NORTH CAROLINA

ACCESS2040

ACCESS2040

AN ALTERNATIVE TO THE PROPOSED I-540 EXTENSION

Wake County, North Carolina

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SUMMARY

ACCESS2040 is proposed as an alternative to *Complete 540*, a planned 28.4-mile six-lane toll road between the existing terminus of NC 540 at NC 55 Bypass in Apex and US 64/264 in Knightdale. ACCESS2040 features seven improved arterial road corridors —three east-west and four north-south —through the study area (southeast Wake County) established by the *Complete 540* project. Most of the improvements to the seven corridors in ACCESS2040 would be projects identified as either funded or needed by the *CAMPO 2040 Metropolitan Transportation Plan (MTP)*. To this base of *CAMPO 2040 MTP* projects (predominantly widening of roads to a four- or six-lane cross section and some grade-separated interchanges) ACCESS2040 would add segments of new road to extend and connect existing roads, forming continuous routes throughout the study area.

The recommended designs for ACCESS2040 corridors are adaptations of the NCDOT standard multi-lane highway cross sections. These adaptations, recognizing that the study area is already urbanizing and will continue to do so, would accommodate all modes of travel and prepare the widened roads to serve as armatures for the expected growth.

ACCESS2040 would meet the two primary purposes of the *Complete 540* project:[1]

1. It would provide over half of the mobility gains attained by *Complete 540*. Within the entire Triangle region (study area included) it would provide MORE congestion relief than *Complete 540*.
2. ACCESS2040 also meets the *Complete 540* secondary purpose of providing direct connections between the existing NC 540 terminus of Triangle Expressway in Holly Springs and US 64/264 in Knightdale or I-40 south with three east-west corridors: Ten Ten Road, Tryon Road Corridor and NC 55/NC 42.

The difference in environmental impacts between ACCESS2040 and *Complete 540* could hardly be starker. ACCESS2040, building on long-planned improvements to the entire network of roads in the study area, has few negative environmental impacts, few property takings and yields a network of improved arterial roads becoming armatures for the inevitable growth. By contrast, *Complete 540* has major negative environmental impacts (noise, damage to wetlands), does little to shape the emerging urban growth of the study area and to the contrary imposes a 70 MPH barrier through the center of the area.

The costs attributable solely to ACCESS2040 are "unfunded" projects (i.e., beyond year 2040) from the *CAMPO 2040 MTP* and projects not included anywhere in the *CAMPO 2040 MTP*. These costs attributable solely to ACCESS2040 are only $ 294 million, or one-seventh of the $2.24 billion cost of the Complete 540 Preferred Alternative. Even if ACCESS2040 were assessed with the cost of all of its components from the *CAMPO 2040 MTP*, its total cost would be only $1.18 billion, or around one third of the total of $ 3.12 billion cost of the Preferred Alternative similarly assessed with the cost of its supporting components from the *CAMPO 2040 MTP*.

ACCESS2040 would be a cost-effective use of public funds, yielding a positive benefit-cost ratio. This benefit/cost relationship stands in sharp contrast to that of *Complete 540*, which fails to meet criteria for funding from either "traditional" NCDOT (non-toll) sources or revenue-bond toll financing.

BACKGROUND

This report proposes ACCESS2040 as a more cost-efficient and environmentally sensitive alternative to *Complete 540*, the proposed 18.4-mile toll road extension of NC 540 (Triangle Expressway) through Southeast Wake County, NC. This extension of NC 540 has been adopted as the Preferred Alternative of the *Complete 540* project by NCDOT (Figure 1).

In arriving at this Preferred Alternative, NCDOT first identified twelve alternative concepts. In a first tier screening, three alternatives (TDM, TSM and Mass Transit/Multi-Modal) were dismissed as ineffective for meeting any of the project purposes of mobility, congestion relief or regional connectivity. Travel demand and traffic performance for the remaining nine alternatives were modeled with the Triangle Regional Model (TRM). Of the remaining nine alternatives, "build" alternatives incorporating segments of new road and/or widening of existing roads, all but the "New Location Highway" were eliminated as not ranking high enough in a "quartile analysis" measuring the primary purposes "to improve mobility within or through the study area during peak travel periods [and] to reduce forecast congestion on the existing roadway network".[2]

In a third-tier screening NCDOT analyzed 17 different route configurations (Detailed Study Alternatives, or DSA's) for the "New Location Highway" alternative. Each DSA was built from some combination of nine color-coded "preliminary corridor alternatives" segments.

In February 2016 the NCDOT recommended DSA 2 as the *Complete 540* Preferred Alternative. DSA 2 calls for 28.4 miles of new 6-lane limited access toll road connecting the existing I-540 terminus at NC 55 in Apex with US 64/264 in Knightdale and with 11 intermediate interchanges at existing roads. The cost of the Preferred Alternative has been estimated by NCDOT at $2.24 billion.

In a 2017 update[3] of the first tier screening process NCDOT updated the quartile ranking with year 2040 TRM outputs. NCDOT again found that only a "New Location Highway" (NC 540 extension from Apex to Knightdale) would meet the project purposes.

OBJECTIVES OF THE PROPOSED ALTERNATIVE ACCESS2040

The objectives of ACCESS2040 are to:

1. Achieve most of the benefits (mobility, congestion relief and regional connectivity) of *Complete 540* at a fraction of its cost and environmental impact.
2. Attain objectives of mobility, congestion relief and regional connectivity by augmenting projects already recommended in plans adopted by the Capital Area Metropolitan Planning Organization (CAMPO).

Important secondary objectives of ACCESS2040 are to:

