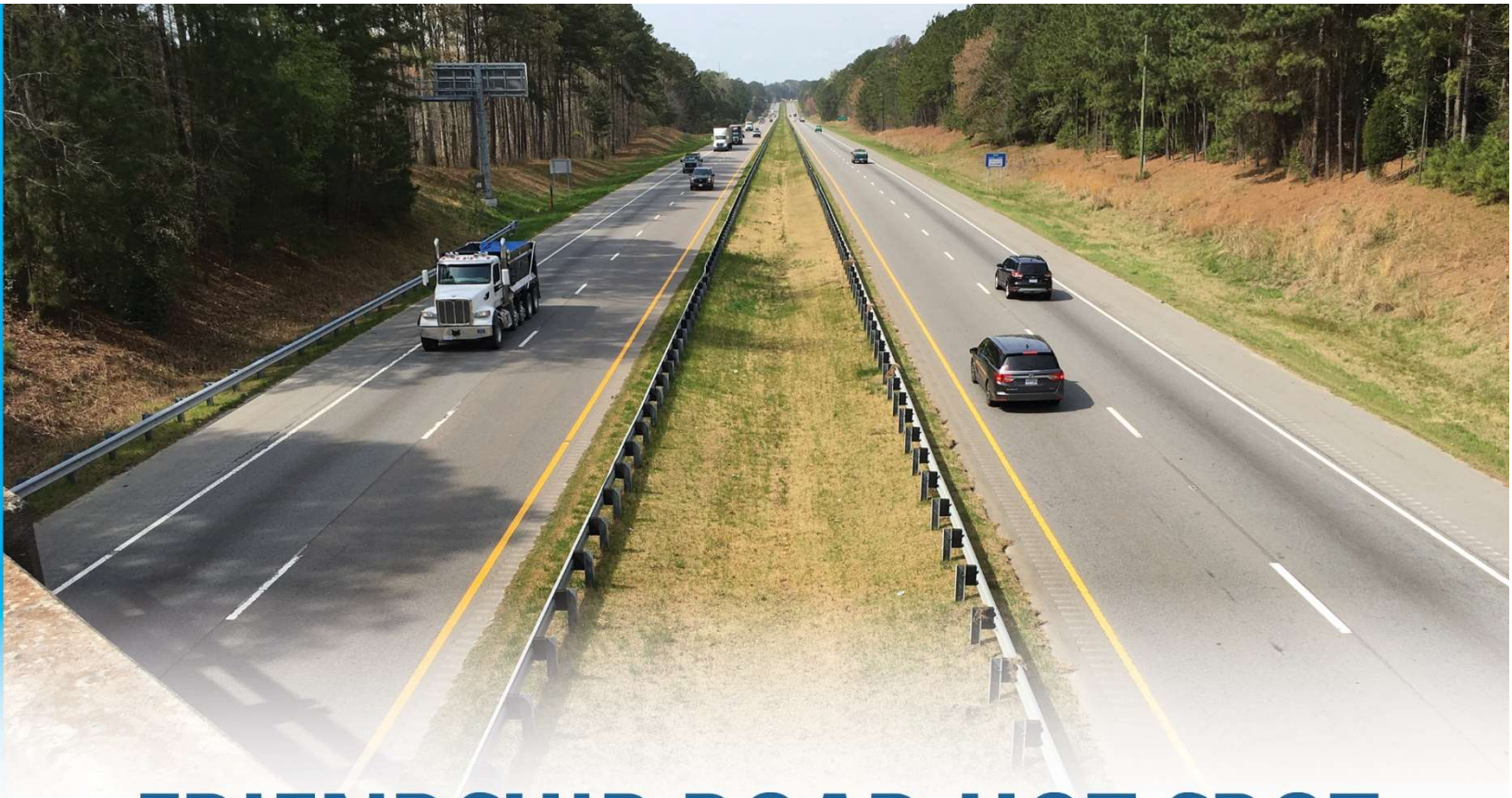
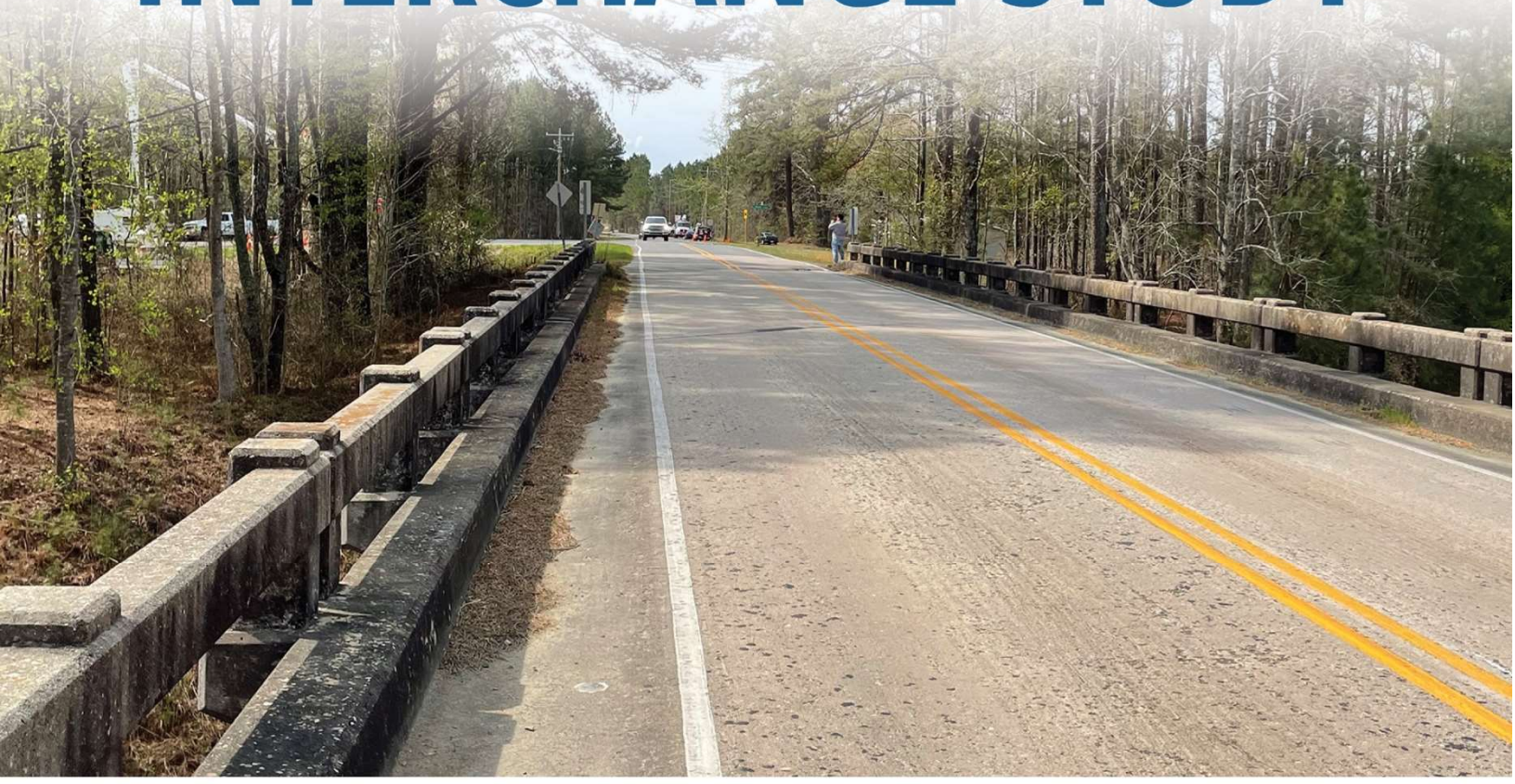


FRIENDSHIP ROAD HOT SPOT INTERCHANGE STUDY



CAMPO
NC Capital Area Metropolitan Planning Organization

Feasibility Study
CAMPO Project Number A648

June 2022

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EXECUTIVE SUMMARY

The NC Capital Area Metropolitan Planning Organization (CAMPO) is conducting a hot spot study on Friendship Road at US 1. The project limits include the proposed Friendship Road interchange at US 1 and proposed Friendship Road on new location from the existing Friendship Road in the Town of Holly Springs to Old US Hwy 1 in the Town of Apex.

The Friendship Road Hot Spot feasibility study addresses transportation strategies for the proposed Friendship Road interchange, including local mobility, connectivity, and ongoing and future land use relationships for the rapidly growing areas of the Town of Apex and the Town of Holly Springs. This study uses the currently adopted TRM 6.2, which is based on the CAMPO's 2050 MTP, to predict future traffic volumes for the roadway network and proposed improvements. The need for a four-lane median divided roadway was confirmed through evaluations that included a comparison of existing traffic volumes and future traffic forecast without and with the proposed US 1 interchange.

Surrounding land uses, environmental features, interchange spacing on US 1, and the proximity of the proposed US 1 interchange to the Friendship Road bridge were evaluated to determine the appropriate interchange location. Once the appropriate interchange location was determined, six distinct interchange types were evaluated to determine the best-fit interchange:

- Alternative 1 Tight Diamond (includes the replacement of Friendship Road bridge)
- Alternative 2 Tight Diamond with Roundabouts (includes the replacement of Friendship Road bridge)
- Alternative 3 Partial Cloverleaf with a Loop in the Southeast Quadrant
- Alternative 4 Standard Diamond (includes the removal of the Friendship Road bridge)
- Alternative 5 Tight Diamond with a New Access to the Amgen Facility
- Alternative 6 Tight Diamond with a New Access to the Amgen Facility and New Intersection at Friendship Road

An evaluation matrix was prepared to assist in preliminary decisions on location of the interchange and recommended interchange alternatives. The evaluation matrix (including stakeholder input, traffic/safety analyses, nearby developments, proximity to the Friendship Road bridge, environmental features, utility, right of way, and planning costs) assisted in recommending two best-fit interchanges – interchange alternatives 1 and 6.

Interchange Alternative 1 Tight Diamond consists of a six-lane roadway typical section divided by a median. Interchange Alternative 6 Tight Diamond with a New Access to the Amgen Facility and New Intersection at Friendship Road consists of a six-lane roadway typical section divided by a median. Both interchange configurations accommodate four through lanes, two left-turn lanes to access US 1, and bicycle and pedestrian facilities.

Jurisdictional responsibility and the extent of right of way preservation would conform to limits and right of way dimensions determined by interchange alternatives 1 and 6 and each municipality's roadway right of way requirements.

1 INTRODUCTION

The NC Capital Area Metropolitan Planning Organization (CAMPO) is conducting a hot spot study on Friendship Road at US 1. The Friendship Road Hot Spot project limits include the proposed Friendship Road interchange at US 1 and proposed Friendship Road on new location from the existing Friendship Road in the Town of Holly Springs to Old US Hwy 1 in the Town of Apex. The study limits for the purpose of roadway network traffic modeling and traffic forecasting include the New Hill Holleman Road (and US 1 interchange) to the west, the intersection of Friendship Road and Holly Springs New Hill Road to the south, NC 540 (and US 1 interchange) to the east, and Olive Chapel Road to the north.

The Friendship Road Hot Spot feasibility study addresses transportation strategies for the proposed Friendship Road interchange, including local mobility, connectivity, and ongoing and future land use relationships for the rapidly growing areas of the Town of Apex and the Town of Holly Springs. The study identifies the existing roadway network and proposed roadway and pedestrian/bicyclist improvements, analyzes traffic models/forecasts for the transportation network, evaluates the appropriate location of the proposed Friendship Road interchange at US 1, evaluates interchange alternatives and new Friendship Road roadway alignments in Holly Spring and in Apex, and determines the best-fit interchange and roadway alignments.

This study would support the North Carolina Department of Transportation's (NCDOT's) procedure in developing interchange justification studies and preparing an Interchange Justification Report (IJR). This feasibility study would also support the process of advancing the proposed Friendship Road interchange at US 1 for inclusion in the State Transportation Implementation Plan (STIP).

The Friendship Road Hot Spot Interchange is evaluated in three phases:

- Tech Memo 1 – Existing and future years analysis
- Tech Memo 2 – Project feasibility analysis
- Tech Memo 3 – Project impact analysis

Tech Memo 1 identifies and evaluates existing land use and traffic conditions and will determine future traffic volumes on the no-build and build roadway networks. Tech Memo 2 identifies and evaluate the feasibility of appropriate transportation improvements, focusing interchange location, interchange operations, corridor and alignment options, and safety of the new roadway and future roadway and mobility network. Tech Memo 3 identifies and develops sound concepts and determine the best fit interchange. Key elements from each tech memo contributed to this feasibility study report. The complete tech memos are included in Appendix A.

Figure 1. US 1 from the Friendship Road Bridge

At the study area, US 1 is a four-lane highway divided by a 36-foot grass median, with 12-foot paved shoulders on both sides. Adjacent interchanges are New Hill Holleman Road to the south and NC 540 to the north. Friendship Road is a two-lane undivided highway, with four-foot shoulders (two-foot paved) on both sides. The Friendship Road and Holly Springs New Hill Road intersection is a T-intersection that includes a stop sign for the westbound lane of Holly Springs New Hill Road. At the intersection, Friendship Road includes a shared through and right turn lane northbound and a shared through and left turn lane southbound and Holly Springs New Hill Road includes a shared left/right turn lane. Friendship Road continues south to a T-intersection with New Hill Holleman Road and continues north to a T-intersection with Woods Creek Road and further north on a bridge over US 1. The Friendship Road bridge over US 1 maintains the two-lane undivided roadway and does not provide access to US 1.

2 PLAN AND LAND USE REVIEWS

2.1 Plan Review

Proposed roadway improvements and existing travel conditions within the study area were obtained from reviews of the following key sources:

- The 2050 Metropolitan Transportation Plan (MTP)
- The Triangle Regional Model v6.2 (TRM)
- Traffic Impact Analyses (TIA) from nearby existing and planned developments: Amgen Manufacturing, Friendship Innovation Master Plan, Carolina Springs, Woods Creek Elementary, Duke Energy Operations, Fire Station #3, Green Oaks Tech Center, Oakview Innovation, and Goodwin Industrial in Holly Springs; Friendship Station, Retreat at Friendship, Friendship Village, Gracewood, Apex Friendship Elementary School, Apex Friendship High School in Apex.
- Holly Springs Comprehensive Transportation Plan (CTP) – Bicycle/Pedestrian Component (2011)
- Town of Holly Spring's Bicycle and Pedestrian System Plans 2022
- Traffic forecasts from nearby NCDOT projects U-6066, U-5981 and B-5321
- Town of Apex's planned Richardson Road Improvements
- Wake County Greenway Plan (2016)
- 2019 Southwest Area Study

2.2 Land Use Review

Existing and future land uses within the study area and nearby traffic generators outside of the study area were documented from review of geographic information system (GIS) data and field observations as follows:

- Town of Apex Interactive Development Map
- Friendship Station Subdivision Plans
- The Friendship Innovation Master Plan
- New Hill Subdivision Master Plan
- Amgen manufacturing facility plans
- Fujifilm Diosynth Biotechnologies manufacturing facility plans
- CAMPO Webmaps
- Wake County Imaps
- The North Carolina Department of Natural and Cultural Resources' HPOWEB 2.0

Figure 2. Amgen facility roadway construction

Community and environmental features within the study area include:

- Harris Lake County Park
- Wake County Fire Training Center
- Oakview Elementary School
- Holly Springs Fire Station No. 3
- New Hill Historic District
- Apex Friendship High School
- Little White Oak Creek
- White Oak Creek
- Farmlands along Friendship Road and Boscoe Road in Apex
- Duke Energy Utility Easements
- CSX Transportation Railway

Figure 3. Holly Springs Fire Station No. 3

Land uses, proposed developments, and community and environmental features are shown in the Project Location Map in Figure 4.

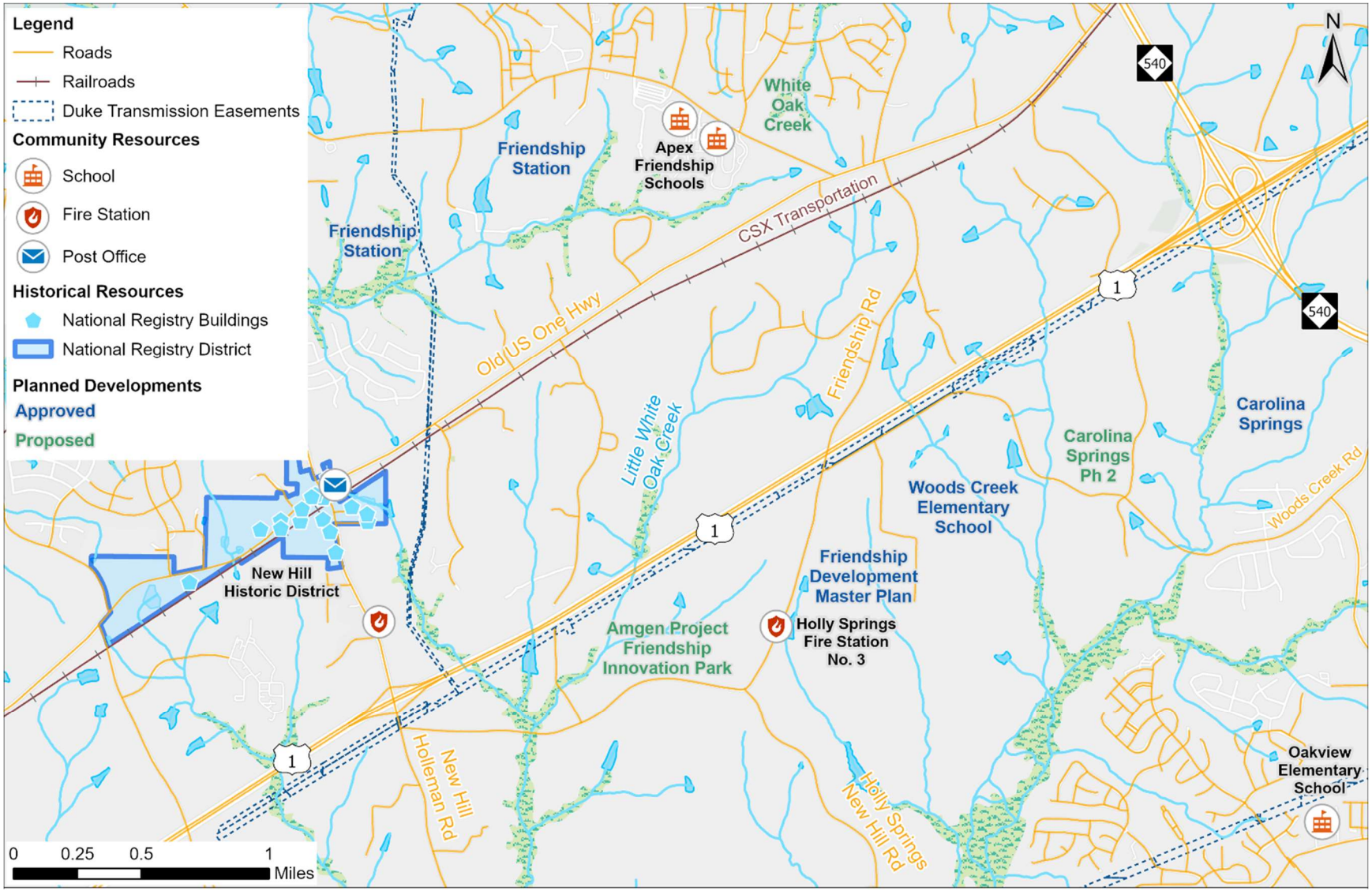

Figure 4. Project Location Map

3 TRAVEL DEMAND MODEL

As a major metropolitan and urbanized area, CAMPO utilizes the TRM for projecting future traffic volumes and transit ridership for transportation planning and for regional transportation funding. This study uses the currently adopted TRM version, TRM 6.2, which is based on the CAMPO's 2050 MTP. All traffic modeling files are available through CAMPO's project SharePoint site.

3.1 Review of Model Network and Socio-Economic Data

Traffic evaluation for the proposed Friendship Road interchange and new Friendship Road alignments is based on 2050 socio-economic data, and towns of Holly Springs and Apex CTPs and the 2050 MTP roadway networks near the study area.

Growth analysis considered development plans provided by the towns of Holly Springs and Apex and the 2050 total population and employment in seven traffic analysis zones (TAZs) near the study area. Since the total population and employment growths from 2020 to 2050 are consistent with proposed development growth, no changes are needed to the 2050 socio-economic data.

Daily traffic volumes considered traffic volumes from the 2050 MTP model run and traffic volumes from recently completed TIAs for major developments near the study area. The location of major developments within TAZs and proposed site access plans from TIAs were included in the evaluation; minor changes to the 2050 MTP model network included adjustments to centroid connector loadings.

3.2 Network Scenarios

Three different network scenarios were modeled for this feasibility study:

- No Build – 2050 MTP network without the Friendship Road interchange and new Friendship Road
- MTP – 2050 MTP network with Friendship Road interchange and new Friendship Road
- MTP+ – 2050 MTP network with the Friendship Road interchange, new Friendship Road and two additional projects from the Apex CTP
    - Richardson Road New Location from Old US 1 Hwy to Humie Olive Road
    - Richardson Road widening from Humie Olive Road to Olive Chapel Road

The two additional projects were included to evaluate future US 1/Friendship Road interchange traffic volumes with the extension of Richardson Road. Both the Richardson Road New Location and the Richardson Road widening are assumed four-lane median divided roadways, with posted speeds of 45 mph, based on traffic forecasts and for scenario comparison. The Apex CTP indicated a four-lane median divided roadway including a side path for the Richardson Road New Location from Old US 1 Hwy to Humie Olive Road. The need for a four-lane median divided roadway was confirmed through evaluations that included a comparison of existing traffic volumes and future traffic forecast with and without the proposed US 1 interchange.

Figure 5 shows projects in the three network scenarios. Project A represents the Friendship Road interchange and new Friendship Road. Project B represents Richardson Road New Location from Old US 1 Hwy to Humie Olive Road. Project C represents Richardson Road widening from Humie Olive Road to Olive Chapel Road. The No Build scenario does not include any of the projects. The MTP scenario includes project A only. The MTP+ scenario includes all three projects A, B and C.

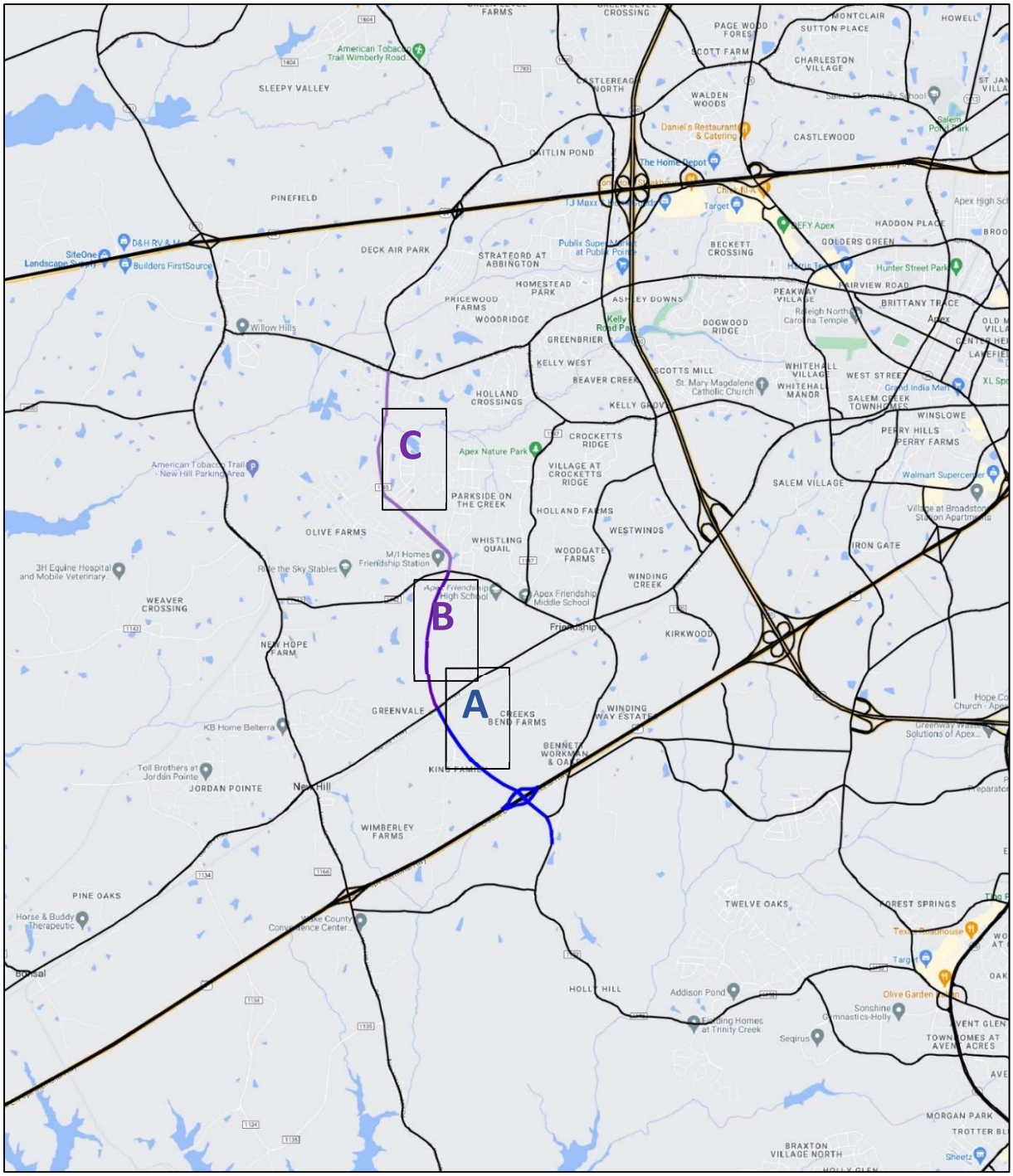

Figure 5. Model Network Scenarios

3.3 Model Volumes

Table 1 compares model daily volumes for key links for No-Build, MTP and MTP+ scenarios.

Table 11. Daily Volumes from Model

Roadway	Location	2050 No Build	2050 MTP	2050 MTP+
US 1	West of New Hill Holleman Rd	58,100	57,500	57,800
	Between New Hill Holleman Rd and Proposed Friendship Rd Interchange	76,500	76,700	76,200
	Between Proposed Friendship Rd Interchange and NC 540	76,500	84,400	86,500
	East of NC 540	90,400	94,800	94,200
Old US 1 Hwy	West of New Hill Holleman Rd	7,500	7,400	6,800
	Between New Hill Holleman Rd and Proposed Friendship Rd Intersection	12,600	10,700	8,200
	East of Proposed Friendship Rd Intersection	8,700	9,300	7,300
NC 540	North of Old US 1 Hwy / S Salem St	73,800	73,600	71,300
	Between Old US 1 Hwy and US 1	86,900	88,100	83,300
	South of US 1	64,800	63,500	62,800
Proposed Friendship Rd New Alignment	North of Old US 1 Hwy	-	-	21,100
	Between Old US 1 Hwy and US 1	-	11,700	21,000
	South of US 1	-	14,300	16,900
	North of Friendship Rd	7,000	15,200	17,200
New Hill Holleman Rd	North of US 1	31,200	23,000	21,200
	South of US 1	46,000	40,500	40,000
	South of Friendship Rd	37,100	36,800	37,000
Other	Holly Springs New Hill Rd South of Friendship Rd	7,300	7,800	8,900
	Old Holly Springs Apex Rd west of NC 540	38,600	36,400	36,100
	Old Holly Springs Apex Rd east of NC 540	19,400	18,400	18,200

3.6 Peak Hour Volume Estimates

Daily (24-hour) and peak hour (AM and PM) traffic volumes were estimated for the No-Build, the MTP, and the MTP+ scenarios. The estimated daily traffic volumes were based on the 2050 TRM. Details on TRM scenario assumptions and outputs are included in Appendix A, Tech Memo 1.

3.6.1 Estimated 2050 Daily Traffic Volumes

The estimated 2050 daily traffic volumes considered NCDOT's Annual Average Daily Traffic (AADT) volumes, nearby traffic forecasts, recent traffic counts, and TIAs provided by the towns of Holly Springs and Apex. Traffic design factors including design hour factor (K), peak hour directional split (D), and direction of peak for AM and PM were subsequently developed from these data.

Figure 6, Figure 7, and Figure 8 show estimated 2050 daily traffic volumes for the No Build, MTP scenario, and MTP+ scenario, respectively.

3.6.2 Estimated 2050 Peak Hour Traffic Volumes

The estimated 2050 peak hour volumes considered daily volume estimates and traffic design factors in the calculation. The calculation included the NCDOT's Intersection Analysis Utility (IAU) spreadsheet to determine peak hour turn movement traffic volumes at interchanges and intersections within the study area. Estimated peak hour traffic volumes were used for traffic operations and capacity analysis.

Figure 9, Figure 10, and Figure 11 show estimated 2050 peak hour traffic volumes the No Build, MTP scenario, and MTP+ scenario, respectively.

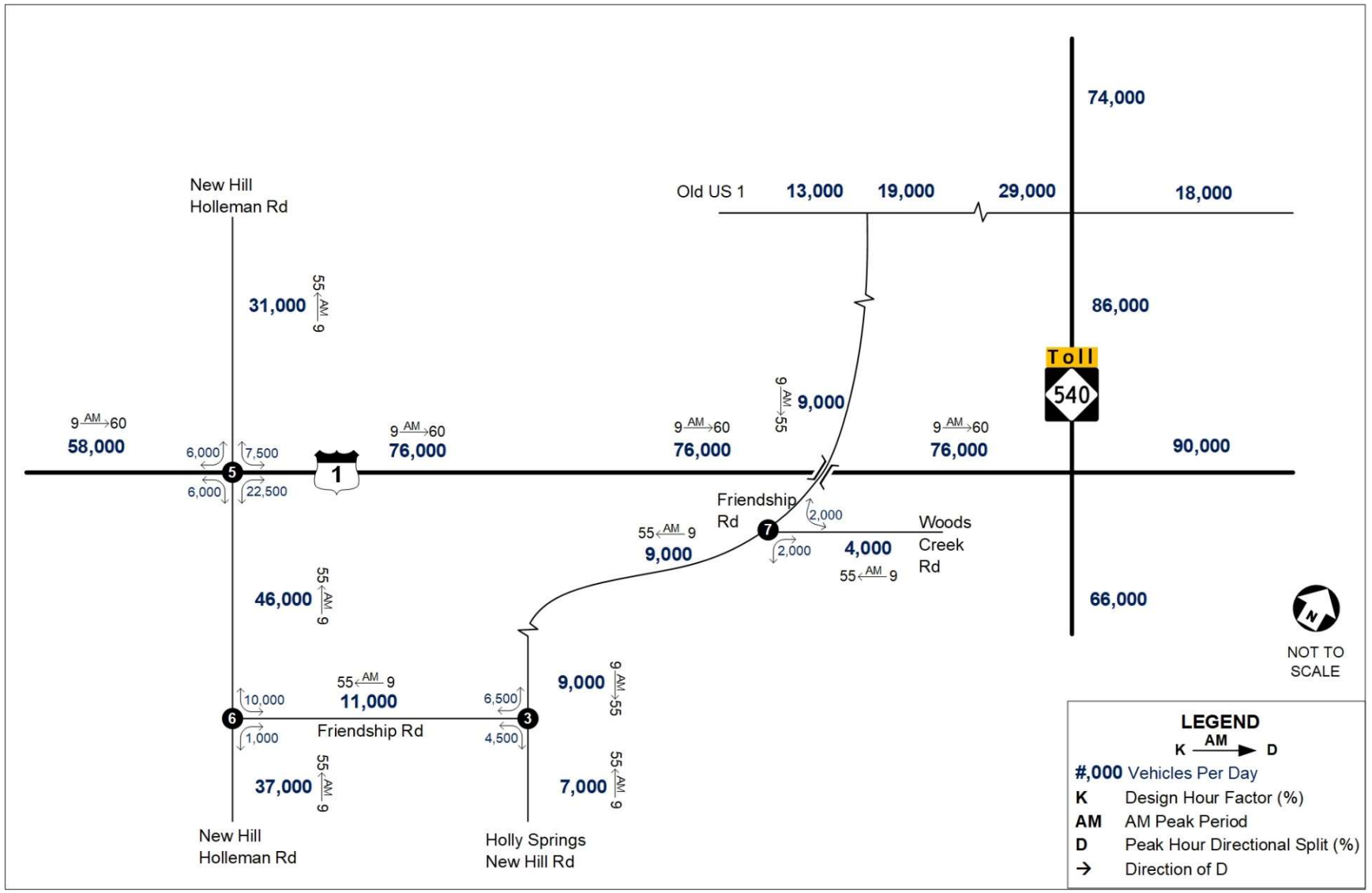

Figure 6. No Build Scenario 2050 Daily Traffic Volumes

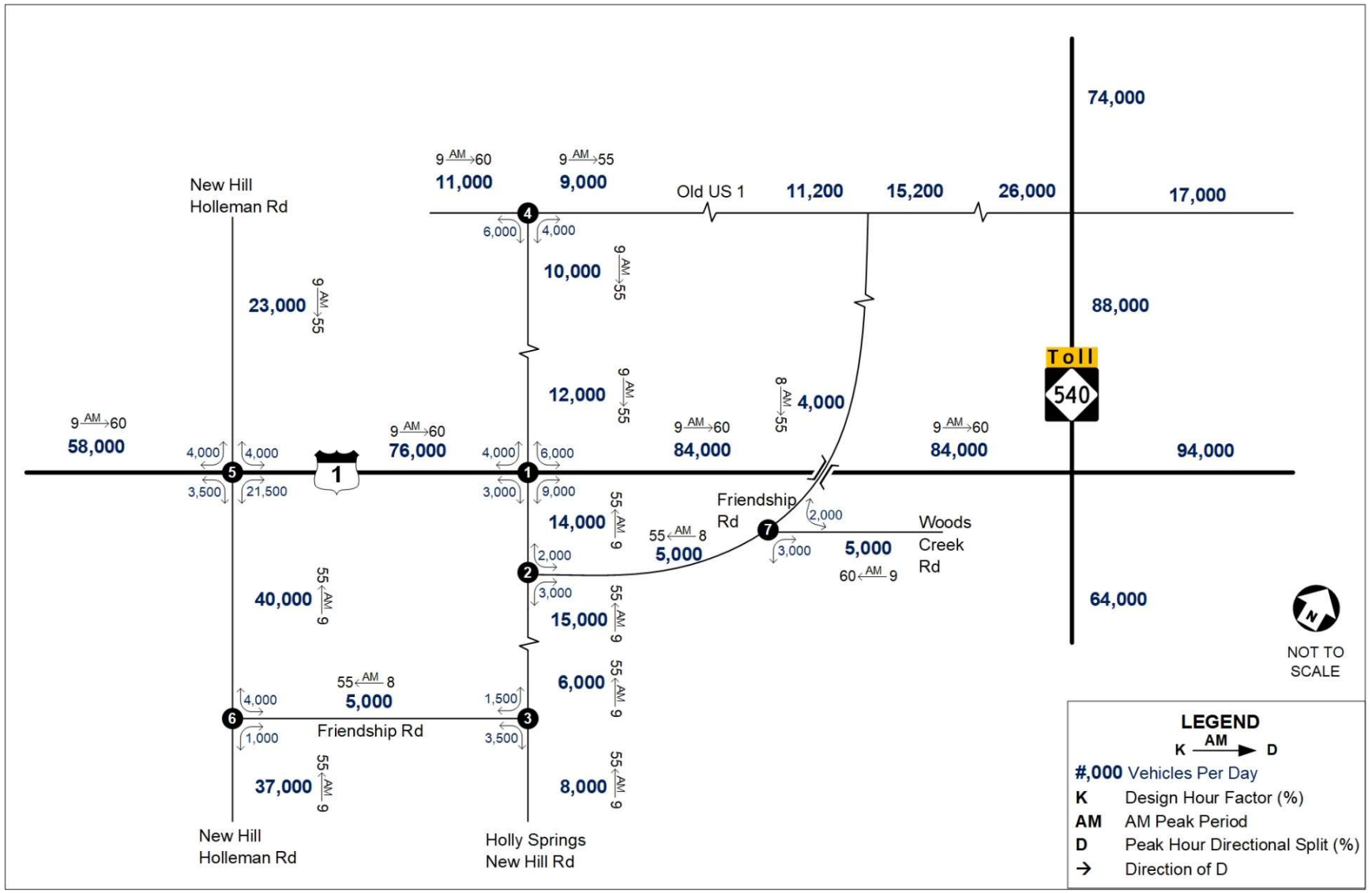

Figure 7. MTP Scenario 2050 Daily Traffic Volumes

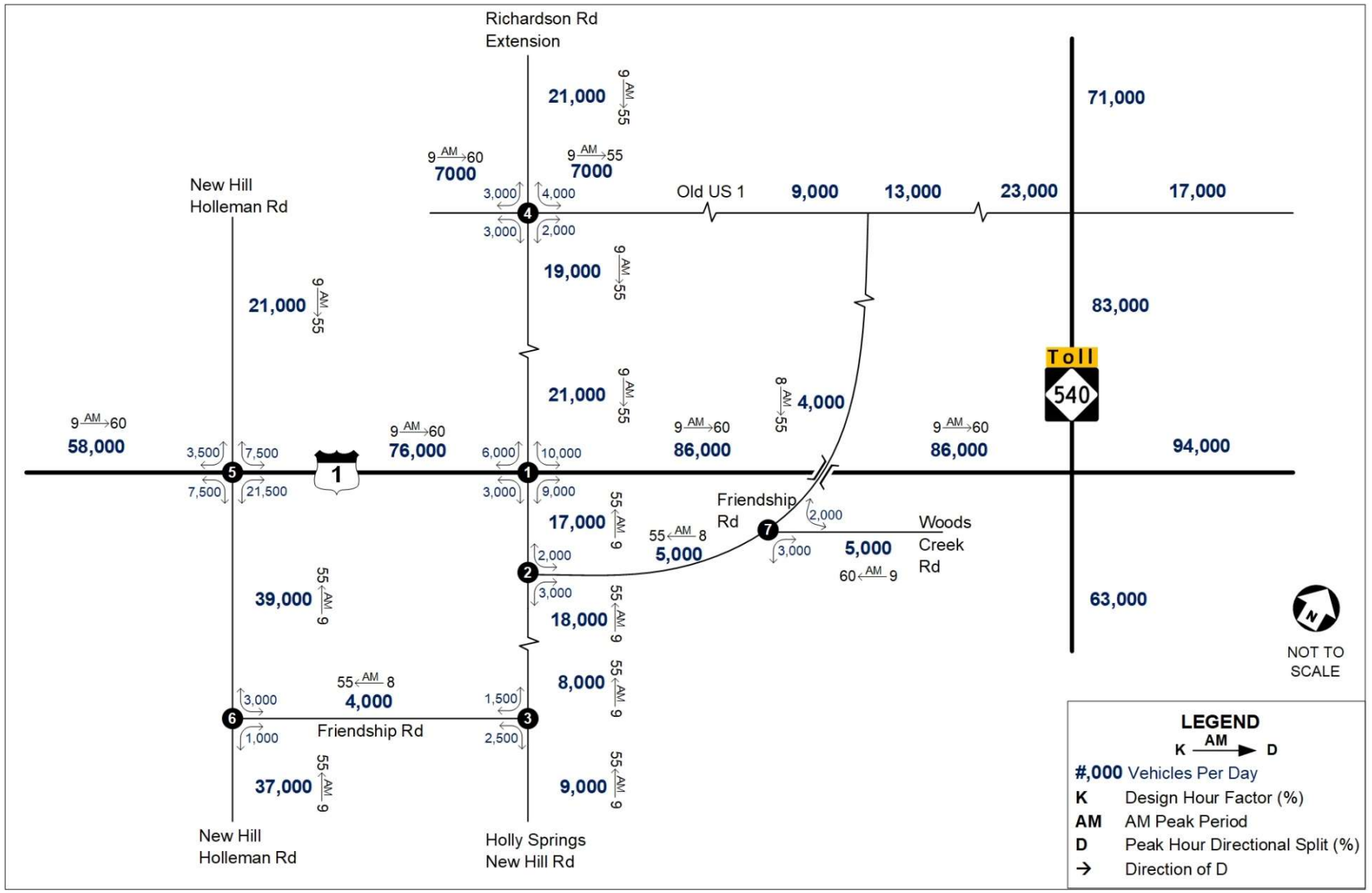

Figure 8. MTP+ Scenario 2050 Daily Traffic Volumes

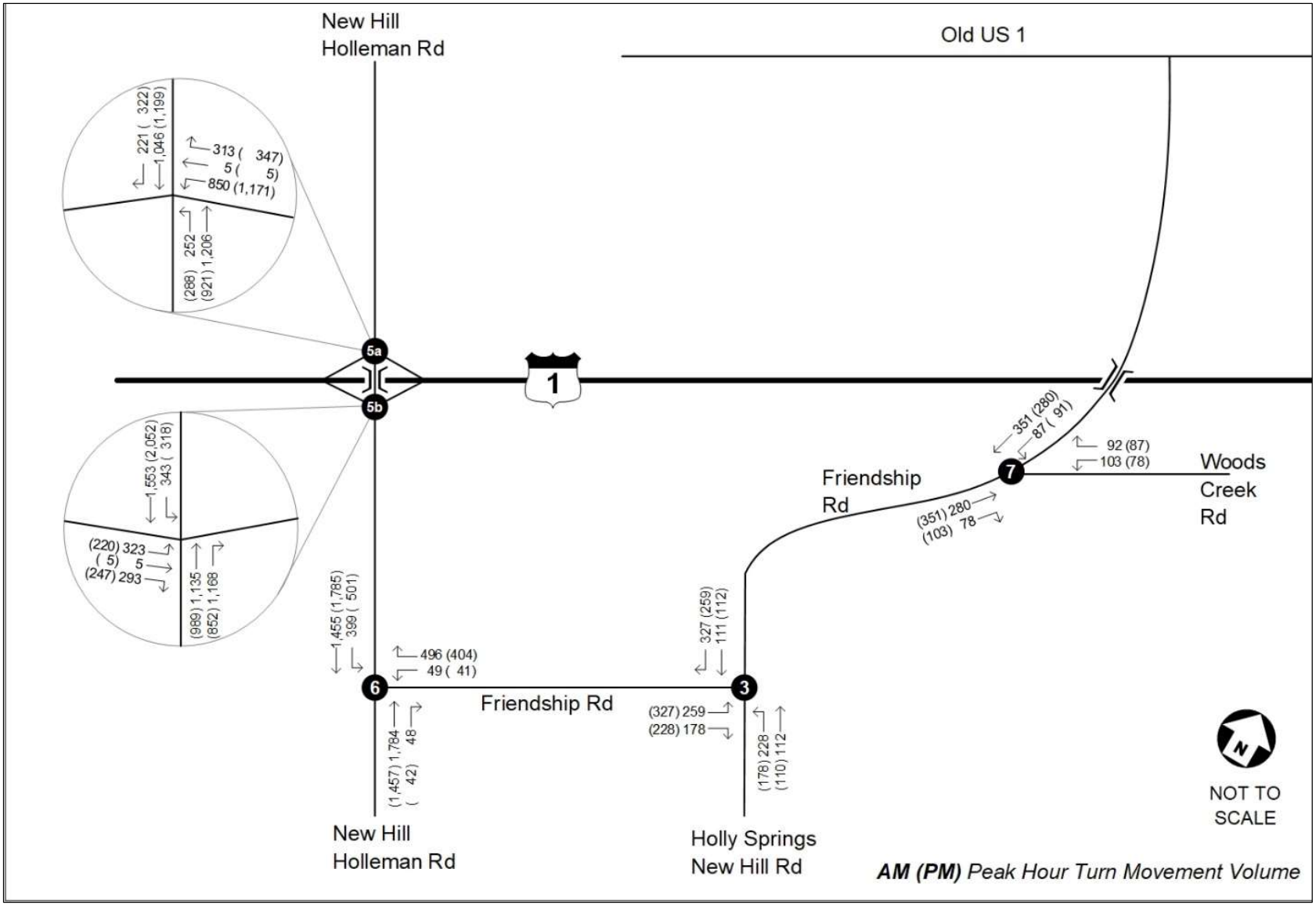

Figure 9. No Build Scenario 2050 Peak Hour Traffic Volumes

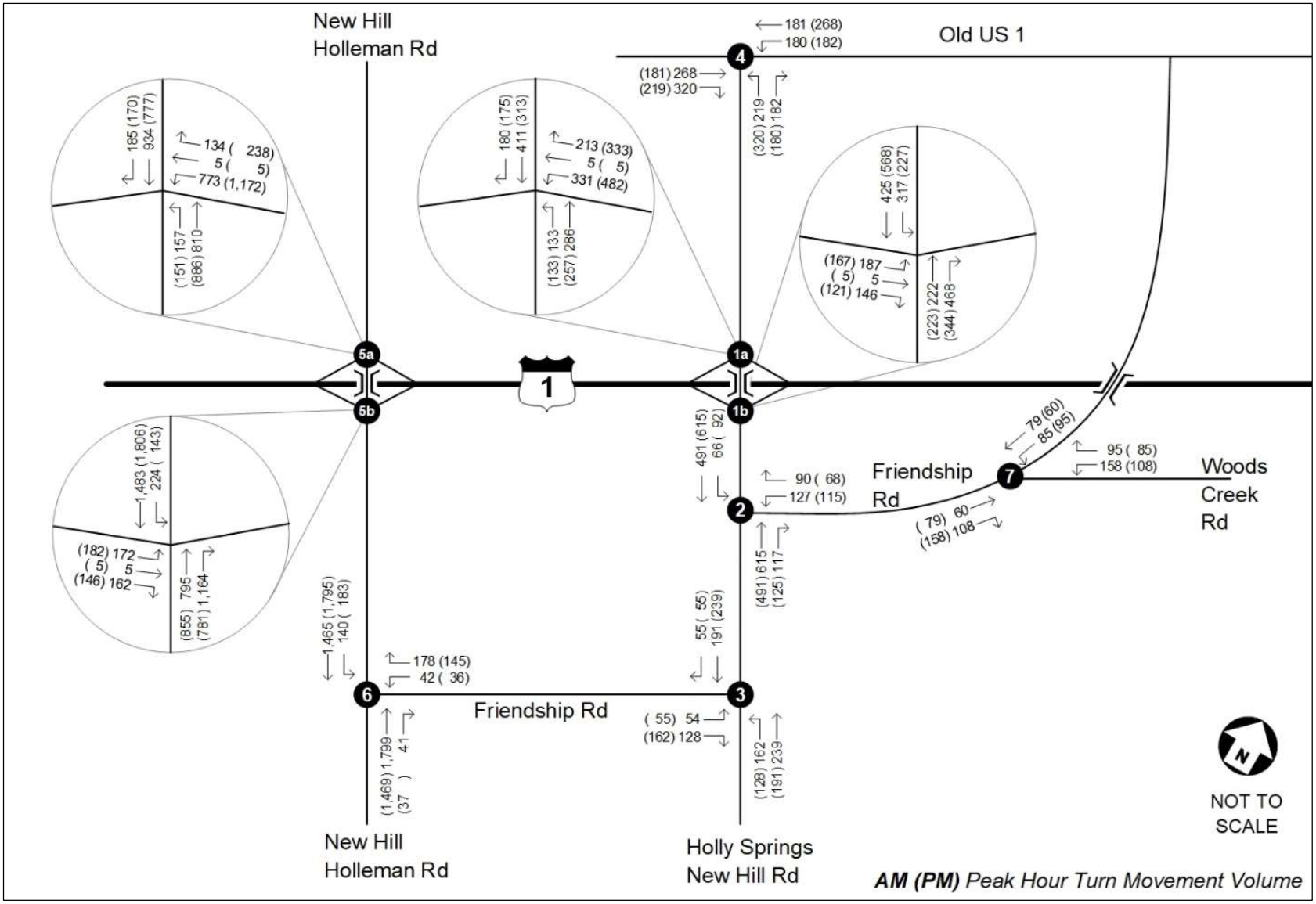

Figure 10. MTP Scenario 2050 Peak Hour Traffic Volumes

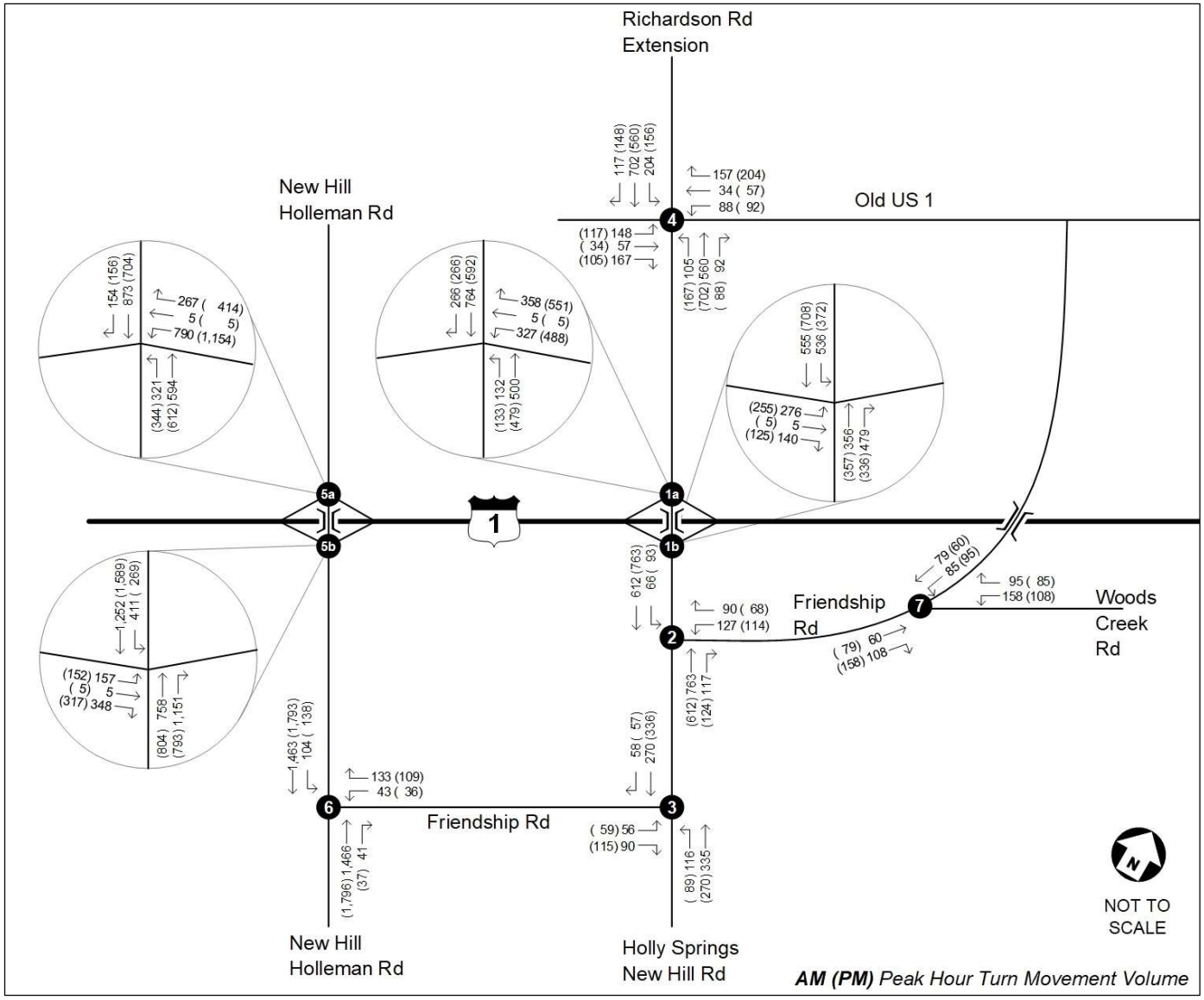

Figure 11. MTP+ Scenario 2050 Peak Hour Traffic Volumes

4 PLANNED IMPROVEMENTS

The Friendship Road Hot Spot Interchange Study includes proposed improvements which will enhance access to US 1 and improve connectivity/mobility between the towns of Holly Springs and Apex. This study considers roadway improvements included in the towns of Holly Spring and Apex CTPs and roadway improvements included in CAMPO's 2050 MTP. Each town currently maintains or have updated CTP's, which include roadways and pedestrian/bicyclist improvements that contribute to the Friendship Road Hot Spot Interchange study and are evaluated in this feasibility study. The CTP for the Town of Holly Springs is Vision Holly Springs 2018 Update approved by the town council May 2022. The CTP for the Town of Apex is the Advance Apex 2045 Plan adopted February 2019.

