character and run counter to prevalent planning concepts to make Hillsborough and Morgan Streets more multimodal and context-sensitive. The demand to serve this additional traffic could compete for limited right-of-way with efforts to add on-street parking, widen sidewalks, provide bicycle accommodations, and consider streetcar routes within the corridor.

In terms of design, both alternatives will involve impacts to the study area in order to cross the existing rail lines. Alternative #4 will require a bridge structure crossing the rail with minimal right-of-way impacts or grade issues north of the rail line, but requiring a grade of approximately 6% for 1,000 feet before matching existing grade approximately 500 feet north of Western Boulevard. Alternative #5 would require either tunneling under the existing rail lines or building a parallel rail bridge. Both opportunities and challenges exist to this option due to the undecided future of high speed, commuter, or light rail in the corridor. Alternative #5 would also require substantial coordination and cooperation with the rail companies and rail line service providers using the corridor.

Alternative #4



Alternative #5

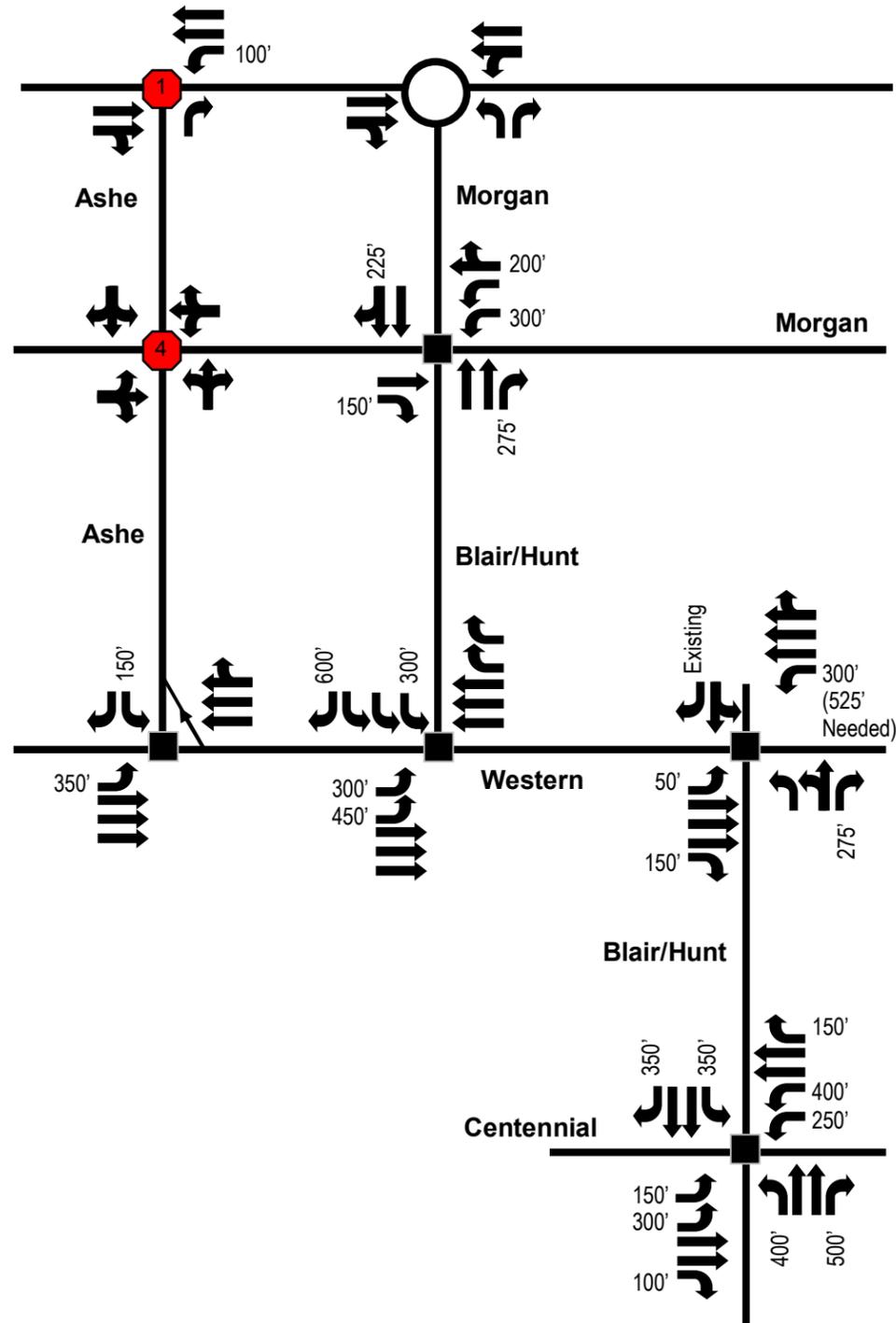