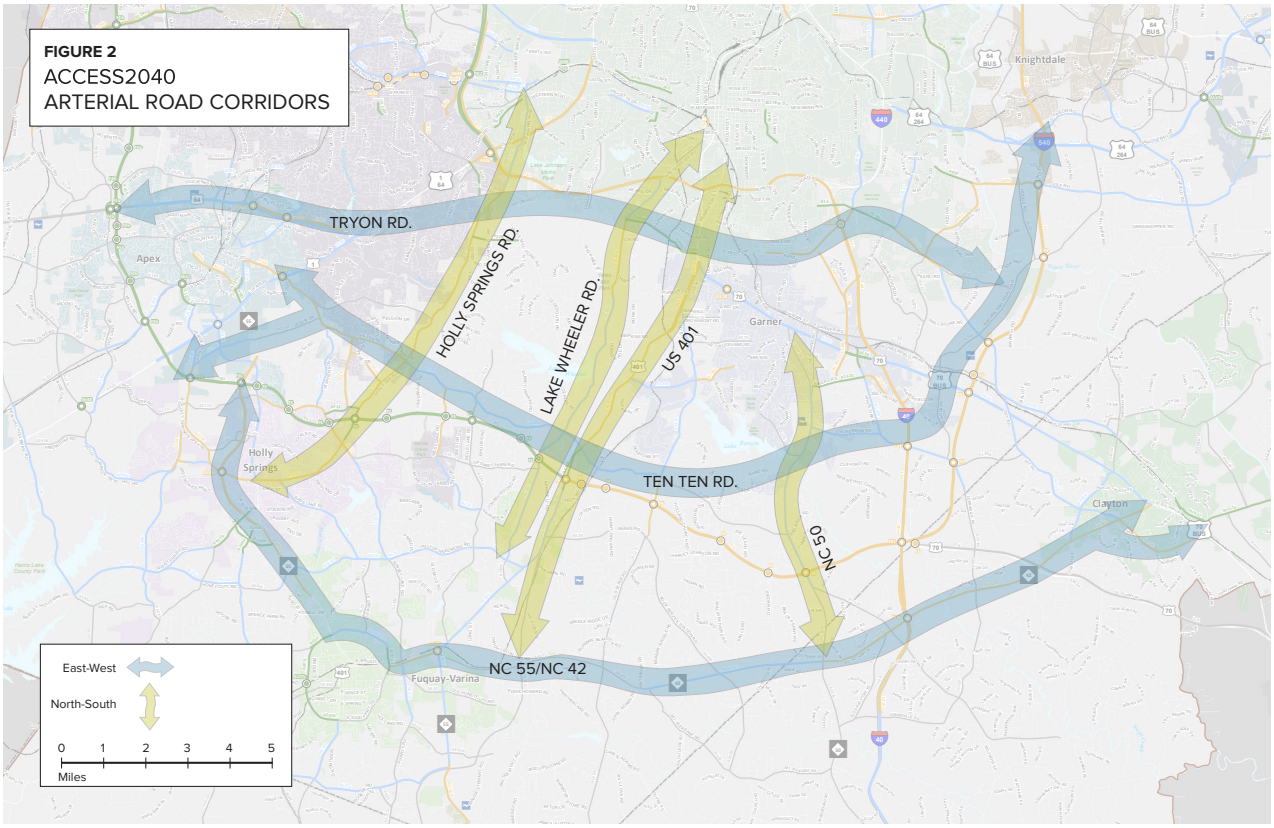
1. Create transportation solutions for a wide range of users.
2. Guide the suburban growth in Southern Wake County into sustainable patterns.

Cost Effective Congestion Relief and Regional Mobility

In its first tier screening of alternatives, treatment of all "ER" (Existing Road) alternatives, NCDOT appears oblivious to the concept of cost effectiveness. Instead of assessing alternatives on the basis of their benefits compared to their costs the NCDOT dismisses all of them except New Location Highway for simply not being in the top quartile of the applied measures of effectiveness (MOE's). The results suggest that the quartile ranking is inadequate as the sole measure for screening alternatives. For example, the alternative Improve Existing 3-Arterials (IE3-A) yields around one half of the mobility gains and more congestion relief than the New Location Highway. Yet NCDOT dismisses it in the quartile ranking as not accomplishing project goals. In fact, the reported performance of Alternative IE3-A suggests a promising and affordable (fiscally and environmentally) alternative to *Complete 540*. ACCESS2040, an improvement over alternative IE3-A, should be considered as a strong, cost effective solution.

Build on Foundation of CAMPO Projects

ACCESS2040 starts with a foundation of 52 projects selected from the *2040 Metropolitan Transportation Plan* (hereinafter *2040 CAMPO MTP*) adopted by the North Carolina Capital Area Metropolitan Planning Organization (CAMPO). Most of these projects are widening of roads



to multi-lane divided arterials. To this base of improvements, ACCESS2040 would add a small mileage of extensions to existing roads. These widenings and extensions would create continuous multi-lane arterial routes across southern Wake County in both the east-west and north-south directions.

The ACCESS2040 approach of building on a base of *CAMPO 2040 MTP* projects differs somewhat from the "IE" ("Improve Existing") alternatives that NCDOT eliminated. The first tier screening selected only a limited ("fiscally constrained") number of the planned CAMPO projects, thereby eliminating almost all projects with more than a 15-20 year funding horizon.

It should come as no surprise that an assembly of projects from the *CAMPO 2040 MTP* and including Complete 540 would meet the travel needs of the study area. The *CAMPO 2040 MTP* vision of "patterns of development that contribute to a distinctive place" and its goal to "manage growth by linking land use patterns" steers the resulting plan toward more, improved and better-connected local roads. The single limited- access 70-MPH spine of the Triangle Expressway Extension in *Complete 540* does little toward meeting this goal, and may even obstruct its attainment. The travel demand forecast ("traffic") model underpinning the *CAMPO 2040 MTP* project selection reflects travel desires of the residents of the area. The Triangle Expressway extension, not emerging from this modeling process but rather superimposed on it as a "given," adds little to the ability of the other CAMPO projects to meet the forecast travel demand. The cost-effectiveness test ("payback" period) for each *CAMPO 2040 MTP* project assures a plan that in its entirety meets needs with projects whose benefits outweigh their costs.

All-Mode Travel

ACCESS2040 anticipates an increase in transit travel as projected by the *Wake County Transit Plan* and the GoRaleigh five-year transit improvement plan. ACCESS 2040 also anticipates and meshes with projects for non-motorized (bicycle and pedestrian) travel as programmed in the *CAMPO 2040 MTP*. ACCESS2040 would complement these plans with road designs that immediately accommodate a wide range of users and anticipates and provides for future increases in non-automobile travel.

By contrast, *Complete 540* is concerned solely with a 70 MPH toll road completing a freeway or toll road ring around the greater Raleigh area.

Future Urban Fabric

ACCESS2040 is designed to provide southern Wake County with a connected network of arterial roads and streets serving as armatures for growth anticipated by the cities (Apex, Holly Springs,

Fuquay-Varina, Garner and Knightdale) within the study area. Further, ACCESS2040 would equip these armatures for sustainable growth with design features such as street connectivity, attractive routing for transit, large mileage of new sidewalk and selected grade-separated intersections. These features would help guide suburban growth in Southern Wake County into sustainable patterns.

By contrast, the sole alternative seriously considered in the *Complete 540* project is a six-lane 70 MPH limited access toll road with no value as an armature for urban growth and no ability to transition into a more useful form as growth occurs. To the contrary, as southern Wake County continues to urbanize the *Complete 540* increasingly becomes a barrier, separating the communities and their population into "inside the beltway" and "outside the beltway" contingents. Rather than fostering the growth of a dense network of local and collector streets that is essential for "smart growth", *Complete 540* would permanently restrict the development of north-south local and collector streets.

Table 1: Summary of Site-Specific Improvements ACCESS2040

Corridor (Figure number)	Widen to Four Lanes		Widen to Six Lanes		New Roadway		Grade-Separated Interchanges
	Qty	Miles	Qty	Miles	Qty	Miles	
Tryon Road (3)	5	6.23	2	6.50	2	2.65	2
Ten Ten Road (3)	13	34.92			3	2.24	
NC 55/NC 43 (3)	8	15.66	1	5.95			3
Holly Springs Road (4)	8	12.31					
Lake Wheeler Road (4)	5	10.98					
US 401 (4)			4	11.56			
NC 50 (4)	3	12.39					
All Corridors (2)	42	92.59	7	24.01	5	4.89	5

Notes: Corridor improvements are summarized in Figure 2 and shown in detail in Figures 3 and 4
Qty–Number of road segments with improvement type indicated
Source: Appendix Tables A.1 through A.7

CONCEPT PLAN FOR ACCESS2040

The overarching concept of ACCESS2040 consolidates and extends improvement projects identified in the *CAMPO 2040 MTP* to form seven arterial (road or street) corridors (Figure 2).