4.1 Proposed Roadway Network Improvements

The CTPs for the towns of Holly Springs and Apex include proposed roadway improvements within the Friendship Road Hot Spot study area:

- **Interchange at US 1 and New Location Road (Holly Springs CTP ID# 10)**
- **New Location Road and proposed sidewalk/side path from Friendship Road to the proposed US 1 Interchange (Holly Springs CTP ID# A648)**
- Friendship Road widening and proposed wide outside lane and sidewalks from the proposed US 1 Interchange to US 1 Highway (Holly Springs CTP ID # A186a)
- Friendship Road Widening and proposed wide outside lane and sidewalks from New Hill Holleman Road to Holly Springs New Hill Road (Holly Springs CTP ID# A163b)
- Holly Springs New Hill Road Widening and proposed wide outside lane and sidewalks from Friendship Road to Old Holly Springs Apex Road (Holly Springs CTP ID# A163c)
- New Hill Holleman Road and Friendship Road Intersection Improvement (Holly Springs CTP ID# 47))
- New Hill Holleman Road Widening and proposed sidewalk/side path from Friendship Road to Avent Ferry Road (Holly Springs CTP ID# A190)
- Woods Creek Road Widening and proposed sidewalk/side path from Woodfield Dead End Road to Old Holly Springs Apex Road (Holly Springs CTP ID# A423)
- Woodfield Dead End Road Extension and proposed wide outside lane from Holly Springs New Hill Road to Woods Creek Road (Holly Springs CTP ID# 415)
- New Location Road and proposed wide outside lane from New Hill Holleman Road to Holly Springs New Hill Road (Holly Springs CTP ID# 414)
- **New US 1 Interchange (Apex CTP)**
- **Richardson Road New Location (new location of Friendship Road) from the New US 1 Interchange to Old US 1 Hwy, three-lane roadway and side path (Apex CTP)**
- Richardson Road New Location from Old US 1 Hwy to Humie Olive Road, four-lane median divided roadway and side path (Apex CTP)

- New location of Boscoe Road and sidewalks from Boscoe Road to the new location of Friendship Road (Apex CTP)
- Old US 1 Hwy Widening and proposed sidewalks from New Hill Holleman Road to NC 540 (Apex CTP)
- New Hill Holleman Road Widening from US 1 to Old US 1 Hwy (Apex CTP)
- New Hill Holleman Road Intersection Improvement (Apex CTP)
- U-5981 US 1 at NC 55 Interchange Improvements (Apex CTP)
- U-6066 US 1 Widening from NC 55 to US 64 (Apex CTP)

Projects within the Friendship Road Hot Spot project limits are shown in bold text. These projects are also included in CAMPO's 2050 MTP. Other identified projects are part of the roadway network and multimodal transportation connectivity at the Friendship Road Hotspot. Roadway widening and new location/realignment projects from the Holly Springs CTP's Multimodal Assessment and Recommendations section are shown in Figure 12 and Figure 13. The Richardson Road New Location from the proposed Friendship Road interchange at US 1 to Old US 1 Hwy, and from Old US 1 Hwy to Humie Olive Road (Richardson Road Extension) are shown in Figure 14.

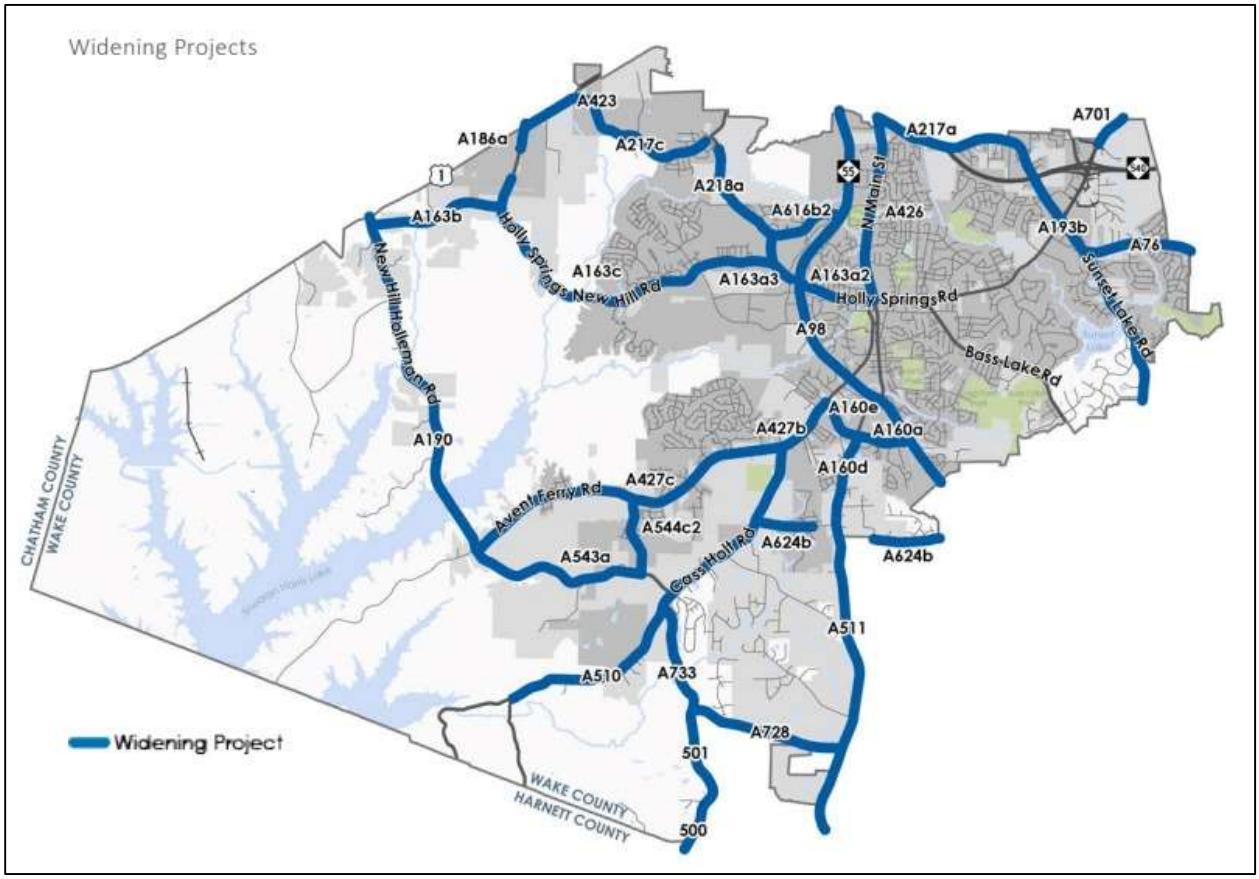

Figure 12. Holly Springs CTP Proposed Widening Projects

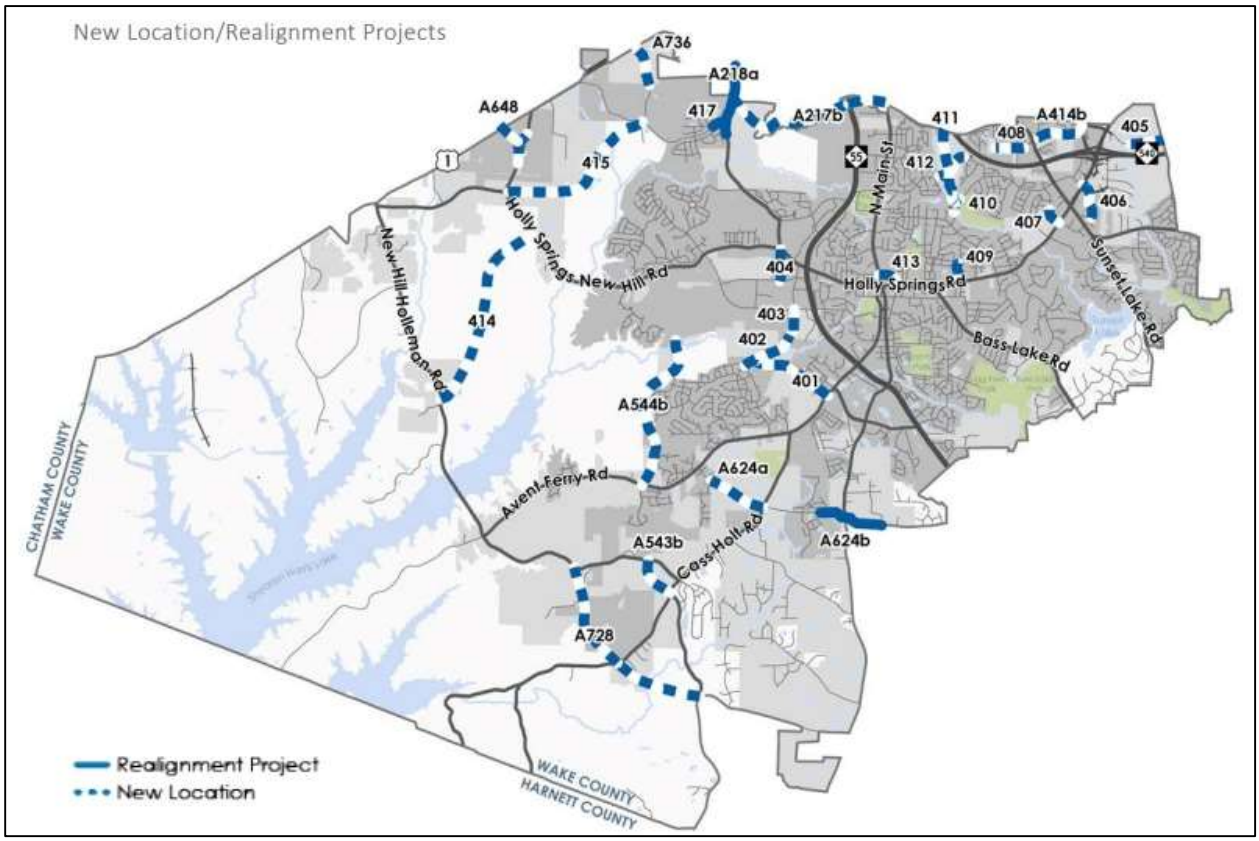

Figure 13. Holly Springs CTP Proposed New Location and Realignment Projects

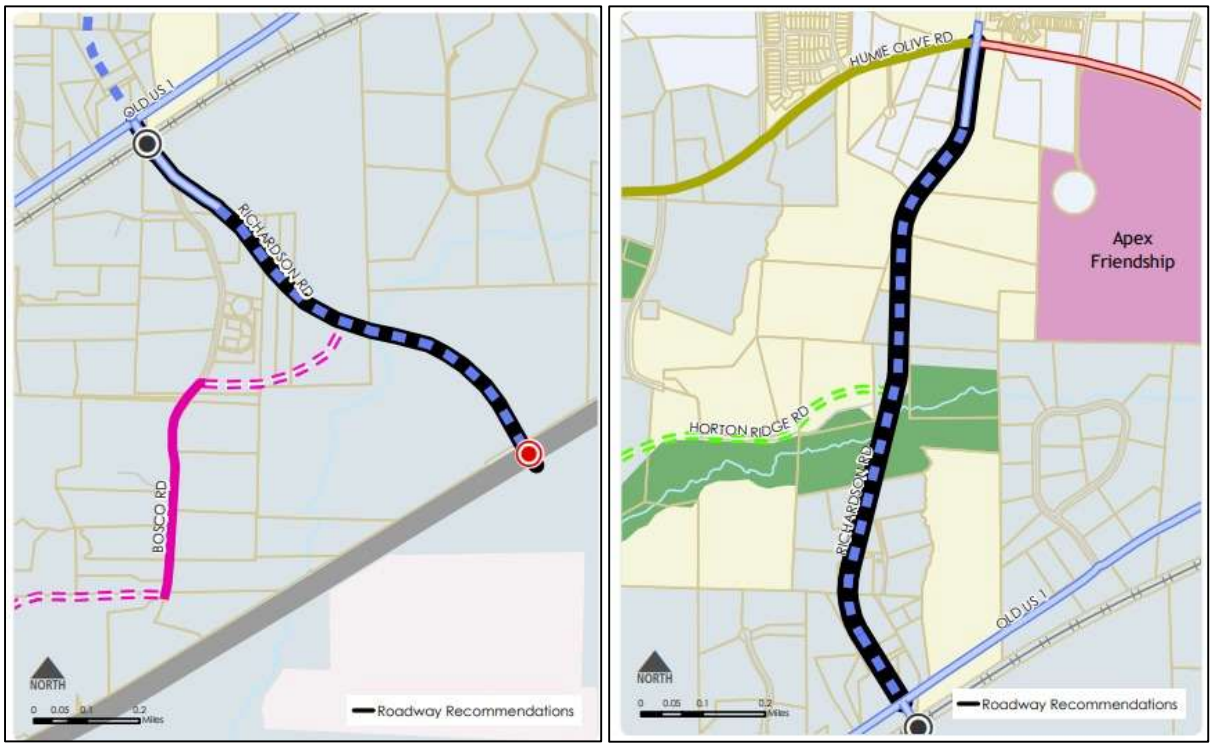

Figure 14. Apex CTP Proposed Location of Friendship Road and Richardson Rd Extension

4.2 Proposed Interchange Location

The surrounding land uses, environmental features and constraints, existing topography, interchange spacing on US 1, and the proximity of the proposed US 1 interchange to the Friendship Road bridge were evaluated to determine the appropriate interchange location.

Surrounding land uses include single-family residential properties, active farmlands, the Amgen facility (under construction) and Friendship Road Park developments, and utilities including the Duke Energy transmission lines adjacent to US 1. The proposed interchange location avoided single-family residential properties, active farmland accesses, and the site and access locations of the Amgen facility (see Figure 15). It is anticipated that the interchange and new roadway construction can avoid or minimally impact Duke Energy transmission lines.

Environmental features and topography provide significant constraints to locating the proposed US 1 interchange further west along US 1. Little White Oak Creek presents potential environmental concerns and anticipated permits, and the area near Little White Oak Creek exhibit significant changes in topography that could present difficulties in the design and construction of the proposed interchange.

The spacing of Friendship Road between the New Hill Holleman Road and NC 540 interchanges is integral in determining the interchange location. The proposed US 1 interchange could not encroach on the Friendship Road bridge. By avoiding Little White Oak Creek and the Friendship Road bridge, the proposed US 1 interchange would be located approximately 1.5 miles from the New Hill Holleman Road interchange and similarly 1.5 miles from the NC 540 interchange.

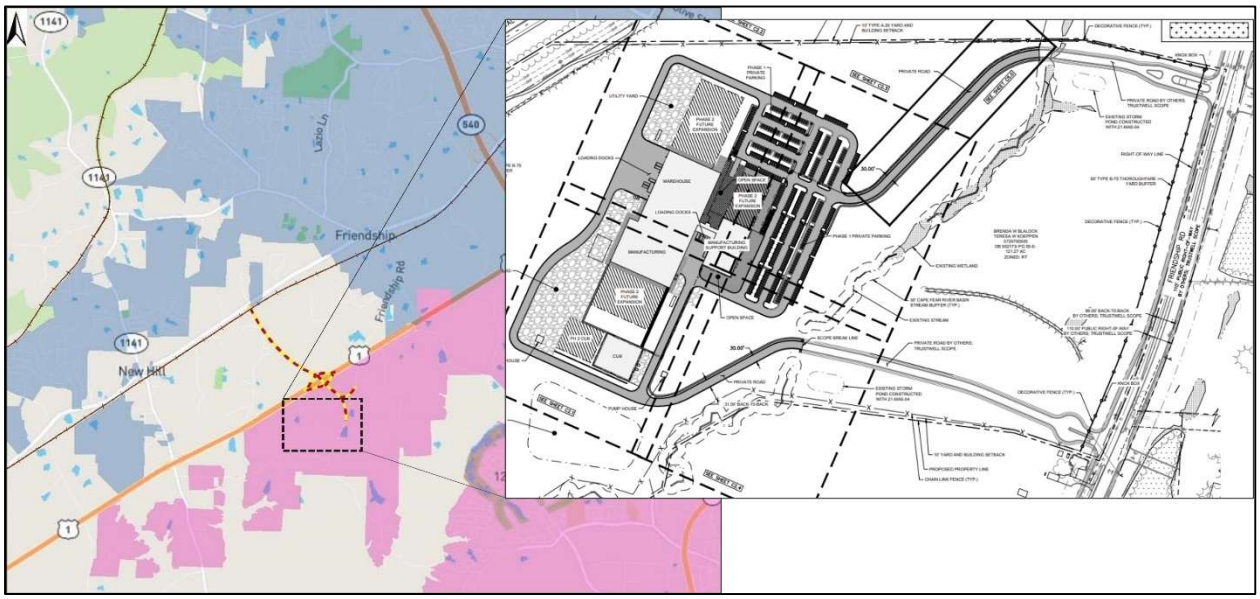

Figure 15. Amgen Facility Site Plan

4.3 Proposed Interchange Alternatives

The towns of Apex and Holly Springs indicate the need for a US 1 interchange between the New Hill Holleman Road interchange and the NC 540 interchange. The US 1 / Friendship Road interchange are included in their respective CTPs. During the course of this Hot Spot Study, six interchange alternatives were evaluated and presented for a US 1 / Friendship Road interchange:

- Alternative 1 Tight Diamond (includes replacement of existing Friendship Road bridge)
- Alternative 2 Tight Diamond with Roundabouts (includes replacement of existing Friendship Road bridge)
- Alternative 3 Partial Cloverleaf with a Loop in the Southeast Quadrant
- Alternative 4 Standard Diamond (includes removal of existing Friendship Road bridge)
- Alternative 5 Tight Diamond with a New Access to the Amgen Facility
- Alternative 6 Tight Diamond with a New Access to the Amgen Facility and New Intersection at Friendship Road

The new Friendship Road alignments included in the interchange alternative discussion calls for full capacity four-lane median divided thoroughfares, based on traffic analysis and for uniform interchange alternative comparisons. A four-lane median divided thoroughfare for the new Friendship Road is consistent with the Town of Holly Springs CTP, but not with the Town of Apex CTP. The Apex CTP calls for a three-lane undivided thoroughfare for their portion of the new Friendship Road. The three-lane undivided thoroughfare with a center turn lane currently proposed for the Richardson Road New Location (new location of Friendship Road) from the New US 1 Interchange to Old US 1 Hwy in the Advanced Apex 2045 Plan is presented in Section 4.4.2 New Friendship Road in Apex.

Each interchange concept is illustrated and described below, and alternative benefits and concern are summarized in Section 6.

4.3.1 Interchange Alternative 1

Interchange Alternative 1: Tight Diamond – Consists of a six-lane roadway typical section divided by a median. This interchange configuration accommodates four through lanes and two left-turn lanes to access US 1. Single-lane on ramps will include dedicated right-turn lanes. Double-lane off ramps will allow for dedicated left and right turn lanes. Intersections at the interchange will not be signalized. The tight diamond interchange, bridge cross-section, and roadway configuration are shown in Figure 16.

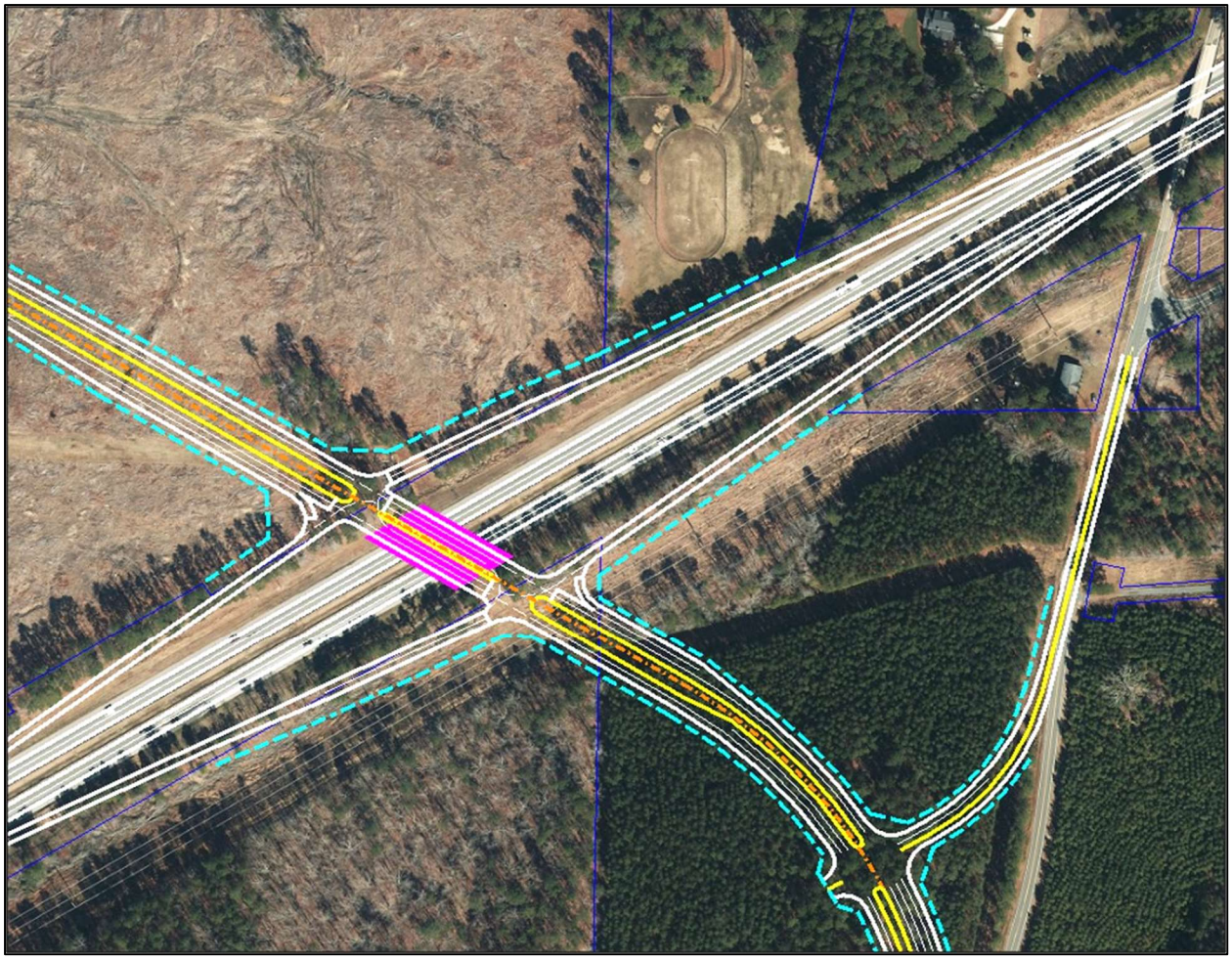

Figure 16. Interchange Alternative 1

Roadway and bridge improvements adjacent to interchange Alternative 1 will include the realignment and widening of Friendship Road to a four-lane median divided thoroughfare, a signalized intersection, and a new two-lane undivided roadway tie back to existing Friendship Road south of Woods Creek Road, and replacement of Friendship Road bridge to accommodate off and on ramps.

Benefits of interchange Alternative 1 include the least right of way acquisition or need for corridor preservation relative to the other interchange alternatives and allows for optimum intersection spacing to Friendship Road and the Amgen facility driveway. Interchange Alternative 1 concerns include the requirement for a wider bridge to accommodate both through lanes and full left turn lanes and the potential cost of replacement of the Friendship Road bridge.

4.3.2 Interchange Alternative 2

Interchange Alternative 2: Tight Diamond with Roundabouts – Consists of a four-lane roadway typical section divided by a median. This interchange configuration accommodates four through lanes and two double-lane roundabouts to access US 1. Single-lane on ramps will include dedicated right-turn lanes to access US 1 from the new Friendship Road, and dedicated roundabout exits to access US 1 from roundabouts. Double-lane off ramps will allow for dual right turns to access the new Friendship Road southbound (towards Holly Springs) or access the roundabout to access Friendship Road northbound (towards Apex). The tight diamond with roundabout interchange, bridge cross-section, and roadway configuration are shown in Figure 17.

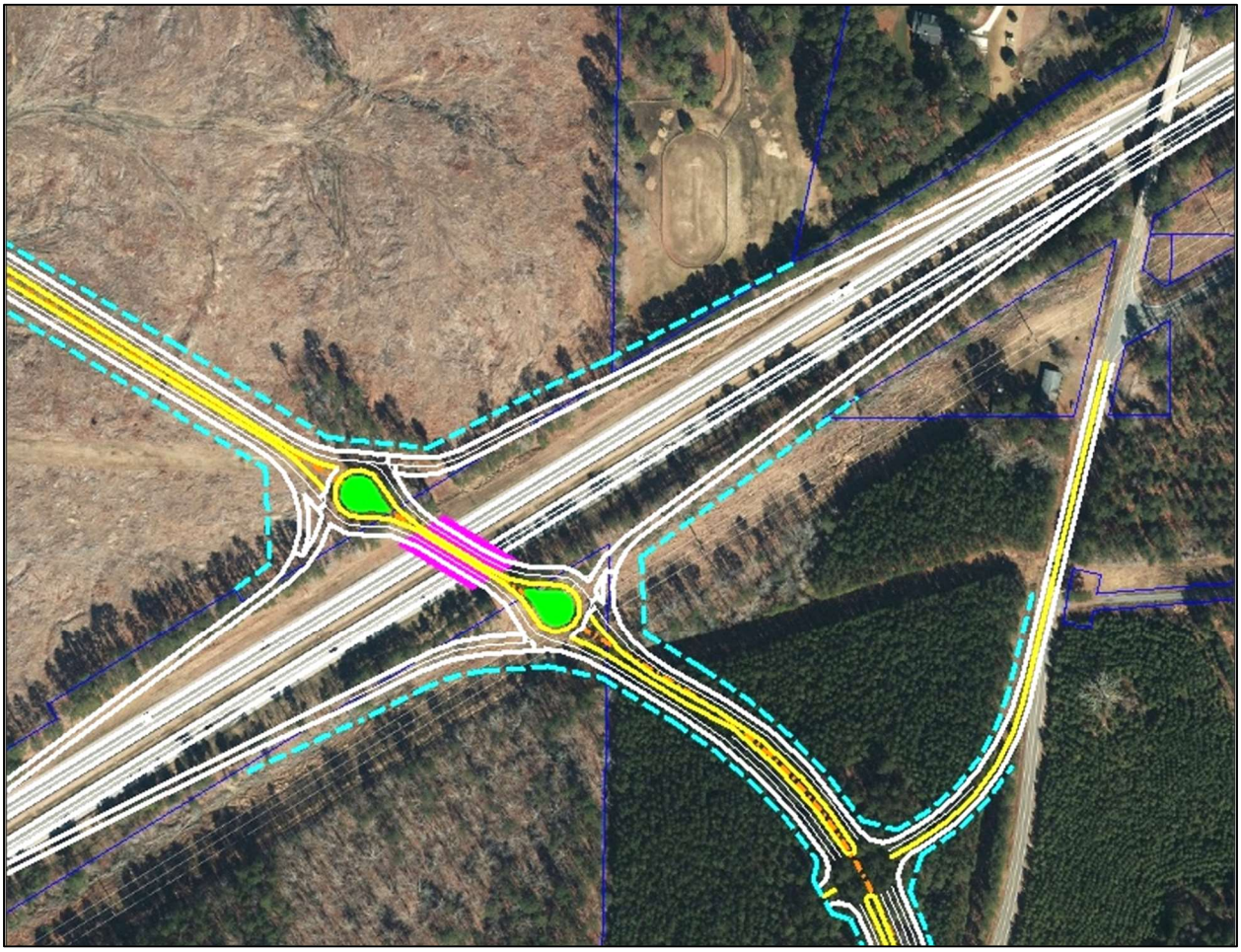

Figure 17. Interchange Alternative 2

Roadway and bridge improvements adjacent to interchange Alternative 2 will include the realignment and widening of Friendship Road to a four-lane median divided thoroughfare, a signalized intersection, and a new two-lane undivided roadway tie back to existing Friendship Road south of Woods Creek Road, and replacement of Friendship Road bridge to accommodate off and on ramps.

Benefits of interchange Alternative 2 include the least right of way acquisition or need for corridor preservation relative to the other interchange alternatives, allows for optimum intersection spacing to Friendship Road and the Amgen facility driveway, a narrower bridge, and

improved safety at ramp intersections. Interchange Alternative 2 concerns include the potential cost of replacement of the Friendship Road bridge and finite capacity of roundabout intersections which may lead to intersection failure.

4.3.3 Interchange Alternative 3

Interchange Alternative 3: Partial Cloverleaf with a Loop in the Southeast Quadrant – Consists of a five-lane roadway typical section divided by a median. This interchange configuration accommodates four through lanes and one left-turn lanes to access US 1 southbound. US 1 southbound can also be accessed through a dedicated right turn lane on the new Friendship Road. Access to US 1 northbound utilizes a loop ramp at the southeast quadrant of the partial cloverleaf interchange. Motorists travelling southbound on the new Friendship Road can access US 1 northbound by making a right turn at the loop ramp. Motorists travelling northbound on the realigned Friendship Road can access US 1 northbound by making a left turn at the partial cloverleaf ramp northbound ramp. Double-lane and multi-lane southbound and northbound off ramps, respectively, will allow for dedicated left and right turn lanes. The partial cloverleaf interchange, bridge cross-section, and roadway configuration are shown in Figure 18.

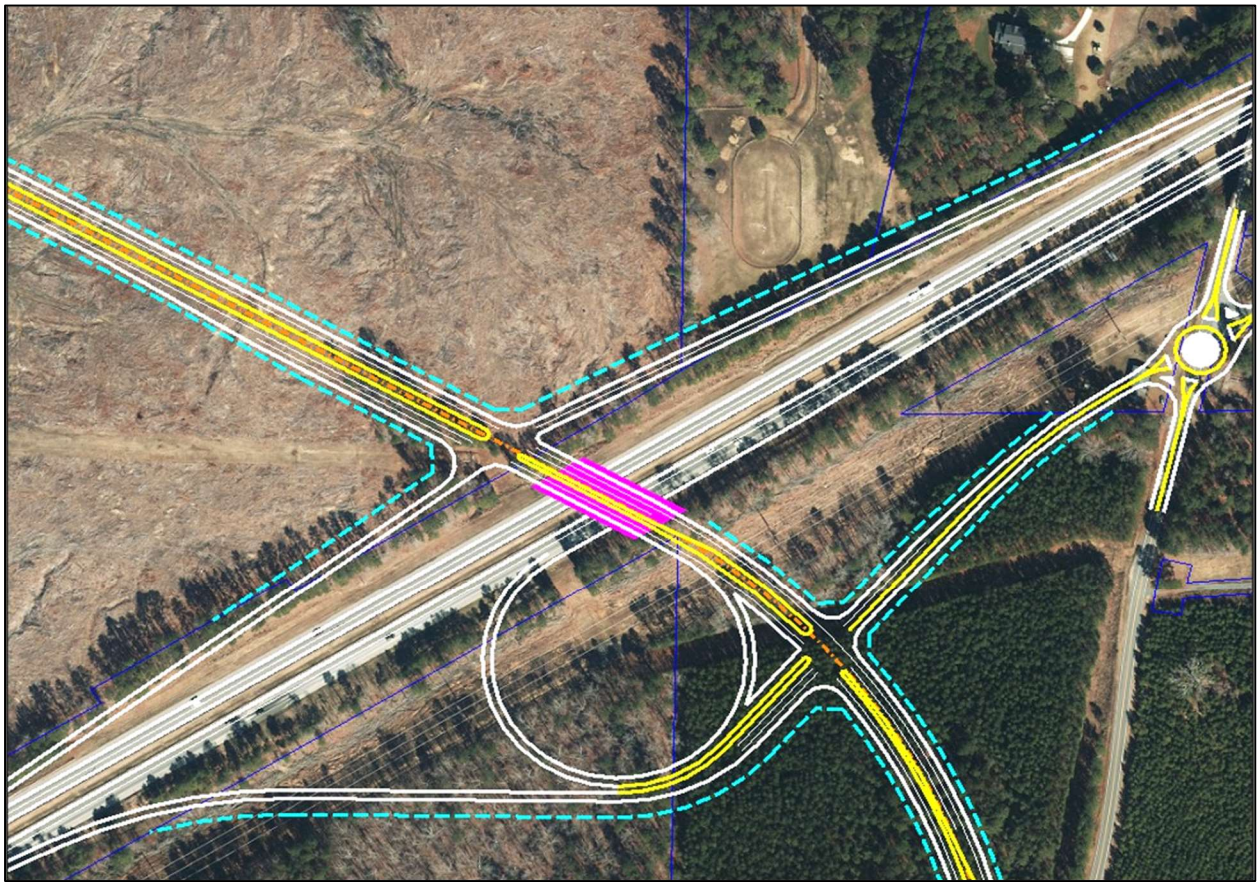

Figure 18. Interchange Alternative 3

This interchange configuration includes a signalized intersection at the partial cloverleaf ramp that accommodates the four-lane median divided Friendship Road realignment, and a new two-lane undivided roadway tie back to Woods Creek Road with a single lane roundabout.

Benefits of interchange Alternative 3 include a narrower five-lane bridge, better ramp terminal intersection spacing, allows for optimum intersection spacing to Friendship Road and the Amgen facility driveway, and Friendship Road bridge could be preserved and would not have to be replaced. Interchange Alternative 3 concerns include increased right of way acquisition or need for corridor preservation relative to other interchange alternatives (primarily on the Holly Springs side of US 1) and potential intersection conflict for motorist travelling northbound on the realigned Friendship Road and making a left turn at the partial cloverleaf to access US 1 northbound.

4.3.3.1 Interchange Alternative 3 Disposition

CAMPO, the NCDOT, the Town of Apex, and the Town of Holly Springs evaluated the functional design and effectiveness of Interchange Alternative 3 Partial Cloverleaf with a Loop in the Southeast Quadrant during the May 25, 2022 Teams meeting (project Meeting #2) and recommended the elimination of Alternative 3 from further consideration because the option shows no clear advantage with regards to functional design and right of way requirements and/or interchange and corridor preservation.

4.3.4 Interchange Alternative 4

Interchange Alternative 4: Standard Diamond – Consists of a six-lane roadway typical section divided by a median. This interchange configuration accommodates four through lanes and two left-turn lanes to access US 1. Single-lane on ramps will include dedicated right-turn lanes. Double-lane off ramps will allow for dedicated left and right turn lanes. Intersections at the interchange will not be signalized. The standard diamond interchange, bridge cross-section, and roadway configuration are shown in Figure 19.

Roadway and bridge improvements adjacent to interchange Alternative 4 will include the realignment of Friendship Road and widening to a four-lane median divided roadway, a signalized intersection, and a new two-lane undivided roadway tie back to existing Friendship Road south of Woods Creek Road, and replacement of Friendship Road bridge to accommodate off and on ramps. Benefits of interchange Alternative 4 include optimum ramp terminal intersection spacing, allows for optimum intersection spacing to Friendship Road and the Amgen facility driveway, eliminates Friendship Road bridge (lesser cost to demolish than to replace) and provides frontage road access from new Friendship Road north of the interchange to old Friendship Road. Interchange Alternative 4 concerns include increased right of way acquisition or need for corridor preservation relative to other interchange alternatives (primarily on the Apex side of US 1), additional right of way cost/corridor preservation due to the new Friendship Road alignment, and potentially longer trip time to travel from existing Friendship Road in Apex to the new Friendship Road connection.

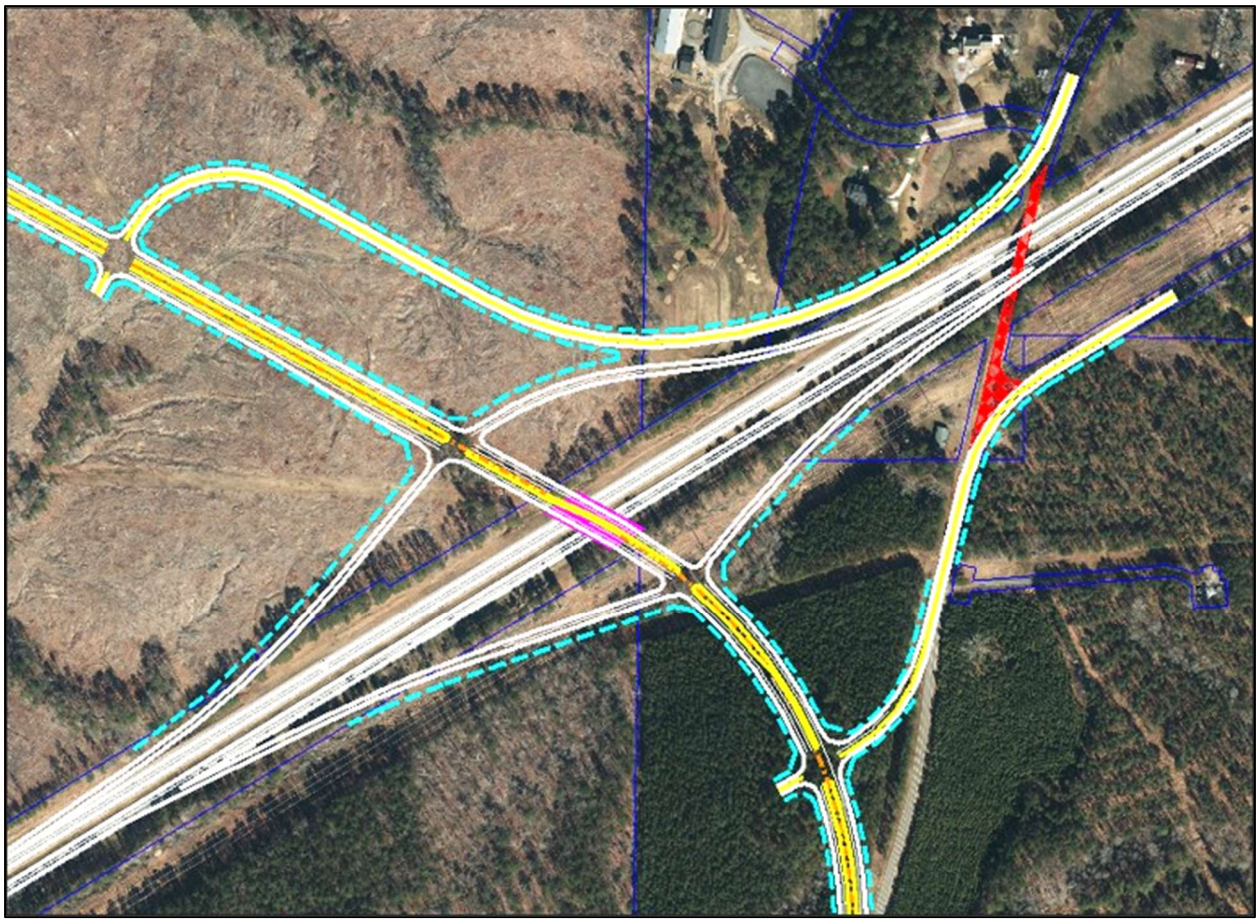

Figure 19. Interchange Alternative 4

4.3.5 Interchange Alternative 5

Interchange Alternative 5: Tight Diamond located further southwest – Consists of a six-lane roadway typical section divided by a median. The location of interchange Alternative 5 was shifted further south (approximately 800 feet) to avoid ramp conflicts with the Friendship Road bridge and accommodate the new access to the Amgen Facility. This interchange configuration accommodates four through lanes and two left-turn lanes to access US 1. Single-lane on ramps will include dedicated right-turn lanes. Double-lane off ramps will allow for dedicated left and right turn lanes. Intersections at the interchange will not be signalized. The tight diamond interchange, bridge cross-section, and roadway configuration are shown in Figure 20.

Roadway and bridge improvements adjacent to interchange Alternative 5 will include the realignment and widening of Friendship Road to a four-lane median divided thoroughfare, a signalized intersection, a new access to the Amgen Facility (north side of the property), and a new two-lane undivided roadway tie back to existing Friendship Road south of Woods Creek Road.