BLAIR-HUNT-MORGAN CONNECTOR

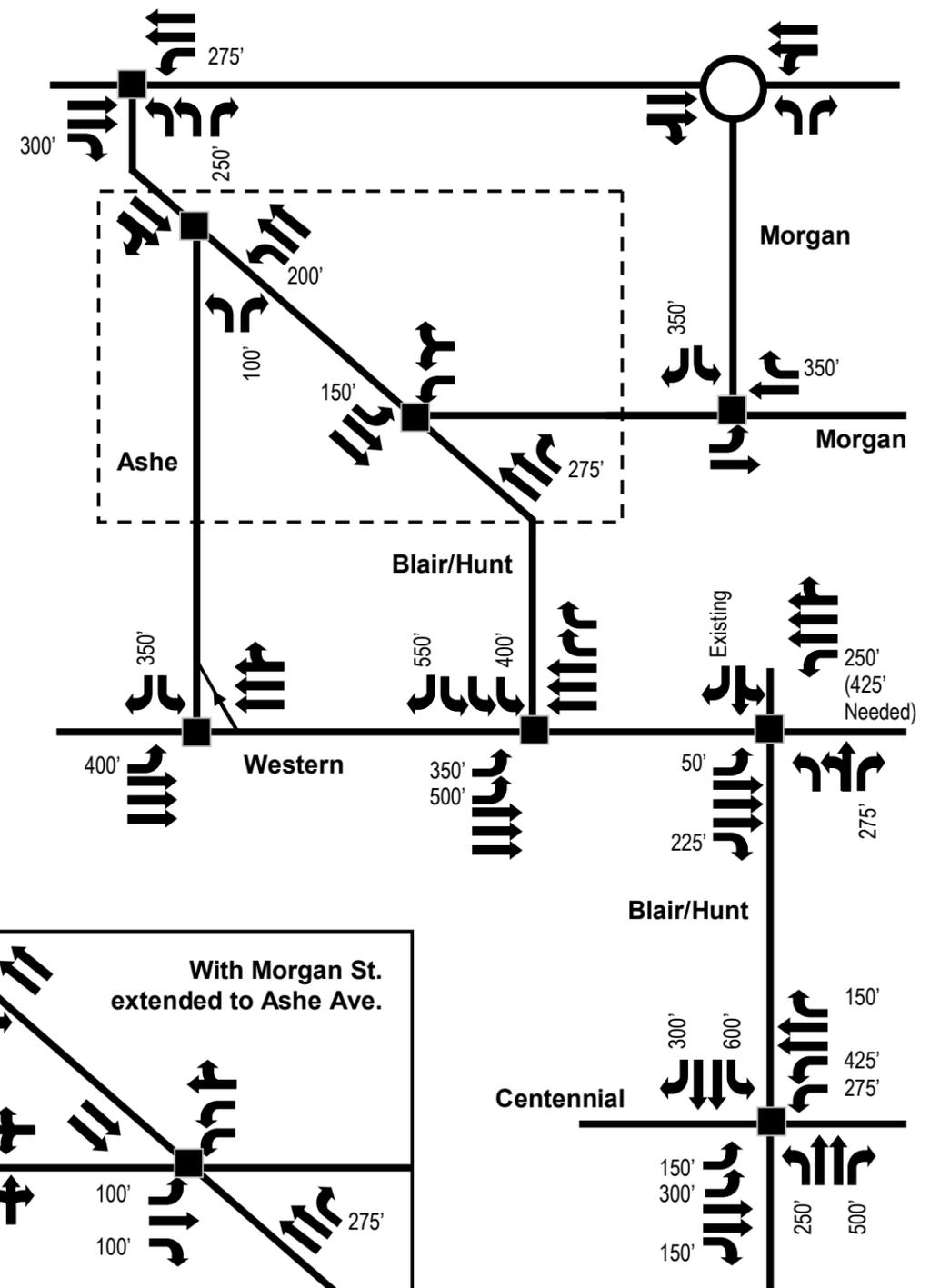
CITY OF RALEIGH PLANNING DEPARTMENT

FIGURE 2
2035 AADT TRAFFIC FORECAST

Alternative #4

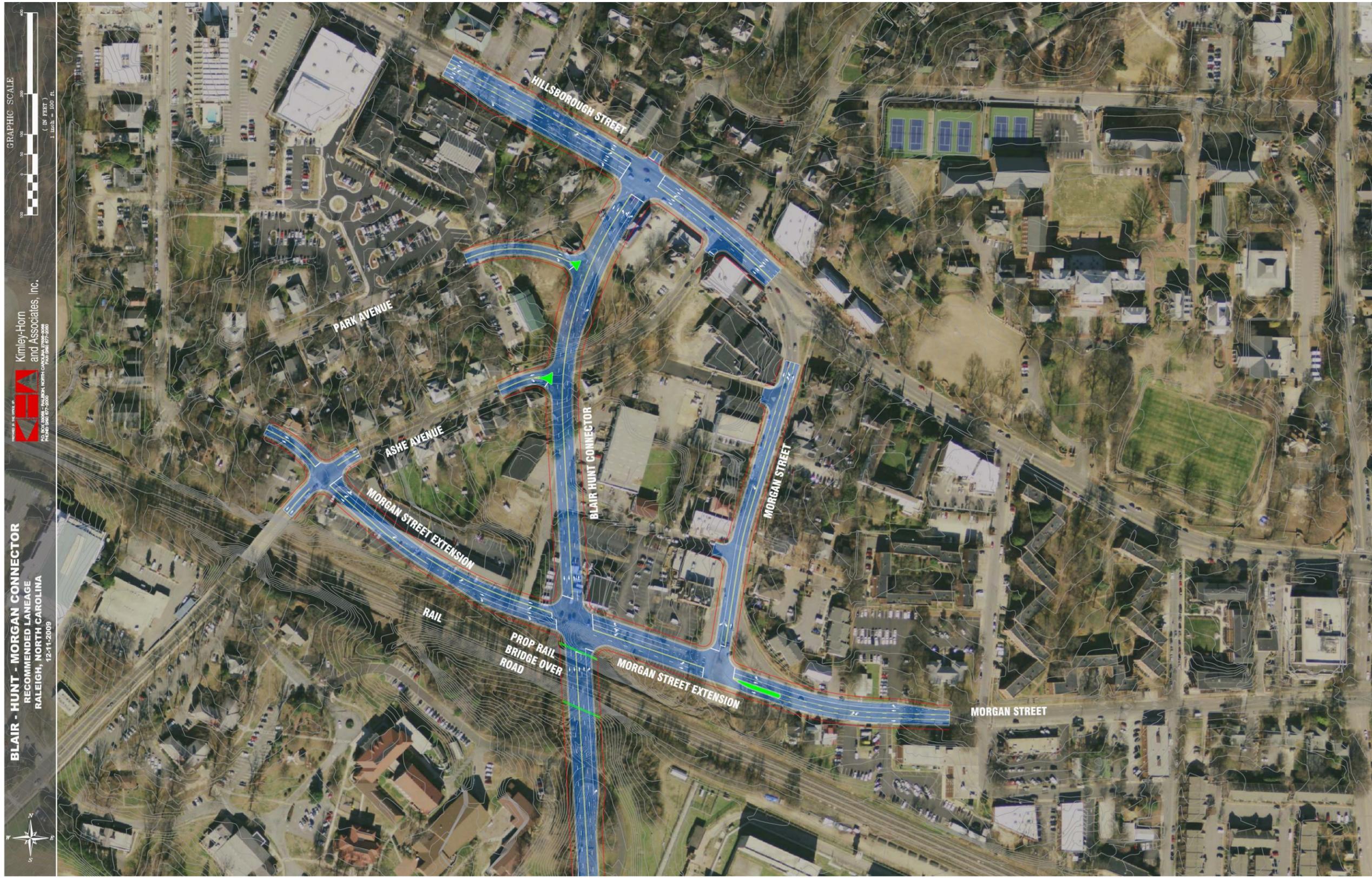


Alternative #5



LEGEND

- 1 T-intersection (minor street stop)
- 4 Four-way stop
- Roundabout
- Signalized



BLAIR - HUNT - MORGAN CONNECTOR
 RECOMMENDED LANEAGE
 RALEIGH, NORTH CAROLINA
 12-11-2010

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GRAPHIC SCALE
 (IN FEET)
 1 inch = 100 ft

BLAIR-HUNT-MORGAN CONNECTOR

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FIGURE 4
CONCEPTUAL DESIGN – ALT. #5, OPTION B