The proposed improvement to these corridors would yield both: (1) increased all-mode capacity for local trips (within the study area); and (2) increased connectivity for external travel (trips with origin, destination or both outside the study area). East-west regional connectivity, an important purpose of the *Complete 540* project, would be served by three corridors.

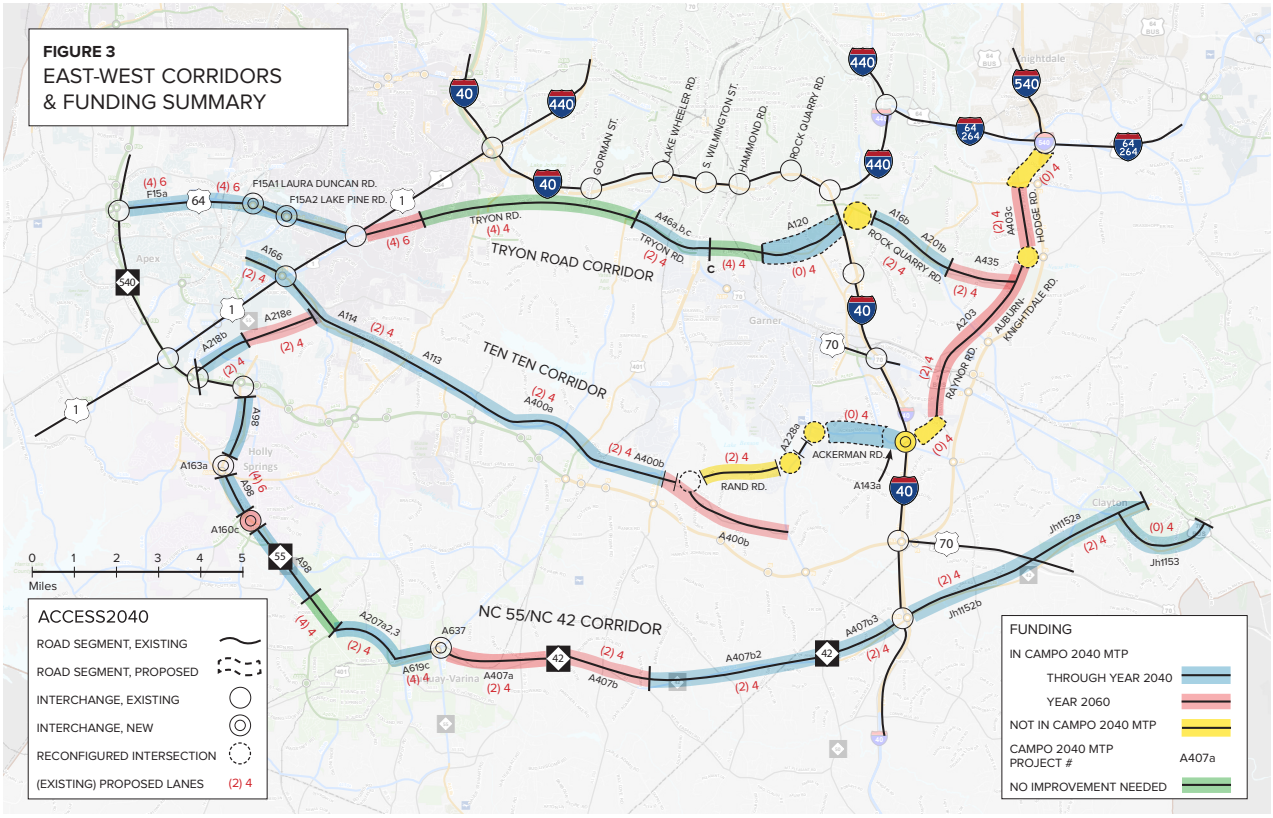
In addition to improving capacity and mobility, the seven corridors would all serve as armatures of continued growth.

For the seven corridors in ACCESS2040, site-specific improvements (Table 1 and Figures 2, 3 and 4) are:

1. Widening of roads, generally to a four-lane divided cross section
2. New road segments, extending and/or connecting existing roads
3. Replacement of at-grade intersection with grade-separated interchanges

In addition to the site-specific improvements identified in Table 1, three general improvements apply throughout all corridors:

1. Provision on most widened roads for all modes (pedestrian, bicycle, transit) of travel
2. Incorporating subarea plans as developed in the CAMPO Southeast and Southwest area studies
3. Managing access, following the guidelines in the NCDOT Access Management Manual.



DETAILED DESCRIPTION OF ACCESS2040 CORRIDORS

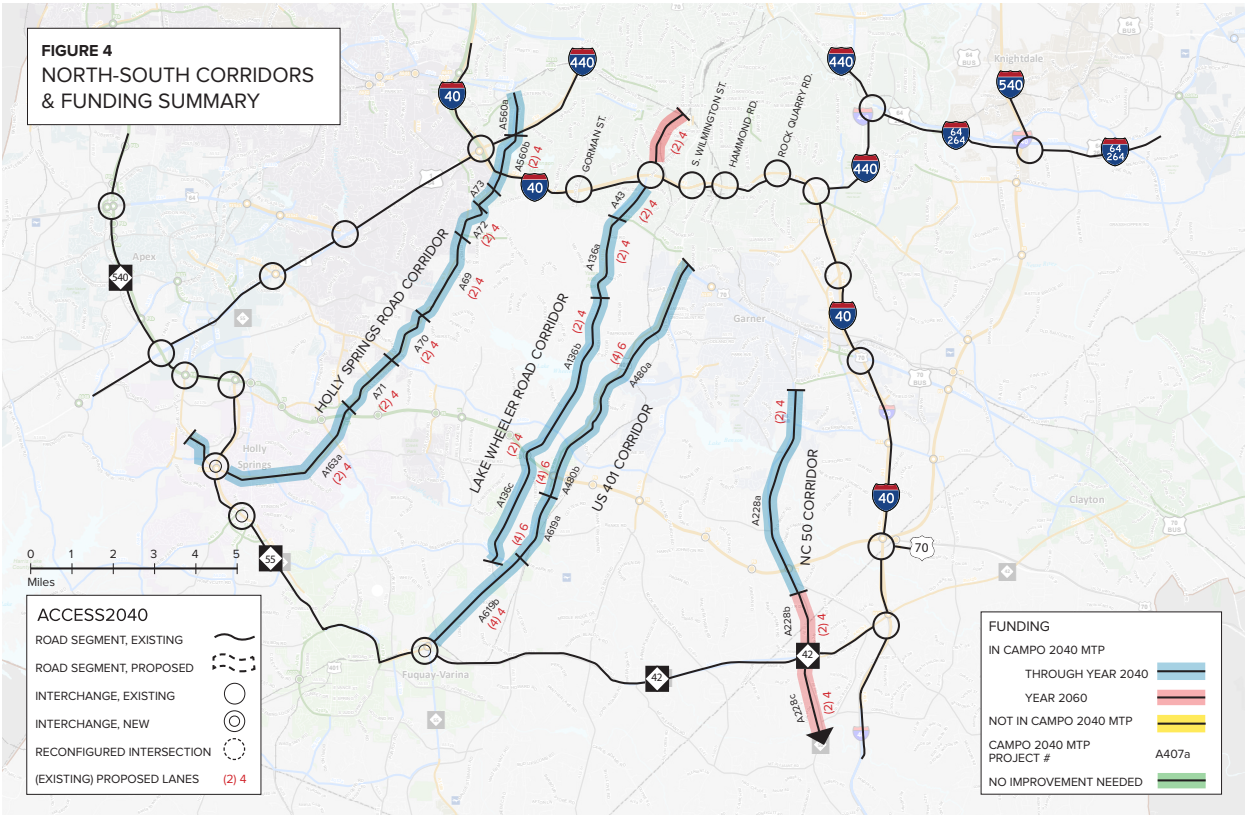
East-West Corridors

Figure 3, Table 1 and Appendix Tables A.1 through A.3 summarize the three east-west corridors in ACCESS2040.