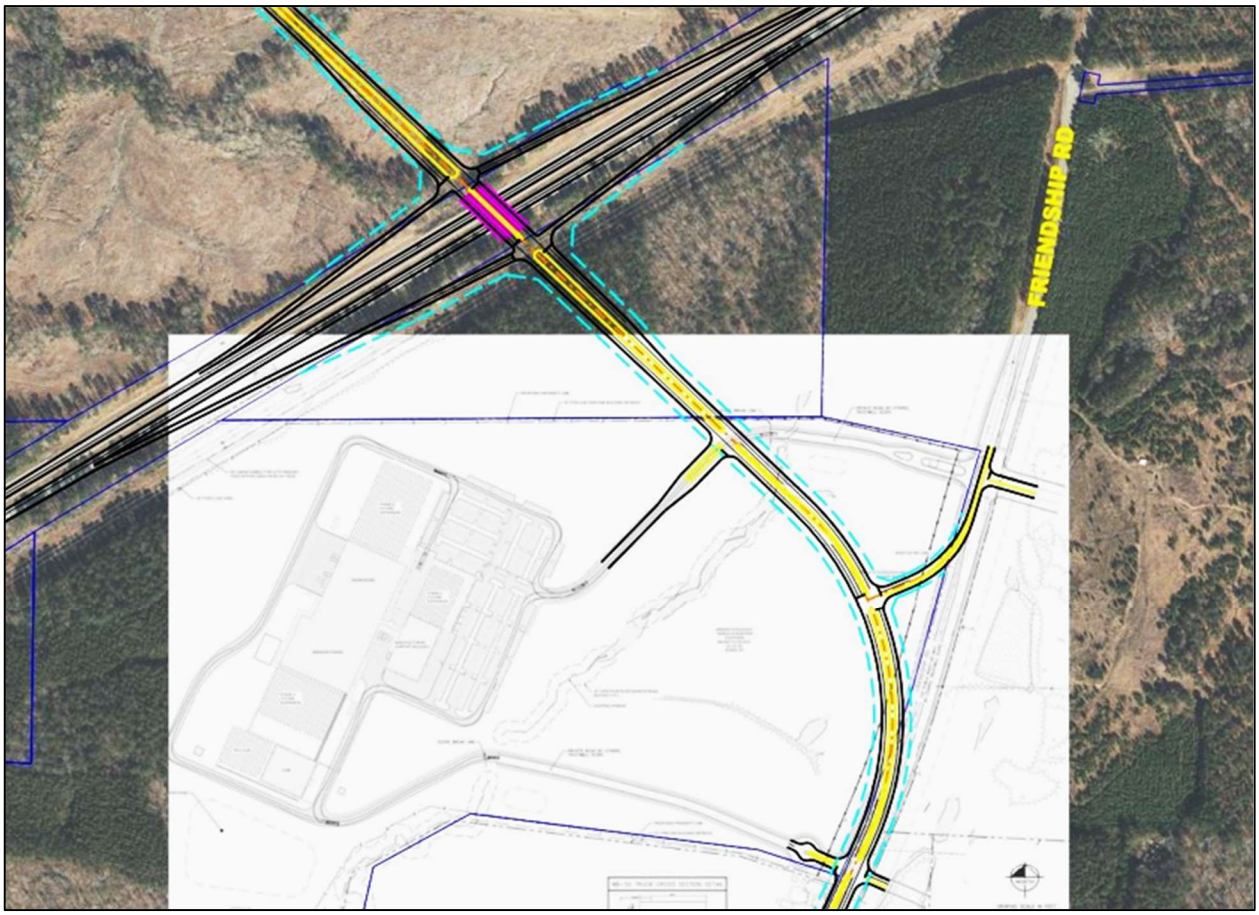

Figure 20. Interchange Alternative 5

Benefits of interchange Alternative 5 include the least right of way acquisition or need for corridor preservation relative to the other interchange alternatives and provides bridge over US 1 that is not on skew. Interchange Alternative 5 concerns include the requirement for a wider bridge to accommodate both through lanes and full left turn lanes and anticipated conflicts with streams and necessity for stormwater drainage at Little White Oak Creek.

4.3.6 Interchange Alternative 6

Interchange Alternative 6: Tight Diamond with roundabout intersection at Old Friendship Road – Consists of a six-lane roadway typical section divided by a median. The location of interchange Alternative 5 was shifted further south (approximately 800 feet) to avoid ramp conflicts with the Friendship Road bridge and accommodate the new access to the Amgen Facility. This interchange configuration accommodates four through lanes and two left-turn lanes to access US 1. Single-lane on ramps will include dedicated right-turn lanes. Double-lane off ramps will allow for dedicated left and right turn lanes. Intersections at the interchange will not be signalized. On and off ramps on the south side of the interchange (Holly Springs side) were further tightened to minimize encroachment into the Duke Energy utility easement. The tight diamond interchange, bridge cross-section, and roadway configuration are shown in Figure 21.

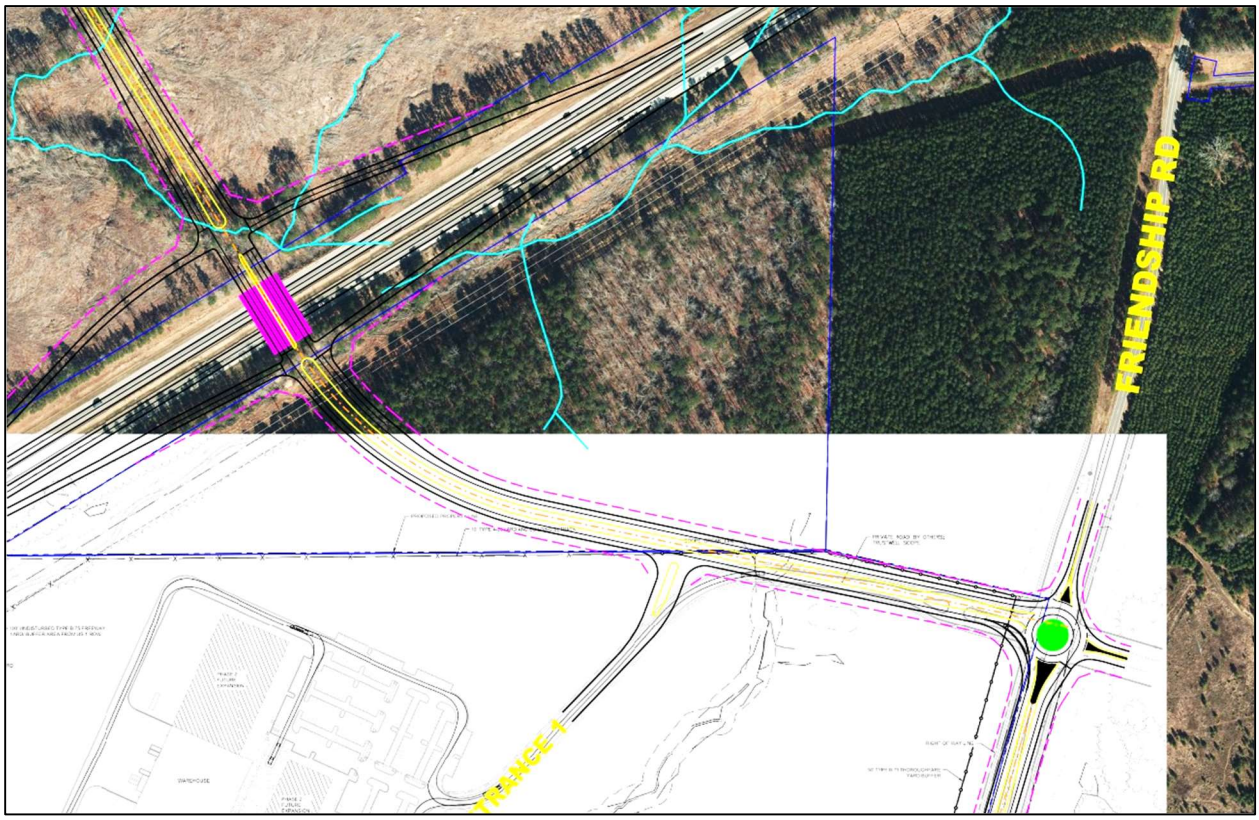

Figure 21. Interchange Alternative 6

Roadway and bridge improvements adjacent to interchange Alternative 6 will include the realignment and widening of Friendship Road to a four-lane median divided thoroughfare, and a signalized intersection at Friendship Road.

Benefits of interchange Alternative 6 include the least right of way acquisition and/or corridor preservation relative to the other interchange alternatives, provides bridge over US 1 that is not on skew, and allows for optimum intersection spacing to Friendship Road and the Amgen facility driveway. Interchange Alternative 6 concerns include the requirement for a wider bridge to accommodate both through lanes and full left turn lanes and anticipated conflicts with streams and necessity for stormwater drainage at Little White Oak Creek.

4.4 Proposed Roadway Alignment Options

The towns of Apex and Holly Springs indicate the need for a new Friendship Road alignment in coordination with the proposed US 1 interchange. The New Location Road at the proposed US 1 interchange in Holly Springs, and the Richardson Road New Location (new location of Friendship Road) from the new US 1 Interchange to Old US 1 Hwy in Apex are included in their respective CTPs. The overall proposed roadway network improvements, pedestrian and bicycle improvements, roadway functional classifications and designs, land use planning context, proposed community development, identified and anticipated right-of-way constraints, and anticipated traffic volumes were evaluated in determining the appropriate roadway alignment and cross-section for the new Friendship Road in Holly Springs and Apex.

4.4.1 New Friendship Road in Holly Springs

Within the Town of Holly Springs, The New Location Road from Friendship Road to the proposed US 1 Interchange and the Friendship Road widening from the proposed US 1 Interchange to US 1 Highway are in included in the Vision Holly Springs 2018 Update within the Business and Industrial land use west of Friendship Road and the Innovation Village land use near the Friendship Road and Holly Springs New Hill Road intersection.

The New Location Road from Friendship Road to the proposed US 1 Interchange is a considered long-term project. The Friendship Road Widening from the proposed US 1 Interchange to US 1 Highway, the northern part of the New Hill Holleman Road Widening, the western part of the Holly Springs New Hill Road Widening, the Woodfield Dead End Road Extension, and the Woods Creek Road Widening are proposed mid-term projects.

According to the Holly Springs CTP, the New Location Road and the Friendship Road Widening are considered thoroughfares that are limited by adjacent land uses, designed for relatively lower traffic volumes and speeds than major thoroughfares, and offer local and regional mobility. The proposed implementation plan for the New Location Road and the Friendship Road Widening is a four-lane median divided thoroughfare with sidewalks/bike lanes (wide outside lane) on both sides of the roadway.

4.4.1.1 Friendship Road

The Holly Springs CTP indicates a four-lane median divided thoroughfare for the widening of Friendship Road from Holly Springs New Hill Road to the new location of Friendship Road at the proposed US 1 interchange. The need for a four-lane median divided thoroughfare was confirmed through evaluations that included a comparison of existing traffic volumes and future traffic forecast without the proposed US 1 interchange, and future traffic forecast with the proposed US 1 interchange. This proposed improvement includes 10-foot inside lanes, 14-foot outsides lanes (to accommodate bicycles), a 17.5-foot raised median, and five-foot sidewalks on both sides of the roadway consistent with the Holly Springs CTP implementation plan. The minimum right of way requirement is 118 feet. The four-lane median divided thoroughfare cross-section T-4B is shown in Figure 22.

Figure 22. T-4B Four-Lane Thoroughfare Cross-Section

The Amgen facility northern and southern driveways are currently under construction. These driveways directly access Friendship Road. The proposed Friendship Road widening will accommodate the Amgen facility driveways, the future Woodfield Dead End Road Extension, and future developments at Friendship Innovation Park.

4.4.1.2 The New Location of Friendship Road

The Holly Springs CTP indicates a four-lane median divided thoroughfare for the New Location Road from Friendship Road to the proposed US 1 interchange. The need for a four-lane median divided thoroughfare was confirmed through evaluations that included a comparison of existing traffic volumes and future traffic forecast without the proposed US 1 interchange, and future traffic forecast with the proposed US 1 interchange. This proposed improvement includes four 10-foot through lanes, a 17.5-foot raised median, a five-foot sidewalk and a five-foot side path consistent with the Holly Springs CTP implementation plan. The minimum right of way requirement is 118 feet. The four-lane median divided thoroughfare cross-section T-4A is shown in Figure 23.

Figure 23. T-4A Four-Lane Thoroughfare Cross-Section

The Friendship Road realignment will avoid the Amgen facility and driveways and will accommodate future developments at Friendship Road Innovation Park.

Intersections for the Friendship Road realignment are proposed corresponding to each interchange alternatives presented in Section 4.3. Intersections would connect the Friendship Road realignment (four-lane median divided thoroughfare) to existing Friendship Road and Woods Creek Road. Intersection options include a two-lane roundabout, a three-way unsignalized (stop condition) intersection, and a three-way signalized intersection.

4.4.2 New Friendship Road in Apex

Within the Town of Apex, the new US 1 Interchange and Richardson Road New Location (new location of Friendship Road) from the New US 1 Interchange to Old US 1 Hwy are included in the Advance Apex 2045 Plan Suburban context area. The suburban context area is heavily reliant on vehicle travel and dependable roadway networks due to relatively higher traffic volumes. Roadway design priorities include optimum roadway capacity, median dividers on major roadways, and sidewalks and separation for pedestrians and bicyclists. The new location of Friendship Road from the proposed US 1 interchange to Old US 1 Hwy is anticipated to be a three-lane roadway including a side path. The full capacity typical section would likely be a four-lane median divided roadway (similar to the proposed Richardson Road New Location from Old US 1 Hwy to Humie Olive Road). Proposed roadway cross-sections may include a three-lane undivided thoroughfare with a center turn lane, a four-lane median divided thoroughfare accommodating a 110-foot right of way, or the Apex Peakway (four-lane median divided thoroughfare) accommodating a 100-foot right of way.

The Apex CTP indicates a three-lane roadway including a side path for the Richardson Road New Location (new Friendship Road) from the new US 1 interchange to Old US 1 Hwy. This proposed improvement includes 11-foot through lanes, a 12-foot center turn lane, and five-foot sidewalks or side paths on both sides of the roadway consistent with the Apex CTP implementation plan. The minimum right of way requirement is 80 feet. The three-lane undivided thoroughfare cross-section is shown in Figure 24.

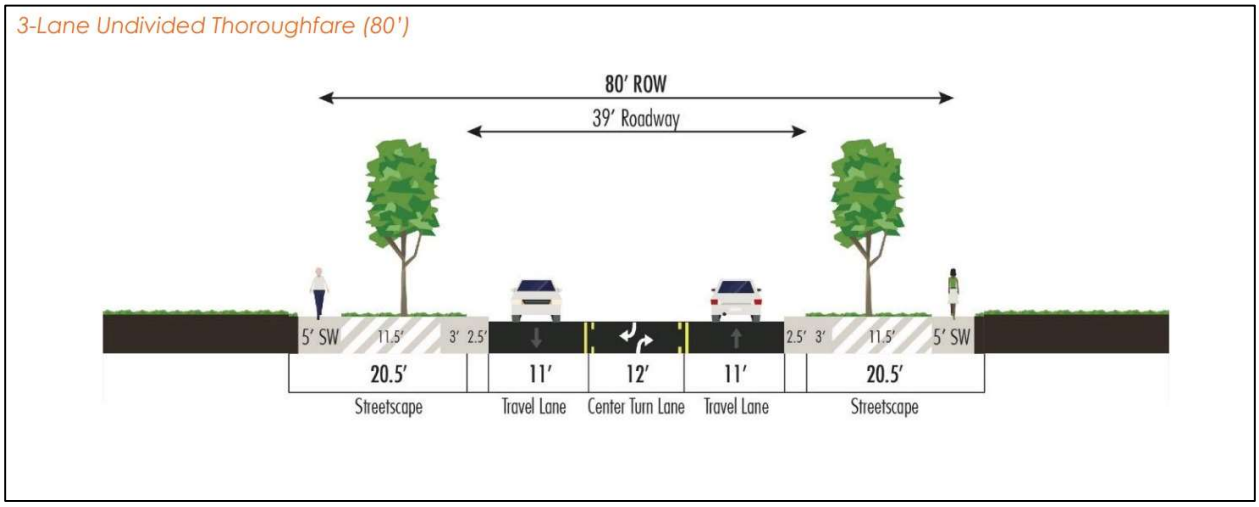

Figure 24. Three-Lane Undivided Thoroughfare Cross-Section

The need for a four-lane median divided roadway was confirmed through evaluations that included a comparison of existing traffic volumes and future traffic forecast without the proposed US 1 interchange, and future traffic forecast with the proposed US 1 interchange. A four-lane median divided roadway is included in the Apex CTP, but currently is not proposed for this roadway segment. Should the Apex CTP be updated and call for a four-lane median divided roadway for this segment, available cross-sections include a four-lane divided thoroughfare with and the Apex Peakway.

The four-lane divided thoroughfare includes 11-foot lanes, a 23-foot raised median, five-foot sidewalks or side paths on both sides, with a 110-foot right of way. The Apex Peakway includes 11-foot inside lanes, 13-foot outside lanes, an 18-foot raised median, a five-foot sidewalk, a 10-foot side path, with a 100-foot right of way. The four-lane divided thoroughfare and the Apex Peakway cross-sections are shown in Figure 25.

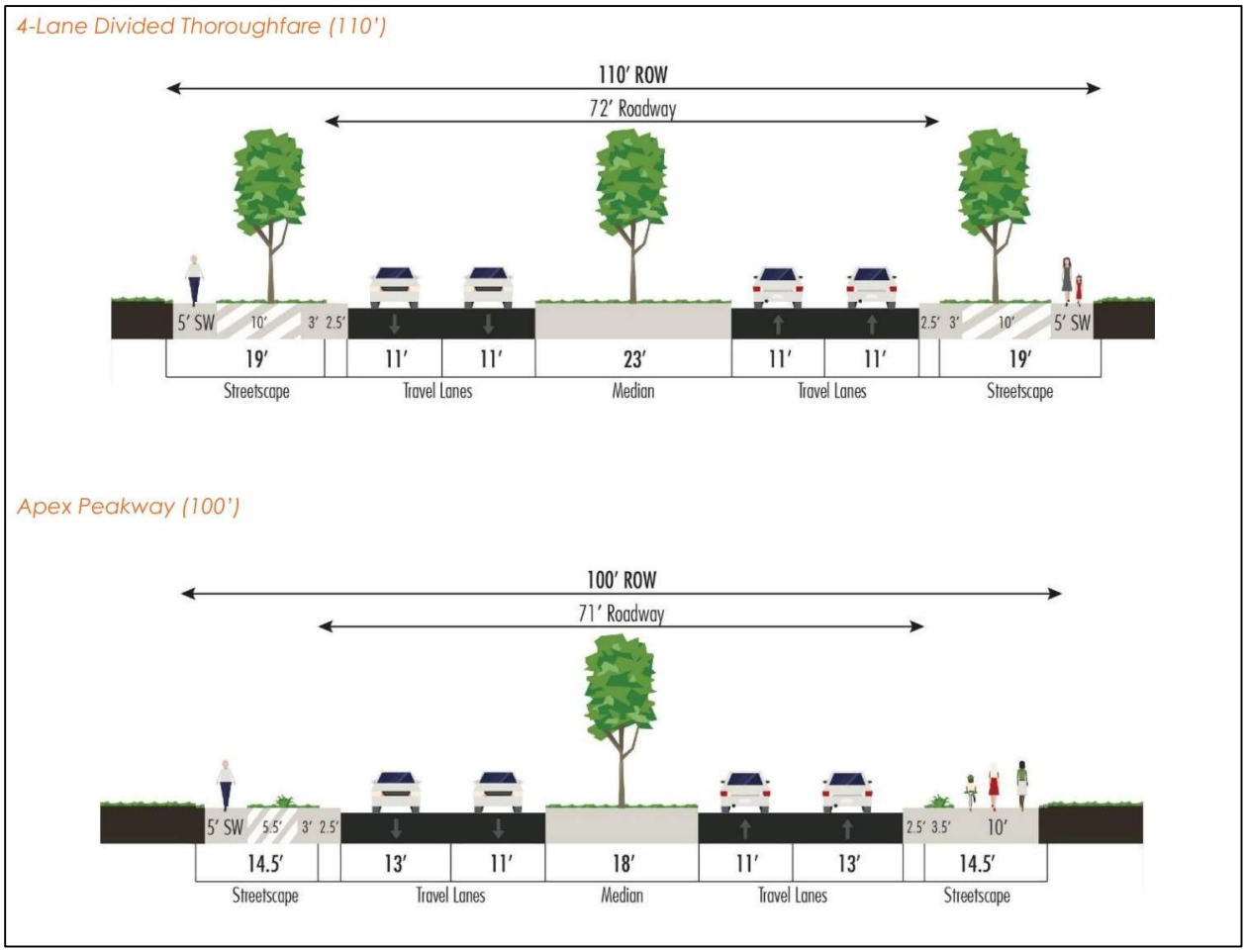

Figure 25. Four-Lane Divided Thoroughfare and Apex Peakway Cross-Sections

The proposed Friendship Road interchange at US 1 and Richardson Road New Location (new location of Friendship Road in Apex) optimized alignment and right of way would still encroach on streams and possible wetlands at Little White Oak Creek. Stream crossings may require drainage culverts or bridge culverts and stormwater permits. Wetland encroachment may require environmental permits.

5 INTERSECTION OPERATIONAL AND SAFETY ANALYSIS

Traffic capacity and operational analyses utilized Synchro 10 software analyses for conventional intersections and Sidra software analyses for roundabouts including the No-Build, MTP, and MTP+ scenarios. Intersection operations and safety performance were evaluated for the six interchange alternatives using the Intersection Control Evaluation (ICE). Synchro10 and Sidra files are available through CAMPO's project SharePoint site.

5.1 Traffic Operations Analysis

Conventional and roundabout intersection level of service (LOS) were calculated for year 2050 scenarios. The analysis shows the MTP and MTP+ scenarios would provide an acceptable level of traffic operations, resulting in LOS D or better, for the AM and PM peak hour. The No-Build scenario results in three intersections along New Hill-Holleman Road that would operate at LOS E or F. These three intersections would have reduced traffic volumes and operate at LOS D or better if traffic flow is diverted to the proposed Friendship Road interchange at US 1. Table 2 provides a summary of intersection year 2050 LOS including analysis of the No-Build and six Friendship Road interchange alternatives.

The proposed intersection of the new location of Friendship Road in Apex (Richardson Road New Location/Richardson Road New Location from Old US 1 Hwy to Humie Olive Road) and Old US 1 Hwy was evaluated as an at-grade and a grade-separated signalized intersection for the MTP and MTP+ scenarios. A summary of intersection year 2050 LOS AM and PM peak hour LOS is provided in Table 3.

Table 2. Intersection Level of Service for Scenario Year 2050 Interchange Alternatives

Intersection Level of Service (LOS) Scenario Year 2050		No-Build Scenario	MTP Scenario					MTP+ Scenario				
Intersection	**Time**	**No Build**	**Alt. 1**	**Alt. 2**	**Alt. 4**	**Alt. 5**	**Alt. 6**	**Alt. 1**	**Alt. 2**	**Alt. 4**	**Alt. 5**	**Alt. 6**
US 1 SB Ramps / Friendship Rd	AM	-	C	A	B	C	C	C	B	C	C	C
	PM	-	C	A	C	C	C	C	C	C	C	C
US 1 NB Ramps / Friendship Rd	AM	-	C	A	C	C	C	B	C	C	B	B
	PM	-	B	A	B	B	B	B	B	B	B	B
New Friendship at Old Friendship Rd / Woods Creek Rd	AM	-	B	B	B	B	A	B	B	B	B	A
	PM	-	B	B	B	B	A	B	B	B	B	A
Friendship Rd at Holly Springs-New Hill Rd	AM	B	B	B	B	B	B	C	C	C	C	C
	PM	B	B	B	B	B	B	B	B	B	B	B
Old US 1 at New Friendship Rd	AM	-	C	C	C	C	C	D	D	D	D	D
	PM	-	C	C	C	C	C	D	D	D	D	D
US 1 SB Ramps / New Hill Holleman Rd	AM	D	C	C	C	C	C	C	C	C	C	C
	PM	E	D	D	C	D	D	D	D	D	D	D
US 1 NB Ramps and New Hill Holleman Rd	AM	D	D	D	C	D	D	D	D	D	D	D
	PM	E	B	B	A	B	B	C	C	C	C	C
New Hill Holleman Rd and Friendship Rd	AM	F	D	D	D	D	D	D	D	D	D	D
	PM	E	C	C	C	C	C	B	B	B	B	B

Table 3. Intersection Level of Service for the Old US 1 Hwy Intersection

Scenario Year: 2050	Peak Period	MTP Scenario	MTP+ Scenario	MTP+ Scenario
		Signalized T-Intersection	Signalized Intersection	Signalized Quadrant Intersection
Old US 1 Hwy and New Friendship Rd / Richardson Rd	AM	C	D	C / C
	PM	C	D	C / C

5.2 Intersection Control Evaluation

ICE is a safety evaluation tool that helps identify optimum and safe intersections measure of effectiveness (MOE) by incorporating a comprehensive comparison and analysis of diverse projects. ICE compares multiple concepts against several factors including future interchange/intersection operations, safety performance, environmental constraints, and planning level costs.

ICE compared traffic operations, safety, and planning level costs to rank the six interchange alternatives including the MTP+ scenario. Table 4 shows ICE comparison and ranking of the interchange alternatives.

Table 4. ICE Comparison and Ranking for Interchange Alternatives

Measure of Effectiveness	Alt. 1	Alt. 2	Alt. 4	Alt. 5	Alt. 6
AM LOS:	C / C	B / C	C / C	C / C	C / C
PM LOS:	B / B	C / B	C / B	B / B	B / B
CMF[1]:	1.02	0.76	1.0	1.02	1.02
Cost[2]:	$3,900,000	$3,200,000	$3,000,000	$3,900,000	$3,900,000
Rank:	2	1	3	2	2

[1] *Determined from FHWA Crash Modification Factor (CMF) Clearinghouse*

[2] *Additional costs compared to standard diamond interchange, does not include utility impacts*

6 RECOMMENDATIONS

6.1 Stakeholder Input

The Friendship Road Hot Spot Interchange Study engaged and solicited responses from local stakeholders and state transportation agencies. Scope of work, traffic model for the roadway network, interchange locations, interchange alternatives, safety, and planning level costs were presented to the following stakeholders through the course of three stakeholder meetings:

- CAMPO
- Town of Holly Springs
- Town of Apex
- Wake County
- NCDOT
- North Carolina Turnpike Authority (NCTA)

PowerPoint presentations, meeting minutes, and stakeholder responses associated with stakeholder meetings held on April 18, 2022 (Meeting 1), May 25, 2022 (Meeting 2), and June 22, 2022 (Meeting 3) are included in Appendix B. Stakeholder responses for a request to rank viable interchange alternatives after Meeting 2, and responses for a request to coordinate interchange alternatives 5 and 6 with Amgen property owners after Meeting 3 are included in Appendix B.

6.2 Evaluation Matrix

The five viable interchange alternatives were evaluated for the following factors and potential impacts:

- Stakeholder input
- Traffic analysis
- Safety analysis
- Existing and proposed developments
- The Friendship Road bridge
- General environmental features
- Environmental easements
- Utility easements
- Right of way acquisition
- Planning costs

An evaluation and ranking matrix for the five viable interchange alternatives are shown in Table 5 and Table 6 respectively. These matrices are intended to aid preliminary decisions on location of the interchange and recommended interchange alternatives only. Interchange alternatives 1, 2, and 4 avoids environmental conflicts. Interchange alternatives 5 and 6 avoids the Friendship

Road bridge replacement and environmental easements. Interchange Alternative 6 has the least utility easement conflict and development conflict when compared to Interchange Alternative 5. Interchange alternatives 2 and 4 typically ranks higher than the rest in terms of traffic, safety, and planning costs. Interchange alternatives 1 and 6 ranks higher on stakeholder preference.

Table 5. Evaluation Matrix

Potential Impacts	Alt. 1	Alt. 2	Alt. 4	Alt. 5	Alt. 6
Developments	None	None	None	Moderate	Minimal
Friendship Road Bridge	Moderate	Moderate	Significant	None	None
Environmental Features	None	None	None	Moderate	Moderate
Environmental Easements	Moderate	Moderate	Moderate	None	None
Utility Easements	Moderate	Moderate	Moderate	Moderate	Minimal
Right of Way	Moderate	Moderate	Moderate	Minimal	Minimal

Table 6. Ranking Matrix

Ranking Criteria	Alt. 1	Alt. 2	Alt. 4	Alt. 5	Alt. 6
Level of Service (1 best LOS)	3	1	2	4	3
Crash Modification Factor (1 safest)	3	1	2	4	3
Planning Cost (1 lowest cost)	3	2	1	4	3
Stakeholder Preference (1 most preferred)	**2**	**4**	**5**	**3**	**1**

6.3 Recommended Interchange Location

CAMPO, the Town of Holly Springs, and the Town of Apex agree on two interchange locations:

- For Interchange Alternative 1, the interchange would be located approximately 1.5 miles from the New Hill Holleman Road interchange and similarly 1.5 miles from the NC 540 interchange, thereby avoiding Little White Oak Creek. This interchange location would also avoid encroachment on the Amgen Facility with the construction of the Friendship Road realignment. This interchange location would result in a skewed bridge and the replacement of the Friendship Road bridge to fit northbound and southbound ramps associated with the proposed interchange.
- For Interchange Alternative 6, the interchange would be located approximately 800 feet southwest of the Interchange Alternative 1 location to avoid the Friendship Road bridge replacement or removal. This interchange location would allow for a bridge that is not on skew. This interchange location would result in the Friendship Road realignment

requiring a new Amgen facility access at the north side of the property, minimal encroachment into the northern side of the Amgen facility property, and potential conflict with Little White Oak Creek tributaries.

6.4 Recommended Interchange Alternatives

CAMPO, the Town of Holly Springs, and the Town of Apex agree on the following recommend interchange alternatives:

- Alternative 1 Tight Diamond (includes the replacement of Friendship Road bridge)
- Alternative 6 Tight Diamond with a New Access to the Amgen Facility and New Intersection at Friendship Road

Interchange Alternative 1 Tight Diamond consists of a six-lane roadway typical section divided by a median. This interchange configuration accommodates four through lanes and two left-turn lanes to access US 1. Single-lane on ramps will include dedicated right-turn lanes. Double-lane off ramps will allow for dedicated left and right turn lanes. Intersections at the interchange will not be signalized.

Interchange Alternative 6 Tight Diamond with a New Access to the Amgen Facility and New Intersection at Friendship Road consists of a six-lane roadway typical section divided by a median. The location of interchange Alternative 5 was shifted further south (approximately 800 feet) to avoid ramp conflicts with the Friendship Road bridge and accommodate the new access to the Amgen Facility. This interchange configuration accommodates four through lanes and two left-turn lanes to access US 1. Single-lane on ramps will include dedicated right-turn lanes. Double-lane off ramps will allow for dedicated left and right turn lanes. Intersections at the interchange will not be signalized. On and off ramps on the south side of the interchange (Holly Springs side) were further tightened to minimize encroachment into the Duke Energy utility easement.

6.4.1 TransModeler Results

The study simulated future traffic conditions with and without the Friendship Road interchange at US 1 using TransModeler. The TransModeler analysis was developed for interchange alternatives 1 and 6. With the new interchange, build condition interchange alternatives 1 and 6 show acceptable operations through design year 2050. The No-Build condition showed considerable congestion at the New Hill/Holleman interchange that was alleviated by the inclusion of the Friendship Road interchange. TransModeler files and videos are available through CAMPO's project SharePoint site.

7 CONCLUSION AND NEXT STEPS

The Friendship Road Hot Spot Interchange Study concludes with recommendations for interchange location and selection of interchange alternatives 1 and 6 as the preferred interchange options. The next steps include recommendation of potential funding sources for the proposed improvements, assignment of transportation jurisdictional responsibilities, initial development of transportation policies, and opportunities to preserve transportation right of way.

7.1 Funding Opportunities

Available funding opportunities include the Strategic Transportation Investments (STI) funding, federal discretionary grants, and transportation bonds.

The proposed improvement may qualify for division project STI funding. However, this funding is competitive and limited.

The Friendship Road interchange and new roadway alignment may qualify for the following federal discretionary grants:

- RAISE grant – The new Rebuilding American Infrastructure with Sustainability and Equity (RAISE) is an existing grant previously known as Better Utilizing Investments to Leverage Development (BUILD) and Transportation Investment Generating Economy Recovery (TIGER) discretionary grants. RAISE investments include highway projects focusing on significant regional or local impact to safety, quality of life, environmental sustainability, mobility and community connectivity, economic competitiveness, collaboration, and technical innovation.
- MPDG – The US Department of Transportation recently combined the National Infrastructure Project Assistance program (or MEGA), the Infrastructure of Rebuilding America program (or INFRA), and the Rural Surface Transportation Grant program (or RURAL) programs into the Multimodal Projects Discretionary Grant (MPDG) to increase the stream of projects under the Bipartisan Infrastructure Law. MPDG funds complex projects including highways for both urban and rural areas. Funding goals include the creation of good paying jobs, economic growth, reduction of emissions, safety improvements, a sustainable and resilient transportation network, improvements to critical freight movements, the elimination of supply chain bottlenecks, and expansion of transportation options to agricultural areas and other underserved communities.

Federal discretionary grants typically require project cost-benefit analyses and a 20 percent local match.

Lastly, transportation bonds such as a bond referendum would allow municipalities to raise transportation funds through the sale of bonds. Bonds supplements municipal budgets making capital projects more affordable. A referendum would allow the issuance of general obligation funds for specific projects such as the Friendship Road interchange and new roadway alignments. However, developing specific projects for transportation bonds can be a significant and time-constrained process dependent on municipal election schedules.

7.2 Jurisdictional Responsibilities

At the project limits, US 1 is the jurisdictional boundary between the Town of Holly Springs and the Town of Apex. Thoroughfare cross-sections and required right of ways differ between the two municipalities. The Holly Springs CTP indicates a four-lane median divided thoroughfare for the New Location Road from Friendship Road to the proposed US 1 interchange. This includes four 10-foot through lanes, a 17.5-foot raised median, and a five-foot sidewalk and a five-foot side path.

The Apex CTP indicates a three-lane roadway including a side path for the Richardson Road New Location (new Friendship Road) from the new US 1 interchange to Old US 1 Hwy. This includes 11-foot through lanes, a 12-foot center turn lane, and five-foot sidewalks or side paths on both sides of the roadway.

Each municipality would be responsible for maintaining segments of the new Friendship Road and right of way and may share responsibility in maintaining the proposed cross-section of the new Friendship Road interchange bridge (either interchange alternatives 1 or 6).

7.3 Access Management and Right of Way Preservation

Intersections (in Holly Springs or Apex) associated with Interchange Alternative 1 and the new access to the Amgen facility included in Interchange Alternative 6 would be located approximately 1,000 feet or more from the proposed Friendship Road interchange at US 1 to meet minimum access management and intersection justification requirements. Right of way preservation would depend on each established processes for the towns of Holly Spring and Apex, respectively.

7.3.1 Town of Holly Springs

Intersections and the new access to the Amgen facility included in interchange alternatives 5 (should Interchange Alternative 5 be reconsidered as the preferred alternative) should be located approximately 1,000 feet or more from the proposed Friendship Road interchange at US 1 to meet minimum access management and intersection justification requirements.

The four-lane median divided roadway would require a minimum right of way of 118 feet. This proposed right of way would moderately impact the Amgen facility property with the selection of Interchange Alternative 1 and would minimally impact the property with Interchange Alternative 6 as the preferred option. Preservation of this extent of right of way is anticipated for private properties adjacent to the proposed interchange, the Amgen facility property, and Friendship Innovation Park properties. Right of way preservation should also consider potential conflicts with streams on the Amgen facility and Friendship Innovation Park properties, and the Duke Energy utility easement adjacent to US 1.

After right of way preservation, the next step in Holly Spring's project development (consistent with their CTP's Implementation Plan) would be a planning study, preliminary engineering, and environmental review to identify specific solutions.

7.3.2 Town of Apex

Intersections, median breaks, and accesses to the proposed realignment of Boscoe Road, the proposed realignment of Friendship Road included in Interchange Alternative 4 (should this alternative be reconsidered as the preferred alternative), and properties along Richardson Road New Location would be located approximately 1,000 feet or more from the proposed Friendship Road interchange at US 1 to meet minimum access management and intersection justification requirements.

The three-lane roadway would require a minimum right of way of 80 feet. This proposed right of way would impact private properties in Apex with the selection of either interchange alternatives 1 or 6. Preservation of this extent of right of way is anticipated for private properties adjacent to the proposed interchange, along Boscoe Road, and near Old US 1 Hwy. Right of way preservation should also consider potential conflicts with streams and environmental easements in the area.

APPENDIX A: TECHNICAL MEMORANDUMS

Tech Memo 1
Tech Memo 2
Tech Memo 3

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FIGURES

TABLES

1 INTRODUCTION

The NC Capital Area Metropolitan Planning Organization (CAMPO) is conducting a hot spot study on Friendship Road at US 1. The Friendship Road Hot Spot Interchange study will address transportation strategies for the proposed Friendship Road interchange, including local mobility, connectivity, and ongoing and future land use relationships for the rapidly growing areas of the Town of Apex and the Town of Holly Springs. The Friendship Road Hot Spot Interchange study will be evaluated in three phases:

- Tech Memo 1 – Existing and future years analysis
- Tech Memo 2 – Project feasibility analysis
- Tech Memo 3 – Project impact analysis

Tech Memo 1 identifies and evaluates existing land use and traffic conditions and will determine future traffic volumes on the no-build and build roadway networks.

Figure 1. US 1 from the Friendship Road bridge

Near the study area, US 1 is a four-lane highway divided by a 36-foot grass median, with 12-foot paved shoulders on both sides. Adjacent interchanges are New Hill Holleman Road to the south and NC 540 to the north. Friendship Road is a two-lane undivided highway, with four-foot shoulders (two-foot paved) on both sides. The Friendship Road and Holly Springs New Hill Road intersection is a T-intersection that includes a stop sign for the westbound lane of Holly Springs New Hill Road. At the intersection, Friendship Road includes a shared through and right turn lane northbound and a shared through and left turn lane southbound and Holly Springs New Hill Road includes a shared left/right turn lane. Friendship Road continues south to a T-intersection with New Hill Holleman Road and continues north to a T-intersection with Woods Creek Road and further north on a bridge over US 1. The Friendship Road bridge over US 1 maintains the two-lane undivided roadway and does not provide access to US 1.

2 PLAN REVIEW

Proposed roadway improvements and existing travel conditions within the study area were obtained from reviews of the following key sources:

- The 2050 MTP
- The Triangle Regional Model v6.2 (TRM)
- Traffic Impact Analyses (TIA) from nearby existing and planned developments: Amgen Manufacturing, Friendship Innovation Master Plan, Carolina Springs, Woods Creek Elementary, Duke Energy Operations, Fire Station #3, Green Oaks Tech Center, Oakview Innovation, and Goodwin Industrial in Holly Springs; Friendship Station, Retreat at

Friendship, Friendship Village, Gracewood, Apex Friendship Elementary School, Apex Friendship High School in Apex.

- Holly Springs Comprehensive Transportation Plan – Bicycle/Pedestrian Component (2011)
- Town of Holly Spring's Bicycle and Pedestrian System Plans 2022
- Traffic forecasts from nearby North Carolina Department of Transportation (NCDOT) projects U-6066, U-5981 and B-5321
- Town of Apex's planned Richardson Road Improvements
- Wake County Greenway Plan (2016)
- 2019 Southwest Area Study

3 LAND USE REVIEW

Existing and future land uses within the study area and nearby traffic generators outside of the study area were documented from review of GIS data and field observations as follows:

- Town of Apex Interactive Development Map
- Friendship Station Subdivision Plans
- The Friendship Innovation Master Plan
- New Hill Subdivision Master Plan
- Amgen manufacturing facility plans
- CAMPO Webmaps
- Wake County Imaps
- The North Carolina Department of Natural and Cultural Resources' HPOWEB 2.0

Community and environmental features within the study area include:

- Harris Lake County Park
- Wake County Fire Training Center
- Oakview Elementary School
- Holly Springs Fire Station No. 3
- New Hill Historic District
- Apex Friendship High School

Figure 2. Holly Springs Fire Station No. 3

The Town of Apex and the Town of Holly Springs jurisdictions are shown in the Planning Jurisdiction Map in **Error! Reference source not found.**. Project constraints, land uses, proposed developments, and community and environmental features are shown in the Project Location Map in Figure 3. Planning Jurisdiction Map

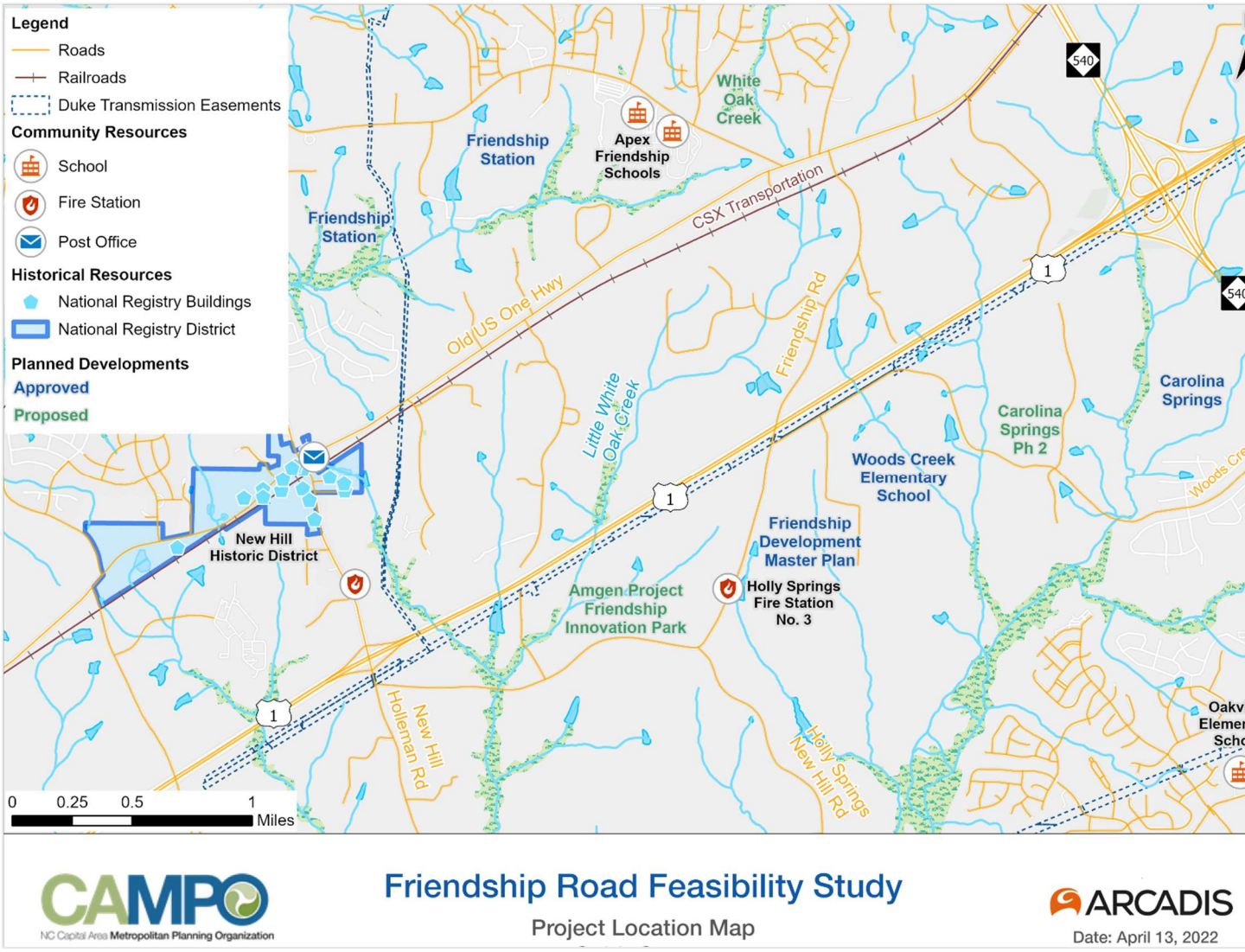
Legend
Roads
Railroads
Duke Transmission Easements
Community Resources
School
Fire Station
Post Office
Historical Resources
National Registry Buildings
National Registry District
Planned Developments
Approved
Proposed
Friendship Station
Apex Friendship Schools
White Oak Creek
Friendship Station
CSX Transportation
Old US One Hwy
Friendship Rd
Little White Oak Creek
Carolina Springs
Carolina Springs Ph 2
Woods Creek Elementary School
New Hill Historic District
Friendship Development Master Plan
Amgen Project Friendship Innovation Park
Holly Springs Fire Station No. 3
New Hill Holleman Rd
Holly Springs New Hill Rd
540
1
0 0.25 0.5 1 Miles
CAMPO
NC Capital Area Metropolitan Planning Organization
Friendship Road Feasibility Study
Project Location Map
ARCADIS
Date: April 13, 2022

Figure 4.

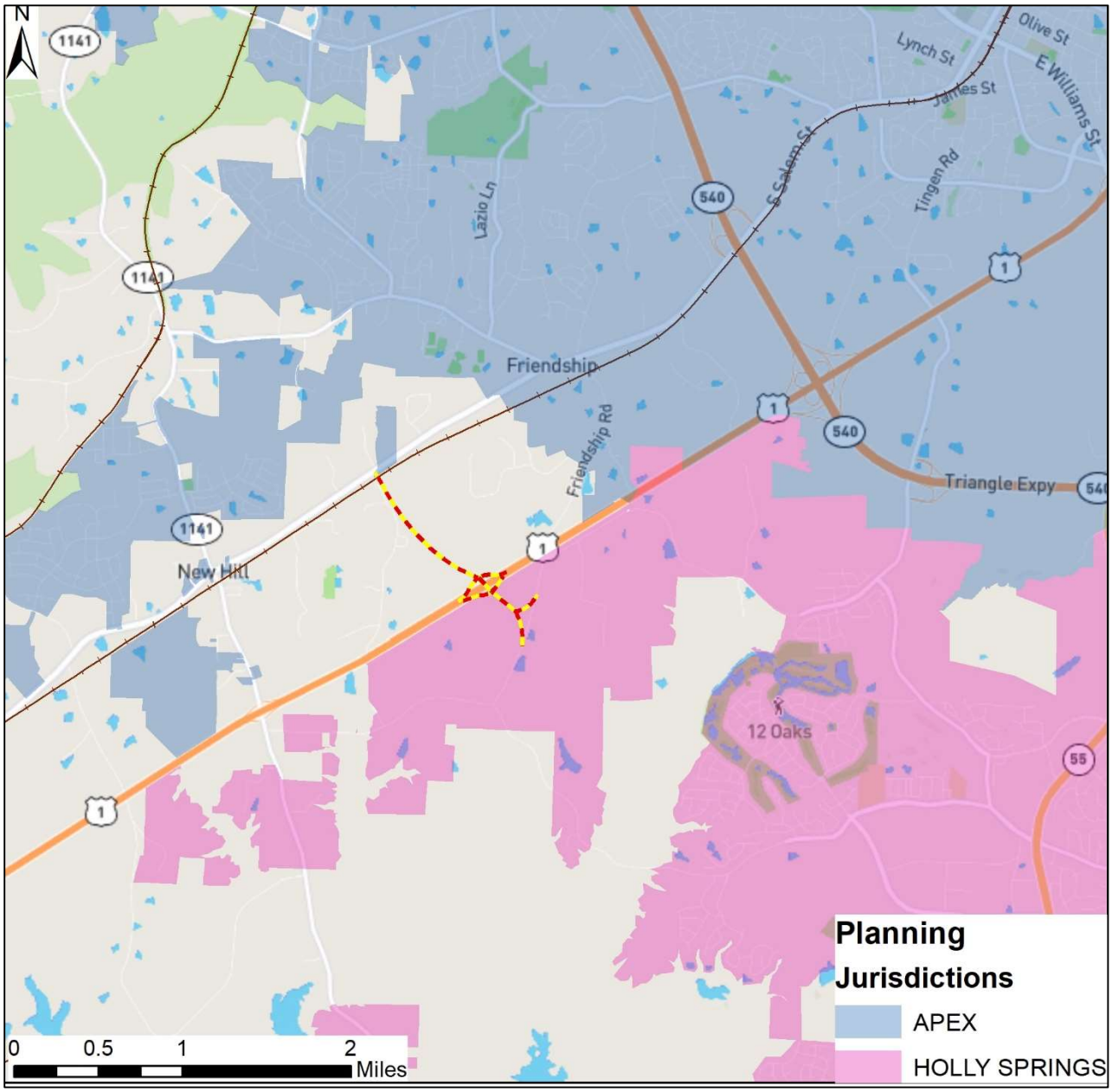

Figure 3. Planning Jurisdiction Map

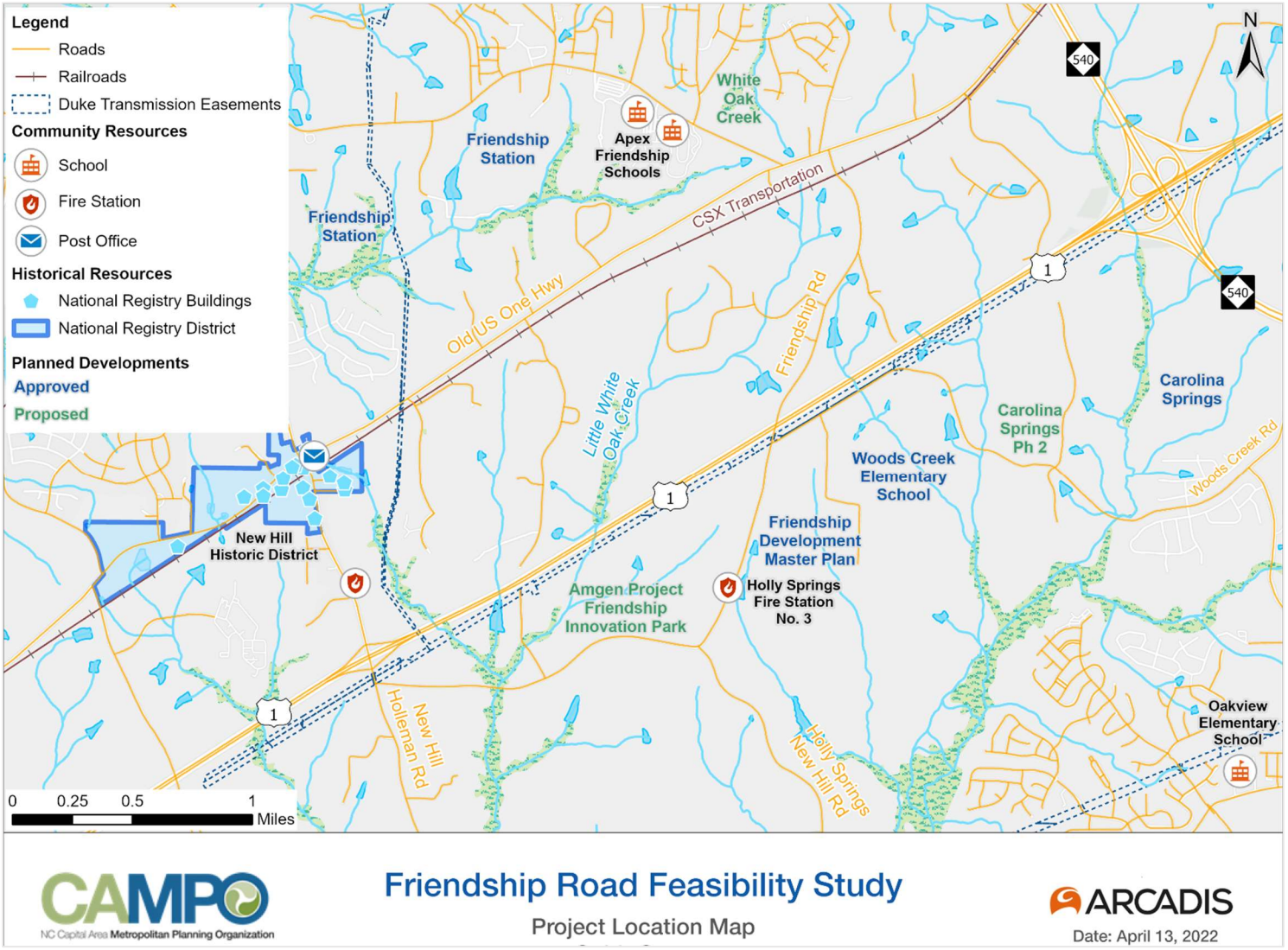

Figure 4. Project Location Map

4 TRAVEL DEMAND MODEL

As a major metropolitan and urbanized area, the region utilizes the Triangle Regional (Travel Demand) Model (TRM) for projecting future traffic volumes and transit ridership to be used in transportation planning and for regional transportation funding. This model provides a valuable tool for examining future traffic patterns.

The currently adopted version, TRM 6.2 based on the 2050 MTP, was utilized for this study.

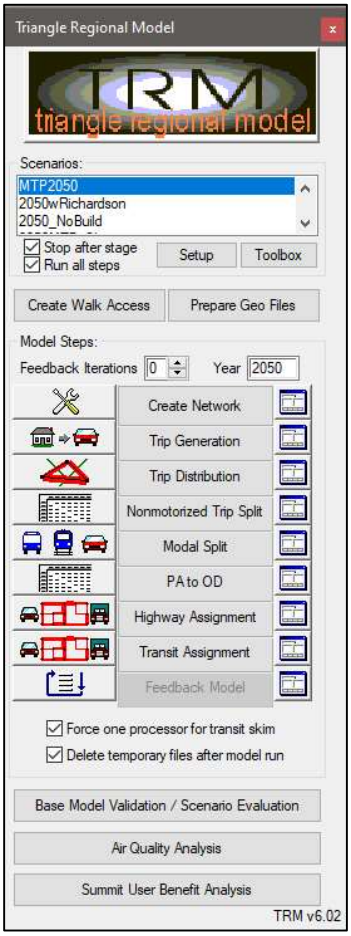

Figure 5. TRM v6.2

4.1 Review of Model Network and SE Data

The 2050 socio-economic (SE) data and MTP transportation network were reviewed near the study area.

Growth from proposed development plans provided by the Town of Apex and Town of Holly Springs was compared to the 2050 total population and total employment in seven TAZs near the study area. The growth in total population and employment from 2020 to 2050 corelated well with the growth from proposed developments. It was determined that no change was needed to SE data.

Daily traffic volume from the official 2050 MTP model run was compared to traffic volumes from recently completed Traffic Impact Analysis (TIA) for major proposed developments near the study area. Based on location of development within the TAZ and proposed site access plan from TIA, minor changes were made to the 2050 MTP model network by modifying centroid connector loadings near the study area.

4.2 Network Scenarios

Three different network scenarios were modeled for this feasibility study:

- **No Build**: 2050 MTP network without the subject project of Friendship Road and US 1 interchange.
- **MTP**: The 2050 MTP network which includes the subject project.
- **MTP+**: The 2050 MTP network with two additional projects from the CTP,
    - **Richardson Road extension** from south of SR 1142 (Humie Olive Road) to Old US Hwy 1 connecting to the subject Friendship Road improvement. Assumed 4-lane divided with 45 mph.
    - **Richardson Road widening** from Olive Chapel Road to SR 1142 (Humie Olive Road). Assumed 4-lane divided with 45 mph.

Figure 6 shows projects in the three different scenarios – No Build does not include any of the projects A, B or C; MTP includes project A only; while MTP+ includes all three projects A, B and C.

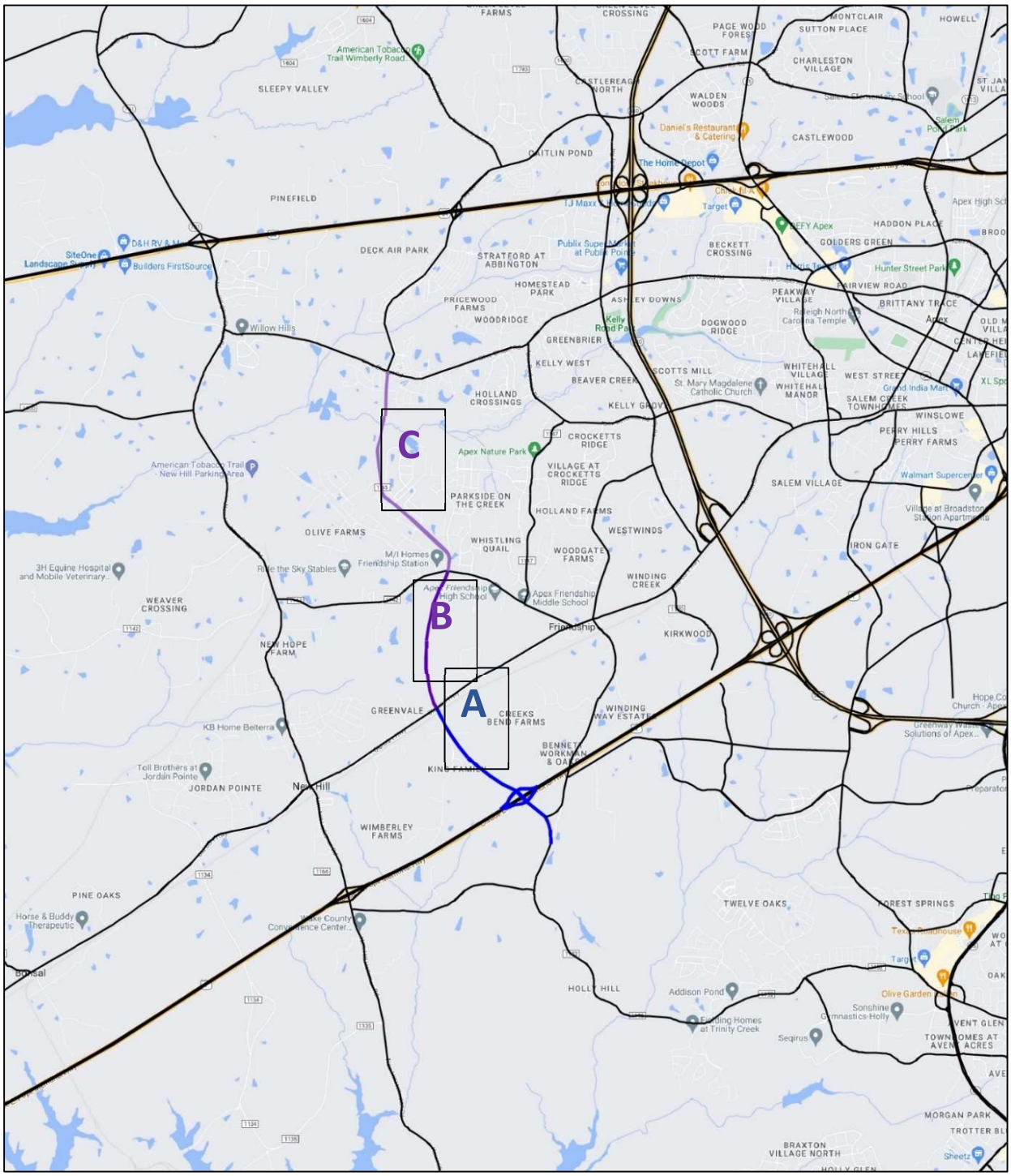

Figure 6. Model Network Scenarios

4.3 Model Volumes

Table 1 compares model daily volumes for key links for No Build, MTP and MTP+ scenarios. Figure 7, Figure 8, and Figure 9 show model daily volume map for the three scenarios.

Table 1. Daily Volumes from Model

Roadway	Location	2050 No Build	2050 MTP (Project A)	2050 MTP+ (Projects A+B+C)
US 1	West of New Hill Holleman Rd	58,100	57,500	57,800
	Between New Hill Holleman Rd and Proposed Friendship Rd Interchange	76,500	76,700	76,200
	Between Proposed Friendship Rd Interchange and NC 540	76,500	84,400	86,500
	East of NC 540	90,400	94,800	94,200
Old US 1 Hwy	West of New Hill Holleman Rd	7,500	7,400	6,800
	Between New Hill Holleman Rd and Proposed Friendship Rd Intersection	12,600	10,700	8,200
	East of Proposed Friendship Rd Intersection	8,700	9,300	7,300
NC 540	North of Old US 1 Hwy / S Salem St	73,800	73,600	71,300
	Between Old US 1 Hwy and US 1	86,900	88,100	83,300
	South of US 1	64,800	63,500	62,800
Proposed Friendship Rd New Alignment	North of Old US 1 Hwy	-	-	21,100
	Between Old US 1 Hwy and US 1	-	11,700	21,000
	South of US 1	-	14,300	16,900
	North of Friendship Rd	7,000	15,200	17,200
New Hill Holleman Rd	North of US 1	31,200	23,000	21,200
	South of US 1	46,000	40,500	40,000
	South of Friendship Rd	37,100	36,800	37,000
Other	Holly Springs New Hill Rd South of Friendship Rd	7,300	7,800	8,900
	Old Holly Springs Apex Rd west of NC 540	38,600	36,400	36,100
	Old Holly Springs Apex Rd east of NC 540	19,400	18,400	18,200

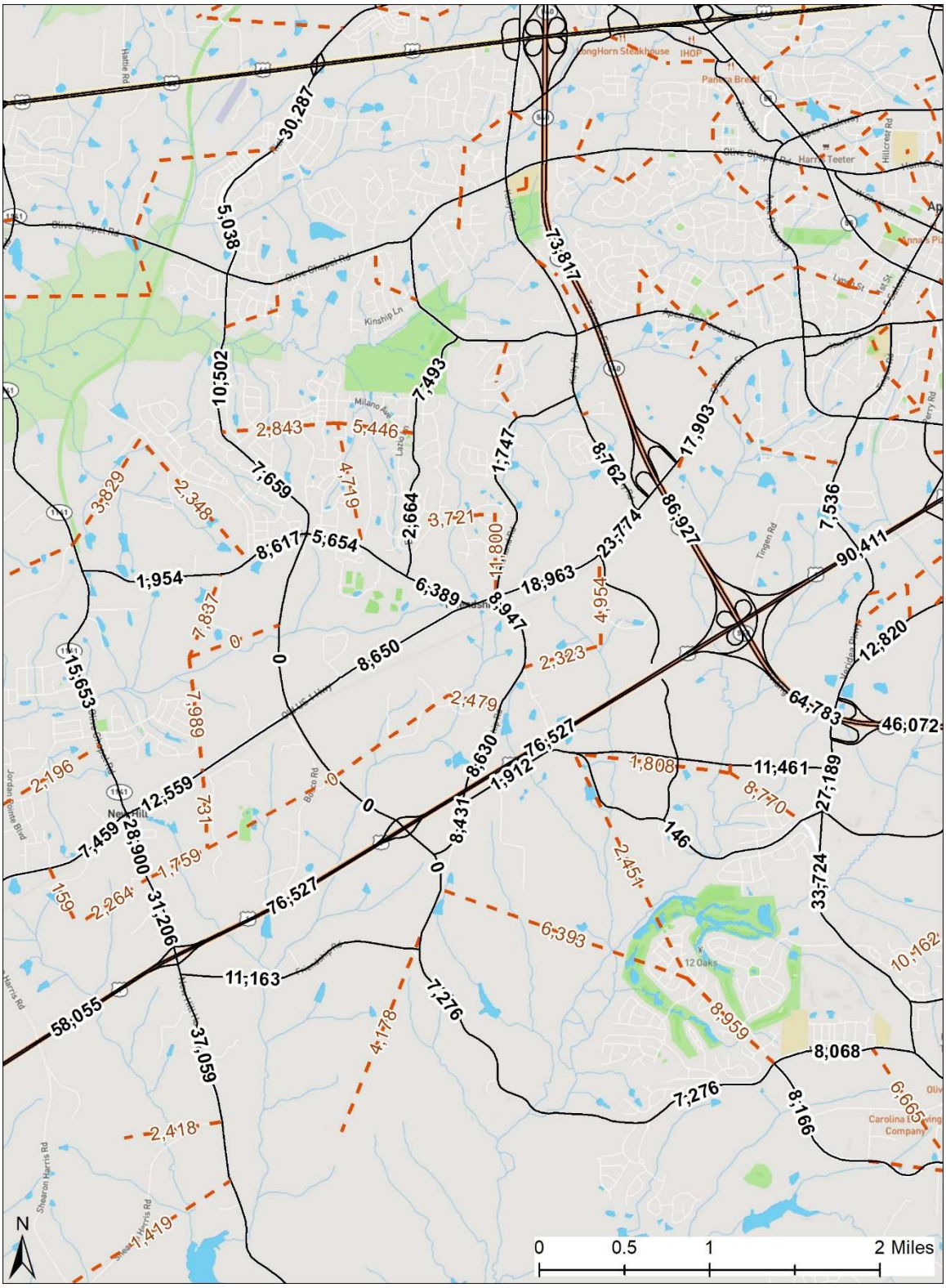

Figure 7. 2050 No Build Model Daily Volume Map

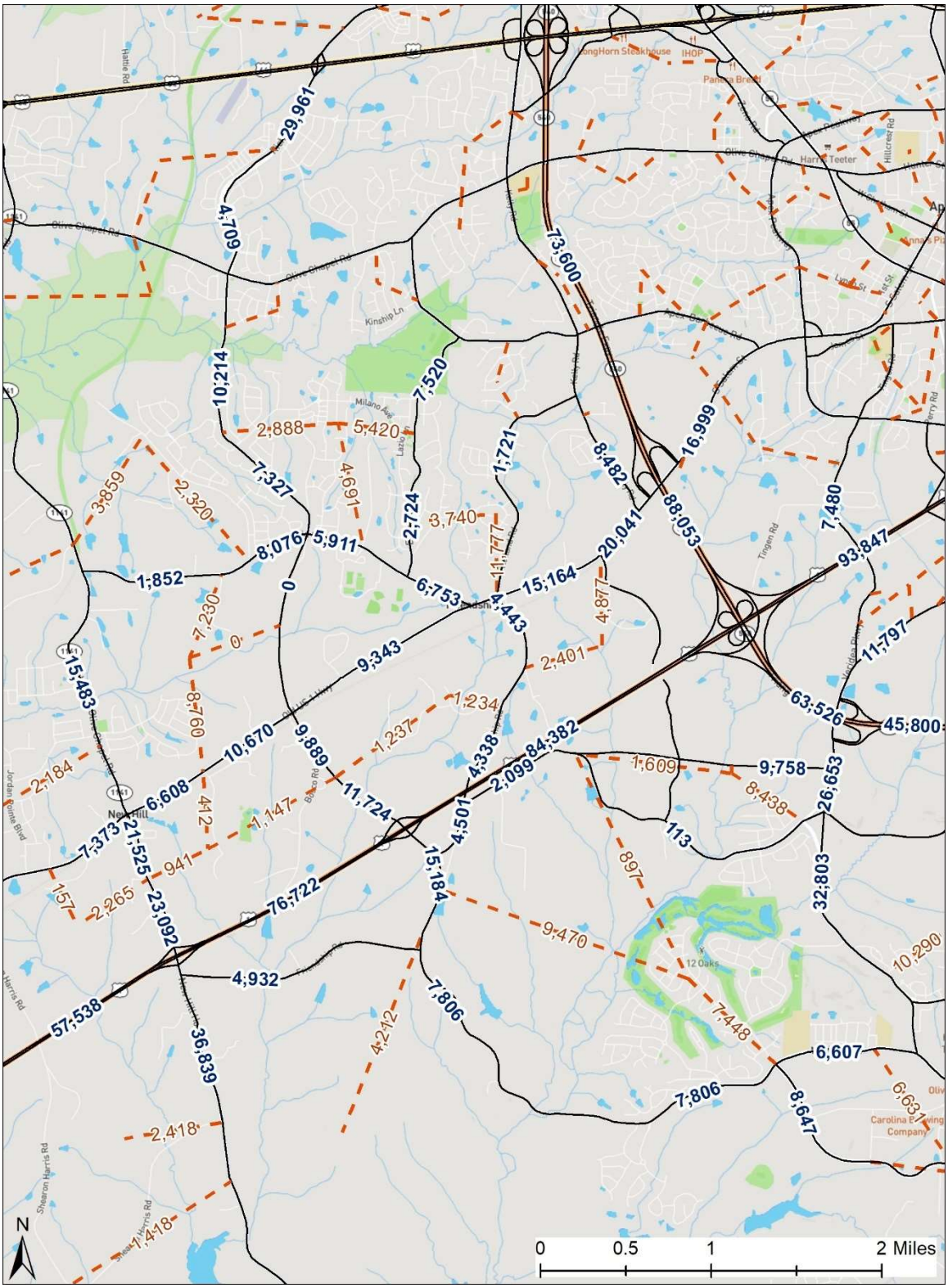

Figure 8. 2050 MTP Scenario Model Daily Volume Map

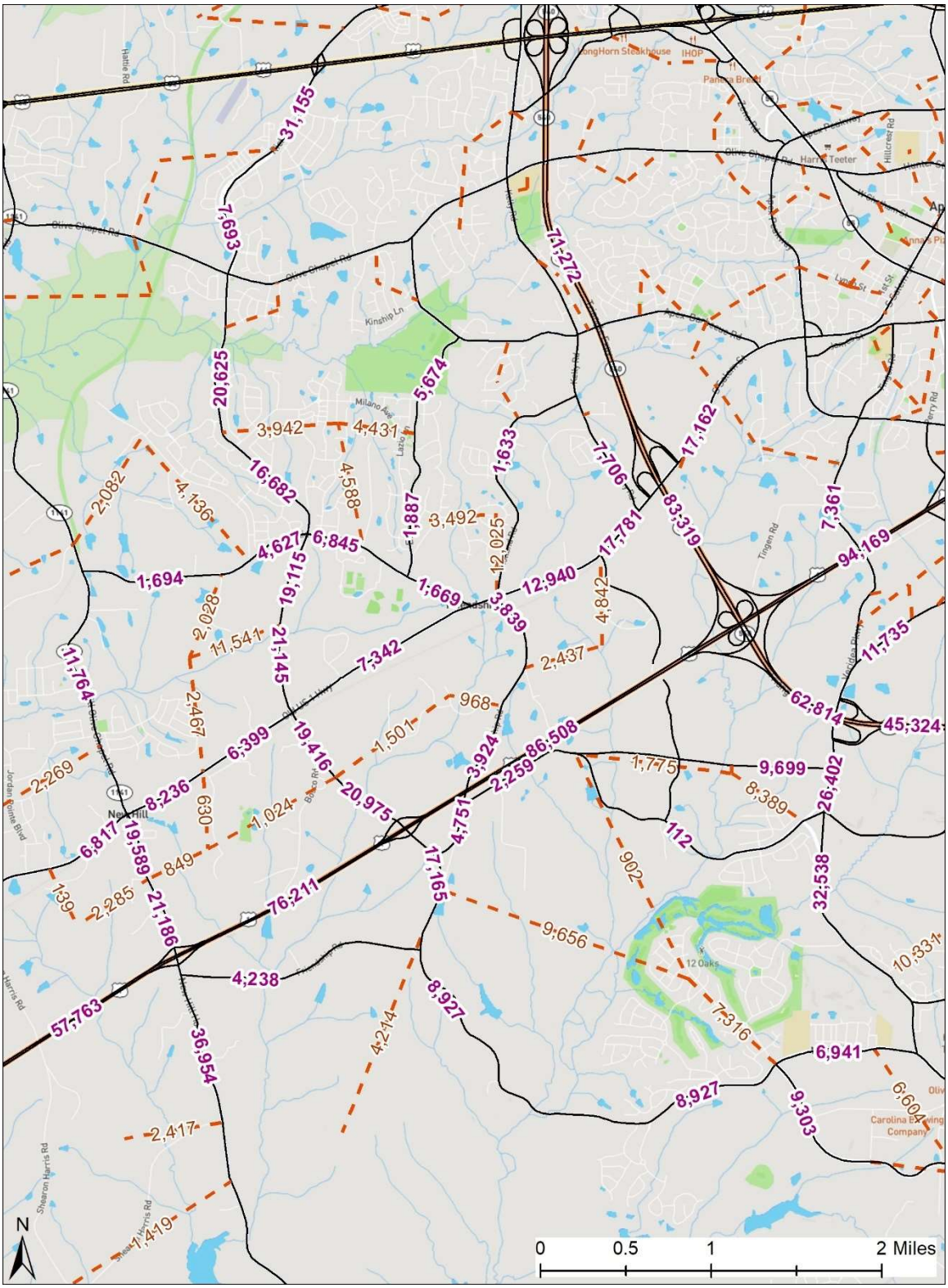

Figure 9. 2050 MTP+ Scenario Model Daily Volume Map

4.4 Volume to Capacity Ratio

Figure 10 and Figure 11 show model link volume to capacity (v/c) ratio for 2050 No Build AM peak hour and 2050 No Build PM peak hour respectively. In the study area, over-capacity (v/c greater than 1.0) is noted for existing Friendship Road and US 1 links. Moderately high v/c ratio (between 0.70 and 1.0) is observed for New Hill-Holleman Road and Old US 1 Hwy.

Figure 10. 2050 No Build AM Peak Hour Volume to Capacity (V/C) Ratio Map

Figure 11. 2050 No Build PM Peak Hour Volume to Capacity (V/C) Ratio Map

Figure 12 and Figure 13 show AM peak hour and PM peak hour v/c ratio for 2050 MTP scenario. With the new interchange and added capacity, Friendship Road shows v/c of 0.70 or better. US 1, west of NC 540, with four lanes would still be over-capacity. Six lanes would be needed on US 1 between NC 540 and the new Friendship Road interchange. The new interchange, however, would slightly improve conditions on US 1 west of it as traffic can enter / exit US 1 earlier rather than at New Hill-Holleman interchange.

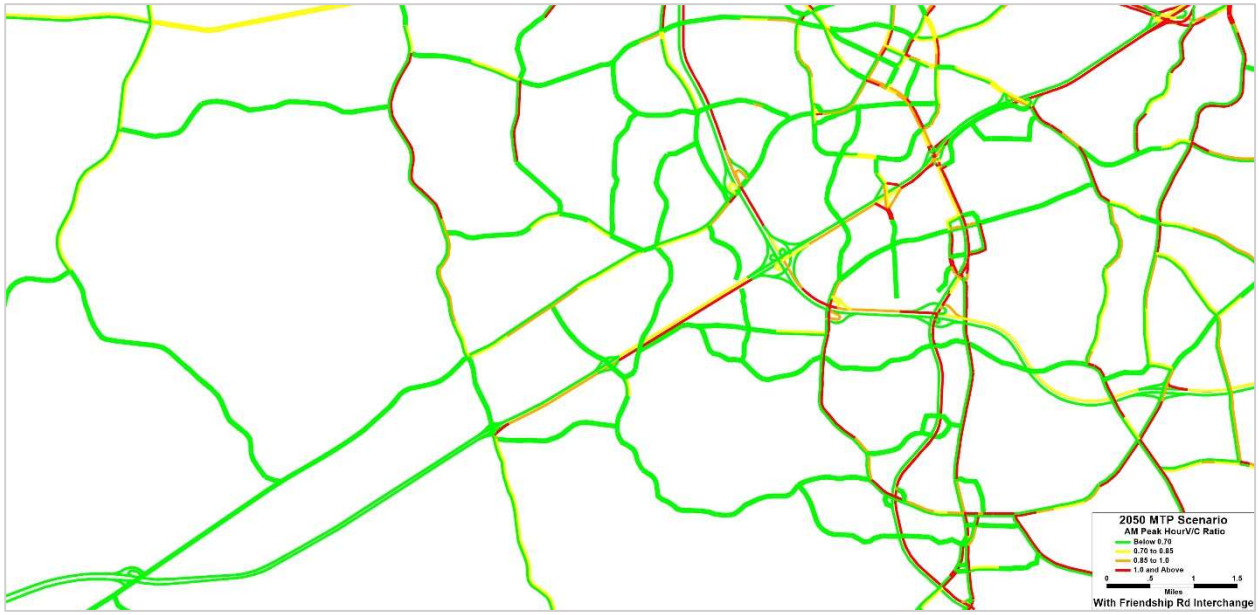

Figure 12. 2050 Build MTP Scenario AM Peak Hour Volume to Capacity (V/C) Ratio Map

Figure 13. 2050 Build MTP Scenario PM Peak Hour Volume to Capacity (V/C) Ratio Map

Figure 14 and Figure 15 show AM peak hour and PM peak hour v/c ratio for 2050 MTP+ scenario. Adding Richardson Road Extension to the network slightly improves v/c on Old US 1 Hwy and New Hill-Holleman Road as some traffic from these shifts to the new north-south corridor. US 1 continues to operate over capacity and widening to six lanes is recommended between NC 540 and the new Friendship Road interchange. The widening can be through adding auxiliary lane in both directions as the third lane.

Figure 14. 2050 Build MTP+ Scenario AM Peak Hour Volume to Capacity (V/C) Ratio Map

Figure 15. 2050 Build MTP+ Scenario PM Peak Hour Volume to Capacity (V/C) Ratio Map

4.5 Diversion Analysis

A diversion analysis was performed to estimate impact of new interchange on adjacent network. The No Build scenario daily volumes were subtracted from Build scenario daily volumes. The analysis was performed for both MTP and MTP+ scenarios.

Figure 16 shows traffic diversion between 2050 MTP and 2050 No Build scenarios. The links in green show an increase while the links in red show a decrease. The line thickness represents the scaled magnitude of change.

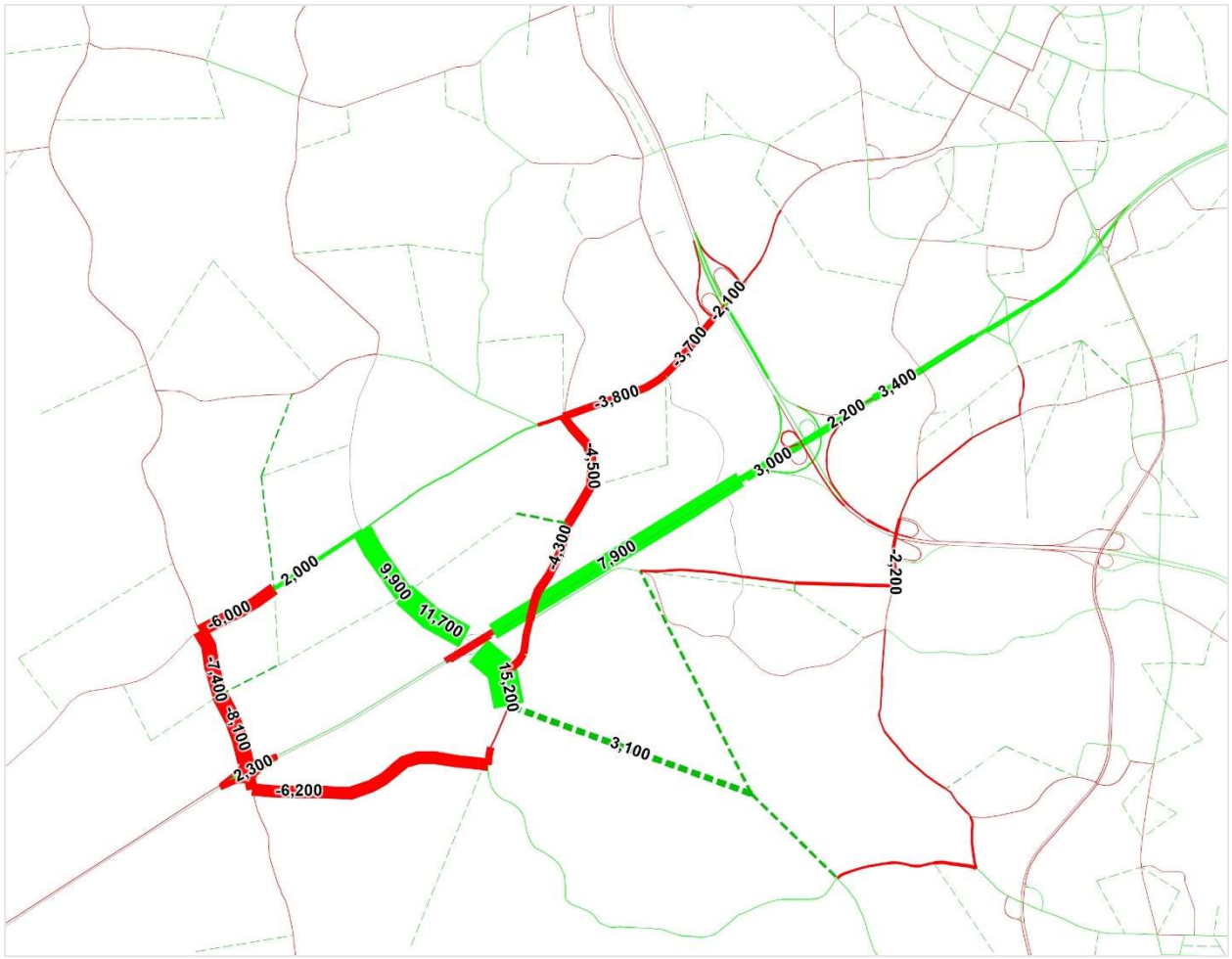

Figure 16. Model volume diversion between MTP and No Build Scenario

As can be seen in Figure 16, the new Friendship Road and US 1 interchange would reduce traffic on:

- Existing Friendship Road between New Hill- Holleman Road and Old US 1 Hwy
- New Hill-Holleman Road between Old US 1 Hwy and Friendship Road
- Old US 1 Hwy east of New Hill- Holleman Road and west of Old US 1 Hwy

The new interchange, however, also increases demand on US 1 east of the interchange as it provides a shorter route to traffic accessing US 1 to go east (towards downtown Raleigh) and north (towards RTP).

Figure 17 shows traffic diversion between 2050 MTP+ and 2050 No Build scenarios.

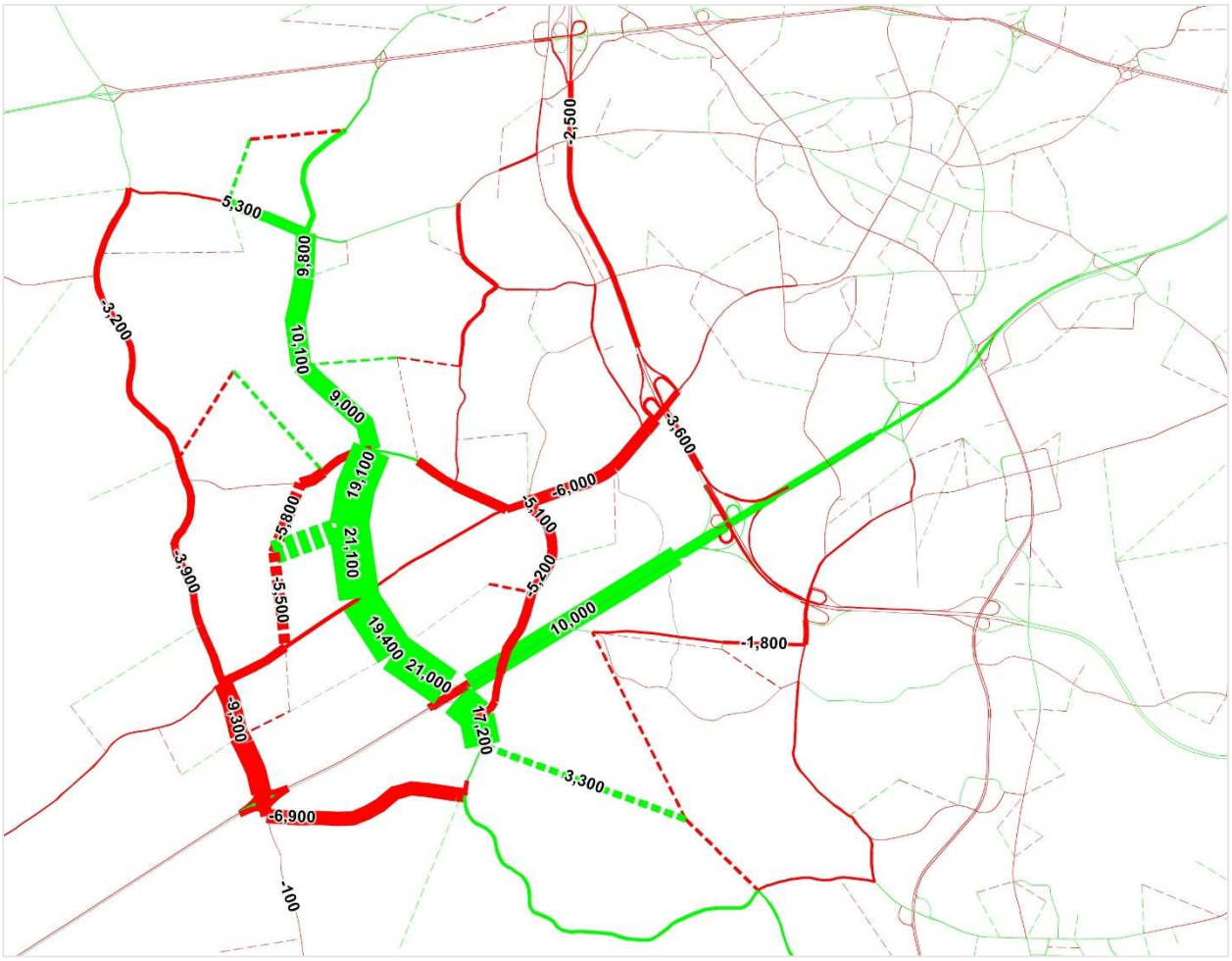

Figure 17. Model volume diversion between MTP+ and No Build Scenario

With Richardson Road extension and new Friendship Road interchange, the corridor provides a north-south linkage between NC 540 and NC 751 / New Hill Holleman Road. In addition to the diversion from new interchange (as described in previous page for MTP scenario), this new north-south linkage attracts about 3,000 trips each from NC 540 and NC 751 north side of US 1.

With both the new Friendship Road interchange and Richardson Road extension, the new facility provides a shorter route and faster access to the transportation network for adjacent land uses.

4.6 Regionwide Performance Measures

To evaluate overall benefit of the proposed infrastructure improvement, the following two regionwide performance measures were calculated from the model:

- Vehicle miles of travel (VMT)
- Vehicle hours of travel (VHT)

Table 2 compares the regionwide lanes miles, VMT and VHT from the model for No Build and the two Build scenarios (MTP and MTP+). Note that these metrics are for the entire Triangle Model region.

Table 2. Regionwide Performance Measures

Performance Measures	No Build	MTP	Difference (from No Build)	MTP+	Difference (from No Build)
Lane Miles	14,995	15,001	*+6*	15,009	*+14*
Total VMT (no C Connectors)	94,254,529	94,228,139	*-26,390*	94,249,810	*-4,719*
Total VHT (no C Connectors)	2,777,970	2,776,646	***-1,324***	2,776,499	***-1,471***

In the MTP scenario, with new Friendship Road interchange, 6 lane-miles are added to the network. The VMT reduces by about 26,400 vehicle-miles as compared to No Build as the new interchange provides a shorter access route for adjacent TAZs. Total VHT decreases by about 1,300 vehicle-hours mostly due to less travel time from shorter route and partially due to reduction in congestion and travel time savings on adjacent links with reduction in traffic.

In the MTP+ scenario, with new Friendship Road interchange and Richardson Road widening-extension, 14 lane-miles are added to the network. The VMT reduces by about 4,700 vehicle-miles as compared to No Build as the new interchange provides a shorter access route to adjacent TAZs. Note that VMT increases as compared to MTP scenario as trips on the north side from nearby congested links divert to Richardson Road while traveling a longer distance. Total VHT decreases by about 1,500 vehicle-hours.

The reduction in VHT can be translated to a dollar figure by applying value of time (VOT) to vehicle-hour savings. Table 3 provides the assumptions from TRM regarding calculation of weighted average value of time. The weighted average is calculated by combining the four model time periods – AM, PM, mid-day (MD), and night (NT), for four different vehicle trip types – single occupancy vehicle (SOV), high occupancy vehicle (HOV), single unit truck (SUT), and multi-unit truck (MUT). The value of time is in terms of year 2009 dollars.

Table 3. Weighted Average Value of Time (VOT) Estimate

	SOV	HOV	SUT	MUT	Total
AM	60,046,429	16,982,459	2,469,153	2,655,209	82,153,250
PM	73,662,092	23,127,605	1,327,262	1,419,478	99,536,437
MD	82,760,276	28,653,730	2,367,124	2,313,252	116,094,382
NT	22,260,522	8,137,856	3,093,788	1,616,551	35,108,718
Daily	**238,729,320**	**76,901,650**	**9,257,328**	**8,004,489**	**332,892,787**
	72%	23%	3%	2%	100%
VOT (2009)	***$ 12.00***	***$ 18.00***	***$ 30.00***	***$ 30.00***	
Weighted Average VOT (2009)					**$ 14.32**

Table 4 provides estimate of annual cost savings for the two Build, MTP and MTP+, scenarios by applying value of time to daily VHT savings and converting daily estimate to an annual estimate assuming 250 workdays per year. Any savings for remaining 115 days (weekends and holidays) are not included in the calculation.

For year 2050, annual travel time cost savings from MTP scenario are estimated to be $4.7 million in 2009 dollars. Similarly, annual travel time cost savings from MTP+ scenario are estimated to be $5.3 million in 2009 dollars.

Table 4. Annual Cost savings

Annual Cost Savings (in 2009 $)	**MTP Scenario**	**MTP+ Scenario**
Daily VHT Savings	1,324	1,471
Wt. Avg. Value of Time (VOT)	$14.32	$14.32
Daily Cost Savings	***$18,960***	***$21,065***
Avg. Workdays / Year	250	250
Annual Cost Savings ($M)*	**$4.7**	**$5.3**

** For year 2050, in 2009 $, as compared to No Build Scenario*

This estimate can be utilized along with other data to estimate project lifecycle benefit and cost, and to develop a benefit-cost ratio for project.

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1 INTRODUCTION

The NC Capital Area Metropolitan Planning Organization (CAMPO) is conducting a hot spot study on Friendship Road at US 1. The Friendship Road Hot Spot Interchange study will address transportation strategies for the proposed Friendship Road interchange, including local mobility, connectivity, and ongoing and future land use relationships for the rapidly growing areas of the Town of Apex and the Town of Holly Springs. The Friendship Road Hot Spot Interchange study will be evaluated in three phases:

- Tech Memo 1 – Existing and future years analysis
- Tech Memo 2 – Project feasibility analysis
- Tech Memo 3 – Project impact analysis

Tech Memo 2 identifies and evaluate the feasibility of appropriate transportation improvements, focusing interchange location, interchange operations, corridor and alignment options, and safety of the new roadway and future roadway and mobility network.

Figure 1. US 1 from the Friendship Road Bridge

The Comprehensive Transportation Plans (CTP) for the Town of Apex (Advance Apex 2045 Plan adopted February 2019) and the Town of Holly Springs (Vision Holly Springs 2018 Update approved May 2022) include proposed roadway improvements within one mile of the Friendship Road Hotspot:

- **Interchange at US 1 and New Location Road (Holly Springs CTP ID# 10)**
- **New Location Road and proposed sidewalk/side path from Friendship Road to the proposed US 1 Interchange (Holly Springs CTP ID# A648)**
- **Friendship Road widening and proposed wide outside lane and sidewalks from the proposed US 1 Interchange to US 1 Highway (Holly Springs CTP ID # A186a)**
- Friendship Road Widening and proposed wide outside lane and sidewalks from New Hill Holleman Road to Holly Springs New Hill Road (Holly Springs CTP ID# A163b)
- Holly Springs New Hill Road Widening and proposed wide outside lane and sidewalks from Friendship Road to Old Holly Springs Apex Road (Holly Springs CTP ID# A163c)
- New Hill Holleman Road and Friendship Road Intersection Improvement (Holly Springs CTP ID# 47))
- New Hill Holleman Road Widening and proposed sidewalk/side path from Friendship Road to Avent Ferry Road (Holly Springs CTP ID# A190)
- Woods Creek Road Widening and proposed sidewalk/side path from Woodfield Dead End Road to Old Holly Springs Apex Road (Holly Springs CTP ID# A423)

- Woodfield Dead End Road Extension and proposed wide outside lane from Holly Springs New Hill Road to Woods Creek Road (Holly Springs CTP ID# 415)
- New Location Road and proposed wide outside lane from New Hill Holleman Road to Holly Springs New Hill Road (Holly Springs CTP ID# 414)
- **New US 1 Interchange (Apex CTP)**
- **Richardson Road New Location (new location of Friendship Road) from the New US 1 Interchange to Old US 1 Hwy, three-lane roadway and side path (Apex CTP)**
- Richardson Road New Location from Old US 1 Hwy to Humie Olive Road, four-lane median divided roadway and side path (Apex CTP)
- New location of Boscoe Road and sidewalks from Boscoe Road to the new location of Friendship Road (Apex CTP)
- Old US 1 Hwy Widening and proposed sidewalks from New Hill Holleman Road to NC 540 (Apex CTP)
- Friendship Road Widening and proposed sidewalks/bike shared lanes from US 1 to Old US 1 Hwy (Apex CTP)
- New Hill Holleman Road Widening from US 1 to Old US 1 Hwy (Apex CTP)
- New Hill Holleman Road Intersection Improvement (Apex CTP)
- U-5981 US 1 at NC 55 Interchange Improvements (Apex CTP)
- U-6066 US 1 Widening from NC 55 to US 64 (Apex CTP)

Projects located within the Friendship Road Hotspot are shown in bold text. Other identified projects are part of the roadway network and multi-modal transportation connectivity at the Friendship Road Hotspot. Roadway widening and new location/realignment projects from the Holly Springs CTP's Multimodal Assessment and Recommendations section are shown in Figure 2 and Figure 3. The Richardson Road New Location from the new US 1 interchange to Old US 1 Hwy (new location of Friendship Road), and from Old US 1 Hwy to Humie Olive Road (Richardson Road Extension) (from the Apex CTP) are shown in Figure 4.