Ten Ten Corridor—The Ten Ten Road corridor in ACCESS2040 would provide a continuous east-west four-lane arterial route through the study area, connecting the existing Triangle Expressway terminus at NC 55 Bypass in Apex with US 64/264 in Knightdale. With its connection to the Triangle Expressway to the west, the Ten Ten corridor would accomplish a key purpose (accommodating work trips between southern Wake County and the RTP) of the *Complete 540* project. The Ten Ten corridor would also meet the *Complete 540* objective of providing a continuous route for "external" trips (trips with neither origin nor destination within the study area).

At its western end, the Ten Ten corridor would begin with two spurs: (1) a new segment of Jessie Drive connecting Ten Ten Road to Old Holly Springs Apex Road (Veridea Parkway) just north of its interchange on the Triangle Expressway near Holly Springs and (2) a segment of Center Street in Apex, transitioning into Ten Ten Road thereby connecting to US 1 and the Apex Peakway. The Ten Ten corridor would continue eastward along Ten Ten Road to its intersection with Rand Road. The corridor would then follow Rand Road to NC 50. After a short run on NC 50, the corridor would follow the proposed extension of Ackerman Road, then onward on the existing Ackerman Road to its intersection with White Oak Road. The route would then follow White Oak Road to Hicks Road, where it would intersect with and follow a new segment of road taking it to Raynor Road. The route then follows a sequence of Raynor Road, Auburn Knightdale Road and Hodge Road to just north of Poole Road, where it would join a new road segment connecting to an interchange on US 64/264.

Tryon Corridor—This corridor, comprised mainly of Tryon Road and its extensions, would cross the northern edge of the study area. At its western end, it would connect to the Triangle Expressway/US 64 interchange in Apex, thereby accommodating work trips to and from RTP. At its eastern end, the route would join the Ten Ten corridor, which would then connect with an interchange on US 64/264 in Knightdale. With this connection, the Tryon Road Corridor, like the Ten Ten Road corridor, would meet the *Complete 540* objective of regional linkage, by providing a continuous route for trips between the Triangle Expressway in Apex and the US 64/264 interchange in Knightdale.



From its western end at the Triangle Expressway to US 1, the Tryon Road corridor would follow US 64, which would be widened and upgraded to a six-lane freeway with interchanges replacing the at-grade signalized intersections at Laura Duncan Road and Lake Pine Road. Between US 1 and Rock Quarry Road, the route would follow a combination of existing four-lane Tryon Road and new four lane extensions. The route would then follow a combination of Rock Quarry Road and Battle Bridge Road, intersecting with the Auburn Knightdale Road segment of the Ten Ten Corridor, in turn connecting to an interchange with US 64/264 in Knightdale.

NC 55/NC 42 Corridor—At its western end this corridor would connect directly with the existing terminus of the Triangle Expressway, thereby accommodating travel from the southern study area to the RTP, Durham and I-40 west. At its eastern end, the corridor would connect to I-40 and US 70, thereby serving external regional east-west travel through the study area, for example between the Triangle Expressway and I-40 to/from the south.

From its interchange with the Triangle Expressway at its western end to Dickens Road, the NC 55/ NC 42 route would follow NC 55, widened to six lanes. Within this segment of NC 55, two at-grade intersections (at Old Holly Springs Apex Road and Ralph Stevens Road) would be replaced with grade-separated interchanges. From Dickens Road southward the route would follow the existing four-lane NC 55, then Judd Parkway eastward, continuing on NC 42 and US 401 to the grade-separated interchange that would replace the signalized intersections at the US 401/NC 42/NC 55 junction. The route would then follow NC 42 widened to four lanes to its interchange with I-40 and beyond to US 70 Business in Clayton. The eastern end of the corridor in Clayton would include a spur, a four-lane extension of Guy Road between NC 42 and US 70, bypassing the center of Clayton.

North-South Corridors

Figure 4, Table 1 and Appendix Tables A-4 through A-7 summarize the four north-south corridors in ACCESS2040. In addition to serving local trips (i.e., entirely within the study area) and serving as armatures for growth, the north-south corridors would serve two regional travel needs: (1) connection between residential trip origins (households) in southern Wake County and the major employment destinations to the north (among them downtown Raleigh, NCSU and Rex Hospital) and (2) connecting links to the three east- west corridors (Figure 3) all of which would connect directly to the Triangle Expressway on the west and either US 64/264 or I-40 to the east.

Holly Springs Road Corridor—This corridor would link Holly Springs and Fuquay-Varina to large employment centers, among them NCSU and Rex Hospital, in western Raleigh. From its southern end at NC 55, the route would follow a combination of Holly Springs Road and Jones Franklin Road to Western Boulevard.

Lake Wheeler Road Corridor—This corridor would connect the center of the study area to employment, state government and commercial destinations in Downtown Raleigh, including the state capitol area. With its interchange with I-40, the Lake Wheeler corridor would also comprise part of a route between the center of the study area and the RTP.

The Lake Wheeler corridor is parallel to and serves much of the same area as US 401, and would become increasingly important as a reliever to US 401.

Beginning at Hilltop Needmore Road, this corridor would follow Lake Wheeler Road northward to South Saunders Street.

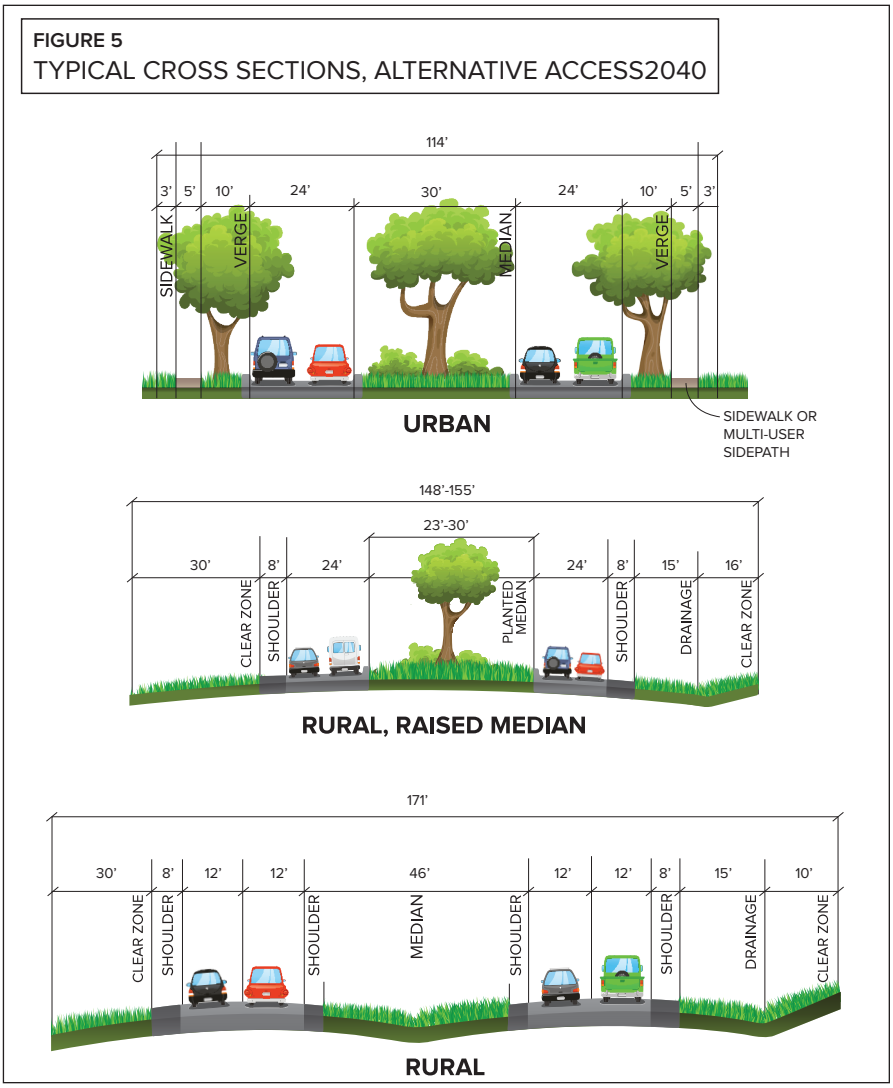
US 401 Corridor—This major arterial road would connect Fuquay-Varina and areas to the south of it to Garner, Downtown Raleigh and I-40. The corridor would begin at NC 42 and would continue to the US 401/US 70 interchange in Garner.

NC 50 Corridor—This corridor would serve as an alternative to I-40 for travel between the eastern part of the study area and US 70, in turn serving Garner and downtown Raleigh. The corridor would begin at NC 42 west of I-40, continuing northward to the Timber Drive.

Cross Sections

The proposed cross section for segments of road widening (49 segments) and road extensions (three segments) included in the seven ACCESS2040 corridors would be adaptations of standard NCDOT cross sections for arterial roads. Reflecting existing and expected land use conditions along these corridors, one of three cross section options (Figure 5) would be fitted:

FIGURE 5
TYPICAL CROSS SECTIONS, ALTERNATIVE ACCESS2040



1. *Urban Raised Median*—An adaptation of the standard NCDOT "raised median" cross section to account for anticipated future urban conditions[4]. Adaptation would involve: (a) substituting enclosed drainage ("curb and gutter") for the open swale drainage, (b) verges of 10 feet outside the curbs and (c) sidewalks outside the verge on both sides of the road, with the possibility on selected road segments of substituting a multi-use trail for one or both of the sidewalks. Indicators for the choice of the "Urban Raised Median" cross section are surroundings that are already developed, proximity to commercial areas, fronting commercial destinations, school zones, incorporated areas and areas zoned for intensive development.
2. *Rural Raised Median*—The standard NCDOT cross section recommended "when widening [an] existing two lane-two way facility to four lanes with very restricted R/W [Right of Way]".[5] Although there is no firm definition by NCDOT of "very restricted" right of way, much of the road frontage in the seven corridors included in the ACCESS2040 would likely require the "Rural Raised Median" cross section.
3. *Rural 46' Median*— The standard NCDOT cross section for "widening or resurfacing" for "Use when there are existing right of way constraints".[6] This cross section is best for open country in unincorporated areas, with minimal year 2040 projected development.

Figure 5 and Table 2 summarize the proposed cross sections.

Table 2: ACCESS2040 Cross Section Summary

Cross Section Element	Cross Section Type		
	Urban Raised Median	Rural Raised Median	Rural 46' Median
Right of way (R/W) width (ft)	114–124	148–155	171
Number of lanes	4	4	4
Lane width (ft)	12	12	12
Median width (ft)	23–30	23–30	46
Median cross section	Raised	Raised	Swale
Roadside drainage	Curb & gutter	Swale, ditch	Swale, ditch
Sidewalks	Both sides	No	No
Multi-use trail	In place of one or both sidewalks	Not in standard R/W	Not in standard R/W
Speed limit (miles per hour)	45	45	55
Median plantings greater than 6" dbh	Permitted	Permitted	Prohibited
Roadside planting greater than 6" dbh	Permitted in verge	Prohibited in R/W	Prohibited in R/W

Notes: Cross sections adapted from *NCDOT Roadway Design Manual*, 1-2B
For six-lane cross section, add 24 feet to Right of Way (R/W) width

Property Takings and Relocations Required for ACCESS 2040

Components of ACCESS2040 not included in the *CAMPO MTP* could require around twenty residential relocations. Most of these relocations would be near the proposed extensions of Ten Ten Road and some segments of new road in that corridor. ACCESS 2040 would not divide or require access reconfiguration for any neighborhood developments.

In addition to relocations needed for its *CAMPO 2040 MTP* components, *Complete 540* would require 217 relocations (209 residential, five business and three non-profit) to accommodate the proposed six-lane toll road and its interchanges. Complete 540 would also bisect or require access reconfiguration for five neighborhood developments.

PERFORMANCE OF ACCESS2040

ACCESS2040 meets the two primary objectives[7] of the *Complete 540* project "to improve mobility and to reduce traffic congestion in the project area" and its secondary objective "to improve system linkage in the area roadway network."

Improving Mobility and Reducing Traffic Congestion

The ability of ACCESS2040 to meet the primary objectives (mobility and congestion reduction) of *Complete 540* can be gauged from Alternative IE3-A (Improve Existing [Highways] 3-Arterial). IE3-A is the first tier concept alternative that most closely resembles ACCESS2040, and can therefore serve as a surrogate. Although Alternative IE3-A lacks some of the important components of ACCESS2040, it nevertheless establishes a reasonable basis for gauging the **minimum** performance of ACCESS2040.

Table 3 compares the attainment of *Complete 540* objectives by Alternative IE3-A and therefore the minimum attainment by its surrogate ACCESS2040 to that of the "New Location Highway".[8]

Table 3: Minimum Attainment of Measures of Effectiveness Alternative IE3-A and ACCESS2040 versus New Location Highway *(Complete 540)*

Project Purpose	Year 2040 MOE	Region Wide		Study Area	
		PM Peak	Daily	PM Peak	Daily
Improve Mobility	Travel Speed	62%	57%	52%	50 %
	Travel Time, RTP	59%			
	Travel Time, Brier Creek	44%			
Reduce Congestion	Reduction, VHT		58%		40 %
	Reduction, Congested VMT	85%	IE3-A and ACCESS2040 Outperform NLH	87 %	IE3-A and ACCESS2040 Outperform NLH
	Reduction, Congested VHT	63%	IE 3-A and ACCESS040 Outperform NLH	59 %	IE3-A and ACCESS2040 Outperform NLH
	Reduction, Congested Roadway Mileage	87%	IE3-A and ACCESS2040 Outperform NLH	IE3-A and ACCESS2040 Outperform NLH	IE3-A and ACCESS2040 Outperform NLH

Notes: MOE - Measure of Effectiveness
VHT - Vehicle Hours of Travel
VMT - Vehicle Miles of Travel
IE3-A - Alternative Improve Existing [Highways] 3-Arterial, as defined in first tier screening
NLH - New Location Highway (Triangle Expressway Extension)

MOE data from *First Tier Concepts Screening and Traffic Reassessment*, December 12, 2017, Tables 2 through 8, and tables titled "2040 Alternatives Analysis PM Travel Times" for "Origin: Research Triangle Park" and for "Origin: Brier Creek"

Percentage attainment for ACCESS 2040 is the ratio of improvement over "No Build" attained by Alternative IE3-A (referred to as "Improve 3 - Arterial in Tables 2-8 referenced above) to that attained by "New Location Highway ("NLH)"). Attainment is difference between "No Build" and subject alternative.