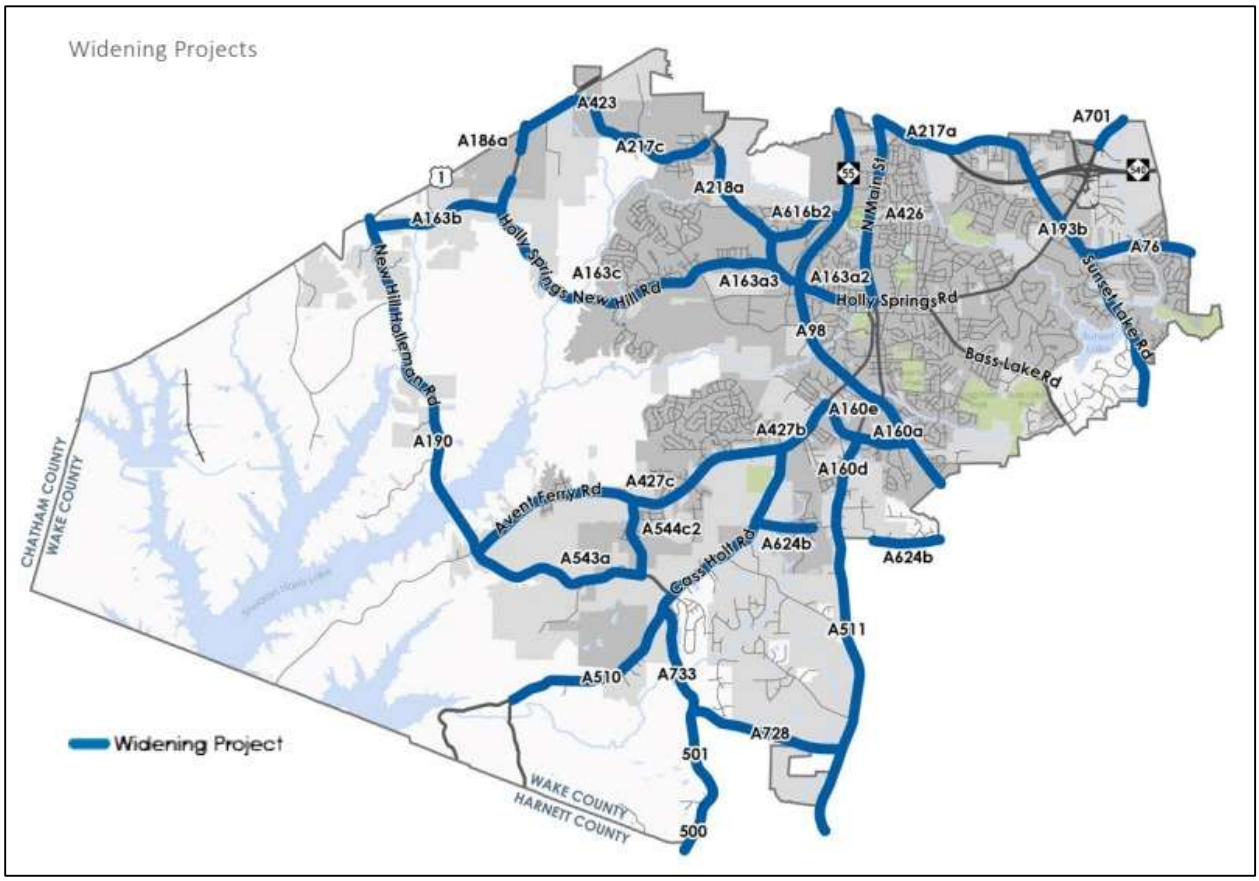

Figure 2. Holly Springs CTP Proposed Widening Projects

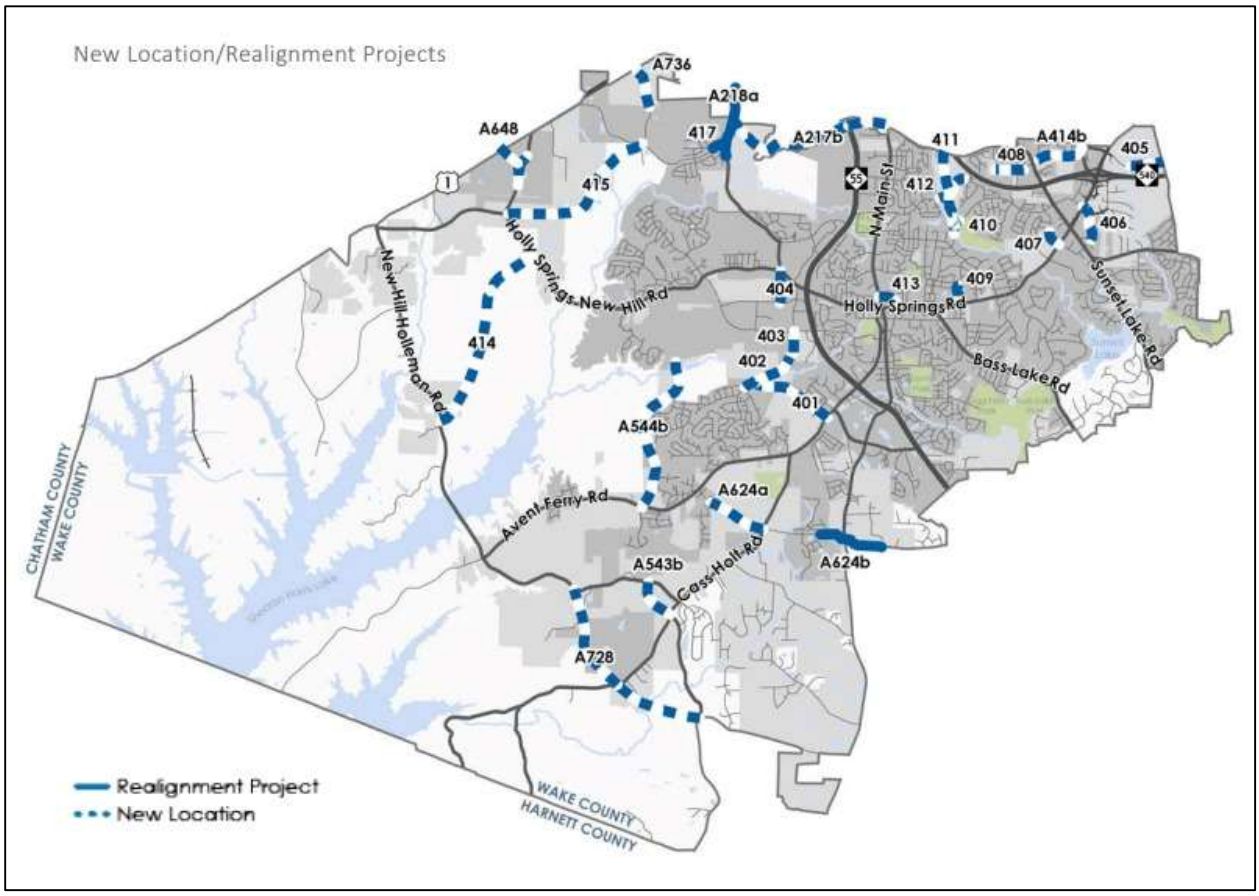

Figure 3. Holly Springs CTP Proposed New Location and Realignment Projects

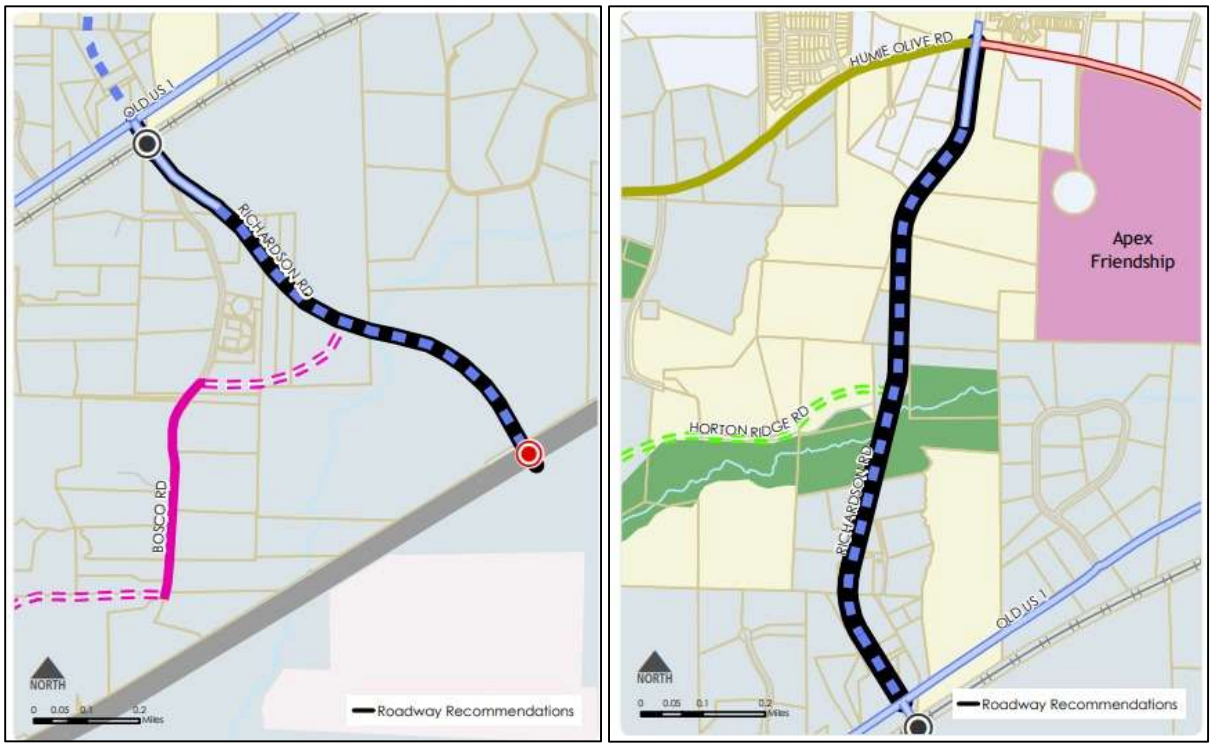

Figure 4. Apex CTP Proposed New Location of Friendship Road and Extension of Richardson Road

2 INTERCHANGE LOCATION

The surrounding land uses, environmental features and constraints, existing topography, the distances from the New Hill Holleman Road interchange to the proposed US 1 interchange, the distance from the NC 540 interchange to the proposed US 1 interchange, and the proximity of the proposed US 1 interchange to the Friendship Road bridge were evaluated to determine the appropriate interchange location.

Surrounding land uses include single-family residential properties, active farmlands, the Amgen facility (under construction) and Friendship Road Park developments, and utilities including the Duke Energy transmission lines adjacent to US 1. The proposed interchange location avoided single-family residential properties, active farmland accesses, and the site and access locations of the Amgen facility. It is anticipated that the interchange and new roadway construction can avoid or minimally impact Duke Energy transmission lines.

Environmental features and topography provide significant constraints to locating the proposed US 1 interchange further west along US 1. Little White Oak Creek presents potential environmental concerns and anticipated permits, and the area near Little White Oak Creek exhibit significant changes in topography that could present difficulties in the design and construction of the proposed interchange.

The spacing of the New Hill Holleman Road and NC 540 interchanges and distance from the Friendship Road bridge are integral in determining the interchange location. The proposed US 1 interchange could not encroach on the Friendship Road bridge. By avoiding Little White Oak Creek and the Friendship Road bridge, the proposed US 1 interchange would be located approximately 1.5 miles from the New Hill Holleman Road interchange and similarly 1.5 miles from the NC 540 interchange.

3 INTERCHANGE OPTIONS

The towns of Apex and Holly Springs indicate the need for a US 1 interchange between the New Hill Holleman Road interchange and the NC 540 interchange. The Friendship Road New US 1 Interchange in Holly Springs, and the New US 1 Interchange in Apex are included in their respective CTPs. Four distinct interchange types were evaluated and presented for the proposed US 1 interchange:

- Option 1 Tight Diamond
- Option 2 Tight Diamond with Roundabouts
- Option 3 Partial Cloverleaf with a Loop in the Southeast Quadrant
- Option 4 Standard Diamond (includes the removal of the Friendship Road bridge)

The realigned, widened, and new Friendship Road alignments included in the interchange option discussion calls for full capacity four-lane median divided thoroughfares, consistent with the towns of Holly Springs and Apex CTPs and for uniform interchange option comparisons. The three-lane undivided thoroughfare with a center turn lane currently proposed for the Richardson Road New Location (new location of Friendship Road) from the New US 1 Interchange to Old US 1 Hwy in the Advanced Apex 2045 Plan is presented in Section 4 Alignment Options.

3.1 Interchange Option 1

Interchange Option 1 Tight Diamond consists of a six-lane roadway typical section divided by a median. This interchange configuration accommodates four through lanes and two left-turn lanes to access US 1. Single-lane on ramps will include dedicated right-turn lanes. Double-lane off ramps will allow for dedicated left and right turn lanes. Intersections at the interchange will not be signalized. The tight diamond interchange, bridge cross-section, and roadway configuration are shown in Figure 5.

Roadway and bridge improvements adjacent to interchange Option 1 will include the realignment and widening of Friendship Road to a four-lane median divided thoroughfare, a signalized intersection, and a new two-lane undivided roadway tie back to existing Friendship Road south of Woods Creek Road, and replacement of Friendship Road bridge to accommodate off and on ramps.

Benefits of interchange Option 1 include the least right of way acquisition or need for corridor preservation relative to the other interchange options and allows for optimum intersection spacing to Friendship Road and the Amgen facility driveway. Interchange Option 1 concerns

include the requirement for a wider bridge to accommodate both through lanes and full left turn lanes and the potential cost of replacement of the Friendship Road bridge.

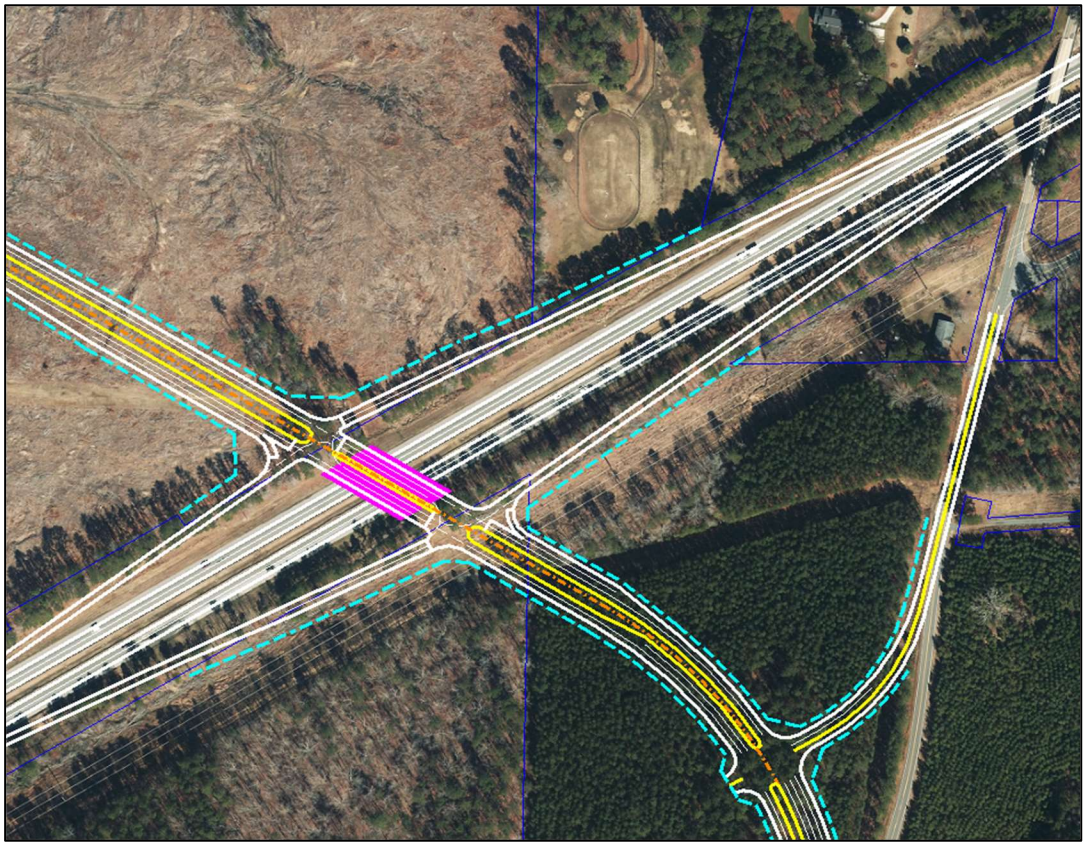

Figure 5. Interchange Option 1

3.2 Interchange Option 2

Interchange Option 2 Tight Diamond with Roundabouts consists of a four-lane roadway typical section divided by a median. This interchange configuration accommodates four through lanes and two double-lane roundabouts to access US 1. Single-lane on ramps will include dedicated right-turn lanes to access US 1 from the new Friendship Road, and dedicated roundabout exits to access US 1 from roundabouts. Double-lane off ramps will allow for dual right turns to access the new Friendship Road southbound (towards Holly Springs) or access the roundabout to access Friendship Road northbound (towards Apex). The tight diamond with roundabout interchange, bridge cross-section, and roadway configuration are shown in Figure 6.

Roadway and bridge improvements adjacent to interchange Option 2 will include the realignment and widening of Friendship Road to a four-lane median divided thoroughfare, a signalized intersection, and a new two-lane undivided roadway tie back to existing Friendship

Road south of Woods Creek Road, and replacement of Friendship Road bridge to accommodate off and on ramps.

Benefits of interchange Option 2 include the least right of way acquisition or need for corridor preservation relative to the other interchange options, allows for optimum intersection spacing to Friendship Road and the Amgen facility driveway, a narrower bridge, and improved safety at ramp intersections. Interchange Option 2 concerns include the potential cost of replacement of the Friendship Road bridge and finite capacity of roundabout intersections which may lead to intersection failure.

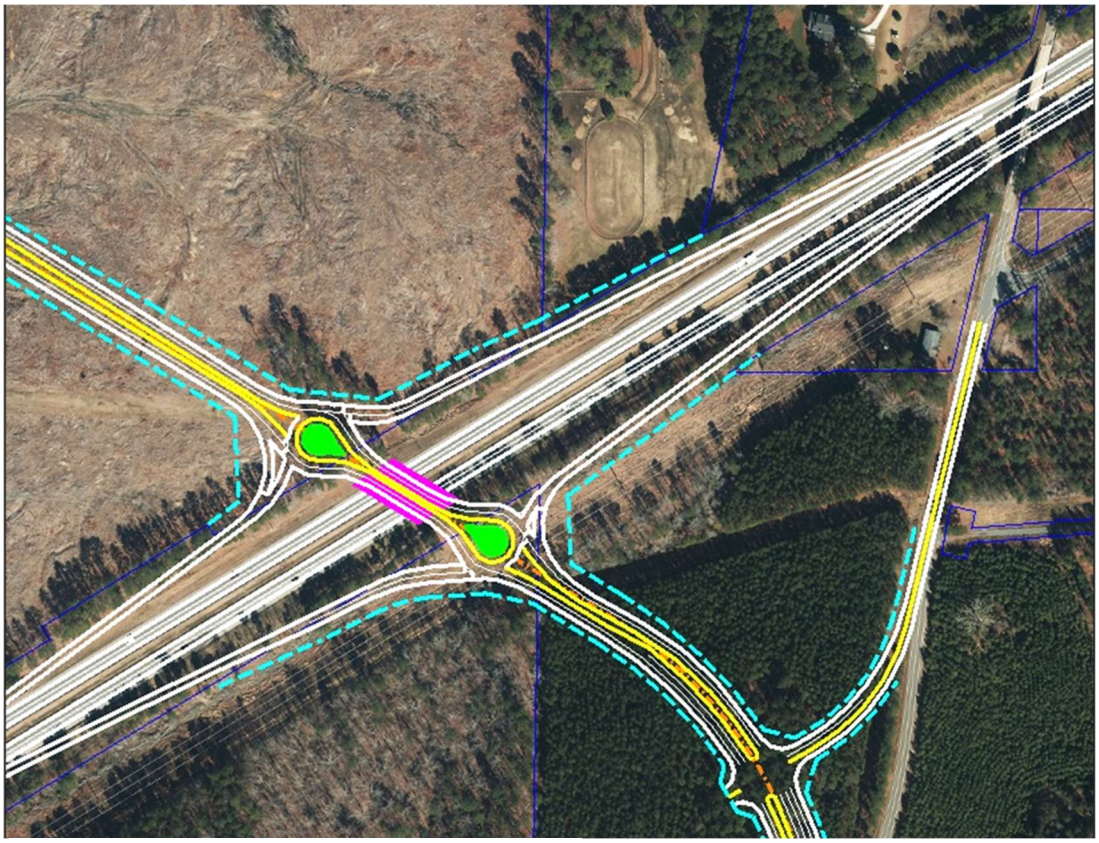

Figure 6. Interchange Option 2

3.3 Interchange Option 3

Interchange Option 3 Partial Cloverleaf with a Loop in the Southeast Quadrant consists of a five-lane roadway typical section divided by a median. This interchange configuration accommodates four through lanes and one left-turn lanes to access US 1 southbound. US 1 southbound can also be accessed through a dedicated right turn lane on the new Friendship Road. Access to US 1 northbound utilizes a loop ramp at the southeast quadrant of the partial cloverleaf interchange. Motorists travelling southbound on the new Friendship Road can access US 1 northbound by making a right turn at the loop ramp. Motorists travelling northbound on the realigned Friendship

Road can access US 1 northbound by making a left turn at the partial cloverleaf ramp northbound ramp. Double-lane and multi-lane southbound and northbound off ramps, respectively, will allow for dedicated left and right turn lanes. The partial cloverleaf interchange, bridge cross-section, and roadway configuration are shown in Figure 7.

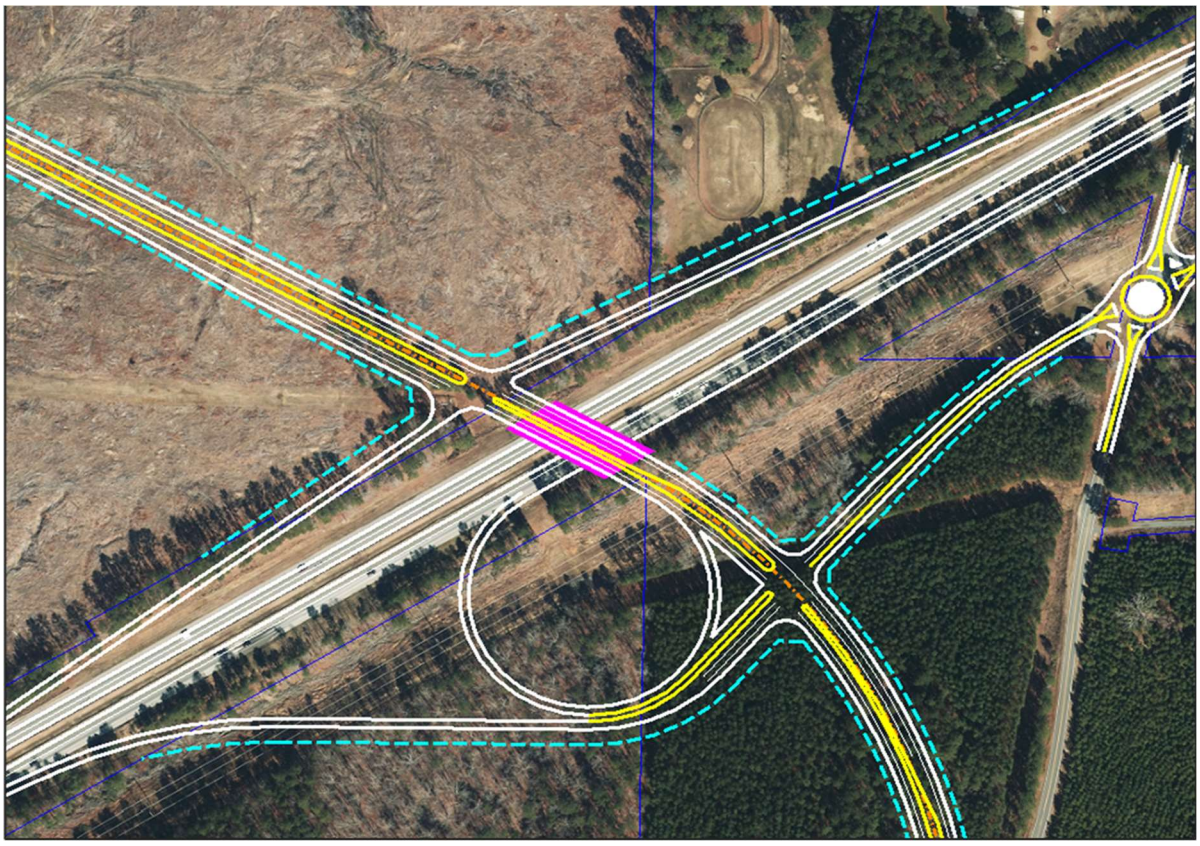

Figure 7. Interchange Option 3

This interchange configuration includes a signalized intersection at the partial cloverleaf ramp that accommodates the four-lane median divided Friendship Road realignment, and a new two-lane undivided roadway tie back to Woods Creek Road with a single lane roundabout.

Benefits of interchange Option 3 include a narrower five-lane bridge, better ramp terminal intersection spacing, allows for optimum intersection spacing to Friendship Road and the Amgen facility driveway, and Friendship Road bridge could be preserved and would not have to be replaced. Interchange Option 3 concerns include increased right of way acquisition or need for corridor preservation relative to other interchange options (primarily on the Holly Springs side of US 1) and potential intersection conflict for motorist travelling northbound on the realigned Friendship Road and making a left turn at the partial cloverleaf to access US 1 northbound.

3.3.1 Interchange Option 3 Disposition

CAMPO, the NCDOT, the Town of Apex, and the Town of Holly Springs evaluated the functional design and effectiveness of Interchange Option 3 Partial Cloverleaf with a Loop in the Southeast Quadrant during the May 25, 2022 Teams meeting (project Meeting #2) and recommended the elimination of Option 3 from further consideration because the option shows no clear advantage with regards to functional design and right of way acquisition/interchange and corridor preservation.

3.4 Interchange Option 4

Interchange Option 4 Standard Diamond consists of a six-lane roadway typical section divided by a median. This interchange configuration accommodates four through lanes and two left-turn lanes to access US 1. Single-lane on ramps will include dedicated right-turn lanes. Double-lane off ramps will allow for dedicated left and right turn lanes. Intersections at the interchange will not be signalized. The standard diamond interchange, bridge cross-section, and roadway configuration are shown in Figure 8.

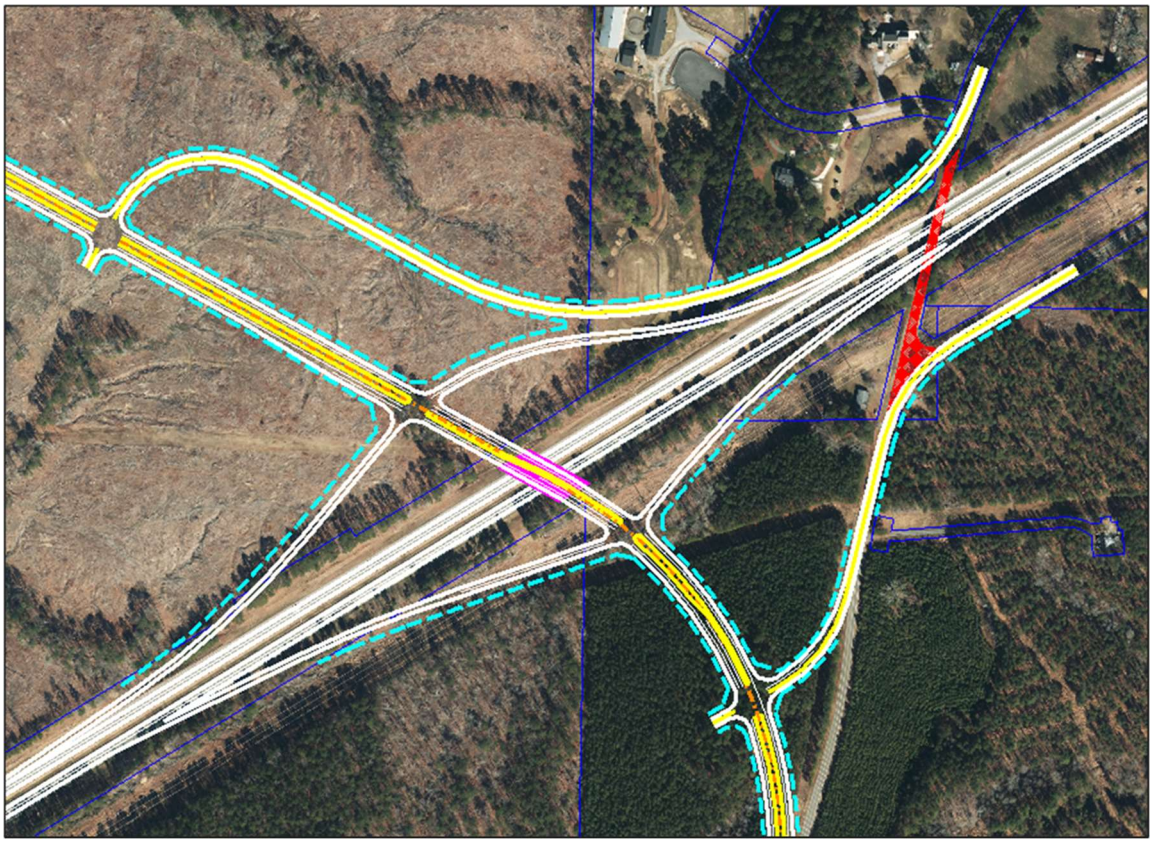

Figure 8. Interchange Option 4

Roadway and bridge improvements adjacent to interchange Option 4 will include the realignment of Friendship Road and widening to a four-lane median divided roadway, a signalized intersection, and a new two-lane undivided roadway tie back to existing Friendship Road south of Woods Creek Road, and replacement of Friendship Road bridge to accommodate off and on ramps.

Benefits of interchange Option 4 include optimum ramp terminal intersection spacing, allows for optimum intersection spacing to Friendship Road and the Amgen facility driveway, eliminates Friendship Road bridge (lesser cost to demolish than to replace) and provides frontage road access from new Friendship Road north of the interchange to old Friendship Road. Interchange Option 4 concerns include increased right of way acquisition or need for corridor preservation relative to other interchange options (primarily on the Apex side of US 1), additional right of way cost/corridor preservation due to the new Friendship Road alignment, and potentially longer trip time to travel from existing Friendship Road in Apex to the new Friendship Road connection.

4 ALIGNMENT OPTIONS

The towns of Apex and Holly Springs indicate the need for a new Friendship Road alignment in coordination with the proposed US 1 interchange. The New Location Road at the proposed US 1 interchange in Holly Springs, and the Richardson Road New Location (new location of Friendship Road) from the new US 1 Interchange to Old US 1 Hwy in Apex are included in their respective CTPs. The overall proposed roadway network improvements, pedestrian and bicycle improvements, roadway functional classifications and designs, land use planning context, proposed community development, identified and anticipated right-of-way constraints, and anticipated traffic volumes were evaluated in determining the appropriate roadway alignment and cross-section for the new Friendship Road in Holly Springs and Apex.

4.1 New Friendship Road and Roadway Network in Holly Springs

Within the Town of Holly Springs, The New Location Road from Friendship Road to the proposed US 1 Interchange and the Friendship Road widening from the proposed US 1 Interchange to US 1 Highway are in included in the Vision Holly Springs 2018 Update within the Business and Industrial land use west of Friendship Road and the Innovation Village land use near the Friendship Road and Holly Springs New Hill Road intersection.

The New Location Road from Friendship Road to the proposed US 1 Interchange is a considered long-term project. The Friendship Road Widening from the proposed US 1 Interchange to US 1 Highway, the northern part of the New Hill Holleman Road Widening, the western part of the Holly Springs New Hill Road Widening, the Woodfield Dead End Road Extension, and the Woods Creek Road Widening are proposed mid-term projects.

According to the Holly Springs CTP, the New Location Road and the Friendship Road Widening are considered thoroughfares that are limited by adjacent land uses, designed for relatively lower

traffic volumes and speeds than major thoroughfares, and offer local and regional mobility. The proposed implementation plan for the New Location Road and the Friendship Road Widening is a four-lane median divided thoroughfare with sidewalks/bike lanes (wide outside lane) on both sides of the roadway.

4.1.1 Friendship Road from Holly Springs New Hill Road to the Proposed US 1 Interchange

The Holly Springs CTP indicates a four-lane median divided thoroughfare for the widening of Friendship Road from Holly Springs New Hill Road to the proposed US 1 interchange. The need for a four-lane median divided thoroughfare was confirmed through evaluations that included a comparison of existing traffic volumes and future traffic forecast without the proposed US 1 interchange, and future traffic forecast with the proposed US 1 interchange. This proposed improvement includes 10-foot inside lanes, 14-foot outsides lanes (to accommodate bicycles), a 17.5-foot raised median, and five-foot sidewalks on both sides of the roadway consistent with the Holly Springs CTP implementation plan. The minimum right of way requirement is 118 feet. The four-lane median divided thoroughfare cross-section T-4B is shown in Figure 9.

Figure 9. T-4B Four-Lane Thoroughfare Cross-Section

The Amgen facility northern and southern driveways are currently under construction. These driveways directly access Friendship Road. The proposed Friendship Road widening will accommodate the Amgen facility driveways, the future Woodfield Dead End Road Extension, and future developments at Friendship Innovation Park. The Friendship Road and Holly Springs

New Hill Road intersection currently is a Y-intersection that prioritizes through traffic on both lengths of Friendship Road. This configuration results in left-turning traffic conflicts and potential line-of-sight concerns on Friendship Road southbound and Holly Springs New Hill Road westbound. The widening and alignment of Friendship Road will include the realignment of the Friendship Road and Holly Springs New Hill Road to a T-intersection that prioritize through traffic between Holly Springs New Hill Road and Friendship Road towards the proposed US 1 interchange. The proposed Friendship Road widening and alignment, and the proposed T-intersection at Friendship Road and Holly Springs New Hill Road are shown in Figure 10.

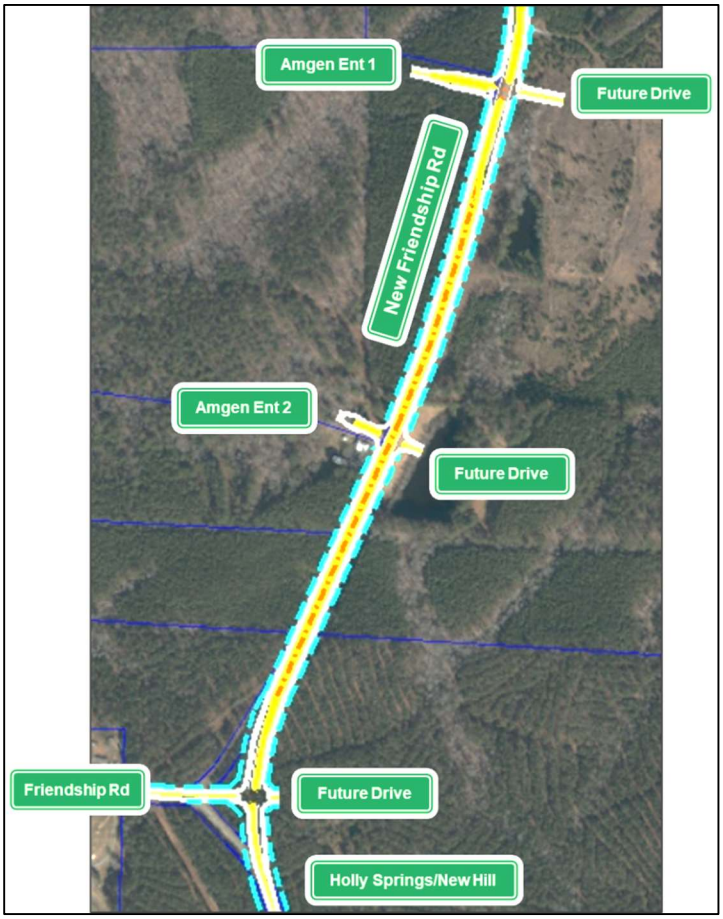

Figure 10. Friendship Road Widening and Alignment

The Holly Springs CTP includes the Friendship Road widening to a four-lane median divided thoroughfare from New Hill Holleman Road to Holly Springs/New Hill Road. Evaluation of future traffic forecasts with and without the proposed US 1 interchange, including travel demand adjustments, indicate a decrease in traffic volume for this portion of Friendship Road. This is considered a secondary effect of this feasibility study for the Friendship Road Hotspot. A new evaluation of travel demand and future traffic volumes (including the widening of Friendship Road from Holly Springs New Hill Road to the US 1 interchange, the realignment of Friendship Road at the US 1 interchange, and the construction of the US 1 interchange) should be conducted for this portion of Friendship Road, exclusively, to confirm the anticipated decrease in traffic and adjust the Holly Spring CTP, if necessary.

4.1.2 The New Location of Friendship Road

The Holly Springs CTP indicates a four-lane median divided thoroughfare for the New Location Road from Friendship Road to the proposed US 1 interchange. The need for a four-lane median divided thoroughfare was confirmed through evaluations that included a comparison of existing traffic volumes and future traffic forecast without the proposed US 1 interchange, and future traffic forecast with the proposed US 1 interchange. This proposed improvement includes four 10-foot through lanes, a 17.5-foot raised median, a five-foot sidewalk and a five-foot side path

consistent with the Holly Springs CTP implementation plan. The minimum right of way requirement is 118 feet. The four-lane median divided thoroughfare cross-section T-4A is shown in Figure 11.

Figure 11. T-4A Four-Lane Thoroughfare Cross-Section

The Friendship Road realignment will avoid the Amgen facility and driveways and will accommodate future developments at Friendship Road Innovation Park.

Intersections for the Friendship Road realignment are proposed corresponding to each interchange options presented in Section 3. Intersections will connect the Friendship Road realignment (four-lane median divided thoroughfare) to existing Friendship Road and Woods Creek Road. Intersection options include a two-lane roundabout, a three-way unsignalized (stop condition) intersection, and a three-way signalized intersection.

4.2 New Friendship Road and Roadway Network in Apex

Within the Town of Apex, the new US 1 Interchange and Richardson Road New Location (new location of Friendship Road) from the New US 1 Interchange to Old US 1 Hwy are included in the Advance Apex 2045 Plan Suburban context area. The suburban context area is heavily reliant on vehicle travel and dependable roadway networks due to relatively higher traffic volumes. Roadway design priorities include optimum roadway capacity, median dividers on major roadways, and sidewalks and separation for pedestrians and bicyclists. The new location of Friendship Road from the proposed US 1 interchange to Old US 1 Hwy is anticipated to be a three-lane roadway including a side path. The full capacity typical section would likely be a four-lane median divided roadway (similar to the proposed Richardson Road New Location from Old US 1 Hwy to Humie Olive Road). Proposed roadway cross-sections may include a three-lane

undivided thoroughfare with a center turn lane, a four-lane median divided thoroughfare accommodating a 110-foot right of way, or the Apex Peakway (four-lane median divided thoroughfare) accommodating a 100-foot right of way.

4.2.1 Richardson Road New Location from the New US 1 Interchange to Old US 1 Hwy

The Apex CTP indicated a three-lane roadway including a side path for the Richardson Road New Location (new Friendship Road) from the new US 1 interchange to Old US 1 Hwy. This proposed improvement includes 11-foot through lanes, a 12-foot center turn lane, and five-foot sidewalks or side paths on both sides of the roadway consistent with the Apex CTP implementation plan. The minimum right of way requirement is 80 feet. The three-lane undivided thoroughfare cross-section is shown in Figure 12.

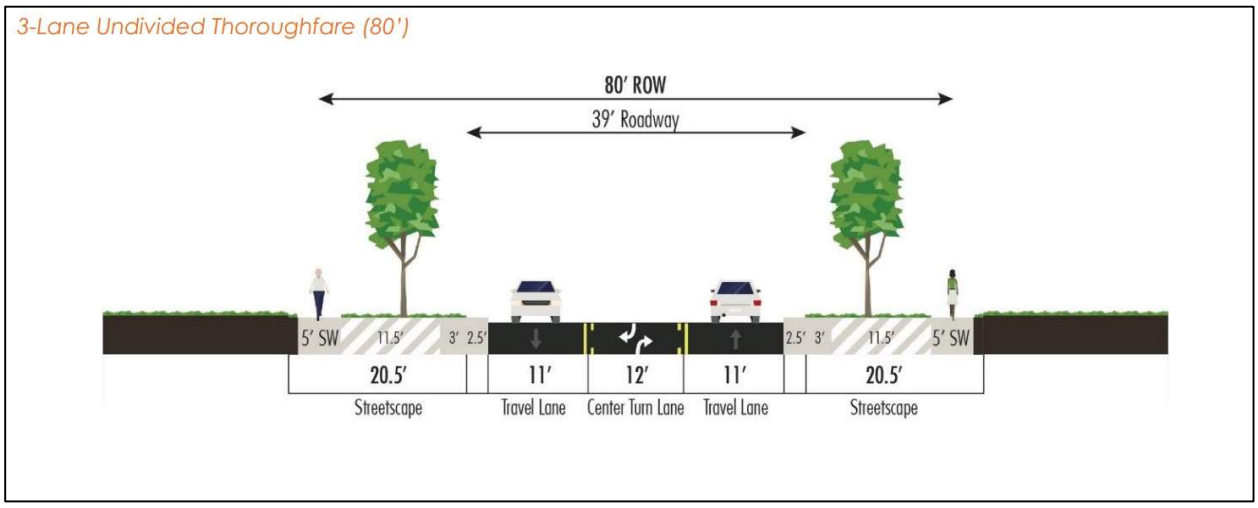

Figure 12. Three-Lane Undivided Thoroughfare Cross-Section

The need for a four-lane median divided roadway was confirmed through evaluations that included a comparison of existing traffic volumes and future traffic forecast without the proposed US 1 interchange, and future traffic forecast with the proposed US 1 interchange. A four-lane median divided roadway is included in the Apex CTP, but currently is not proposed for this roadway segment. Should the Apex CTP be updated and call for a four-lane median divided roadway for this segment, available cross-sections include a four-lane divided thoroughfare with a 110-foot right of way and the Apex Peakway with a 100-foot right of way. Both cross-sections are discussed in detail in Section 4.2.2.

Figure 13. New Friendship Road at Old US 1 Hwy

4.2.2 Richardson Road New Location from Old US 1 Hwy to Humie Olive Road

The Apex CTP indicated a four-lane median divided roadway including a side path for the Richardson Road New Location (Richardson Road Extension) from Old US 1 Hwy to Humie Olive Road. The need for a four-lane median divided roadway was confirmed through evaluations that included a comparison of existing traffic volumes and future traffic forecast without the proposed US 1 interchange, and future traffic forecast with the proposed US 1 interchange. According to the Apex CTP, a four-lane divided thoroughfare with a 110-foot right of way or the Apex Peakway with a 100-foot right of way are preferred cross-section for this portion of new Friendship Road. The four-lane divided thoroughfare includes 11-foot lanes, a 23-foot raised median, and five-foot sidewalks or side paths on both sides of the roadway consistent with the Apex CTP. The Apex Peakway includes 11-foot inside lanes, 13-foot outside lanes, an 18-foot raised median, a five-foot sidewalk, and a 10-foot side path consistent with the Apex CTP. The four-lane divided thoroughfare and the Apex Peakway cross-sections are shown in Figure 14.

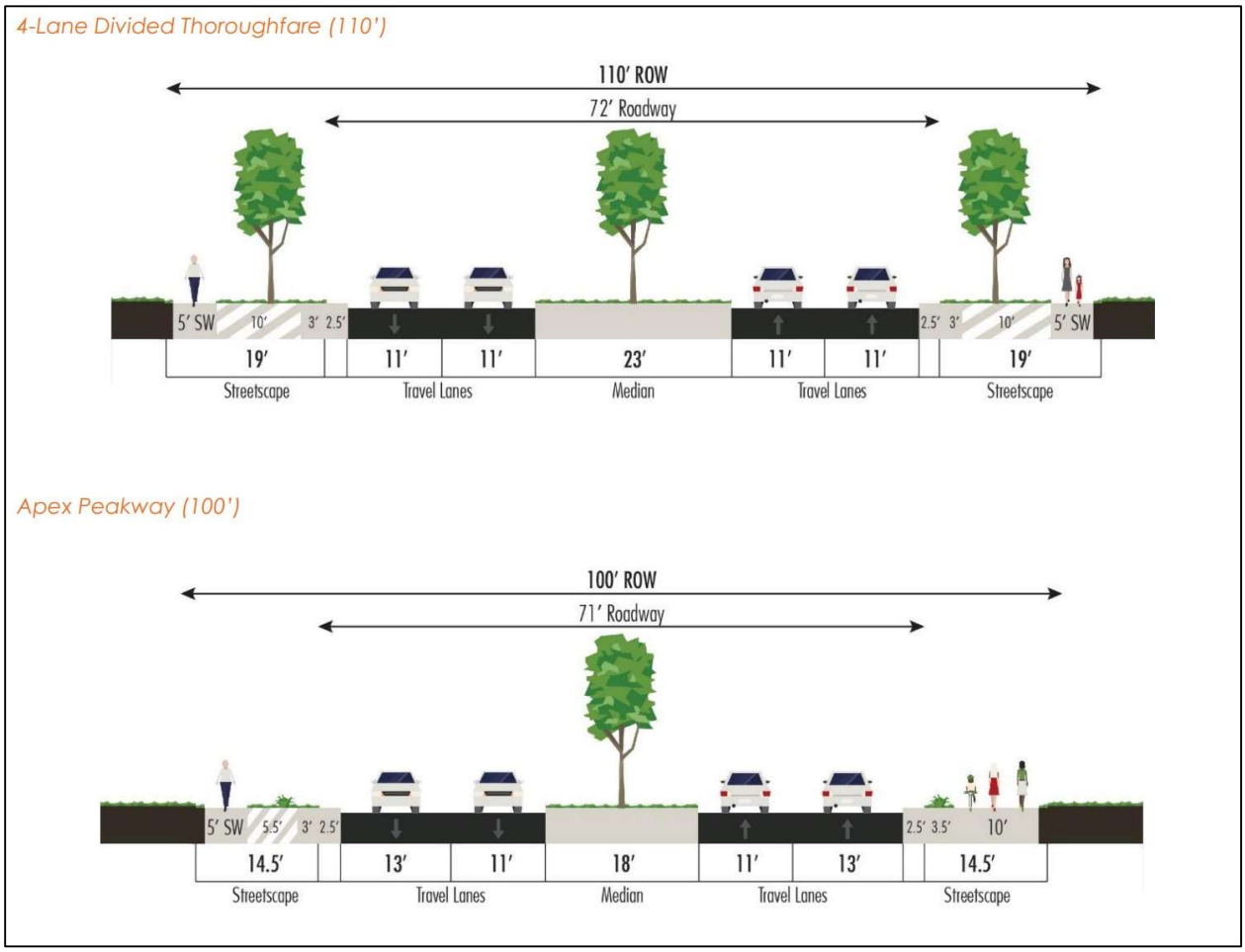

Figure 14. Four-Lane Divided Thoroughfare and Apex Peakway Cross-Sections

5 PEAK HOUR VOLUME ESTIMATES

Daily (24-hr) and peak hour (AM and PM) traffic volume estimates were developed for the following three scenarios for year 2050:

- No Build,
- Build 1 (MTP Scenario), and
- Build 2 (MTP+ Scenario) which includes Richardson Road widening and extension.