ACCESS2040 would deliver more than half the mobility benefits of *Complete 540*:

- For all time/area categories of the most broad-based mobility MOE (travel speed) ACCESS2040 would deliver over half the benefit of *Complete 540*.
- For the most comprehensive time/area category (daily, region-wide) of the travel speed MOE ACCESS2040 would deliver 57 percent of the gain attained by *Complete 540*.
- For the more narrowly defined MOE's measuring travel times to/from RTP or Brier Creek ACCESS 2040 would deliver 59 percent and 44 percent, respectively, of the reduction in travel time attained by *Complete 540*.

The accomplishment by ACCESS2040 of at least 50 percent of the average speed increase of *Complete 540* is significant, despite what at first might appear to be low percentages of attainment. *Complete 540* gains much of its increase in average speed through the single measure of a lengthy segment of high-speed (70 MPH) Triangle Expressway extension. That ACCESS2040 would accomplish around half of this speed increase should not be interpreted as a shortcoming in ACESS2040, but rather more as an indication of the extensive improvement that could gained from simply improving arterial roads, as does ACCESS2040.

In attaining the congestion relief purpose, ACCESS2040 would ***outperform*** *Complete 540*:

- For all three MOE's that directly measure congestion[9], ACCESS2040 would provide more relief than *Complete 540*, for both of the most wide-ranging time/area categories: daily within both the region and study area.
- For the three congestion relief MOE's in the PM peak ACCESS2040 would attain from 59 percent to more than 100 percent of the *Complete 540* attainment. That *Complete 540* outperforms Alternative IE3-A and ACCESS2040 during the PM peak in no way indicates overall superiority of *Complete 540*. Rather, the daily MOE's which include the peak period indicate overall superiority of the Alternative IE3-A and ACCESS2040, confirming that the small PM peak advantage shown for *Complete 540* comes "at the expense" of a net daily gain in congestion. Reducing congestion for only the PM peak could, in proper context, be a reasonable MOE. However, reducing congestion during only the PM peak while increasing it by a greater amount for the entire day is neither technically supportable as transportation planning nor likely to be acceptable to the public.

The inclusion, in ACCESS2040, of some major improvements not included in its surrogate Alternative IE3-A assures that ACCESS2040 would perform even better than indicated above in Table 3:

- Extension of Ten Ten Road corridor with new segments of four-lane divided road which would provide a continuous four-lane route between Apex and Knightdale
- Grade separations at some locations on NC 42 and widening it throughout, which would provide a continuous and partially grade separated route between Holly Springs and Clayton
- Widening of some segments of north-south routes on the Lake Wheeler Road and NC 50 corridors.

Improving System Linkage in the Area Roadway Network

ACCESS2040, with continuous multi-lane (four-lane or six-lane) roads in its Ten Ten Road and Tryon Road corridors, would provide the same signature improvement in system linkage as *Complete 540*: arterial road connection between NC 540 in Apex/Holly Springs and US 64/264 in Knightdale.

In meeting this overarching goal of continuity between NC 540 and US 64/264, ACCESS 2040 would provide many more ancillary opportunities for system linkage than *Complete 540*. *Complete 540* would add to regional linkage with one limited-access toll road connecting to a single point at either end (NC 540 and Us 64/264) with eleven intermediate access points (interchanges). By contrast, ACCESS 2040 would provide three east-west multilane road links between numerous origin/destination points (see Figure 2, 3 and 4). Each of these east-west routes would connect to all north-south intersecting roads, rather than at just eleven interchanges as in *Complete 540*.

Table 4: ACCESS2040 Cost Summary

Corridor	Project Costs ($ millions)			
	In *CAMPO 2040 MTP*		Not in *CAMPO 2040 MTP*	ACCESS2040 Total
	Through Horizon Year 2040	Beyond Horizon Year 2040		
East-West Corridors				
Tryon Road	87.5	14.8	1.9	104.2
Ten Ten Road	200.7	112.5	48.5	361.7
NC 55 & NC 42	260.9	51.0	0	311.9
North-South Corridors				
Holly Springs Road	99.6	0	0	99.6
Lake Wheeler Road	88.3	8.6	0	96.9
US 401	112.7	0	0	112.7
NC 50	36.8	56.4	0	93.2
Entire ACCESS2040	886.5	243.3	50.4	1,180.2

COST OF ACCESS2040

The total cost of ACCESS2040 is $1,180 million (Table 4).

Three quarters (75 percent) of the entire cost of ACCESS2040 ($886 million of $1,180 million) is from "financially feasible" projects (i.e. included in horizon years 2020, 2030 and 2040) in the *CAMPO 2040 MTP*. Another 21 percent ($243 million) of the cost of ACCESS2040 is from horizon year 2060 projects (planned but not yet funded) in the *CAMPO 2040 MTP*. Only four percent ($50 million) of the cost of ACCESS2040 is from projects not included at all (i.e., neither funded nor unfunded) the *CAMPO 2040 MTP*.

Two corridors account for over half of the cost of ACCESS2040. At $361 million (31 percent of total cost) the widening and extension of Ten Ten Road is the costliest of the seven corridors in ACCESS2040. This cost reflects widening of around 35 miles of road to four lanes, 2.2 miles of new four-lane road and four reconfigured intersections (Appendix Table A.2). The NC 55/NC 42 route is the second most costly at $313 million (26 percent of total cost). Most of this cost comes from 23 miles of widening and three grade-separated intersections (Appendix Table A.3).

The $50 million for projects in ACCESS2040 that are not included in the *CAMPO 2040 MTP* is mostly for new road segments on the Ten Ten corridor.

COST COMPARISON, ACCESS2040 AND COMPLETE 540

The "financially feasible" components of the *CAMPO 2040 MTP* are common to both ACCESS2040 and Complete 540. In comparing the costs of the two alternatives (Table 5) the appropriate cost measure is therefore the cost increment beyond that of the *CAMPO 2040 MTP* projects common to both alternatives.

Table 5 : Increment of Cost Beyond Horizon Year 2040, CAMPO 2040 MTP ACCESS2040 and *Complete 540*

Cost Increment	ACCESS2040 ($ Million)	Complete 540 ($ Million)
CAMPO 2040 MTP, Horizon Year beyond 2040	243.3	
Not in CAMPO 2040 MTP	50.4	2,240.0
Total increment beyond CAMPO 2040 MTP Horizon Year 2040	293.7	2,240.0

COST EFFECTIVENESS OF ACCESS2040

Although the documentation for *Complete 540* offers no analysis of cost effectiveness for any of the alternatives considered, project data does support a simplified approximation (Table 6) of such analysis for ACESS2040 and *Complete 540*.

The ACCESS2040 Benefit/Cost ratio of 2.10 indicates a project whose benefits would far outweigh its cost, indicating a sound investment. A Benefit/Cost ratio this high is not surprising, given that in the CAMPO 2040 MTP, source of much of ACCESS2040, projects typically have ratios around 2.0 - 2.5.

The *Complete 540* Benefit/Cost ratio of 0.47 reveals a project whose benefits would fail to cover even one half of the project cost. Transportation project analysis guidelines recommend that only "projects that can demonstrate a benefit/cost ratio equal to or greater than 1.0 can be regarded as economically suitable".[10]

Two other approaches confirm that *Complete 540* would not come close to being a financially feasible project:

1. *NCDOT Strategic Transportation Investment (STI) Prioritization and Programming Process*—This process includes a benefit/cost component that compares monetized travel time savings over a 10-year period to the NCDOT share of the cost. For *Complete 540*, this 10-year benefit of travel time saving would be around $530 million[11], indicating that the NCDOT share could be at most around one-quarter of the project's cost of $2,200 and that toll financing would have to "write down" the NCDOT cost to $530 million. However, as noted below nowhere near this level of toll financing is anticipated.
2. *Planning Level Traffic and Revenue Study, May 2017*—This report, the first projection of revenue for *Complete 540* as a toll road, projects a Net Present Value (NPV) of toll revenues of $1.155 million for the first 25 years of operation. These revenues are 52 percent (around one-half) of the *Complete 540* cost of $2,200 million, affirming earlier admissions by NCDOT that the project is far from feasible as a toll road unless heavily subsidized by public funding.

Table 6: Cost Effectiveness, ACCESS2040 and *Complete 540*

	ACCESS2040	*Complete 540*
Travel Benefits, Year 2050	60.3	102.4
Travel benefits, Year 2025	36.5	62.0
Net Present Value (NPV) of Travel Benefits	617.3	1,048.4
Project Cost	293.7	2,240.0
Benefit/Cost	**2.10**	**0.47**

Notes: Travel benefits, Year 2050 - increased from year 2040 benefits as per *Traffic and Revenue Report*, Table 4.16, Scenario 1

Travel benefits, Year 2025 - reduction from year 2040 based on reduction over same period, *Traffic and Revenue Report*, Table 4.16, Scenario 1

Net Present Value (NPV) computed for 30 years, IRR 3.5%

Project Cost - Cost increment beyond *CAMPO 2040* MTP projects, from Table 5

Results of the three above approaches to cost effectiveness— cost effectiveness analysis in Table 6, the *NCDOT Strategic Transportation Investment* guidelines and the *Planning Level Traffic and Revenue Study*—converge on two findings:

1. *Complete 540* is a poor use of public funding, falling far short of *NCDOT STI* and CAMPO guidelines for cost effectiveness
2. *Complete 540* is far from feasible as a toll-only project, earning revenue of less than half that required to cover its cost. Inability of the project to offset its cost was foreseen in the *Alternatives Development and Analysis Report* which concluded that "A completely non-tolled (traditionally funded) scenario would not be reasonable" and further that "Traditional (non-toll) transportation funding sufficient to fully fund this project is not likely in the foreseeable future".[12]

As the mileage of proposed toll roads increases throughout the US, funding schemes that use tolls to pay for part of the project and therefore "write down" to acceptable levels the remaining publicly financed part are regularly claimed to be "innovative" public/private partnerships. In reality, rather than innovative funding this type of "partnership" is an accounting device to mask a project's lack of feasibility for either toll financing or for meeting cost-effectiveness criteria of transportation agencies.

APPENDIX A

Detailed Route Descriptions

The following seven tables provide a link-by-link description of the seven arterial road corridors comprising ACCESS2040.

Table A.1: ACCESS2040
Tryon Road Corridor

Segment	From	To	Miles	Improvement
US 64	I-540	US 1	5.70	Widen to six lanes
US 64	Interchange, US 64/Old Apex Rd			Interchange
US 64	Interchange, US 64/Lake Pine Dr			Interchange
Tryon Rd	US 1	Kildare Farm Rd	0.80	Widen to six lanes
Tryon Rd	Kildare Farm Rd	Lake Wheeler Rd	2.49	Existing four lanes
Tryon Rd	Lake Wheeler Rd	Norfolk Southern RR	1.30	Widen to four lanes
Tryon Rd	Norfolk Southern RR	Existing Tryon Rd	0.50	New four lane road
Tryon Rd	Existing Tryon Rd	S Wilmington St	0.09	Widen to four lanes
Tryon Rd	S Wilmington St	W Garner Rd	1.34	Existing four lane road
Tryon Rd extension	W Garner Rd	Rock Quarry Rd	2.15	New four lane road
Rock Quarry Rd	Intersection, Rock Quarry Rd/Sunnybrook Rd			Reconfigure
Rock Quarry Rd	Sunnybrook Rd	New Hope Rd	1.09	Widen to four lanes
Rock Quarry Rd	New Hope Rd	Battle Bridge Rd	1.40	Widen to four lanes
Battle Bridge Rd	Rock Quarry Rd	Auburn Knightdale Rd	1.85	Widen to four lanes

Table A.2: ACCESS2040
Ten Ten Road Corridor

Segment	From	To	Miles	Improvement	CAMPO STIP (year)
Jessie Dr	Old Holly Springs Rd	NC 55	1.64	Widen to four lanes	A218b (2040)
Jessie Dr	NC 55	Ten Ten Rd	1.58	Widen to four lanes	A218e (2060)
Ten Ten Rd	Apex Peakway	US 1	1.04	Widen to four lanes	A166 (2030)
Ten Ten Rd	US 1	Holly Springs Rd	3.40	Widen to four lanes	A114 (2030)
Ten Ten Rd	Holly Springs Rd	Bells Lake Rd	1.95	Widen to four lanes	A113 (2040)
Ten Ten Rd	Bells Lake Road	Old Stage Rd	5.10	Widen to four lanes	A400a (2040)
Ten Ten Rd	Old Stage Rd	NC 50	3.43	Widen to four lanes	A400b (2060)
Ten Ten Rd	Ten Ten/Rand intersection			Reconfigure intersection	
Rand Rd	Ten Ten Rd	NC 50	1.70	Widen to four lanes	
Rand Rd	Rand Rd/NC 50 intersection			Realign intersection	
NC 50	Rand Rd	Ackerman Rd ext	(T A.7)	Widen to four lanes	A228a (2040)
NC 50	NC 50/proposed Ackerman	Rd extension		Realign intersection	
Proposed Ackerman Rd extension	NC 50	Bryan Rd	0.50	New four-lane road	A577 (2040)
Ackerman Rd	Bryan Rd	White Oak Rd	1.14	Widen to four lanes	A577 (2040)
White Oak Rd	Ackerman Rd	Hicks Rd	4.46	Widen to four lanes	A143a (2040)
ACCESS2040 new segment	White Oak Rd	Raynor Rd	0.63	New four-lane road	
Raynor Rd & Auburn Knightdale Rd	ACCESS2040 new segment	Hodge Rd	7.58	Widen to four lanes	A203 (2060)
Hodge Rd	Auburn Knightdale Rd	Poole Rd	1.90	Widen to four lanes	A403c (2060)
Hodge Rd	Hodge Rd/ACCESS2040 new segment			Realign Hodge Rd	
ACCESS2040 new segment	Poole Rd	I-540/US 64 interchange	1.11	New four-lane road	
I-540/US 64 interchange	Interchange modification			Add ramps to/from S	