2050 Daily Volume Estimates

The 2050 daily volumes were based on Triangle Regional Model (TRM). Details on TRM scenario assumptions and outputs are provided in Tech Memo 1.

NCDOT AADTs, nearby traffic forecasts and recent counts in vicinity were reviewed along with TIAs provided by Towns of Holly Springs and Apex. Based on these data sources, traffic design

factors including design hour factor (K), peak hour directional split (D) and direction of peak for AM and PM were also developed.

Figure 15, Figure 16, and Figure 17 show daily traffic volume estimates for 2050 No Build, 2050 Build 1 (MTP scenario), and 2050 Build 2 (MTP+ scenario) respectively.

2050 Peak Hour Volume Estimates

The 2050 peak hour volumes were calculated using daily volume estimates and traffic design factors. NCDOT's Intersection Analysis Utility (IAU) spreadsheet was utilized to calculate peak hour turn movement volumes at interchanges and intersections within the study area.

The peak hour volumes were used for traffic operations and capacity analysis presented in next section.

Figure 18, Figure 19, and Figure 20 show peak hour traffic volume estimates for 2050 No Build, 2050 Build 1 (MTP scenario), and 2050 Build 2 (MTP+ scenario) respectively.

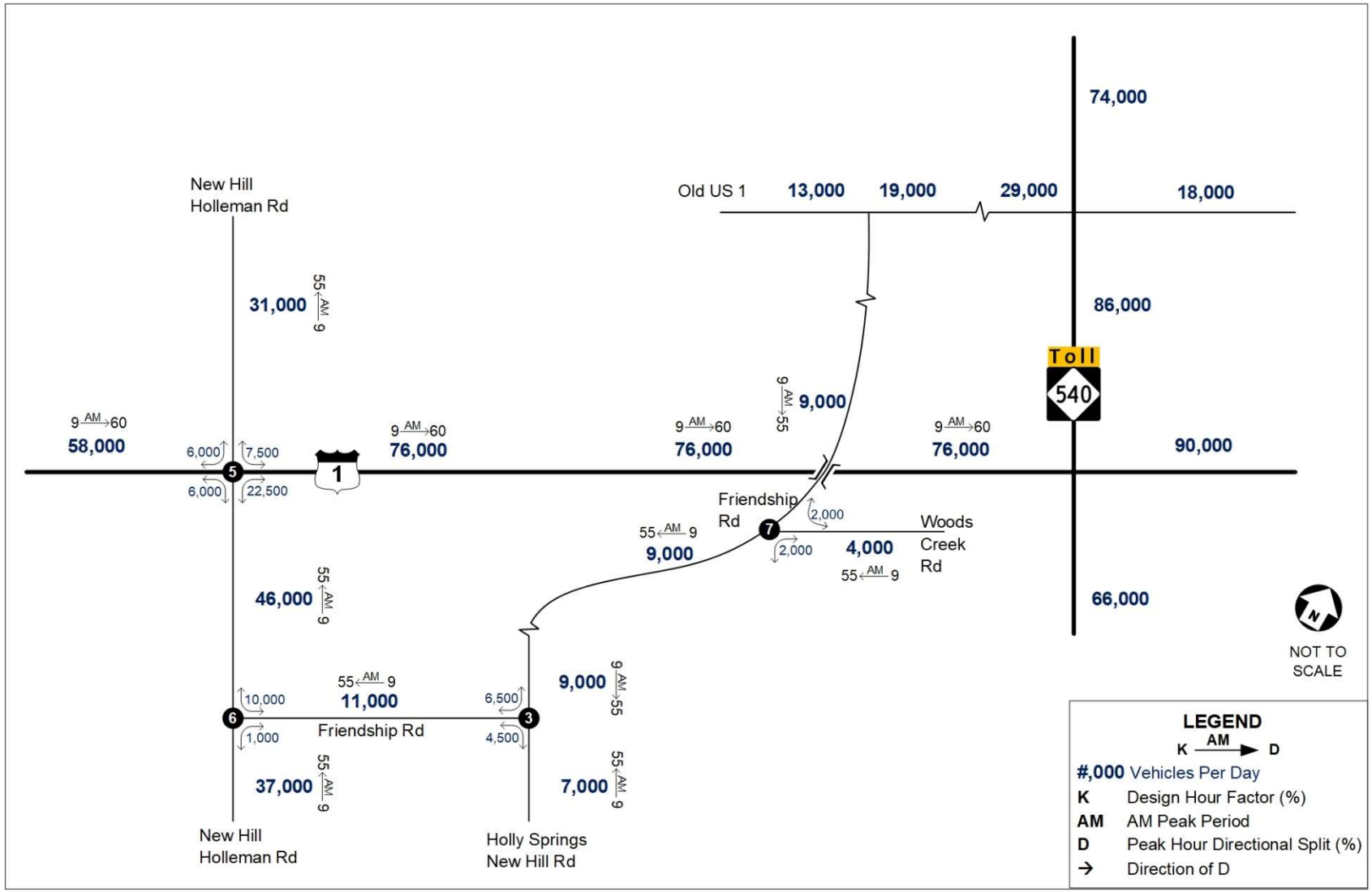

Figure 15. No Build 2050 Daily Volume Estimate

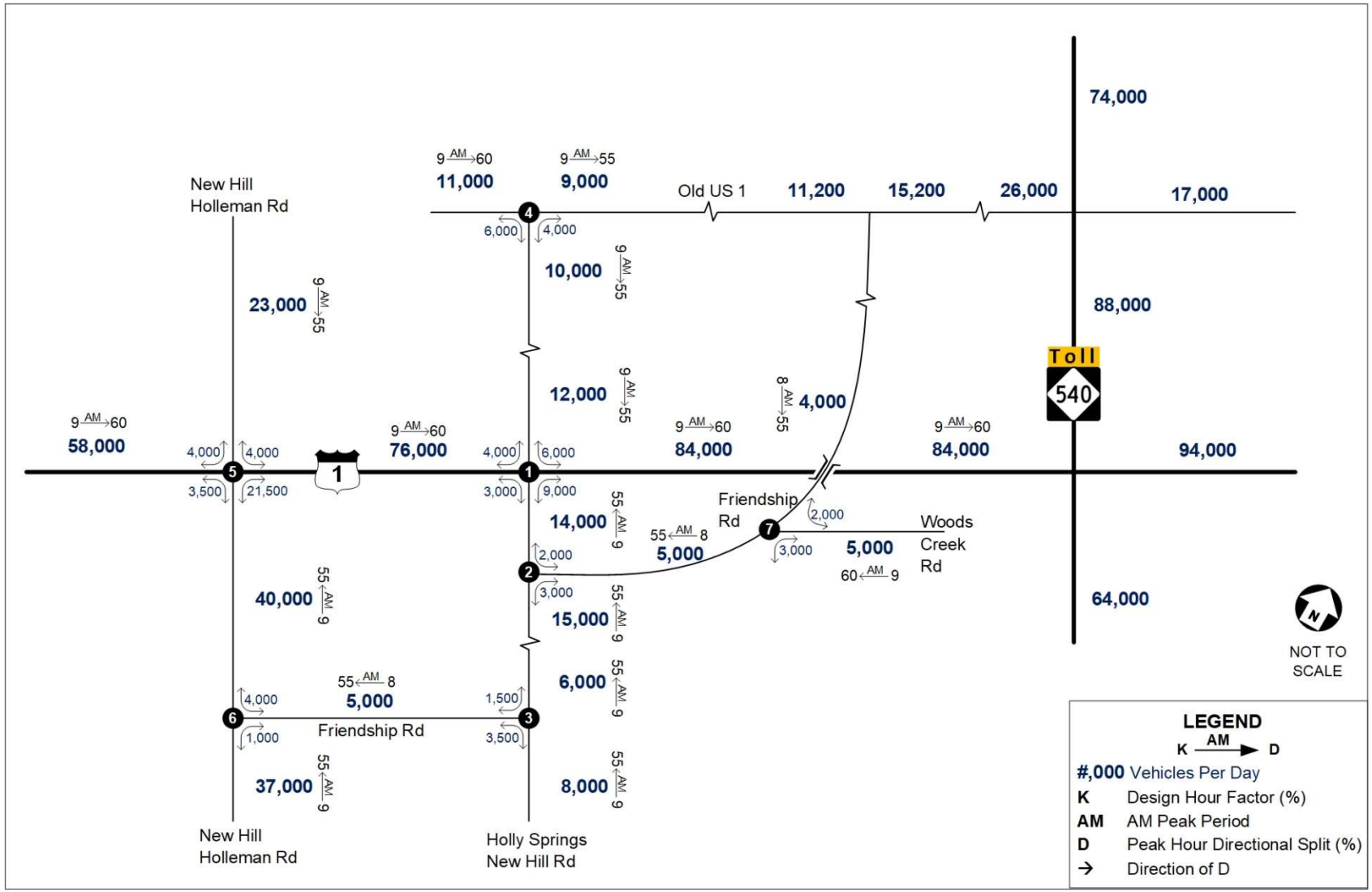

Figure 16. Build 1 (MTP scenario) 2050 Daily Volume Estimate

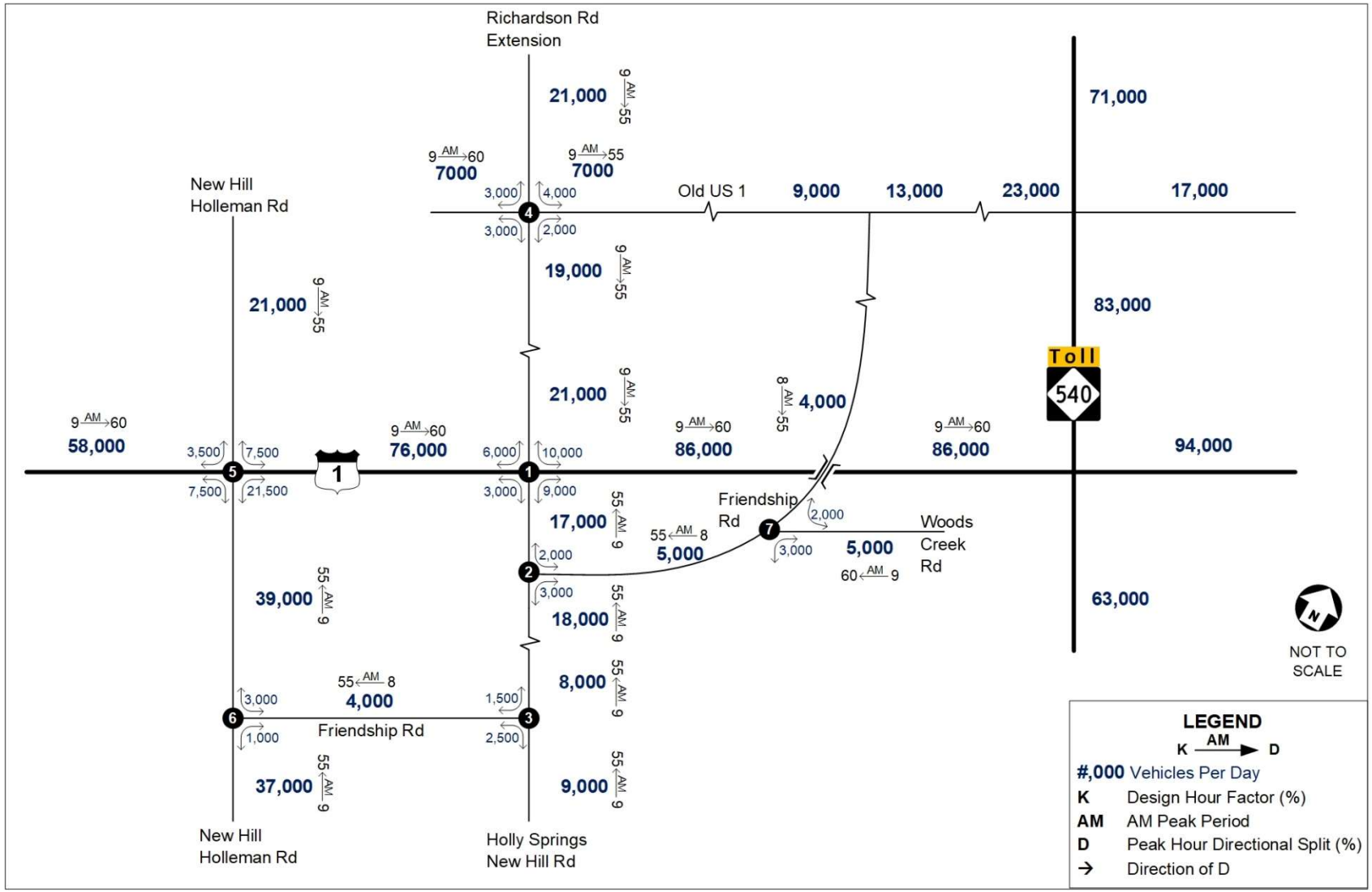

Figure 17. Build 2 (MTP+ scenario) 2050 Daily Volume Estimate

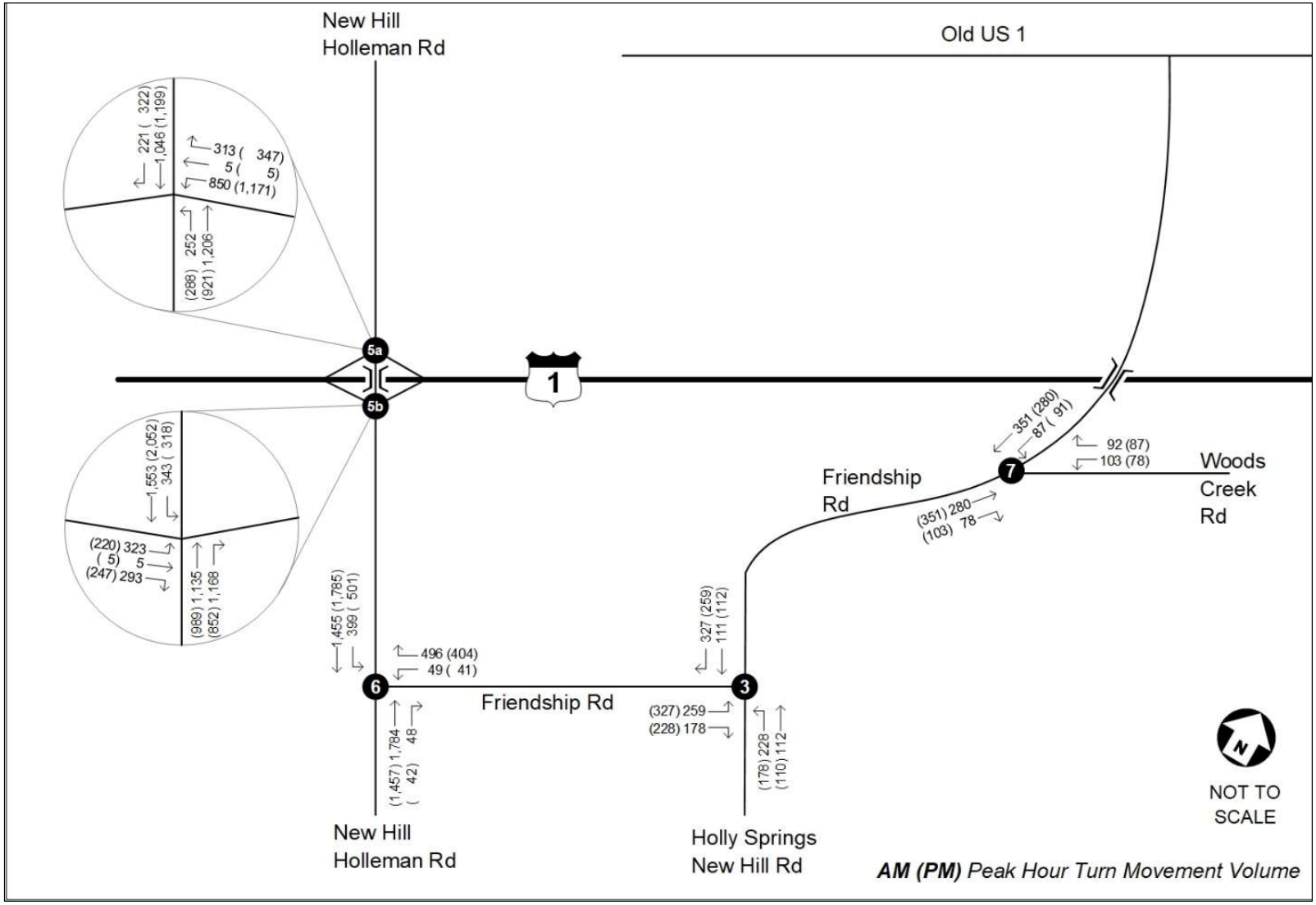

Figure 18. No Build 2050 Peak Hour Volume Estimate

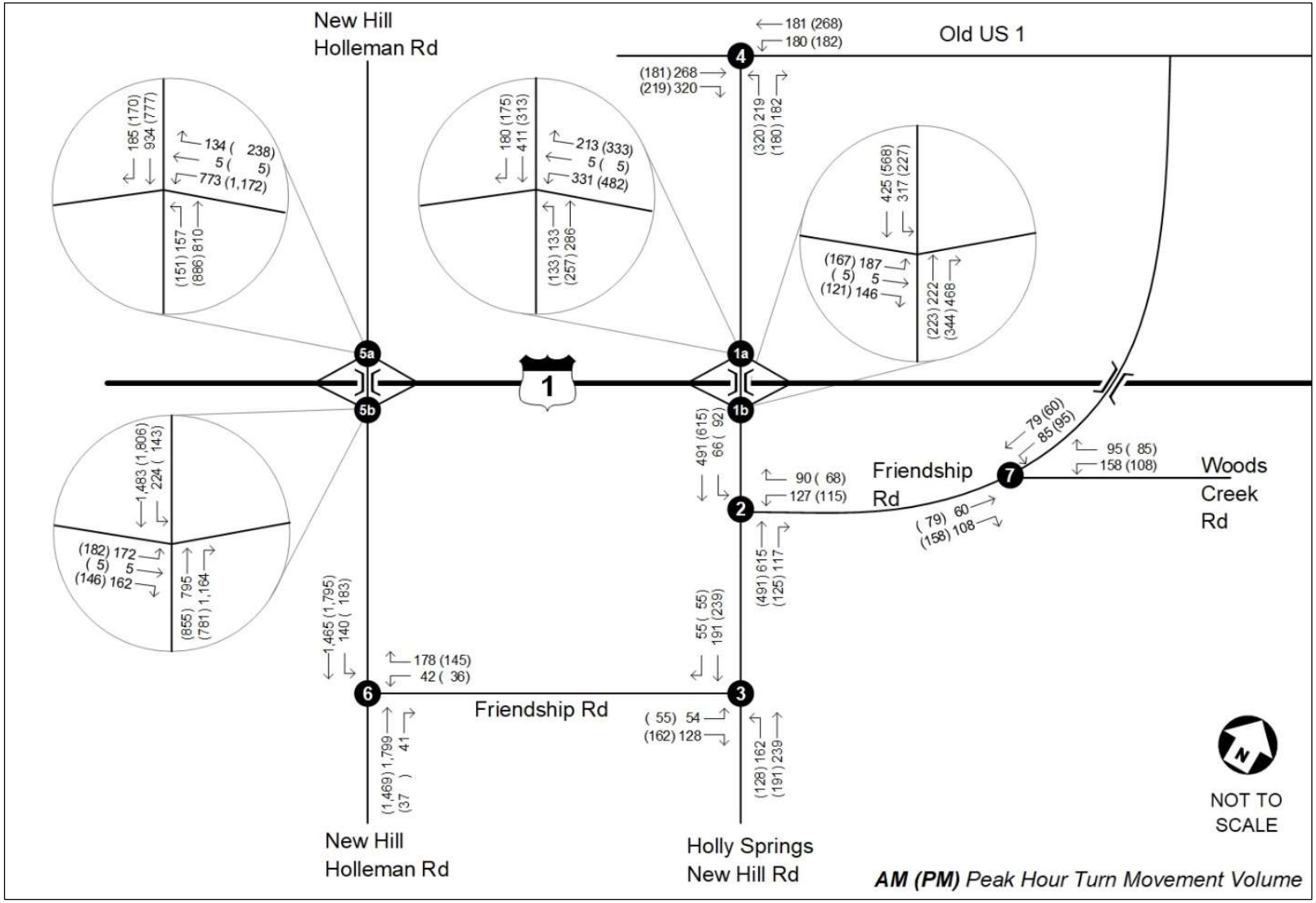

Figure 19. Build 1 (MTP scenario) 2050 Peak Hour Volume Estimate

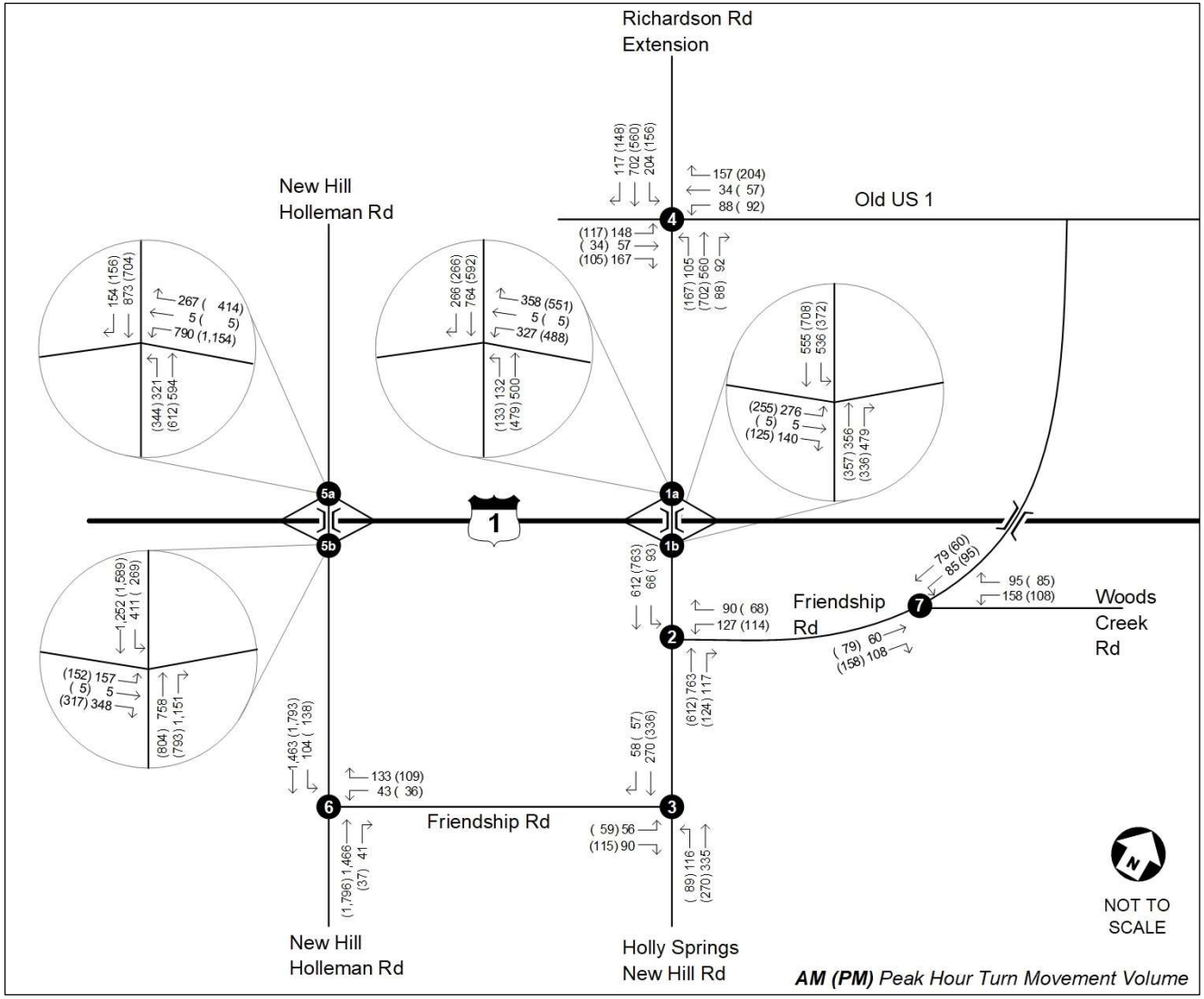

Figure 20. Build 2 (MTP+ scenario) 2050 Peak Hour Volume Estimate

6 INTERSECTION OPERATIONAL AND SAFETY ANALYSIS

Traffic capacity and operational analysis was performed for the alternatives evaluated. Synchro 10 software was used for intersection analysis and Sidra software was used for roundabout analysis.

Traffic Operations Analysis

Table 1. provides a summary of intersection Level of Service (LOS) for analysis year 2050 scenarios for No Build and four Build Interchange Options provided in Chapter 3. The analysis results show all Build options would provide an acceptable level of traffic operations in AM and PM peak hour with LOS D or better. In the No Build condition, the three intersections along New Hill-Holleman operate at LOS E or F. In Build conditions, due to diversion of traffic to the new interchange, the three intersections would operate at LOS D or better with reduced volumes.

Table 1. Intersection Level of Service for Scenario Year 2050 Interchange Alternatives

Intersection Level of Service (LOS) Scenario Year 2050			**No Build Scenario**	**MTP Scenario (Build 1) Friendship Rd Interchange**				**MTP+ Scenario (Build 2) Friendship Rd Interchange and Richardson Rd Extension**			
#	**Intersection**	**Time**	**No Build**	**Tight Diamond**	**Dual Roundabouts**	**Partial Cloverleaf#**	**Conventional Diamond***	**Tight Diamond**	**Dual Roundabouts**	**Partial Cloverleaf#**	**Conventional Diamond***
1a	US 1 SB Ramps and Friendship Rd	AM	-	C	A	C	B	C	B	C	C
		PM	-	C	A	C	C	C	C	C	C
1b	US 1 NB Ramps and Friendship Rd	AM	-	C	A	D	C	B	C	D	C
		PM	-	B	A	C	B	B	B	C	B
2	New Friendship Rd and Old Friendship Rd / Woods Creek Rd	AM	-	B	B	-	B	B	B	-	B
		PM	-	B	B	-	B	B	B	-	B
3	Friendship Rd and Holly Springs New Hill Rd	AM	B	B	B	B	B	C	C	C	C
		PM	B	B	B	B	B	B	B	B	B
4	Old US 1 and New Friendship Rd	AM	-	C	C	C	C	D	D	D	D
		PM	-	C	C	C	C	D	D	D	D
5a	US 1 SB Ramps and New Hill Holleman Rd	AM	D	C	C	C	C	C	C	C	C
		PM	E	D	D	C	C	D	D	D	D
5b	US 1 NB Ramps and New Hill Holleman Rd	AM	D	D	D	D	C	D	D	D	D
		PM	E	B	B	A	A	C	C	C	C
6	New Hill Holleman Rd and Friendship Rd	AM	F	D	D	D	D	D	D	D	D
		PM	E	C	C	C	C	B	B	C	B

** Remove bridge and realign existing Friendship Rd*
** Woods Creek Rd is aligned and connected opposite to the EB Ramps*

The future connection of Friendship Rd / Richardson Rd Extension at Old US 1 Hwy was also analyzed for at-grade and grade-separated options. AM and PM peak hour Level of Service is provided in Table 2.

Table 2. Intersection Level of Service at Old US 1 Hwy and Friendship Road / Richardson Road Extension

Scenario Year: 2050	Peak Period	MTP Scenario Signalized T-Intersection	MTP+ Scenario Signalized Intersection	MTP+ Scenario Signalized Quadrant Intersection
Old US 1 Hwy and New Friendship Rd / Richardson Rd	AM	C	D	C / C
	PM	C	D	C / C

Intersection Control Evaluation (ICE) Analysis

Intersection Control Evaluation (ICE) analysis compares multiple concepts against a number of factors, including future interchange/intersection operations, safety performance, environmental constraints, and cost to provide a more comprehensive comparison. ICE analysis brings safety evaluation early in the planning process.

For this feasibility study, the ICE analysis compared traffic operations, safety, and cost to rank the four Build concepts at the proposed new interchange for Build 2 (MTP+ scenario) only. Table 3 shows ICE comparison and ranking of concepts.

Table 3. ICE Analysis for New Friendship Rd / US-1 Interchange

MOE	Tight Diamond	Dual Roundabouts	Partial Cloverleaf	Diamond Interchange
AM LOS:	C / C	B / C	C / C	C / C
PM LOS:	B / B	C / B	D / C	C / B
CMF[1]:	1.02	0.76	0.98	1.0
Cost[2]:	$3,900,000	$3,200,000	$2,500,000	$3,000,000
Rank:	3	1	4	2

[1] *Determined from FHWA Crash Modification Factor (CMF) Clearinghouse*
[2] *Additional costs compared to standard diamond interchange, does not include utility impacts*

ICE analysis was also performed for Friendship Rd / Richardson Rd extension at Old US 1 Hwy. The results are provided in Table 4.

Table 4. ICE Analysis for Old US 1 Hwy and Friendship Road / Richardson Road Extension

MOE	Signalized	Quadrant Interchange
AM LOS:	D	C / C
PM LOS:	D	C / C
CMF[1]:	1.0	0.8
Cost[2]:	-	$10,900,000
Rank	1	2

[1] *Determined from FHWA Crash Modification Factor (CMF) Clearinghouse*
[2] *Additional costs compared to at-grade signalized intersection, does not include utility impacts*

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FIGURES

TABLES

1 INTRODUCTION

The NC Capital Area Metropolitan Planning Organization (CAMPO) is conducting a hot spot study on Friendship Road at US 1. The Friendship Road Hot Spot Interchange study will address transportation strategies for the proposed Friendship Road interchange, including local mobility, connectivity, and ongoing and future land use relationships for the rapidly growing areas of the Town of Apex and the Town of Holly Springs. The Friendship Road Hot Spot Interchange study will be evaluated in three phases:

- Tech Memo 1 – Existing and future years analysis
- Tech Memo 2 – Project feasibility analysis
- Tech Memo 3 – Project impact analysis

Tech Memo 3 identifies and develops sound concepts and determine the best fit interchange using the ICE tool, Synchro analysis, and a constraints matrix.

2 ADDITIONAL INTERCHANGE ALTERNATIVES

2.1 Interchange Alternative 5

Interchange Alternative 5 Tight Diamond with a New Access to the Amgen Facility consists of a six-lane roadway typical section divided by a median. The location of interchange Alternative 5 was shifted further south (approximately 800 feet) to avoid ramp conflicts with the Friendship Road bridge and accommodate the new access to the Amgen Facility. This interchange configuration accommodates four through lanes and two left-turn lanes to access US 1. Single-lane on ramps will include dedicated right-turn lanes. Double-lane off ramps will allow for dedicated left and right turn lanes. Intersections at the interchange will not be signalized. The tight diamond interchange, bridge cross-section, and roadway configuration are shown in Figure 1.

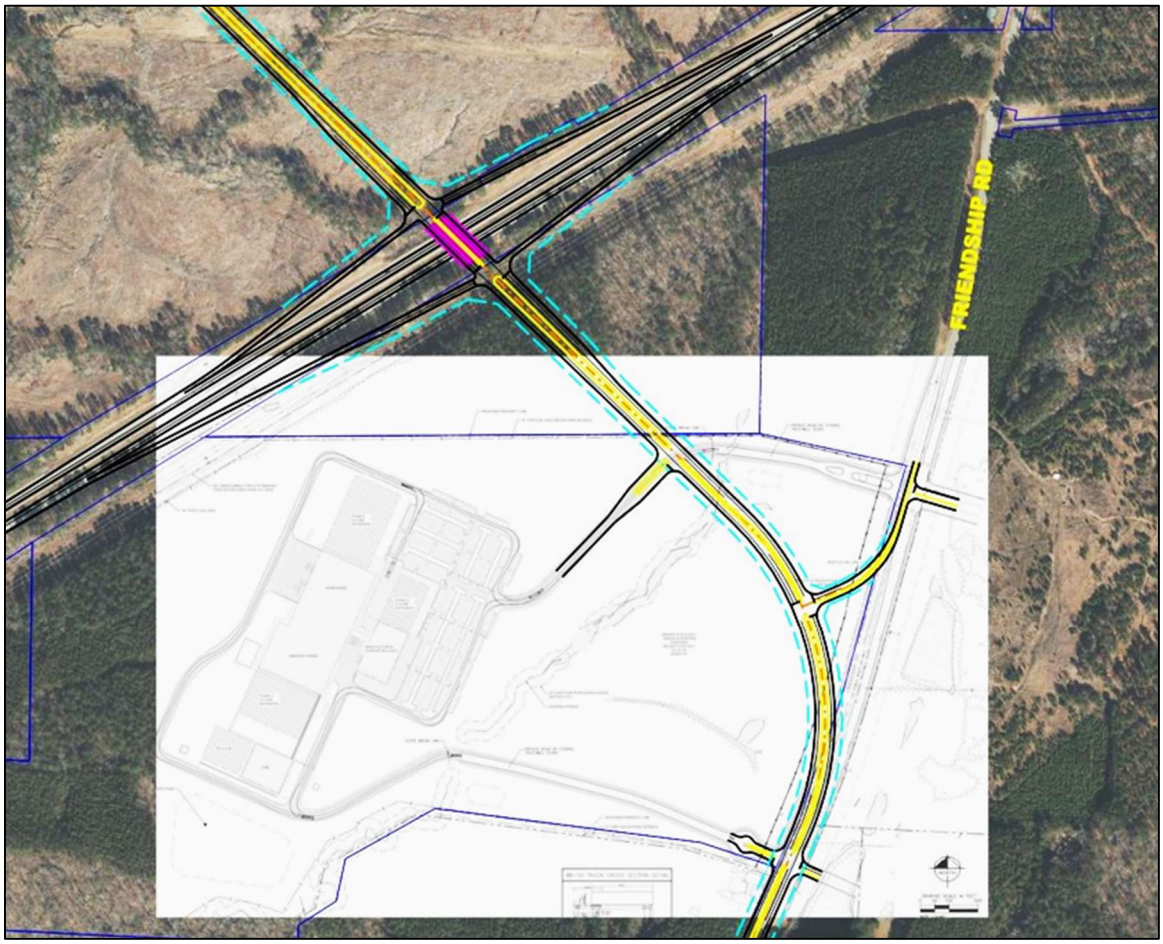

Figure 1. Interchange Alternative 5

Roadway and bridge improvements adjacent to interchange Alternative 5 will include the realignment and widening of Friendship Road to a four-lane median divided thoroughfare, a signalized intersection, a new access to the Amgen Facility (north side of the property), and a new two-lane undivided roadway tie back to existing Friendship Road south of Woods Creek Road.

Benefits of interchange Alternative 5 include the least right of way acquisition or need for corridor preservation relative to the other interchange alternatives and provides bridge over US 1 that is not on skew. Interchange Alternative 5 concerns include the requirement for a wider bridge to accommodate both through lanes and full left turn lanes and anticipated conflicts with streams and necessity for stormwater drainage at Little White Oak Creek.

2.2 Interchange Alternative 6

Interchange Alternative 6 Tight Diamond with a New Access to the Amgen Facility and New Intersection at Friendship Road consists of a six-lane roadway typical section divided by a median. The location of interchange Alternative 5 was shifted further south (approximately 800 feet) to avoid ramp conflicts with the Friendship Road bridge and accommodate the new access to the Amgen Facility. This interchange configuration accommodates four through lanes and two left-turn lanes to access US 1. Single-lane on ramps will include dedicated right-turn lanes. Double-lane off ramps will allow for dedicated left and right turn lanes. Intersections at the interchange will not be signalized. On and off ramps on the south side of the interchange (Holly Springs side) were further tightened to minimize encroachment into the Duke Energy utility easement. The tight diamond interchange, bridge cross-section, and roadway configuration are shown in Figure 2.

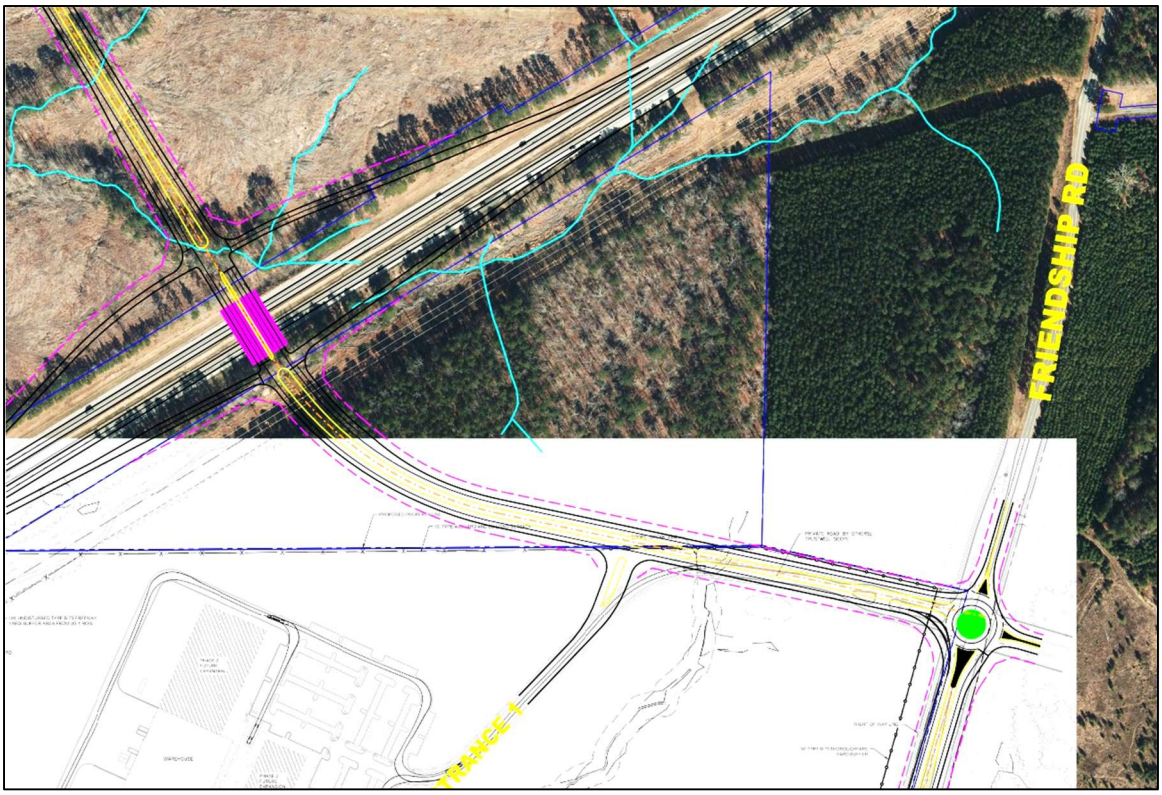

Figure 2. Interchange Alternative 6

Roadway and bridge improvements adjacent to interchange Alternative 6 will include the realignment and widening of Friendship Road to a four-lane median divided thoroughfare, and a signalized intersection at Friendship Road.

Benefits of interchange Alternative 6 include the least right of way acquisition or need for corridor preservation relative to the other interchange alternatives, provides bridge over US 1 that is not on skew, and allows for optimum intersection spacing to Friendship Road and the Amgen facility driveway. Interchange Alternative 6 concerns include the requirement for a wider bridge to accommodate both through lanes and full left turn lanes and anticipated conflicts with streams and necessity for stormwater drainage at Little White Oak Creek.

Intersections for the Friendship Road realignment are proposed corresponding to each interchange alternatives. Intersections would connect the Friendship Road realignment (four-lane median divided thoroughfare) to existing Friendship Road and Woods Creek Road. Intersection options include a two-lane roundabout, a three-way unsignalized (stop condition) intersection, and a three-way signalized intersection.

3 EVALUATION MATRIX

The five viable interchange alternatives were evaluated for the following factors and potential impacts:

- Stakeholder input
- Traffic analysis
- Safety analysis
- Existing and proposed developments
- The Friendship Road bridge
- General environmental features
- Environmental easements
- Utility easements
- Right of way acquisition
- Planning costs

An evaluation matrix and a ranking matrix for the five viable interchange alternatives are shown in

Table 1 and Table 2. The evaluation matrix is intended to assist in preliminary decisions on location of the interchange and recommended interchange alternatives only. Interchange alternatives 1, 2, and 4 avoids environmental conflicts. Interchange alternatives 5 and 6 avoids the Friendship Road bridge replacement and environmental easements. Interchange Alternative 6 has the least utility easement conflict and development conflict when compared to Interchange Alternative 5. Interchange alternatives 2 and 4 typically ranks higher than the rest in terms of traffic, safety, and planning costs. Interchange alternatives 1 and 6 ranks higher on stakeholder preference.

Table 1. Evaluation Matrix

Potential Impacts	Alt. 1	Alt. 2	Alt. 4	Alt. 5	Alt. 6
Developments	None	None	None	Moderate	Minimal
Friendship Road Bridge	Moderate	Moderate	Significant	None	None
Environmental Features	None	None	None	Moderate	Moderate
Environmental Easements	Moderate	Moderate	Moderate	None	None
Utility Easements	Moderate	Moderate	Moderate	Moderate	Minimal
Right of Way	Moderate	Moderate	Moderate	Minimal	Minimal

Table 2. Ranking Matrix

Ranking Criteria	Alt. 1	Alt. 2	Alt. 4	Alt. 5	Alt. 6
Level of Service (1 best LOS)	3	1	2	4	3
Crash Modification Factor (1 safest)	3	1	2	4	3
Planning Cost (1 lowest cost)	3	2	1	4	3
Stakeholder Preference (1 most preferred)	**2**	**4**	**5**	**3**	**1**

4 RECOMMENDATIONS

4.1 Recommended Interchange Location

CAMPO, the Town of Holly Springs, and the Town of Apex agree on two interchange locations:

- For Interchange Alternative 1, the interchange would be located approximately 1.5 miles from the New Hill Holleman Road interchange and similarly 1.5 miles from the NC 540 interchange, thereby avoiding Little White Oak Creek. This interchange location would also avoid encroachment on the Amgen Facility with the construction of the Friendship Road realignment. This interchange location would result in a skewed bridge and the replacement of the Friendship Road bridge to fit northbound and southbound ramps associated with the proposed interchange.
- For Interchange Alternative 6, the interchange would be located approximately 800 feet southwest of the Interchange Alternative 1 location to avoid the Friendship Road bridge replacement or removal. This interchange location would allow for a bridge that is not on skew. This interchange location would result in the Friendship Road realignment requiring a new Amgen facility access at the north side of the property, minimal

encroachment into the northern side of the Amgen facility property, and potential conflict with Little White Oak Creek tributaries.

4.2 Recommended Interchange Alternatives

CAMPO, the Town of Holly Springs, and the Town of Apex agree on the following recommend interchange alternatives:

- Alternative 1 Tight Diamond (includes the replacement of Friendship Road bridge)
- Alternative 6 Tight Diamond with a New Access to the Amgen Facility and New Intersection at Friendship Road

Interchange Alternative 1 Tight Diamond consists of a six-lane roadway typical section divided by a median. This interchange configuration accommodates four through lanes and two left-turn lanes to access US 1. Single-lane on ramps will include dedicated right-turn lanes. Double-lane off ramps will allow for dedicated left and right turn lanes. Intersections at the interchange will not be signalized.

Interchange Alternative 6 Tight Diamond with a New Access to the Amgen Facility and New Intersection at Friendship Road consists of a six-lane roadway typical section divided by a median. The location of interchange Alternative 5 was shifted further south (approximately 800 feet) to avoid ramp conflicts with the Friendship Road bridge and accommodate the new access to the Amgen Facility. This interchange configuration accommodates four through lanes and two left-turn lanes to access US 1. Single-lane on ramps will include dedicated right-turn lanes. Double-lane off ramps will allow for dedicated left and right turn lanes. Intersections at the interchange will not be signalized. On and off ramps on the south side of the interchange (Holly Springs side) were further tightened to minimize encroachment into the Duke Energy utility easement.

4.2.1 TransModeler Analysis

The study simulated future traffic conditions with and without the Friendship Road interchange at US 1 using TransModeler. The TransModeler analysis was developed for interchange alternatives 1 and 6. With the new interchange, build condition interchange alternatives 1 and 6 show acceptable operations through design year 2050. The No-Build condition showed considerable congestion at the New Hill-Holleman Road interchange that was alleviated by the inclusion of the Friendship Road interchange.

Figure 3 and Figure 4 show a snapshot of the TransModeler network Alternative 1 and Alternative 6 respectively.

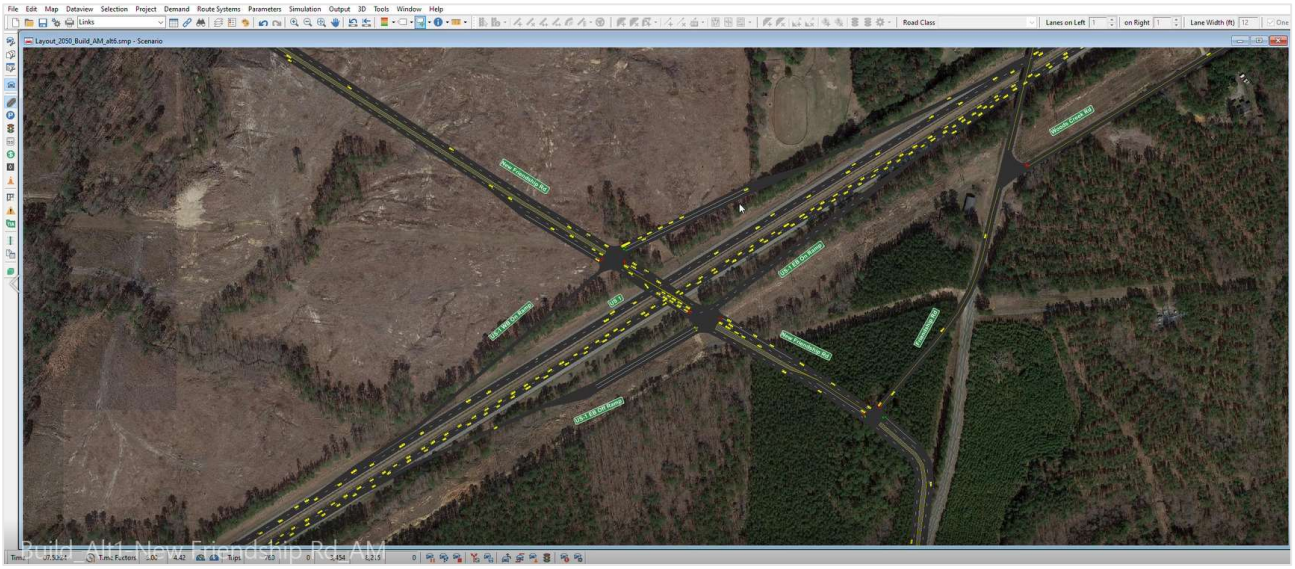

Figure 3. TransModeler Network Snapshot for Alternative 1

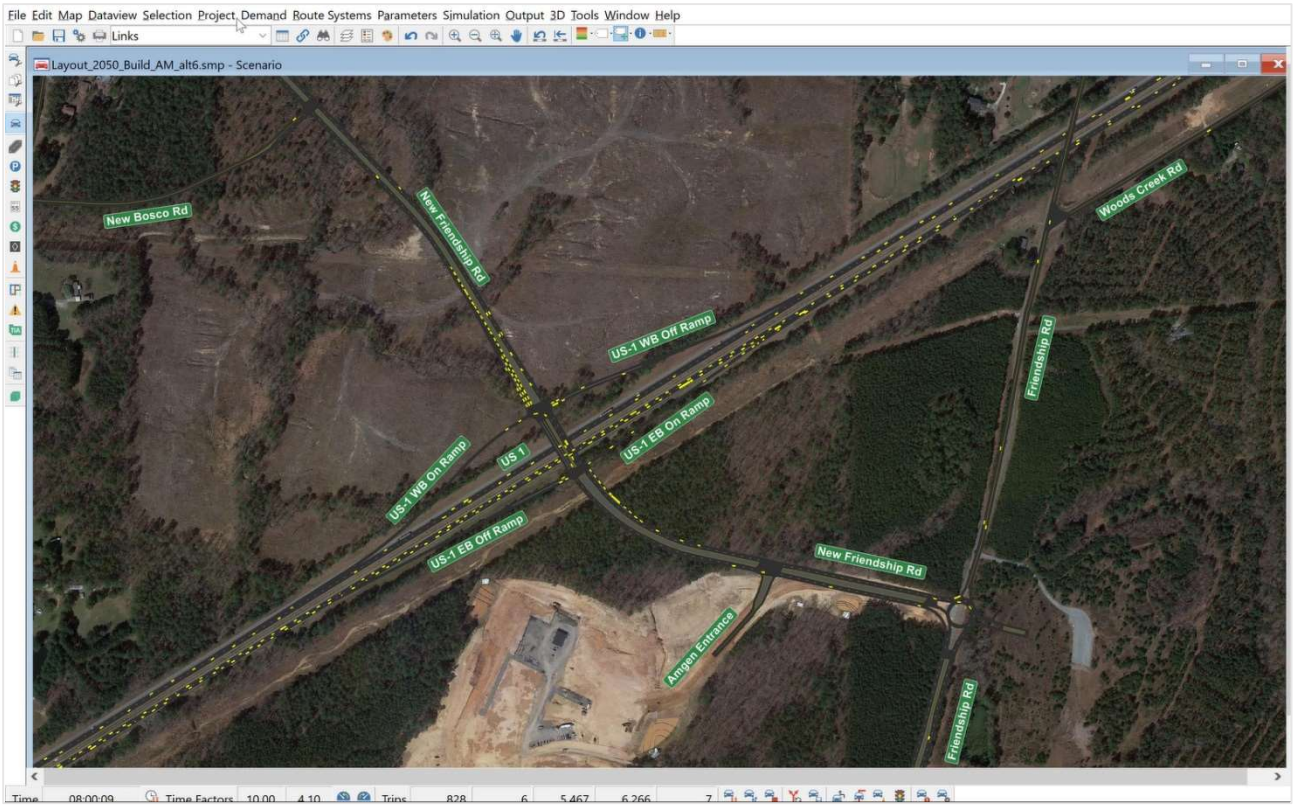

Figure 4. TransModeler Network Snapshot for Alternative 6

APPENDIX B: PRESENTATIONS / MINUTES

Meeting 1 Presentation/Minutes
Meeting 2 Presentation/Minutes
Meeting 3 Presentation/Minutes
Stakeholder Responses

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INTRODUCTION / MEETING AGENDA

- Scope of Study
- Planned Developments
- Project Area Constraints
- Triangle Regional Model (TRM) Results
- Questions / Input from Stakeholders
- Next Steps

1

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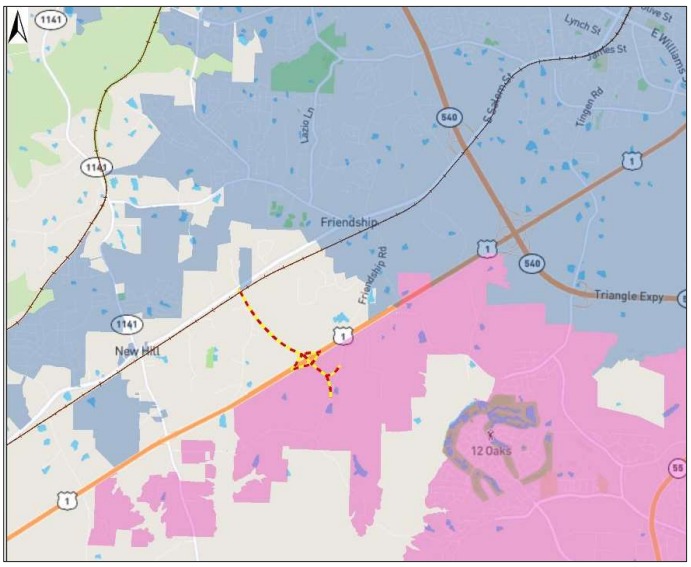
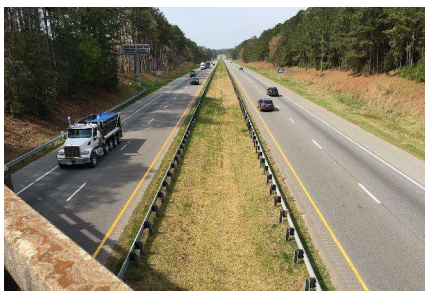
SCOPE OF STUDY





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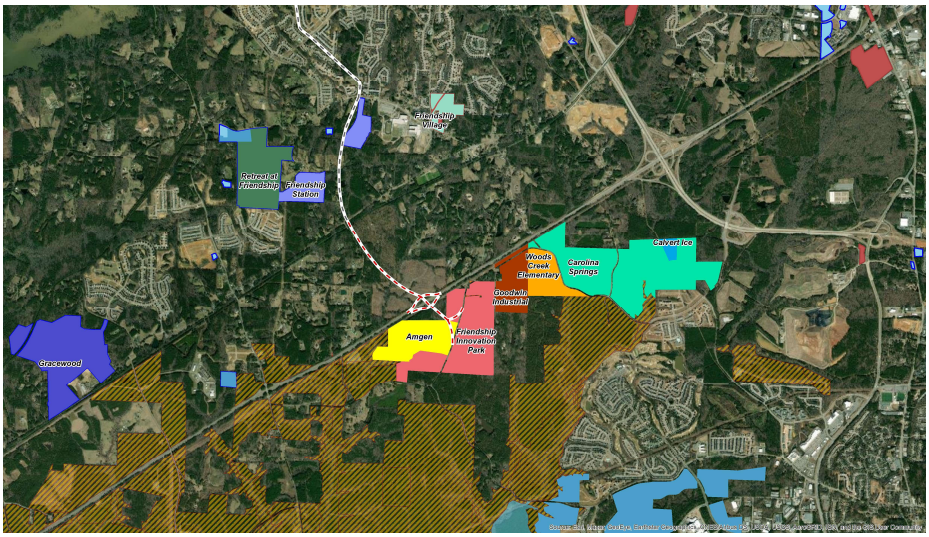
PLANNED AND APPROVED DEVELOPMENTS



Adjacent planned and approved developments

Town of Apex

- Friendship Station
- Retreat at Friendship
- Friendship Village
- Gracewood

Town of Holly Springs

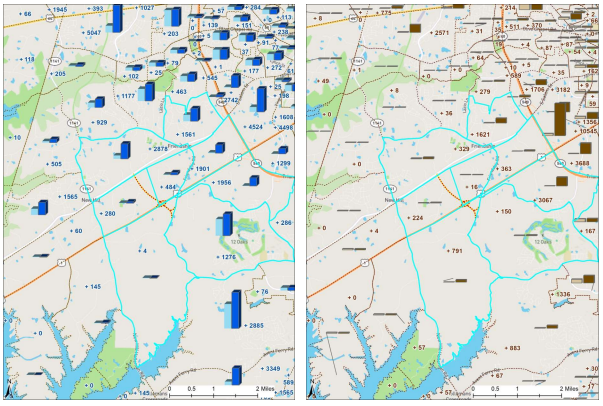
- Carolina Springs
- Friendship Innovation Park
- Amgen
- Goodwin Industrial
- Woods Creek Elementary
- Calvert Ice

3

PLANNED DEVELOPMENTS AND MODEL GROWTH

Development	Type	Units / Daily Trips
Friendship Station	Mixed Use	Need TIA
Retreat at Friendship	Residential	450 units
Friendship Village	Residential	107 units
Carolina Springs	Mixed Use	25,620
Friendship Innovation Park	Mixed Use	9,117
Amgen	Manufacturing	1,424
Goodwin Industrial	Manufacturing	2,579
Woods Creek Elementary	Elementary & Middle School	800 student, 1,100 students

Model SE Data Study Area (7 TAZs)



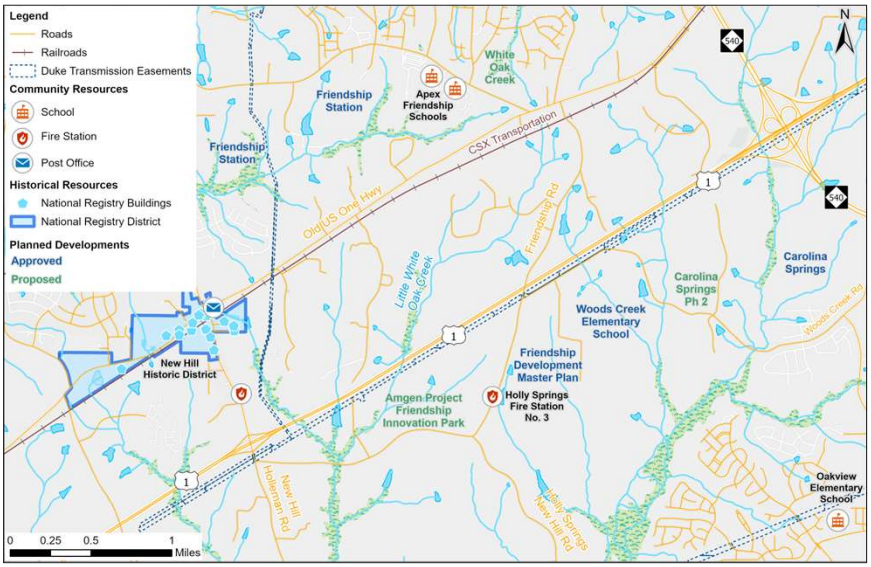
Population Growth
Year 2020: 7,139
Year 2050: 17,480
Change: + 10,341

Employment Growth
Year 2020: 466
Year 2050: 7,027
Change: + 6,561

4

PROJECT AREA CONSTRAINTS

1. Amgen Facility / Friendship Innovation Park Developments
2. Duke energy transmission lines south of US-1
3. I-540 / New Hill Holleman interchange spacing
4. Tie into old US-1 near RR crossing
5. Capacity of US-1 (remains 4 lanes)



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TRM RUNS & RESULTS

- Reviewed land use, development activity, population & employment projections, and transportation network improvements in the study area
- Performed TRM runs in TransCAD for three 2050 scenarios including:
  - 2050 No-Build (Adopted MTP minus the interchange)
  - 2050 MTP (Build)
  - 2050 MTP+ (Build plus 4-lane Richardson Road improvements)

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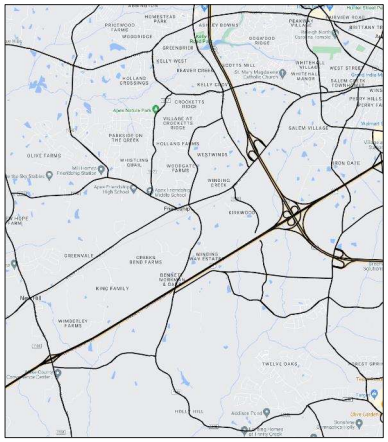
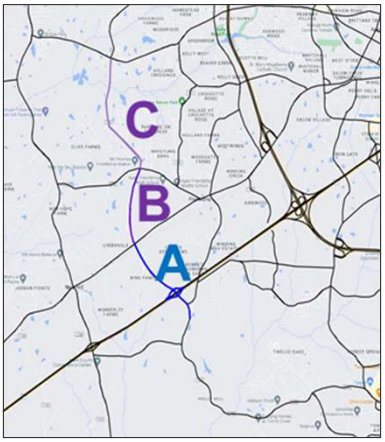
MODEL SCENARIO NETWORKS

No-Build Scenario



MTP Scenario (Project A)
(A) New 4-lane Friendship Road with interchange at US 1

MTP+ Scenario (Project A + B + C)
(B) Richardson Road Extension;
(C) Richardson Rd Widen to 4-lane



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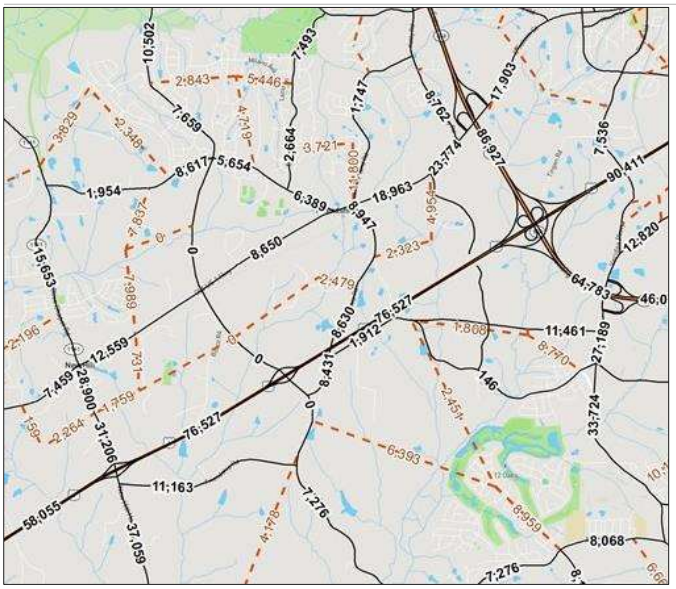
TRM PROJECTIONS: 2050 NO-BUILD SCENARIO DAILY VOLUMES



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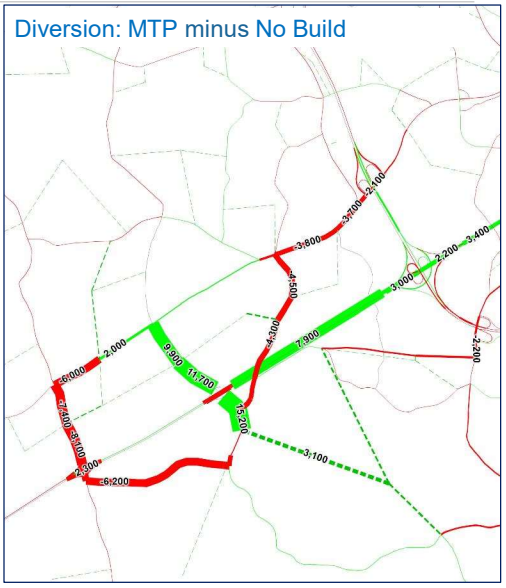
TRM PROJECTIONS: 2050 MTP SCENARIO DAILY VOLUMES AND DIVERSION



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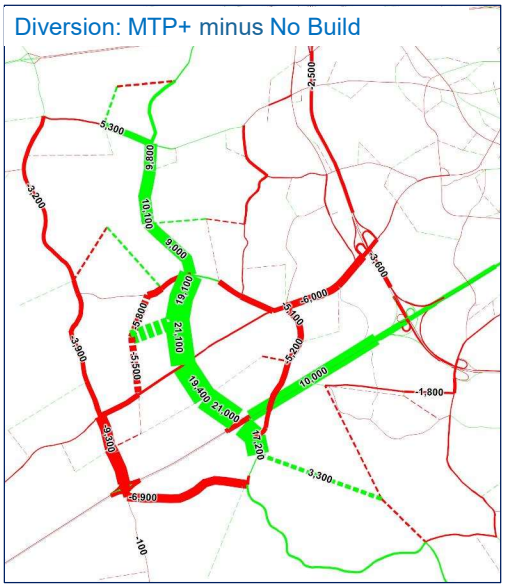
TRM PROJECTIONS: 2050 MTP+ SCENARIO DAILY VOLUMES AND DIVERSION



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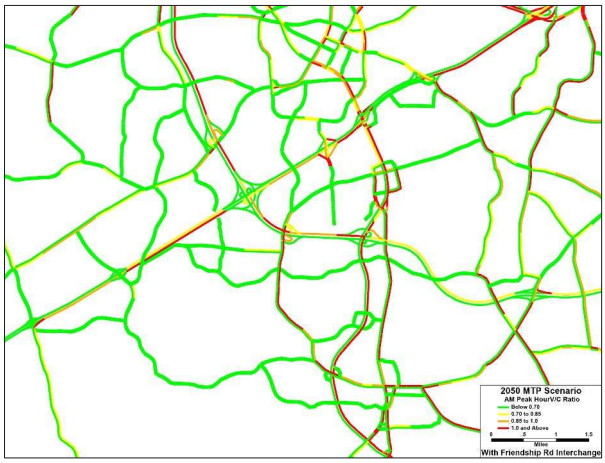
TRM PROJECTIONS: 2050 MTP SCENARIO PEAK HOUR V/C RATIOS

AM Peak



PM Peak

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TRM PROJECTIONS: REGIONWIDE PERFORMANCE MEASURES

Performance Measures	No Build	MTP	*Change*	MTP+	*Change*
Lane Miles	14,995	15,001	***+6***	15,009	***+14***
Total Vehicle Miles of Travel (VMT)	94,254,529	94,228,139	***-26,390***	94,249,810	***-4,719***
Total Vehicle Hours of Travel (VHT)	2,777,970	2,776,646	***-1,324***	2,776,499	***-1,471***

Daily regionwide model summary with no centroid connectors

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NEXT STEPS

- Schedule next stakeholder meeting
- Gather any additional information from stakeholders
- Evaluate environmental / land use constrains
- Develop peak hour turning movement volumes
- Develop and analyze interchange concepts / intersection improvements
- Conduct Intersection Control Evaluation (ICE) analysis of for proposed improvements

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MEETING MINUTES

Project:	CAMPO Friendship Road Interchange Feasibility Study
Date/Time:	Monday, April 18, 2022 @ 2:30PM
Meeting Purpose:	Steering Committee Meeting #1

Participants		E-Mail	Attend	Call-in	Distribution
Powell, Shelby	CAMPO	Shelby.Powell@campo-nc.us			✓
Rickard, Alex	CAMPO	Alex.Rickard@campo-nc.us		✓	✓
Bruff, Mike	CAMPO	Mike.Bruff@campo-nc.us			✓
Chris Lukasina	CAMPO	Chris.Lukasina@campo-nc.us			✓
Reid, Jonathan	Arcadis	Jonathan.Reid@arcadis.com		✓	✓
Shekhar, Shashank	Arcadis	Shashank.Shekhar@arcadis.com		✓	✓
Magsanoc, Ray	Arcadis	Ray.Magsanoc@arcadis.com			✓
Kendra Parrish	Town of Holly Springs	Kendra.Parrish@hollyspringsnc.gov		✓	✓
Chris Hills	Town of Holly Springs	Chris.Hills@hollyspringsnc.gov			✓
Sean Ryan	Town of Holly Springs	Sean.Ryan@hollyspringsnc.gov		✓	✓
Russell Dalton	Town of Apex	Russell.Dalton@apexnc.org		✓	✓
Shannon Cox	Town of Apex	Shannon.Cox@apexnc.org		✓	✓
Dennis Jernigan	NCTA	Dwjernigan@ncdot.gov		✓	✓
Robert Deaton	NCDOT (STIP Central Region)	Rdeaton@ncdot.gov		✓	✓
David Keilson	NCDOT (Div 5)	Dpkeilson@ncdot.gov			✓
Philip Geary	NCDOT (NCDOT TPD)	Pageary@ncdot.gov		✓	✓
Tim Gardiner	Wake County	Tim.Gardiner@wakegov.com		✓	✓
Akul Nishawala	Wake County	Akul.Nishawala@wakegov.com		✓	✓
Elizabeth Goodson	Town of Holly Springs	Elizabeth.Goodson@hollyspringsnc.gov		✓	✓

Purpose of meeting was to introduce and engage the US-1 / Friendship Road Interchange Feasibility Study project steering committee, review project scope, area development plans, project constraints and 2050 TRM model data and discuss next steps for the project.

Meeting Notes:

- Call began at 2:30pm with introductions of steering committee members and a brief project introduction from Alex
- Jonathan began a presentation of the scope of the study, project study area, and maps and data from the development plans collected from the Town of Apex and Town of Holly Springs.
    - It was noted that the TIA document for Friendship Station mixed use development is needed to determine the land use, units and trip data. Russel said to contact Serge Grebenschikov (Serge.Grebenschikov@apexnc.org) to get that information.
    - Shannon indicated that the Friendship Station development is larger than the shape file indicates; the part under construction and the elementary school was not included; Arcadis to review data to ensure that all phases of development are included.
    - Sean indicated that there have been some discussions with Friendship Innovation Park to expand the development area. He will provide additional information but may not yet include trip data. Also working on a new Fire Station location to replace the existing location with a new site by Carolina Springs, and Duke Energy Operations Center and warehouse.
- Potential project constraints were identified on a map, including development footprints, interchange spacing requirements, utility and RR corridors and future US-1 capacity constraints.

- Dennis (NCTA) said the consultant working on US-1 project showed a breakdown in LOS by 2045 along US-1 south of I-540; turnpike perspective is that there will be an interest in auxiliary lanes between the proposed interchange and I-540.
- Shannon identified another constraint of the conservation area north of US-1. There is a dedicated easement that the Richardson Road must be located within by restrictive covenant.

- Shashank reviewed the three modeling scenarios evaluated, including:
  - 2050 No-Build (Adopted MTP minus the interchange)
  - 2050 MTP (Build)
  - 2050 MTP+ (Build plus 4-lane Richardson Road improvements)
- Graphics identified the link volumes for each scenario and the trip diversion for the two build scenarios as well as the peak hour V/C ratios and regionwide performance measures.
- Jonathan reviewed the next steps for the project that include scheduling our second meeting in mid-to-late May. This meeting will review a more detailed evaluation of interchange / intersection operations, a schematic of the interchange area improvements and a review of Intersection Control Evaluations (ICE) to help identify the optimal interchange form and intersection improvements.
- Alex sated that these Hot Stop projects have very short schedules and asks that the stakeholder group be responsive in reviewing materials (including Tech Memos) and providing data to ensure the project is completed before the end of June.
- There is a SharePoint file system set up to contain all of the project documents at the below address: Friendship Rd - US 1 Interchange Feasibility - Home (sharepoint.com)
- As the meeting concluded, Dennis indicated that there is an NCTA policy that there must be an auxiliary lane between any new interchange within 1-mile of I-540, so this will need to be included in the recommendation for this new interchange site. Alex further noted that auxiliary lanes greater than one mile have to be approved and added to the adopted MTP.

Action Items:

1. Arcadis to contact Town of Apex to determine development plans for Friendship Station
2. Arcadis to send out e-mail address of SharePoint site to entire team
3. Include Elizabeth Goodwin in all future invite lists
4. CAMPO to send out a doodle poll to select a date for the next Stakeholder meeting in mid to late May.

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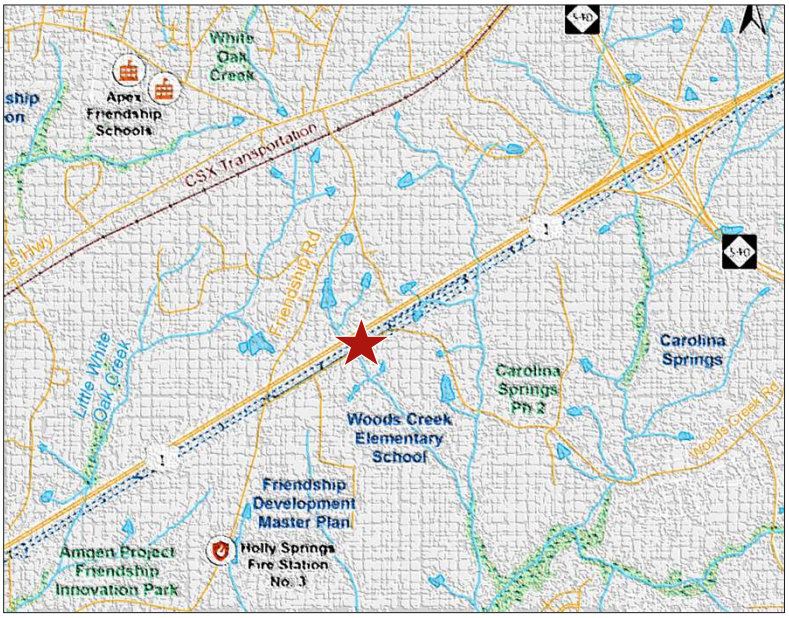
Friendship Road and US 1 Hot Spot Interchange Study

Steering Committee Meeting #2

Wednesday, May 25th, 2022



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STEERING COMMITTEE MEETING #2 AGENDA

- Key Issues
- Project Area Constrains
- Interchange Options and Impacts
- Alignment Options and Impacts
- CSX Railroad Crossings
- Peak Hour Volume Estimates
- Intersection Operational and Safety Analysis
- Questions / Input from Steering Committee
- Next Steps

2

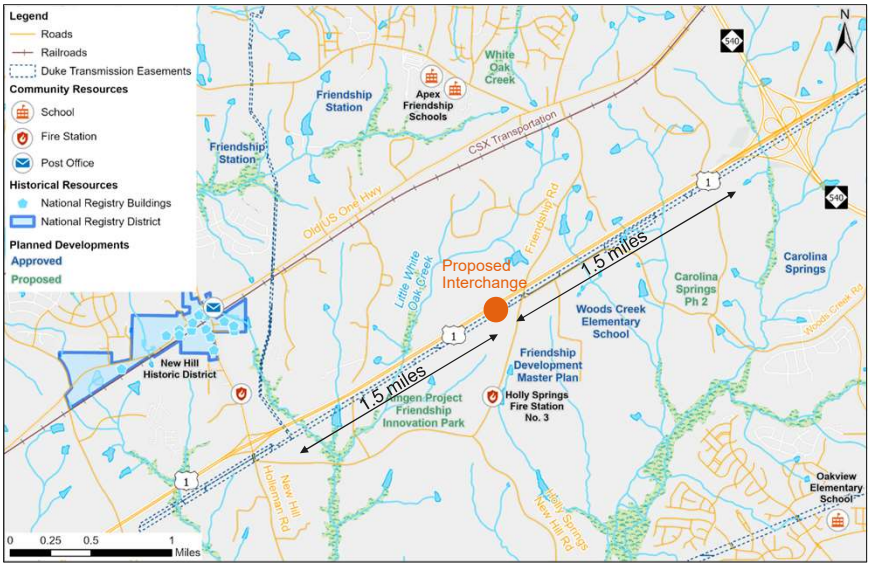
KEY ISSUES

- Location of US-1 Interchange
- Interchange Options and Area Preservation
- Impacts to Corridor
  - Friendship Road Bridge over US-1
  - New Friendship Road at Old US-1 / CSX Crossing

3

LOCATION OF INTERCHANGE

1. Amgen Facility / Friendship Innovation Park Developments
2. Duke energy transmission lines south of US-1
3. I-540 / New Hill Holleman interchange spacing
4. Tie into old US-1 near RR crossing
5. Capacity of US-1 (remains 4 lanes)



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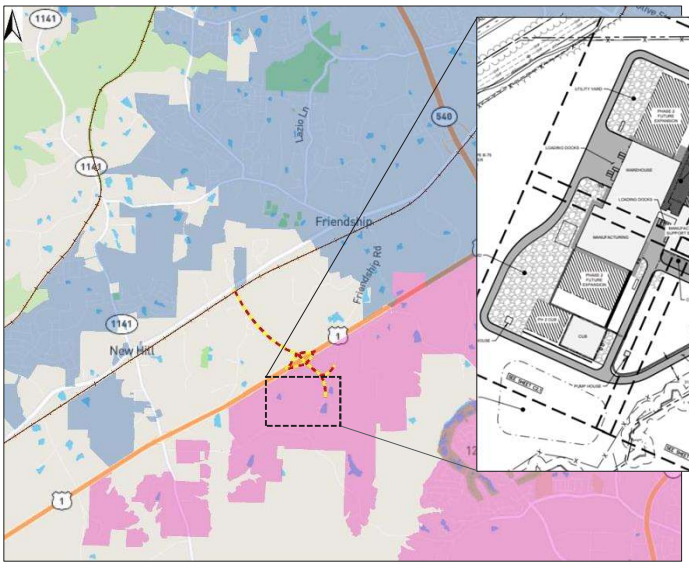
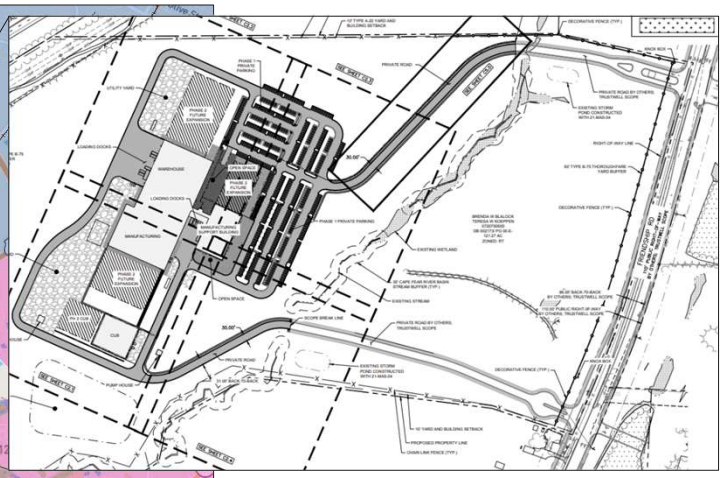
LOCATION OF INTERCHANGE





Amgen Facility Site Plan

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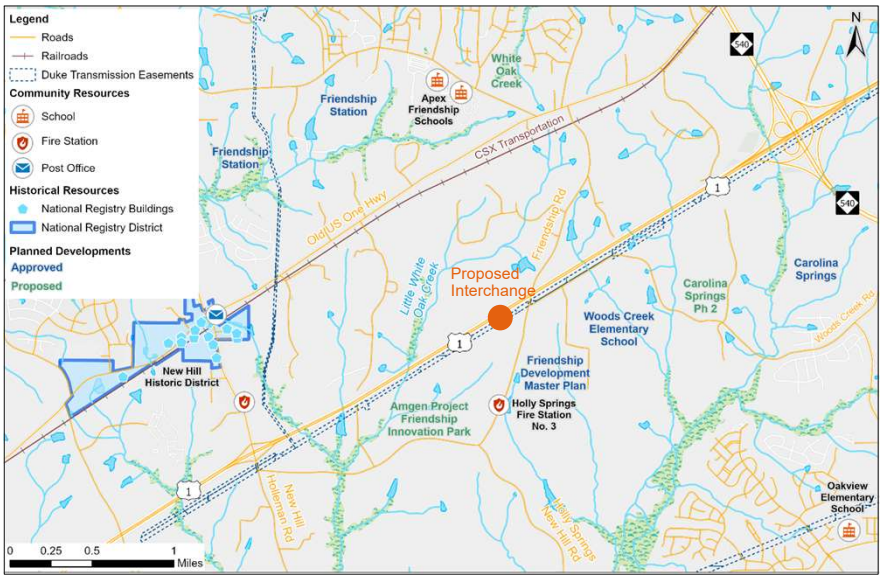
LOCATION OF INTERCHANGE



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INTERCHANGE OPTIONS – CONSTRAINTS

Duke Energy Corridor on Holly Springs Side of US-1

Planned Development Access to Friendship Road

7

INTERCHANGE OPTIONS – TIGHT DIAMOND

BENEFITS:

- Least ROW acquisition / corridor preservation
- Can preserve good intersection spacing to Friendship Road and first driveway to the west

CONCERNS:

- Requires replacement of Friendship Road Bridge to accommodate off- and on-ramp lanes
- Requires wider bridge (6 lanes) to fit two through lanes and full left turn lane in each direction

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INTERCHANGE OPTIONS – DUAL ROUNDABOUTS

BENEFITS:

- Least ROW acquisition / corridor preservation
- Can preserve good intersection spacing to Friendship Road and first access to the west
- Narrower bridge (4 lanes) across US-1
- Improved safety at ramp intersections

CONCERNS:

- Requires replacement of Friendship Road Bridge to accommodate off- and on-ramp lanes
- Finite capacity of RAB intersections

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FRIENDSHIP ROAD BRIDGE

- Current skewed bridge in fair condition (SR=75%) but lacks sidewalk / bike lane
- Proximity to proposed new interchange makes retaining bridge “as is” difficult
- Can create SB off-ramp outside column by replacing slope with vertical wall; more difficult in northbound direction

Southbound US-1

Northbound US-1

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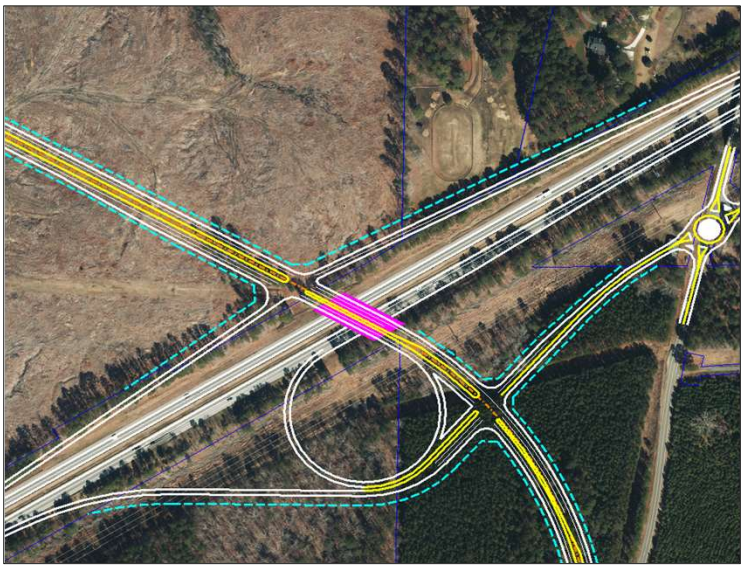
INTERCHANGE OPTIONS – PARTIAL CLOVERLEAF



BENEFITS:

- Does not require Friendship Road bridge replacement
- Better ramp terminal intersection spacing; allows 5-lane bridge
- Can preserve good intersection spacing to Friendship Road and first access to the west

CONCERNS:

- More ROW / corridor preservation on Holly Springs side of interchange
- Left turn from Friendship Road to go North on US-1

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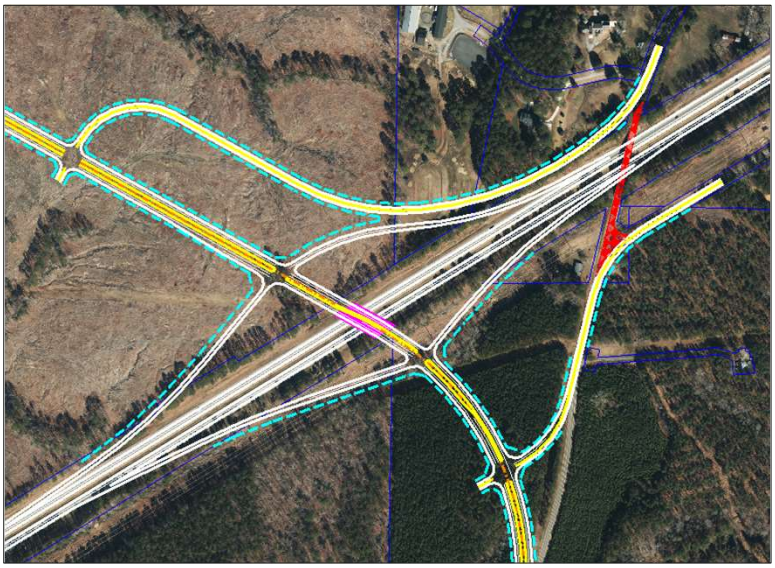
INTERCHANGE OPTIONS – CONVENTIONAL DIAMOND (REMOVE EXISTING BRIDGE)



BENEFITS:

- Good ramp terminal intersection spacing; allows 5-lane bridge
- Can preserve good intersection spacing / control of access to adjacent intersections
- Eliminates Friendship Road Bridge

CONCERNS:

- More ROW / corridor preservation on Apex side of interchange
- Greater ROW / cost for Friendship Road alignment
- Longer trip time for existing Friendship Road

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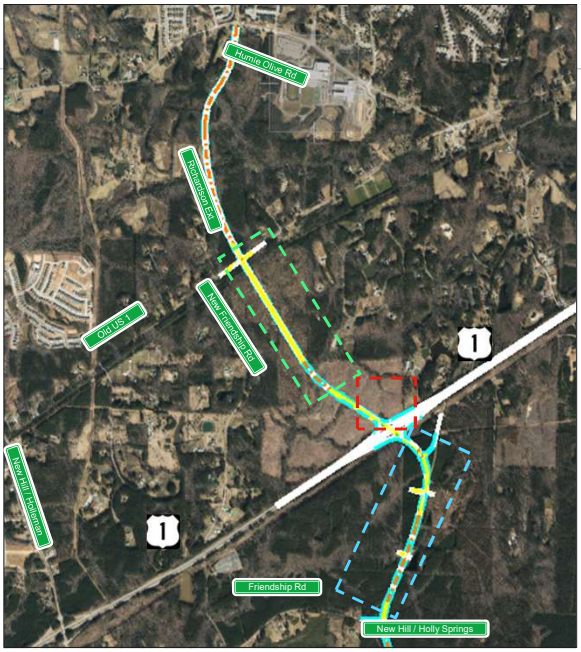
PROJECT CORRIDOR

- US-1 Interchange Area
- Apex Corridor Area
- Holly Springs Corridor Area



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HOLLY SPRINGS CORRIDOR

- New Friendship Road is 4-lane divided from interchange south to Holly Springs New Hill Road (100’ ROW)
- Accommodates Amgen driveways (under construction) and planned future development (Friendship Innovation Park)
- Friendship Road T-intersection at realigned New Friendship / Holly Springs / New Hill Road (N/S through movement)
- With new interchange, volumes on Friendship Road between New Hill/Holleman Road and Holly Springs/New Hill Road decrease; consider dropping proposed widening in MTP

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APEX CORRIDOR – OLD US-1 INTERSECTION

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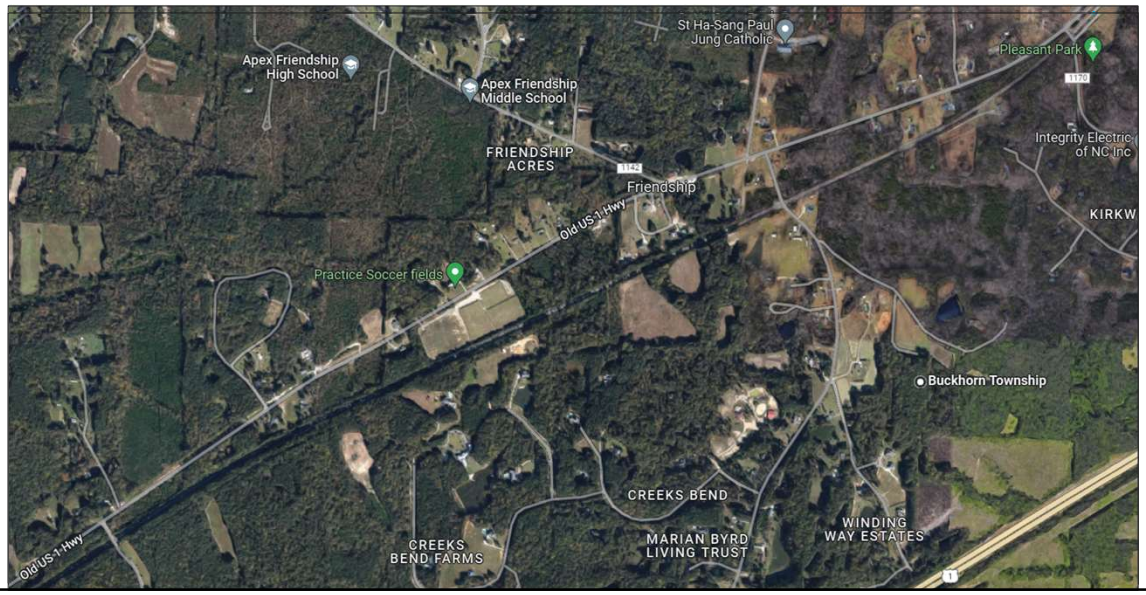
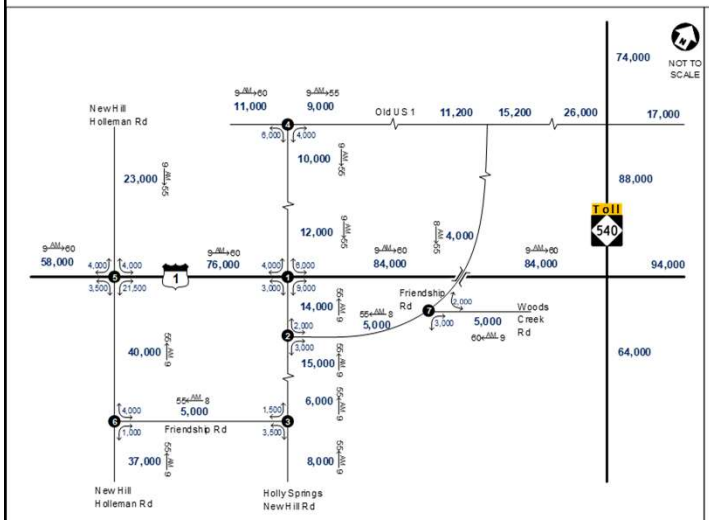
CSX RR PARALLEL TO US-1 - CROSSING LOCATIONS

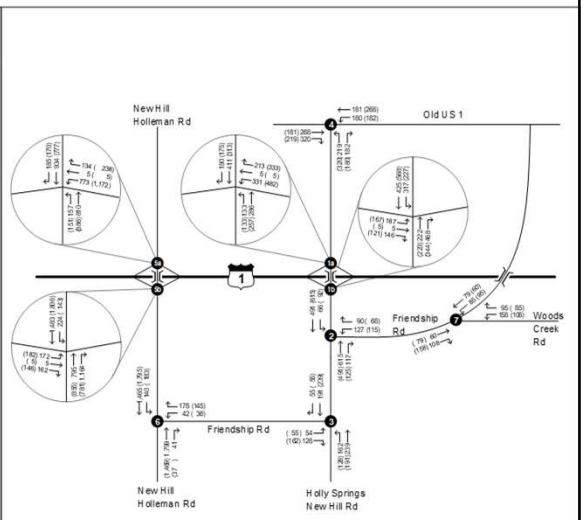


16

TRAFFIC VOLUME ESTIMATES – 2050 BUILD CONDITION (MTP Scenario)



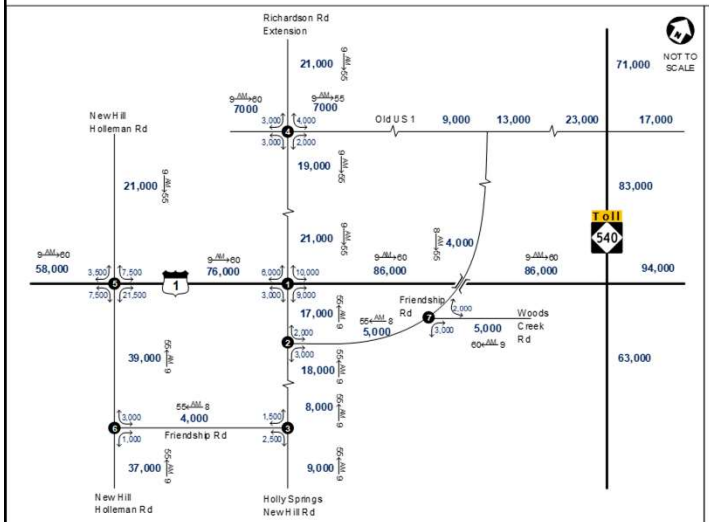
AADT Estimates



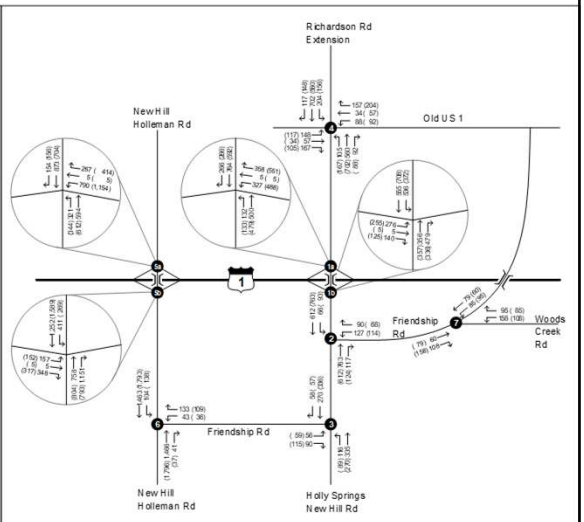
Peak Hour Traffic Volume Estimates

17

TRAFFIC VOLUME ESTIMATES – 2050 BUILD CONDITION (MTP+ Scenario)



AADT Estimates



Peak Hour Traffic Volume Estimates

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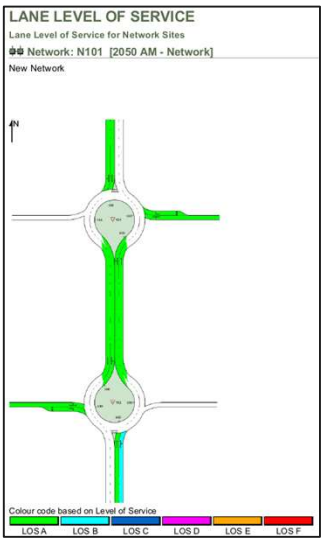
CAMPO NC Capital Area Metropolitan Planning Organization

ARCADIS

INTERSECTION ANALYSIS (SYNCHRO / SIDRA) FOR ALL SCENARIOS

Intersection Analysis Using Synchro



Roundabout Analysis Using Sidra

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CAMPO NC Capital Area Metropolitan Planning Organization

ARCADIS

INTERSECTION ANALYSIS SUMMARY RESULTS

Intersection Level of Service (LOS) Scenario Year 2050			No Build Scenario	MTP Scenario Friendship Rd Interchange				MTP+ Scenario Friendship Rd Interchange and Richardson Rd Extension			
ID#	Intersection	Peak Hour	No Build	Tight Diamond	Dual Roundabouts	Partial Cloverleaf#	Conventional Diamond*	Tight Diamond	Dual Roundabouts	Partial Cloverleaf#	Conventional Diamond*
1a	US 1 SB Ramps and Friendship Rd	AM	-	C	A	C	B	C	B	C	C
		PM	-	C	A	C	C	C	C	C	C
1b	US 1 NB Ramps and Friendship Rd	AM	-	C	A	D	C	B	C	D	C
		PM	-	B	A	C	B	B	B	C	B
2	New Friendship Rd and Old Friendship Rd / Woods Creek Rd	AM	-	B	B	-	B	B	B	-	B
		PM	-	B	B	-	B	B	B	-	B
3	Friendship Rd and Holly Springs New Hill Rd	AM	B	B	B	B	B	C	C	C	C
		PM	B	B	B	B	B	B	B	B	B
4	Old US 1 and New Friendship Rd	AM	-	C	C	C	C	D	D	D	D
		PM	-	C	C	C	C	D	D	D	D
5a	US 1 SB Ramps and New Hill Holleman Rd	AM	D	C	C	C	C	C	C	C	C
		PM	E	D	D	C	C	D	D	D	D
5b	US 1 NB Ramps and New Hill Holleman Rd	AM	D	D	D	D	C	D	D	D	D
		PM	E	B	B	A	A	C	C	C	C
6	New Hill Holleman Rd and Friendship Rd	AM	F	D	D	D	D	D	D	D	D
		PM	E	C	C	C	C	B	B	C	B

** Remove bridge and realign existing Friendship Rd*

** Woods Creek Rd is aligned and connected opposite to the EB Ramps*

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SYNCHRO ANALYSIS - OLD US 1 HWY AND FRIENDSHIP RD

Scenario Year: 2050	Peak Period	MTP Scenario Signalized T-Intersection	MTP+ Scenario Signalized Intersection	MTP+ Scenario Signalized Quadrant Intersection
Intersection Level of Service (LOS)	AM	C	D	C / C
	PM	C	D	C / C

INTERSECTION CONTROL EVALUATION (ICE)

Additional Costs for New Friendship Road / US-1 Interchange (Compared to Standard Diamond Interchange)

ID	Intersection	MOE	Tight Diamond	Dual Roundabouts	Partial Cloverleaf	Diamond Interchange
1	New Friendship Rd at US-1 (Interchange)	AM LOS:	C / C	B / C	C / C	C / C
		PM LOS:	B / B	C / B	D / C	C / B
		CMF[1]:	1.02	0.76	0.98	1.0
		Cost[2]:	$3,900,000	$3,200,000	$2,500,000	$3,000,000
		Rank:	3	1	4	2

Additional Costs for New Friendship Road / Old US-1 Intersection (Compared to At-Grade Signal)

ID	Intersection	MOE	Signalized	Quad Interchange
2	New Friendship Rd at Old US-1	AM LOS:	D	C / C
		PM LOS:	D	C / C
		CMF:	1.0	0.8
		Cost:	-	$10,900,000
		Rank	1	2

1 - Determined from FHWA Crash Modification Factor (CMF) Clearinghouse

2 - Does not include utility impacts

MEETING #2 DECISION POINTS

- Agreement on Location of US-1 Interchange
- Agreement on Interchange Options
- Agreement on ROW Preservations on Holly Springs and Apex Corridors

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NEXT STEPS

- Establish Deadline for Feedback
- Schedule Final Steering Committee Meeting
- Select Preferred Alignment / Interchange Option
- Develop TransModeler Analysis for Preferred Scenario
- Prepare Final Technical Memorandum

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MEETING MINUTES

Project:	CAMPO Friendship Road Interchange Feasibility Study
Date/Time:	Wednesday, May 25, 2022 @ 2:00pm
Meeting Purpose:	Steering Committee Meeting #2

Participants		E-Mail	Call-in	Distribution
Powell, Shelby	CAMPO	Shelby.Powell@campo-nc.us		✓
Rickard, Alex	CAMPO	Alex.Rickard@campo-nc.us	✓	✓
Bruff, Mike	CAMPO	Mike.Bruff@campo-nc.us		✓
Chris Lukasina	CAMPO	Chris.Lukasina@campo-nc.us		✓
Reid, Jonathan	Arcadis	Jonathan.Reid@arcadis.com	✓	✓
Shekhar, Shashank	Arcadis	Shashank.Shekhar@arcadis.com	✓	✓
Magsanoc, Ray	Arcadis	Ray.Magsanoc@arcadis.com	✓	✓
Kendra Parrish	Town of Holly Springs	Kendra.Parrish@hollyspringsnc.gov		✓
Chris Hills	Town of Holly Springs	Chris.Hills@hollyspringsnc.gov	✓	✓
Sean Ryan	Town of Holly Springs	Sean.Ryan@hollyspringsnc.gov	✓	✓
Russell Dalton	Town of Apex	Russell.Dalton@apexnc.org	✓	✓
Shannon Cox	Town of Apex	Shannon.Cox@apexnc.org	✓	✓
Dennis Jernigan	NCTA	Dwjernigan@ncdot.gov		✓
Robert Deaton	NCDOT (STIP Central Region)	Rdeaton@ncdot.gov	✓	✓
David Keilson	NCDOT (Div 5)	Dpkeilson@ncdot.gov		✓
Philip Geary	NCDOT (NCDOT TPD)	Pageary@ncdot.gov	✓	✓
Tim Gardiner	Wake County	Tim.Gardiner@wakegov.com	✓	✓
Akul Nishawala	Wake County	Akul.Nishawala@wakegov.com	✓	✓
Elizabeth Goodson	Town of Holly Springs	Elizabeth.Goodson@hollyspringsnc.gov	✓	✓

Purpose of meeting was to review corridor, interchange and intersection alternatives and review traffic operational results to determine a preferred alternative for the Friendship Road interchange with US-1.