Table A.3: ACCESS2040
NC 55/ NC 42Corridor

Segment	From	To	Miles	Improvement	CAMPO 2040 MTP # (year)
NC 55	North Main St	Dickens Rd	5.95	Widen to six lanes	A98 (2030)
NC 55	NC 55/Old Holly Springs Apex Rd		0.20	Grade separated interchange	A163a (2030)
NC 55	NC 55/Ralph Steven Rd intersection		0.20	Grade separated interchange	A160c (2060)
NC 55 (Broad St)	Dickens Rd	Judd Pkwy		continue as four lane rd	
Judd Pkwy	NC 55	Products Rd	1.50	Widen to four lane	A207a2 (2040)
Judd Pkwy	Products Rd	US 401/NC 55/NC 42	0.60	Widen to four lanes	A207a3 (2020)
US 401, NC 55, NC 42	Judd Pkwy	US 401/ NC 55/NC 42 Intersection	1.18	Add median, access management	A619c (2030)
US 401/NC 42/NC 42	US 401/NC 55/NC 42 intersection		0.20	Grade separated interchange	A637 (2030)
NC 42	US 401/NC 55	Old Stage Rd	4.10	Widen to four lanes	A407a (2060)
NC 42	Old Stage Rd	John Adams Rd	0.95	Widen to four lanes	A407b1 (2060)
NC 42	John Adams Rd	NC 50	4.39	Widen to four lanes	A407b2 (2040)
NC 42	NC 50	I-40	2.17	Widen to four lanes	A407b3 (2030)
NC 42	I-40	Amelia Church Rd	4.27	Widen to four lanes	Jhns2b (2030)
NC 42	Amelia Church Rd	US 70 Business	2.07	Widen to four lanes	Jhns2a (2030)
South connector (Guy Road extension)	NC 42	US 70 Business	2.33	New four-lane bypass	Jhns3 (2030)

Table A.4: ACESS2040
Holly Springs Road Corridor

Segment	From	To	Miles	Improvement	CAMPO 2040 MTP (Year)
Holly Springs Rd	New Hill Rd	Kildare Farm Rd. Connector	4.44	Widen to 4 lanes	A163a (2030)
Holly Springs Rd	Kildare Farm Rd Connector	Ten Ten Rd	0.84	Widen to 4 lanes	A71 (2030)
Holly Springs Rd	Ten Ten Rd	Penny Rd	1.22	Widen to 4 lanes	A70 (2030)
Holly Springs Rd	Penny Rd	Cary Pkwy	2.22	Widen to 4 lanes	A69 (2030)
Holly Springs Rd	SE Cary Parkway	Tryon Rd	0.61	Widen to 4 lanes	A72 (2030)
Jones Franklin Rd	Holly Springs Rd	Dillard Dr	0.67	Widen to 4 lanes	A73a (2030)
Jones Franklin Rd	Dillard Dr	I-440	1.22	Widen to 4 lanes	A560b (2040)
Jones Franklin Rd	I-440	Western Bv	1.09	Widen to 4 lanes	A560a (2040)

Table A.5: ACCESS2040
Lake Wheeler Road Corridor

Segment	From	To	Miles	Improvement	CAMPO 2040 MTP # (Year)
Lake Wheeler Rd	Hilltop Needmore Rd	Ten Ten Rd	3.40	Widen to 4 lanes	A136c (2040)
Lake Wheeler Rd	Ten Ten Rd	Penny Rd	3.55	Widen to 4 lanes	A136b (2040)
Lake Wheeler Rd	Penny Rd	Tryon Rd	1.79	Widen to 4 lanes	A136a (2030)
Lake Wheeler Rd	Tryon Rd	I-40	1.30	Widen to 4 lanes	A43 (2040)
Lake Wheeler Rd	I-40	Centennial Pkwy	0.32	Continue existing four lanes	
Lake Wheeler Rd	Centennial Pkwy	S Saunders St	0.94	Widen to 4 lanes	A136e (2060)

Table A.6: ACCESS2040
US 401 Corridor

Segment	From	To	Miles	Improvement	CAMPO 2040 MTP # (Year)
US 401	NC 55/42	Scott Rd	3.32	Widen to six lanes	A619b (2040)
US 401	Scott Rd	Tech Rd	1.58	Widen to six lanes	A619a (2040)
US 401	Tech Rd	Ten Ten Rd	1.07	Widen to six lanes	A480b (2020)
US 401	Ten Ten Rd	US70	5.59	Widen to six lanes	A480a (2030)

Table A.7: ACCESS2040
NC 50 Corridor

Segment	From	To	Miles	Improvement	CAMPO 2040 MTP # (Year)
NC 50	NC 210	NC 42	5.63	Widen to four lanes	A228c (2060)
NC 50	NC 42	NC 1010 (Cleveland Rd)	1.85	Widen to four lanes	A228b (2060)
NC 50	NC 1010 (Cleveland Rd)	Timber Dr	4.91	Widen to four lanes	A228a (2040)

ENDNOTES

[1] *FEIS*, Chapter 2

[2] *Alternatives Development and Analysis Report*, May 2014

[3] *First Tier Alternative Concepts Screening and Traffic Reassessment*, December 12, 2017

[4] *NCDOT Roadway Design Manual, 23' - 30' Raised Medians*, 1-2B, Figure 5

[5] *ibid., 30' – 36' Medians*, 1-2B, Figure 1

[6] *ibid.*, 1-2B, Figures 2A and 2B

[7] *Alternatives Development and Analysis Report*, May 2014, Section 1, S-1

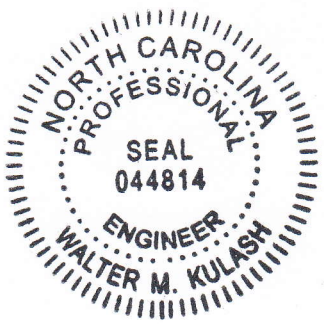
[8] Synonymous terms for the extension of I-540, used as appropriate at various stages of the *Complete 540* project, include "New Location Highway", "Build Alternative", "Triangle Expressway Southeast Extension", "DSA 2", "Preferred Alternative " and recently simply "Complete 540". The terms are interchangeable.

[9] "Reduction, Congested VMT", "Reduction, Congested VHT" and "Reduction, Congested Roadway Mileage" are direct measures of congestion. "Reduction, VMT" can indicate congestion reduction but also measures uncongested travel that is simply faster or more direct.

[10] Martin Wohl and Brian V. Martin, *Traffic Systems Analysis for Engineers and Planners*, section 8.4.2

[11] Travel benefits first ten years (2025-2035) from year 2040 benefit, *First Tier Reassessment*, Table 2 scaled to years 2025-2035 as per traffic growth from *Traffic and Revenue Study*, Table 4.16, Scenario 1

[12] *Alternatives Development and Analysis Report*, May 2014, pages 2-5



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