Meeting Notes:

- Call began at 2:00 pm with a brief synopsis of past efforts and an agenda for this meeting. Key issues include the location of the US-1 interchange, interchange and corridor options and impacts to corridor.
- The interchange location is bound by the spacing of the I-540 and New-Hill/Holleman interchanges and the Amgen site. Other constraints include the existing Friendship Road Bridge and Duke Energy utility corridor.
- Reviewed four different interchange types:
  - Tight diamond – minimizes ROW constraints, difficult to maintain existing Friendship Road bridge
  - Tight diamond w/roundabouts – eliminates signals and improves safety, narrower bridge; same issue with maintaining Friendship Road bridge
  - Partial cloverleaf (loop in SE quadrant) – improves interchange spacing, more impacts to Duke Energy corridor; NB on-ramp can be merged in before Friendship Road bridge
  - Standard diamond w/removal of Friendship Road bridge – New Friendship Road connection on west side of US-1 allows permanent removal of bridge; this alternative could also include other interchange forms (roundabouts); includes Woods creek connection directly to New Friendship Rd
- Group Discussion of Alternatives:
  - Turnpike would prefer six lanes from this new interchange to I-540; Friendship Bridge will eventually become an issue in widening to six lanes
  - Removal of Friendship Road is not a non-starter; depends on what the land use impacts are; Towns want to line up alternatives with planned development to get a better sense of impacts
  - Initial positive opinion of the tight diamond interchange due to lesser land use and property impacts; similar roundabout option on Laura Duncan was not advanced due to lack of support

- Concerns of the impact to budget and if that pushes the project out; analysis would have to be done to determine the cost impacts and whether the project is piecemeal or includes the 6-lane widening of US-1

- Corridor Impacts
  - Holly Springs side of US-1: four-lane corridor from US-1 that includes realignment at the old Friendship Road
  - Apex side: Options for New Friendship Road at Old US-1 include using Bosco/Lindsey Roads, a new alignment to the north or an interchange over both Old US-1 and the CSX rail line
- Peak hour traffic volume forecasts were derived from regional model forecasts based on K and D factors; these forecasts were used to develop Synchro/Sidra models for each interchange alternatives
- Summary of level of service was good for all of the alternatives (LOS D or better); only poor LOS is in the no-build at New-Hill/Holleman interchange, which was improved by all of the build conditions.
- ICE analysis conducted to look at operational, safety and cost factors to determine the "best" intersection/interchange scenario. Crash modification factors were used to determine safety benefits, and preliminary cost estimate impacts were developed. Operational and safety benefits led to the tight diamond with roundabouts to be ranked highest.
- Group Discussion of Results:
  - Important not to change the Richardson Road alignment through the conservation easement
  - Consider the at-grade RR crossing as a fixed point
  - "Open space" had approved plans at one point, which would restrict alignment; provide files to be provided for further evaluation
  - Conservation easement is protected corridor that is being worked out to the south
  - Richardson Road / Old US-1
- Decisions points:
  - Agreement on location of US-1 interchange
  - Agreement on intersection type
  - Some guidance on the corridor alignment
  - Establish timeline for comments
- Group Discussion:
  - Previous Turnpike review of interchange showed some potential queueing back from I-540, so question raised if interchange can be shifted further south
  - Sliding New Friendship Road south would have impacts on existing Amgen site; maybe could move 500-feet
  - Auxiliary lanes dramatically improve operations between this interchange and I-540
  - The sole advantage of the Partial cloverleaf alternative was to remove existing Friendship Road bridge impediments; if the auxiliary lanes are to be part of the project, then it is recommended to remove alternative 3 from consideration
  - Towns, Turnpike Authority and NCDOT agreed to provide comments / feedback on final design alternatives by Friday, June 3. Provide first, second and third choice
  - Final Steering committee meeting the week of June 24th; will include final Transmodeler analysis and submittal of a draft final report.
  - Question was raised if the traffic volumes incorporate mega-site traffic in Moncure (further south on US-1); Mike will look into potential volume changes to growth rate associated with that site.

Action Items:

1. CAMPO and Arcadis to meet on June 6 to review comments and set direction for final analysis and report
2. CAMPO to send out a doodle poll to select a date for the next Steering Committee meeting (week of June 24)

MEETING MINUTES

Project:	CAMPO Friendship Road Interchange Feasibility Study
Date/Time:	Wednesday, June 22, 2022 @ 1:00pm
Meeting Purpose:	Steering Committee Meeting #3

Participants		E-Mail	Call-in	Distribution
Powell, Shelby	CAMPO	Shelby.Powell@campo-nc.us	✓	✓
Rickard, Alex	CAMPO	Alex.Rickard@campo-nc.us	✓	✓
Bruff, Mike	CAMPO	Mike.Bruff@campo-nc.us	✓	✓
Chris Lukasina	CAMPO	Chris.Lukasina@campo-nc.us		✓
Reid, Jonathan	Arcadis	Jonathan.Reid@arcadis.com	✓	✓
Shekhar, Shashank	Arcadis	Shashank.Shekhar@arcadis.com	✓	✓
Magsanoc, Ray	Arcadis	Ray.Magsanoc@arcadis.com		✓
Kendra Parrish	Town of Holly Springs	Kendra.Parrish@hollyspringsnc.gov		✓
Chris Hills	Town of Holly Springs	Chris.Hills@hollyspringsnc.gov	✓	✓
Sean Ryan	Town of Holly Springs	Sean.Ryan@hollyspringsnc.gov	✓	✓
Russell Dalton	Town of Apex	Russell.Dalton@apexnc.org	✓	✓
Shannon Cox	Town of Apex	Shannon.Cox@apexnc.org	✓	✓
Dennis Jernigan	NCTA	Dwjernigan@ncdot.gov	✓	✓
Robert Deaton	NCDOT (STIP Central Region)	Rdeaton@ncdot.gov		✓
David Keilson	NCDOT (Div 5)	Dpkeilson@ncdot.gov		✓
Philip Geary	NCDOT (NCDOT TPD)	Pageary@ncdot.gov		✓
Tim Gardiner	Wake County	Tim.Gardiner@wakegov.com	✓	✓
Akul Nishawala	Wake County	Akul.Nishawala@wakegov.com	✓	✓
Elizabeth Goodson	Town of Holly Springs	Elizabeth.Goodson@hollyspringsnc.gov	✓	✓

Purpose of meeting was to review comments on corridor, interchange and intersection alternatives to determine a preferred alternative for the Friendship Road interchange with US-1.

Meeting Notes:

- Call began at 1:00 pm. Agenda for this meeting included a review of project and alternatives, review of agency feedback received, review of TransModeler analysis results and a discussion on a final preferred alignment and interchange alternative
- The responses received from NCTA, Wake County, Town of Apex and Town of Holly Springs were each presented and reviewed to determine accuracy, omissions or additions. The issues identified were verified, with the following clarifications or new comments:
    - The Town of Apex asked that the current alignment in the MTP be followed as closely as possible due to agreements made over environmental conservancy and stream impacts. Arcadis asked the Town for a GIS file of that alignment.
- In response to the e-mail comments received, Arcadis developed and presented a new interchange option (Alternative 5) that shifted the interchange location approximately 800 feet to the southwest such that the north facing ramps could be built without impacting the exiting Friendship Road bridge over US-1. The alternative had impacts to the existing property, and prior to the meeting, the Town of Holly Springs was able to discuss Alternative 5 with Amgen. At the meeting, the Town conveyed that the impacts of Alternative 5 were inconsistent with Amgen site development plans and therefore could not be supported as a recommended alternative.
- At the meeting, Arcadis presented a sketch of a sixth alternative, that keep the same interchange location in Alternative 5 but minimize the impacts to Amgen by aligning New Friendship Road across the northern site boundary and intersecting Friendship Road with a roundabout intersection.
- The stakeholder group discussed this alternative and agreed that is was worthy of further study. Arcadis agreed to formalize Alternative 6 and send to the group for further discussion and recommendations.

- Arcadis presented the TransModeler results of Alternative 1 for both the No-Build and Build conditions. The No-Build condition showed considerable congestion at the New Hill / Holleman interchange that was alleviated by the inclusion of the Friendship Road interchange. Alex commented that this may be a key finding that will help future funding of the Friendship Road interchange.
- The meeting concluded with the group identify the potential for Alternative 6 to be the recommended preferred alternative subject to a review of the corridor alignment and a review of the interchange configuration by the Towns and a review by Amgen (that may extend beyond the study time constraints). If Alternative 6 is deemed not viable in the future, the consensus was for Alternative 1.

Action Items:

1. Town of Apex to send Arcadis GIS alignment file
2. Arcadis to develop Alternatrive 6 details and send to the stakeholder group.

Magsanoc, Ray

From: Shannon Cox <Shannon.Cox@apexnc.org>
Sent: Thursday, June 2, 2022 1:47 PM
To: Reid, Jonathan; shelby.powell@campo-nc.us; Rickard, Alex; Bruff, Mike; chris.lukasina@campo-nc.us; Shekhar, Shashank; Magsanoc, Ray; Kendra.Parrish@hollyspringsnc.gov; Chris.Hills@hollyspringsnc.gov; Sean.Ryan@hollyspringsnc.gov; Russell Dalton; Dwjernigan@ncdot.gov; Rdeaton@ncdot.gov; Dpkeilson@ncdot.gov; Pageary@ncdot.gov; Tim.Gardiner@wakegov.com; Akul.Nishawala@wakegov.com; Elizabeth.Goodson@hollyspringsnc.gov
Subject: RE: Friendship Road/US 1 Hotspot Meeting Minutes.

Follow Up Flag: Follow up
Flag Status: Completed

Categories: Orange category

Hi Jonathan,

Russell and I were able to meet with additional staff in Apex this morning to brief them about the interchange alternatives and gather comments and preferences. Staff represented Planning, Public Works & Transportation, and Fire. I'm sharing our comments with all in case it is helpful to others as they review the concepts:

Interchange concepts in order of preference:

1. Tie between Tight Diamond with bridge replacement or Dual Roundabout. See notes below.
2. Partial Cloverleaf
3. Conventional Diamond with Pleasant Plains bridge construction

Additional details, comments, and explanation:

- We prefer not to reevaluate the alignment of Richardson Road at Old US 1 Highway and northward. Substantial analysis has already been completed for this alignment and it does not seem to impact the US1/Richardson/Friendship interchange location. An eventual grade separation here is consistent with our Transportation Plan.
- Any alternative that requires complete closure of Friendship Road bridge needs further public input. This community has been actively advocating for additional transparency of public projects. We would not be able to gather adequate input within the timeframe of the hot spot study.
- The Friendship community has been raising concerns about safety of cyclists on Friendship Road. Replacing the bridge with a facility wide enough for sidewalk and bike lanes could have a positive impact.
- If the Friendship Road bridge must be removed, it should be replaced in the same location. If that is not possible, we request that a new crossing at Pleasant Plains Road be programmed with the US 1/Friendship interchange as a single project. The interchange doesn't provide the same function as the grade separation. Removing a grade separation will increase congestion on collector roads and Richardson Road, increase emergency service response times, and remove a lower-volume bike/ped crossing of US 1 Highway. Traffic that does not need to get to US 1 would benefit from an alternative route.
- The dual roundabout concept looks good on paper, but received very negative public feedback when presented as an option for Laura Duncan Road at US 64. We are somewhat hesitant to rely on this as a first choice without more extensive public engagement. The right of way impacts seem similar to the Tight Diamond, but costs of the Tight Diamond are higher. As a conservative approach, would it be better to use the Tight Diamond for future

prioritization, but still keep the Dual Roundabout as an alternative for further study once this interchange is programmed?

- The Conventional Diamond option has substantial property impacts. Our experience has been that the right of way will be very difficult to preserve until a roadway project is funded. A more constrained interchange concept will have a better opportunity for right of way conservation through future rezoning cases. We have very few tools to preserve right of way until projects are funded.
- We're interested in Holly Springs' input on the Partial Cloverleaf. South of US 1, property impacts appear similar to the Conventional Diamond, but the Friendship Road bridge would be reconstructed.
- Question - Is it feasible to rebuild the Friendship Road bridge with the Conventional Diamond option? It isn't presented that way, but we weren't clear whether it is feasible.

Thanks,
Shannon

APEX
NORTH CAROLINA

Shannon Cox, AICP
Long Range Planning Manager
Department of Planning & Community Development
Town of Apex, NC
(919) 249-3505
www.apexnc.org

From: Reid, Jonathan [mailto:Jonathan.Reid@arcadis.com]
Sent: Thursday, June 2, 2022 12:22 PM
To: shelby.powell@campo-nc.us; Rickard, Alex <alex.rickard@campo-nc.us>; Bruff, Mike <mike.bruff@campo-nc.us>; chris.lukasina@campo-nc.us; Shekhar, Shashank <Shashank.Shekhar@arcadis.com>; Magsanoc, Ray <Ray.Magsanoc@arcadis.com>; Kendra.Parrish@hollyspringsnc.gov; Chris.Hills@hollyspringsnc.gov; Sean.Ryan@hollyspringsnc.gov; Russell Dalton <Russell.Dalton@apexnc.org>; Shannon Cox <Shannon.Cox@apexnc.org>; Dwjernigan@ncdot.gov; Rdeaton@ncdot.gov; Dpkeilson@ncdot.gov; Pageary@ncdot.gov; Tim.Gardiner@wakegov.com; Akul.Nishawala@wakegov.com; Elizabeth.Goodson@hollyspringsnc.gov
Subject: RE: Friendship Road/US 1 Hotspot Meeting Minutes.

All:
If you had any difficulty in receiving the Stakeholder Meeting PowerPoint file, you can download using the link below.
The ICE summary spreadsheet is also attached.
Thanks!

Download link

https://we.tl/t-THvJnNnk43

Jonathan Reid | PE, PTOE, RSP
Vice President | Transportation Practice Lead

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5420 Wade Park Boulevard, Suite 350 | Raleigh NC | 27607 | USA
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Professional Registration: PE #27930 (NC); #32806 (GA); #37192 (SC); #122984 (TX)

From: Reid, Jonathan
Sent: Wednesday, June 1, 2022 5:00 PM
To: Shelby.Powell@campo-nc.us; Alex.Rickard@campo-nc.us; Mike.Bruff@campo-nc.us; Chris.Lukasina@campo-nc.us; Reid, Jonathan <Jonathan.Reid@arcadis.com>; Shekhar, Shashank <Shashank.Shekhar@arcadis.com>; Magsanoc, Ray <Ray.Magsanoc@arcadis.com>; Kendra.Parrish@hollyspringsnc.gov; Chris.Hills@hollyspringsnc.gov; Sean.Ryan@hollyspringsnc.gov; Russell.Dalton@apexnc.org; Shannon.Cox@apexnc.org; Dwjernigan@ncdot.gov; Rdeaton@ncdot.gov; Dpkeilson@ncdot.gov; Pageary@ncdot.gov; Tim.Gardiner@wakegov.com; Akul.Nishawala@wakegov.com; Elizabeth.Goodson@hollyspringsnc.gov
Subject: Friendship Road/US 1 Hotspot Meeting Minutes.

All:

Attached are the meeting minutes from last week's Stakeholder Meeting #2. Please let me know if you have any comments or additions to the minutes.

Please note that we are still aiming to receive feedback on the meeting and presentation information provided **no later than COB this Friday**.

Thanks, and look forward to receiving your feedback and recommendations!

Jonathan Reid | PE, PTOE, RSP
Vice President | Transportation Practice Lead
Arcadis G&M of North Carolina, Inc.
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T +1 919 415 2340
M +1 770 757 7601

Professional Registration: PE #27930 (NC); #32806 (GA); #37192 (SC); #122984 (TX)

From: Reid, Jonathan
Sent: Thursday, May 26, 2022 10:47 AM
Subject: Friendship Rd./US 1 Hotspot Meeting Presentation File

All:

Attached is the PowerPoint presented at yesterday's Stakeholder Meeting for the Friendship Road / US-1 Hot Spot Study. I have also attached the spreadsheet used to calculate planning level costs and ICE results. Notes from the meeting will be made available later today or tomorrow at the latest.

Please provide feedback on the interchange and corridor concepts presented (send to both Alex and myself) **no later than Friday June 3** so that we can select a preferred alternative and complete the hot spot study by the end of June.

Thanks!

Magsanoc, Ray

From: Elizabeth Goodson <Elizabeth.Goodson@hollyspringsnc.gov>
Sent: Wednesday, June 8, 2022 5:26 PM
To: Reid, Jonathan; shelby.powell@campo-nc.us; Rickard, Alex; Bruff, Mike; chris.lukasina@campo-nc.us; Kendra Parrish; Chris Hills; Sean Ryan; Russell.Dalton@apexnc.org; Shannon.Cox@apexnc.org; Dwjernigan@ncdot.gov; Rdeaton@ncdot.gov; Dpkeilson@ncdot.gov; Pageary@ncdot.gov; Tim.Gardiner@wakegov.com; Akul.Nishawala@wakegov.com
Cc: Magsanoc, Ray; Shekhar, Shashank
Subject: RE: --[EXTERNAL]--RE: Friendship Road/US 1 Hotspot Meeting Minutes.

Follow Up Flag: Follow up
Flag Status: Completed

Categories: Orange category

Thank you Jonathan and team for the extra time. This allowed us to connect with the a few additional stakeholders on our team as well.

A few additional thoughts/questions are:

- We are similar to Apex with a preference of the Tight Diamond with bridge replacement or Dual Roundabout due to the tighter R/W and reduced impacts on potential development in this area. The partial cloverleaf appears to have much more significant impact to area that is proposed to have development with an approved master plan in this area.
- The location of the new interchange is set as the mid point between the NC540 and existing New Hll Holleman Interchange but is there an opportunity for the new interchange to be moved further west and allow the existing Friendship Bridge to stay in place and still get .
- We are interested in early discussion on thoughts on how we preserve the R/W for the preferred alignment once chosen.
- We have not connected with Duke Energy yet but recommend that we do that too since they have the transmission lines in this area and would be another stakeholder with possible comments.
- Has there be any additional intersection configurations considered for the new intersection T formed with most of these scenarios? (possibly roundabout)

If we have any other comments or feedback, we will let you know.

Thank you for your work on this project.

Elizabeth

Elizabeth C. Goodson, PE | Division Manager
Town of Holly Springs Development Services – Land Development
PO Box 8 | 128 S Main St | Holly Springs, NC 27540
Main Office: (919)557-3908 | Direct: (919)557-3933 | Mobile: (919) 291-9795
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From: Reid, Jonathan <Jonathan.Reid@arcadis.com>
Sent: Tuesday, June 7, 2022 1:32 PM
To: shelby.powell@campo-nc.us; Rickard, Alex <alex.rickard@campo-nc.us>; Bruff, Mike <mike.bruff@campo-nc.us>; chris.lukasina@campo-nc.us; Kendra Parrish <kendra.parrish@hollyspringsnc.gov>; Chris Hills <chris.hills@hollyspringsnc.gov>; Sean Ryan <sean.ryan@hollyspringsnc.gov>; Russell.Dalton@apexnc.org; Shannon.Cox@apexnc.org; Dwjernigan@ncdot.gov; Rdeaton@ncdot.gov; Dpkeilson@ncdot.gov; Pageary@ncdot.gov; Tim.Gardiner@wakegov.com; Akul.Nishawala@wakegov.com; Elizabeth Goodson <Elizabeth.Goodson@hollyspringsnc.gov>
Cc: Magsanoc, Ray <Ray.Magsanoc@arcadis.com>; Shekhar, Shashank <Shashank.Shekhar@arcadis.com>
Subject: --[EXTERNAL]--RE: Friendship Road/US 1 Hotspot Meeting Minutes.

All:

Due to the limited feedback we've received to date, we've extended the time for anyone to provide comments on the US-1 / Friendship Road Hotspot Study to us **no later than 5:00pm this Wednesday (June 9th).** Due to the tight project schedule, this will be the last opportunity for the project stakeholder group to provide comments to CAMPO on the interchange and corridor options. The below link is still active to download the Stakeholder Meeting presentation file and the ICE Summary Table is attached.

Your input is extremely valuable in making the final recommendations in this hotspot project, and we look forward to receiving your comments by COB Wednesday.

Thanks!

From: Reid, Jonathan
Sent: Thursday, June 2, 2022 12:22 PM
Subject: RE: Friendship Road/US 1 Hotspot Meeting Minutes.

All:
If you had any difficulty in receiving the Stakeholder Meeting PowerPoint file, you can download using the link below. The ICE summary spreadsheet is also attached.
Thanks!

Download link

https://we.tl/t-THvJnNnk43

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T +1 919 415 2340
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Professional Registration: PE #27930 (NC); #32806 (GA); #37192 (SC); #122984 (TX)

From: Reid, Jonathan
Sent: Wednesday, June 1, 2022 5:00 PM
To: Shelby.Powell@campo-nc.us; Alex.Rickard@campo-nc.us; Mike.Bruff@campo-nc.us; Chris.Lukasina@campo-nc.us; Reid, Jonathan <Jonathan.Reid@arcadis.com>; Shekhar, Shashank <Shashank.Shekhar@arcadis.com>; Magsanoc, Ray <Ray.Magsanoc@arcadis.com>; Kendra.Parrish@hollyspringsnc.gov; Chris.Hills@hollyspringsnc.gov; Sean.Ryan@hollyspringsnc.gov; Russell.Dalton@apexnc.org; Shannon.Cox@apexnc.org; Dwjernigan@ncdot.gov; Rdeaton@ncdot.gov; Dpkeilson@ncdot.gov; Pageary@ncdot.gov; Tim.Gardiner@wakegov.com;

Akul.Nishawala@wakegov.com; Elizabeth.Goodson@hollyspringsnc.gov
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All:

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Thanks, and look forward to receiving your feedback and recommendations!

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Professional Registration: PE #27930 (NC); #32806 (GA); #37192 (SC); #122984 (TX)

From: Reid, Jonathan
Sent: Thursday, May 26, 2022 10:47 AM
Subject: Friendship Rd./US 1 Hotspot Meeting Presentation File

All:

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Please provide feedback on the interchange and corridor concepts presented (send to both Alex and myself) **no later than Friday June 3** so that we can select a preferred alternative and complete the hot spot study by the end of June.

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Professional Registration: PE #27930 (NC); #32806 (GA); #37192 (SC); #122984 (TX)

Magsanoc, Ray

From: Jernigan, Dennis W <dwjernigan@ncdot.gov>
Sent: Saturday, June 11, 2022 11:32 AM
To: Reid, Jonathan; shelby.powell@campo-nc.us; Rickard, Alex; Bruff, Mike; chris.lukasina@campo-nc.us; Kendra.Parrish@hollyspringsnc.gov; Chris.Hills@hollyspringsnc.gov; Sean.Ryan@hollyspringsnc.gov; Russell.Dalton@apexnc.org; Shannon.Cox@apexnc.org; Deaton, Robert W; Keilson, David P; Geary, Philip A; Gardiner, Tim; Nishawala, Akul; Elizabeth.Goodson@hollyspringsnc.gov
Cc: Magsanoc, Ray; Shekhar, Shashank
Subject: RE: [External] RE: Friendship Road/US 1 Hotspot Meeting Minutes.

Follow Up Flag: Follow up
Flag Status: Completed

Categories: Orange category

I was not able to hit the deadline last Wednesday, but I will share what we have thus far, at least for informational purposes.

We have reviewed the concepts in the CAMPO/Arcadis presentation from an operations perspective. When we performed the high-level analysis of US 1 back in December, we noted that the Friendship Road interchange would increase volumes on US 1 between Friendship Road and NC 540. We recommended that auxiliary lanes should be considered between the two interchanges in each direction of US 1, meaning there would be three lanes in each direction. We also noted that it was a high-level analysis and that an official forecast and analysis should be conducted before official recommendations could be made.

Four alternatives are presented in the presentation:

- *Tight Diamond with signalized intersections*
- *Tight Diamond with roundabouts*
- *Partial Cloverleaf*
- *Conventional Diamond*

Looking at this from purely an NCTA perspective, it doesn't really matter which option is selected because the operational impacts to NC 540 would be the same. At 1.5 miles from NC 540, this interchange could be constructed a host of different ways, and it wouldn't matter. However, the Partial Cloverleaf option allows the existing Friendship Road bridge to remain in place, which means US 1 NB can carry only two lanes at that location. If this option is chosen, it would eliminate the possibility of auxiliary lanes or additional lanes on US 1 NB between Friendship Road and NC 540. This is the option that would concern me from an NCTA perspective, because NCDOT would be spending money elsewhere (utility easement/relocation, increased project construction and limits) to save the current bridge, and would not be fond of removing it anyway later.

From: Reid, Jonathan <Jonathan.Reid@arcadis.com>
Sent: Tuesday, June 7, 2022 1:32 PM
To: shelby.powell@campo-nc.us; Rickard, Alex <Alex.Rickard@campo-nc.us>; Bruff, Mike <mike.bruff@campo-nc.us>; chris.lukasina@campo-nc.us; Kendra.Parrish@hollyspringsnc.gov; Chris.Hills@hollyspringsnc.gov; Sean.Ryan@hollyspringsnc.gov; Russell.Dalton@apexnc.org; Shannon.Cox@apexnc.org; Jernigan, Dennis W

<dwjernigan@ncdot.gov>; Deaton, Robert W <rdeaton@ncdot.gov>; Keilson, David P <dpkeilson@ncdot.gov>; Geary, Philip A <pageary@ncdot.gov>; Gardiner, Tim <tim.gardiner@wakegov.com>; Nishawala, Akul <Akul.Nishawala@wakegov.com>; Elizabeth.Goodson@hollyspringsnc.gov
Cc: Magsanoc, Ray <Ray.Magsanoc@arcadis.com>; Shekhar, Shashank <Shashank.Shekhar@arcadis.com>
Subject: [External] RE: Friendship Road/US 1 Hotspot Meeting Minutes.

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Your input is extremely valuable in making the final recommendations in this hotspot project, and we look forward to receiving your comments by COB Wednesday.

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Professional Registration: PE #27930 (NC); #32806 (GA); #37192 (SC); #122984 (TX)

Magsanoc, Ray

From: Reid, Jonathan
Sent: Friday, June 10, 2022 9:53 AM
To: Magsanoc, Ray
Cc: Shekhar, Shashank
Subject: FW: Friendship Road/US 1 Hotspot Meeting Minutes.

Follow Up Flag: Follow up
Flag Status: Completed

Categories: Orange category

More comments from Wake County to respond to.

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Professional Registration: PE #27930 (NC); #32806 (GA); #37192 (SC); #122984 (TX)

From: Tim Gardiner <Tim.Gardiner@wakegov.com>
Sent: Thursday, June 9, 2022 3:14 PM
To: Reid, Jonathan <Jonathan.Reid@arcadis.com>
Cc: Akul Nishawala <Akul.Nishawala@wakegov.com>; Rickard, Alex <alex.rickard@campo-nc.us>
Subject: RE: Friendship Road/US 1 Hotspot Meeting Minutes.

Jonathan –

- As part of the final products for this can you provide a larger overview map of the alternatives considered? Based on the small view in the powerpoint I am having difficulty determining where the new bridge alts would be compared to the existing friendship bridge.
- Since we are looking at adding traffic and complexity to an existing bridge in some of the alts I would recommend that we clearly note the bike and ped issues. I think a parallel bike and ped bridge could be added for significantly less than a new multi-modal bridge so this likely is not a justification for the new bridge alts outside of other factors – but we should note that this is an issue we have left ourselves if we choose the alts that use the existing bridge.
- Since the comment for Holly Springs was cut off I don't know what they were going after with retaining the existing friendship bridge – but this could also address the bike / ped issue.

From Elizabeth Goodson –

- The location of the new interchange is set as the mid point between the NC540 and existing New Hll Holleman Interchange but is there an opportunity for the new interchange to be moved further west and allow the existing Friendship Bridge to stay in place and still get ????.

Tim Gardiner
Wake County Planning

From: Reid, Jonathan <Jonathan.Reid@arcadis.com>
Sent: Tuesday, June 7, 2022 1:32 PM
To: Powell, Shelby <shelby.powell@campo-nc.us>; Rickard, Alex <alex.rickard@campo-nc.us>; Bruff, Mike <mike.bruff@campo-nc.us>; chris.lukasina@campo-nc.us; Kendra.Parrish@hollyspringsnc.gov; Chris.Hills@hollyspringsnc.gov; Sean.Ryan@hollyspringsnc.gov; Russell.Dalton@apexnc.org; Shannon Cox <Shannon.Cox@apexnc.org>; Dwjernigan@ncdot.gov; Rdeaton@ncdot.gov; Dpkeilson@ncdot.gov; Pageary@ncdot.gov; Tim Gardiner <Tim.Gardiner@wakegov.com>; Akul Nishawala <Akul.Nishawala@wakegov.com>; Elizabeth.Goodson@hollyspringsnc.gov
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ARCADIS

From: Reid, Jonathan
Sent: Wednesday, June 1, 2022 5:00 PM
To: Shelby.Powell@campo-nc.us; Alex.Rickard@campo-nc.us; Mike.Bruff@campo-nc.us; Chris.Lukasina@campo-nc.us; Reid, Jonathan <Jonathan.Reid@arcadis.com>; Shekhar, Shashank <Shashank.Shekhar@arcadis.com>; Magsanoc, Ray <Ray.Magsanoc@arcadis.com>; Kendra.Parrish@hollyspringsnc.gov; Chris.Hills@hollyspringsnc.gov; Sean.Ryan@hollyspringsnc.gov; Russell.Dalton@apexnc.org; Shannon.Cox@apexnc.org; Dwjernigan@ncdot.gov; Rdeaton@ncdot.gov; Dpkeilson@ncdot.gov; Pageary@ncdot.gov; Tim.Gardiner@wakegov.com; Akul.Nishawala@wakegov.com; Elizabeth.Goodson@hollyspringsnc.gov
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Magsanoc, Ray

From: Shannon Cox <Shannon.Cox@apexnc.org>
Sent: Friday, June 24, 2022 10:55 AM
To: Reid, Jonathan; Rickard, Alex; shelby.powell@campo-nc.us; Bruff, Mike; chris.lukasina@campo-nc.us; Shekhar, Shashank; Magsanoc, Ray; Kendra.Parrish@hollyspringsnc.gov; Chris.Hills@hollyspringsnc.gov; Sean.Ryan@hollyspringsnc.gov; Russell Dalton; Dwjernigan@ncdot.gov; Deaton, Robert W; Dpkeilson@ncdot.gov; Pageary@ncdot.gov; Tim Gardiner; Akul Nishawala; Elizabeth.Goodson@hollyspringsnc.gov
Subject: RE: US 1 / Friendship Interchange Hot Spot - Alternative 6

Follow Up Flag: Follow up
Flag Status: Completed

Categories: Orange category

Hi Jonathan,

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Thanks for all of your work on this –
Shannon

Shannon Cox, AICP
Long Range Planning Manager
Department of Planning & Community Development
Town of Apex, NC
(919) 249-3505
www.apexnc.org

From: Reid, Jonathan [mailto:Jonathan.Reid@arcadis.com]
Sent: Friday, June 24, 2022 9:40 AM
To: Rickard, Alex <alex.rickard@campo-nc.us>; shelby.powell@campo-nc.us; Bruff, Mike <mike.bruff@campo-nc.us>; chris.lukasina@campo-nc.us; Shekhar, Shashank <Shashank.Shekhar@arcadis.com>; Magsanoc, Ray <Ray.Magsanoc@arcadis.com>; Kendra.Parrish@hollyspringsnc.gov; Chris.Hills@hollyspringsnc.gov; Sean.Ryan@hollyspringsnc.gov; Russell Dalton <Russell.Dalton@apexnc.org>; Shannon Cox <Shannon.Cox@apexnc.org>; Dwjernigan@ncdot.gov; Deaton, Robert W <rdeaton@ncdot.gov>; Dpkeilson@ncdot.gov; Pageary@ncdot.gov; Tim Gardiner <tim.gardiner@wakegov.com>; Akul Nishawala <Akul.Nishawala@wakegov.com>;

Elizabeth.Goodson@hollyspringsnc.gov
Subject: FW: US 1 / Friendship Interchange Hot Spot - Alternative 6

All:
Still looking for your feedback on this. Really need **by COB today** to have the opportunity review and include in the final report due next week.
Thanks!

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ARCADIS

Professional Registration: PE #27930 (NC); #32806 (GA); #37192 (SC); #122984 (TX)

From: Reid, Jonathan
Sent: Wednesday, June 22, 2022 11:15 PM
To: Rickard, Alex <Alex.Rickard@campo-nc.us>; shelby.powell@campo-nc.us; Bruff, Mike <mike.bruff@campo-nc.us>; chris.lukasina@campo-nc.us; Shekhar, Shashank <Shashank.Shekhar@arcadis.com>; Magsanoc, Ray <Ray.Magsanoc@arcadis.com>; Kendra.Parrish@hollyspringsnc.gov; Chris.Hills@hollyspringsnc.gov; Sean.Ryan@hollyspringsnc.gov; Russell.Dalton@apexnc.org; Shannon.Cox@apexnc.org; Dwjernigan@ncdot.gov; Deaton, Robert W <rdeaton@ncdot.gov>; Dpkeilson@ncdot.gov; Pageary@ncdot.gov; Tim Gardiner <tim.gardiner@wakegov.com>; Akul Nishawala <Akul.Nishawala@wakegov.com>; Elizabeth.Goodson@hollyspringsnc.gov
Subject: US 1 / Friendship Interchange Hot Spot - Alternative 6

All:

Good meeting today! Thanks to receipt of the northern alignment info from Will and Shannon, we were able to modify the Alternative 6 concept to be as consistent as possible with the original alignment up to the divergent point to move the interchange to the southwest. The attached JPEG file illustrates where the proposed alignment deviates from the original alignment north of US-1. There are also two PDFs that show the proposed full project alignment and a closer view of the Amgen impacts and RAB intersection south of US-1. Both include the hydrological layer to show where there are proposed stream impacts.

Several notes about this concept:

- The proposed alignment avoids one longitudinal impact but has one more perpendicular stream crossing
- The project corridor now terminates in Holly Springs at the roundabout intersection
- The tight diamond interchange ramps are ever-so-slightly off center with the freeway to avoid both stream and utility impacts on the south side of US-1

Please let me know if you have comments on this Alternative 6 concept tomorrow (Thursday) or by noon Friday at the latest. If we gain consensus by e-mail (including conformation that Amgen is good with this alignment), we can squeeze this in as the preferred alignment in the final report to be completed next week.

Magsanoc, Ray

From: Daniel Spruill <daniel.spruill@hollyspringsnc.gov>
Sent: Monday, June 27, 2022 1:57 PM
To: Reid, Jonathan; Shannon Cox; Rickard, Alex; shelby.powell@campo-nc.us; Bruff, Mike; chris.lukasina@campo-nc.us; Shekhar, Shashank; Magsanoc, Ray; Kendra Parrish; Chris Hills; Sean Ryan; Russell Dalton; Dwjernigan@ncdot.gov; Deaton, Robert W; Dpkeilson@ncdot.gov; Pageary@ncdot.gov; Tim Gardiner; Akul Nishawala; Elizabeth Goodson
Subject: FW: --[EXTERNAL]--Re: US 1 / Friendship Interchange Hot Spot - Alternative 6

Follow Up Flag: Follow up
Flag Status: Completed

Categories: Orange category

Hi Jonathan,

Apologies for the delay in response. We received feedback from Amgen this morning that they need 1-2 weeks to fully evaluate Alternative 6. Due to time constraints, Holly Springs thinks that going forward with Alternative 6 with a call out if possible to Alternative 2 (Amgen's previous preference) as the recommended options should be fine. Following meetings with Amgen in a couple weeks we should be able to come back to CAMPO and group with any revisions to the southern route. Thank you for all the hard work on this project!

Best,
Daniel S.

Daniel Spruill | Transportation Planner
Development Services | Town of Holly Springs
PO Box 8 | 128 S. Main St. Holly Springs, NC 27540
Office: (919) 567-4724
www.hollyspringsnc.gov

From: "Reid, Jonathan" <jonathan.reid@arcadis.com>
Date: June 24, 2022 at 1:04:08 PM EDT
To: Shannon Cox <Shannon.Cox@apexnc.org>, "Rickard, Alex" <Alex.Rickard@campo-nc.us>, shelby.powell@campo-nc.us, "Bruff, Mike" <mike.bruff@campo-nc.us>, Chris.Lukasina@campo-nc.us, "Shekhar, Shashank" <Shashank.Shekhar@arcadis.com>, "Magsanoc, Ray" <Ray.Magsanoc@arcadis.com>, Kendra Parrish <kendra.parrish@hollyspringsnc.gov>, Chris Hills <chris.Hills@hollyspringsnc.gov>, Sean Ryan <sean.ryan@hollyspringsnc.gov>, Russell Dalton <Russell.Dalton@apexnc.org>, Dwjernigan@ncdot.gov, "Deaton, Robert W" <rdeaton@ncdot.gov>, Dpkeilson@ncdot.gov, Pageary@ncdot.gov, Tim Gardiner <Tim.Gardiner@wakegov.com>, Akul Nishawala <Akul.Nishawala@wakegov.com>, Elizabeth Goodson <Elizabeth.Goodson@hollyspringsnc.gov>
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Thanks Shannon!

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Sent: Friday, June 24, 2022 10:55:04 AM
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From: Reid, Jonathan [mailto:Jonathan.Reid@arcadis.com]
Sent: Friday, June 24, 2022 9:40 AM
To: Rickard, Alex <alex.rickard@campo-nc.us>; shelby.powell@campo-nc.us; Bruff, Mike <mike.bruff@campo-nc.us>; chris.lukasina@campo-nc.us; Shekhar, Shashank <Shashank.Shekhar@arcadis.com>; Magsanoc, Ray <Ray.Magsanoc@arcadis.com>; Kendra.Parrish@hollyspringsnc.gov; Chris.Hills@hollyspringsnc.gov; Sean.Ryan@hollyspringsnc.gov; Russell Dalton <Russell.Dalton@apexnc.org>; Shannon Cox <Shannon.Cox@apexnc.org>; Dwjernigan@ncdot.gov; Deaton, Robert W <rdeaton@ncdot.gov>; Dpkeilson@ncdot.gov; Pageary@ncdot.gov; Tim Gardiner <tim.gardiner@wakegov.com>; Akul Nishawala <Akul.Nishawala@wakegov.com>; Elizabeth.Goodson@hollyspringsnc.gov
Subject: FW: US 1 / Friendship Interchange Hot Spot - Alternative 6

All:
Still looking for your feedback on this. Really need **by COB today** to have the opportunity review and include in the final report due next week.
Thanks!

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From: Reid, Jonathan
Sent: Wednesday, June 22, 2022 11:15 PM
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Subject: US 1 / Friendship Interchange Hot Spot - Alternative 6

All:

Good meeting today! Thanks to receipt of the northern alignment info from Will and Shannon, we were able to modify the Alternative 6 concept to be as consistent as possible with the original alignment up to the divergent point to move the interchange to the southwest. The attached JPEG file illustrates where the proposed alignment deviates from the original alignment north of US-1. There are also two PDFs that show the proposed full project alignment and a closer view of the Amgen impacts and RAB

intersection south of US-1. Both include the hydrological layer to show where there are proposed stream impacts.

Several notes about this concept:

- The proposed alignment avoids one longitudinal impact but has one more perpendicular stream crossing
- The project corridor now terminates in Holly Springs at the roundabout intersection
- The tight diamond interchange ramps are ever-so-slightly off center with the freeway to avoid both stream and utility impacts on the south side of US-1

Please let me know if you have comments on this Alternative 6 concept tomorrow (Thursday) or by noon Friday at the latest. If we gain consensus by e-mail (including conformation that Amgen is good with this alignment), we can squeeze this in as the preferred alignment in the final report to be completed next week.

Thanks for your quick attention to this!

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